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PROCEEDINGS OF THE NATIONAL CONFERENCE ON DEVELOPMENT IN ENGINEERING EDUCATION AND PRACTICES

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E.C.E

Organized By
Pinnacle Group Initiative

PINNACLE EDUCATIONAL TRUST

ELITTE COLLEGE OF ENGINEERING

Sodepur, Kolkata 700113, INDIA

Edited by: **Dr SUDIP BASACK** **MAHUYA G DUTTA**

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PROCEEDINGS

Of the

National Conference On

DEVELOPMENT IN ENGINEERING

EDUCATION AND PRACTICES

(DEEP-2022)

April 6-8, 2022

Organized By

ELITTE COLLEGE OF ENGINEERING

Sodepur, Kolkata, INDIA

Affiliation: **MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY**

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PREFACE

Elitte College of Engineering**,** affiliated to MAKA University of Technology, feels delighted and privileged in organizing the National Conference on Development in Engineering Education and Practices (DEEP-2022) during April 6-8, 2022. We are honored to have this prestigious event organized *By* our college. In the last couple of decades, the field of engineering and technology has undergone significant advancement. Commencing from the sustainable civil infrastructural development, major manufacturing industries, robotics and artificial intelligence to electrical and electronic technologies and modern computational techniques and computerizations, an immense upgradation and modernization has been observed in majority of the countries around the globe including India. Accordingly, the engineering education and technical training curriculum has undergone significant progressive modification as well, with emphasis on the basic conception to recent developments. Further improvement in the technical education scenario in India has been achieved by the introduction of New Education Policy (NEP 2020) by the Government of India in the year of 2000, emphasizing in developing the application-oriented skills and innovative approaches. This special issue focuses on the development in engineering education and practices with particular reference to the Indian condition. This topic has been designed to address the diversified issues while elucidating some contemporary research done towards the growth and sustainable development of different branches of engineering and technical training and education, which are described by deliberate illustrations in the technical articles written by the esteemed authors. We would like to express our gratitude to all the eminent speakers and contributory presenters. We also like to concede the efforts that have been given by our colleagues, members of the organizing committee, students and supporting staffs of Elitte college of Engineering without which this major event would never had been successful.

April 6, 2022
Kolkata, West Bengal, India

Prof. (Dr.) Sudip Basack, Editor
Mahuya G Dutta, Editor

Ref. No. : ECE/National Conference/DEEP 2022/001 ***Date :*** 22nd Feb, 2022

Message from Director (Academics and HR)

Elitte College of Engineering was established in the year of 2015 under the aegis of Pinnacle Educational Trust. Being a premier technical institution for the past seven years, we may consider being in a mature stage to contribute towards creation and dissemination of knowledge as well as provising best education and career counseling to our students. Thus our college has successfully contributed towards the growth and development of technical education in India.

Knowledge creation and formation of new ideas require the ability to combine various technologies with an understanding of people, organizations, and societies. It requires working in teams of people with diverse backgrounds and specializations to create something new. So, to bring them together in a single platform Elitte college of Engineering organizes a National Conference, "Development in Engineering Education & Practices (DEEP, 2022). Our past webinar (FAST 200) on "Featured Advances on Science and Technology" was a grand success, which motivated us to proceed further to organize the current major conference. However, Instead of being complacent, our success has kept us moving in the constant pursuit of wisdom and knowledge.

I extend my warm welcome to the participants of this conference and hope that this mega event will be of immense professional benefit to all the participants as we proceed with a vision to make a technology-conversant India for our next generation.

Best Regards,

Elitte College of Engineering

Director

(Dr. Bazlul Haque)
Director (Academics and HR)
Chief Patron, DEEP 2022

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Ref. No. : ECE/National Conference/DEEP 2022/002 *Date :* 23rd Feb, 2022

Message from Director (Operations)

I feel highly delighted to welcome you all to the online platform of the National Conference on 'Development on Engineering Education and Practices' (DEEP 2022) organized by Elitte College of Engineering, Sodepur, Kolkata, India.

Our College brings together eminent Indian as well as international researchers, engineers, scientists, and specialists in the various research and development fields of engineering and technology by organizing such kind of conferences from time to time. This National Conference DEEP 2022 is one such endeavour. This Conference is aimed to offer a premise for global experts to gather and interact intensively on the topics of technical education and practices covering various emerging areas of mechanical, civil, electrical, computer engineering. I am sure that the participants of this seminar will definitely get enriched with better knowledge and will get exposure to the current trends and developments in their fields of interests.

I heartily appreciate the efforts of the organizers of DEEP 2022 and take this opportunity to congratulate them for bringing it to reality. I wish all success of DEEP 2022.

Best Regards,

Elitte College of Engineering

Director

Mr. Sajal Ghosh
Director (Operations)
Chief Patron, DEEP 2022

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Ref. No.: ECE/P/DEEP22/M/01 Date: 28th February 2022

Message from Principal, ECE

I heartily welcome all to Elitte College of Engineering (ECE), where excellence is nurtured, pursued and celebrated to create positive impact for a better society. Passionate students, staff and alumni, industry and community partners, together with our well-wishers and supporters have all combined to place the College in a strong footing to provide a sustaining service to our society, country and the engineering fraternity as a whole.

To impart state of the art awareness in technical education, ECE continuously takes major to minor initiatives for the benefit of students to make them aware of latest knowledge in their fields of study. In this regard, the college is proud to organize a national conference titled "Development in Engineering Education and Practices" (DEEP 2022). The event will be graced by the presence of leading national-level experts who will be sharing their knowledge on diversified ranges of topics. There will also be significant number of interesting contributory articles to be presented by the authors in various fields of technical education and practice. I sincerely hope that the knowledge and competence of all the participants shall be immensely enhanced and upgraded by these technical deliberations.

As the head of the College, I welcome you all to participate in this mega event and make it a grand success.

Best compliments,

Prof. Dr. Sudip Basack

Patron, DEEP 2022

Dr K HAZRA

Professor and Head
Mechanical Engineering Department
Elitte College of Engineering
PO: Karnamadhabpur, PS: Ghola
Sodepur, Kolkata-700113

Ref. No.: ECE/C/DEEP/001 24th February 2022

Message from the Organizing Chairperson

I, on behalf of the DEEP 2022 Organizing Committee, have a great pleasure welcoming all the participants to this National Conference on Development on Engineering, Education and Practices (DEEP-2022). Elitte College of Engineering (ECE), Sodepur, Kolkata, India on a regular basis has successfully organized such conferences, workshops and seminars on engineering and technological fields. This DEEP 2022 is again another such effort.

The aim of the conference is to provide a forum for delegates from the industry and academia to exchange ideas and presenting their research works including bringing forth the recent developments in the fields being dealt with. In addition, it is an ideal venue for the participants, though being held online due to the presently ongoing pandemic restrictions, for interactions and for them to establish the all-important contacts with each other.

The opening ceremony of this Workshop will be held in the noon of the 6th of April 2022, followed by three days of technical paper presentations until the 8th of April 2022. A total of 28 papers in the fields of Engineering Education, Civil Engineering, Computer Science & Engineering, Electrical Engineering, Mechanical Engineering have been selected for presentation during this period of three days. Subsequently, a proceedings of this conference containing all the papers will be published and out of them, a significant numbers have been selected for publication in an International Journal with DOI.

The keynote speeches will be delivered by some of the most outstanding experts in the relevant fields of Engineering Education and Practices. Besides the technical program, participants may also enjoy cultural program being organized by the College Staffs.

Finally, I would like to thank the ECE authorities for providing all the required infrastructure and logical supports needed for successfully organizing this conference. I also take this opportunity to thank all my colleagues who have extended their able helping hands in organizing of this conference. I wish all the participants a very successful learning and knowledge sharing through fruitful discussions.

With all my best wishes and thanks again,

Dr. Krishna Hazra
Organizing Chairperson,
DEEP 2022

HOD
Dept. of Mechanical Engineering
Elitte College of Engineering
Kolkata - 700 113

Ref. No. : ECE/National Conference/DEEP 2022/005 ***Date :*** 23rd Feb, 2022

"To improve is to change;
To be perfect is to change often"
-Winston Churchill

The old order must give way to the new, is something we have heard as an axiom. However, in today's world, the old is being replaced by new at a pace quite unprecedented. We have known that change is the only thing that is constant, but what is constant is itself getting redefined continuously. Management gurus have variously referred to this phenomenon as VUCA- Volatility, Uncertainty, Complexity and Ambiguity. So, the VUCA in Engineering Education needs to be observed, studied, analyzed and reformed in less than no time. There is a misalignment between engineering education and practices. Engineering Education is unable to evolve in pace with the technological developments, global economics, and digital transformations. The engineering curriculum lacks application oriented skills and innovative approaches. So, the theme for the National Conference, DEEP, 2022 has been designed to address these issues, which are interesting and intriguing indeed, will be keenly deliberated through presentations and panel discussions by some eminent and promising researchers across the country.

In this conference, 28 papers were selected out of 35 papers for presentation by academicians from reputed college and universities located in Kolkata and other states in India. The faculty members and students of Elitte College of Engineering too put their best foot forward. The research contributions from some eminent educators nationwide were the best accolade that our conference could have received. A cultural program, at the end of the second day has also been organized for the participants to enjoy and experience the cultural diversity of India.

I conclude with the assurance that DEEP, 2022 will inspire everyone to continue to foster the spirit of research to drive towards personal, professional and institutional excellence.

Best Regards,

Mahuya Dutta
Convener, DEEP 2022.

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THE NEOTIA UNIVERSITY
ज्ञानम् आत्म प्रदीपाय

B. Ghosh, D.Sc. (Engg.)
Vice Chancellor

Forewords

I am very happy to learn that the Ellite College of Engineering, Sodepur, Kolkata 700 113 is going to organize a national level conference entitled 'Development of Engineering Education and Practices' DEEP-22 during April 6th to 8th at its college premises for sharing the new thoughts and ideas and also to publish the conference proceedings containing the presented materials.

It is projected that by 2050 the world's population will probably reach to the level of 9 billion which will demand for 60% of more food, 55% of more water and 80% of more energy than that of present day consumption. Rapid urbanization is converting the usable cultivable land into habitat places which is directly putting load over our ecology. The National Education Policy-2020 (NEP-20) is knocking at the door and it is redressing our education systems. The academic institution will have to think in integrating with four fold of teaching methodologies like i. Fundamental, ii. Strategic, iii. Applied and iv. Adoptive to match with the NEP-20.

The DEEP-22 will address all of these issues.

I personally hope that proceedings DEEP-22 will give direction towards the pursuits of knowledge in the field of future engineering and allied sciences.

Biswajit Ghosh

Campus: Sarisha, D.H. Road, 24 Paragonas (S), West Bengal-743 368, City Office: Vishwakarma, 86 C, Topsia Road, Kolkata 700 046.

KEYNOTE ARTICLES

Mitigations for Sustainability of the Megacities

Biswajit Ghosh[1*]
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[*]Corresponding author's e-mail: bghosh3@gmail.com

Abstract. The megacities are facing problems like increase in population, enhancement of environmental pollution, collapsing of traffic systems, and dysfunctional of waste management. The vertical extensions in the built-in-systems welcomed urban heat island (UHI) effect and enhance 5-10% more energy consumption. Thus, mitigation of UHI can be done by; i. Reduction of albedo effect by introducing rooftop integrated photovoltaic (RiPV) systems, and ii. Introduction of evapo-transpiration systems like water bodies, greeneries, green roof & green wall. Long term studies showed that introduction of RiPV systems in built-in-system not only reduce the albedo effect but also compensate the additional energy demand.

Keywords. Rooftop integrated photovoltaic (RiPV) systems; evapo-transpiration systems; Sustainability.

1. Introduction

People induced towards the cities due to; i. geographical location, ii. Available infrastructures for health, educations and other essential living supports, iii. access to income generation activities. As a result the cities around the globe are overpopulated and introduced loads on ecology, economy and welcomed the problem of sustainability.

Sustainable development is about 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' [1]. In its application to cities, sustainability adopts the metaphor of metabolism; a city can be defined as becoming more sustainable if it is reducing its resource inputs (land, energy, water & materials) and waste outputs (air, liquid, and solid waste) while simultaneously improving its live ability (health, employment, income, housing, & leisure activities)

To understand the trends of energy use with time in the cities it is important to understand the dynamics of the city. The metabolism of the city can be characterized by assessing its input output items where energy and materials are used as input and waste as output. The metabolism approach is a powerful metaphor for the illustration of the processes that mobilize and control the flows of energy and materials through a city. Thus, the ecological system of a city will help in taking control of the vital links between human actions and the quality of the environment.

Hence, in designing the sustainable scheme for a city, knowledge on human-induced energy and material flows with comparison to those of natural flows is essential.

The significant energy use in cities is not very well perceived in Asian countries. Although a number of studies were conducted on energy consumption across various sectors of the cities have been conducted but most of them are from the national point of view. The dynamics of energy consumptions and its impact on ecology both at local and regional level requires being addressed from the sustainable standpoint of megacities. In the present paper efforts have been made to address the need for ecological adoption of an upcoming megacity around the ancient city, Kolkata, in West Bengal, India.

2. Ecological Impact

It was mentioned in the previous section that rapid increase of population in cities and its periphery induced the growth of mega-cities. To accommodate the people and to offer their access in the economic activities has resulted in the build-up of massive infrastructures and dense settlements. The urban surfaces are converted with asphalt, concrete, and other materials, - referred as 'impervious surfaces'- absorb more incoming solar radiation (INSOLATION) during day hours, converted it into sensible heat and store in the building materials. During night hours the impervious surface released the stored heat into the urban air, creating a warm bubble that can be as much as 1 to 3^{O}C (2-5^{O}F) higher than temperatures in surrounding outskirt of city areas [2].The change in land surface quality has primarily affected solar reflectivity, so-called albedo. The albedo is different from normal reflectivity in the sense that reflectivity might only account for visual bands, whereas albedo accounts for all the incoming solar radiation (INSOLATION) to a surface. Asphalt roads, concrete pavements and corrugated roofs, which form the major part of dense cities, have a low value of albedo. The low albedo surfaces absorb significant proportions of solar radiation and contribute in worsening the urban environment. In addition, loss of vegetation inhibits the evapotranspiration process, in which plants use heat from the air to evaporate water from their leaves. This process enables vegetation to act as a heat sink. Changes in wind patterns have also exacerbated the urban heat (UH) problem [3].

Urban Heat Island (UHI) Effect:

The UHI was discovered in 1800s [4] when it was observed that the cities growing warmer than its surroundings outskirt areas particularly in summer months. Higher ambient temperatures of cities increase the demand for electricity for cooling and this leads to an increase in the production of CO_2 and other pollutants where production of electricity needs fossil fuel. The UHI is not a problem in cities during winter but imposed some other problems on ecology and economy also. Man-made changes to the urban environment are the source of the UHI phenomenon. The radiation balance within the urban system is disrupted as surfaces absorb long-wave radiation and are unable to re-radiate it. An increase in anthropogenic heat discharge, a decrease in surface evaporation, changes in the thermal characteristics of urban surfaces, an increase in traffic population and air pollution, together with the reduction in airflow and humidity caused by the sheltering effect of buildings, are

the major factors behind these changes.

The energy demand is fulfilled through electricity and the combustion of fossil fuels, which ultimately discharge heat into the urban atmosphere. The single greatest source of stationary heat discharge from buildings comes through air-conditioning units. These units are very densely concentrated throughout the cities. Some waste incineration plants and industries located in the outskirt of the cities also release heat directly into the urban environment. Studies revealed that only 13% of the total energy input into transportation is converted into useful work. The rest is dissipated as heat into the environment at the site [5].

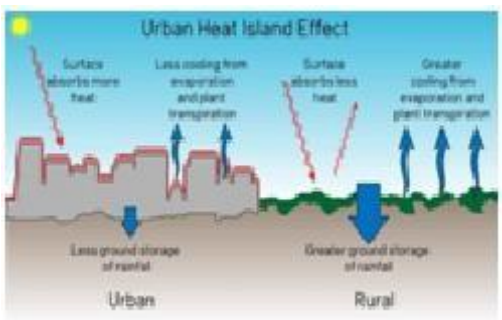

Figure 1: Possible cause behind UHI

Rapid urbanization and population growth in mega- cities has resulted in the build-up of massive infrastructures and dense settlements with scarifies of vegetated land surfaces those are converted into concrete and asphalt. The change in the natural surfaces has primarily affected the albedo (α). As mentioned in the previous section that asphalt roads, concrete pavements and corrugated roofs have a low α value. The value of α for asphalt has 0.05-0.20, and that of concrete has 0.10-0.35 [6]. Low α value surfaces absorb significant proportions of solar radiation and contribute to the worsening of the UH environment.

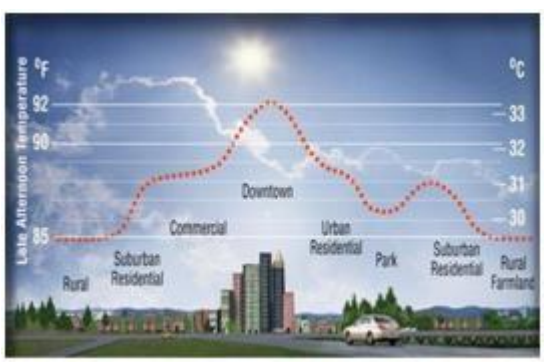

Figure 2: Ambient temperature variation due toUHI

The meager in vegetation surfaces inhibit the reduction of evapo-transpiration process, in which plants act as a heat sink. The formation of an urban canopy changes the wind pattern also and enhancing the total entropy in the city environment. The figure 1 and 2 are the pictorial

representation of UHI.

Impact of UHI:

Following are impact of UHI. i. Enhance energy consumption. Increased temperature in summer enhanced energy consumption to run cooling systems in the habitat places. It has been observed that enhancing $1^{O}F$ or $0.6^{O}C$ ambient temperature in the range of $25^{O}C$, the cooling systems demand 5-10% more energy input. ii. Enhancement of green house gas (GHG) composition density. In meeting the demand for more energy the fossil fuel based power plants consume more fossil fuel and enhanced GHG emission. iii. Poses danger to aquatic systems. Due to raise in ambient temperatures within the urban areas, temperatures over pavements and rooftops are also increases. At higher surface temperatures the heat wave enhanced water body temperature which possibly reduced dissolved O_2 concentration and welcome respiratory problem on the aquatic systems. It has been observed that pavements with temperatures of 38°C can increase initial water temperature from about 21°C to over 35°C and reduced 5-10% reduced dissolved O_2 concentration [7]. iv. Discomfort and danger in human health. Higher air pollution, reduced nighttime cooling, and increased temperatures adversely affect human health. Human health is negatively impacted due to increase in general discomfort, exhaustion, heat-related mortality, respiratory problems, headaches, heat stroke and heat cramps. Exacerbated heat events or sudden temperature increases can result in higher mortality rates. Research by the Center for Disease Control and Prevention indicates that between 1997 and 2003 more than 8,000 premature deaths were registered in the USA owing to excessive heat [8]. v. Secondary impact on weather, climate & eco-systems.

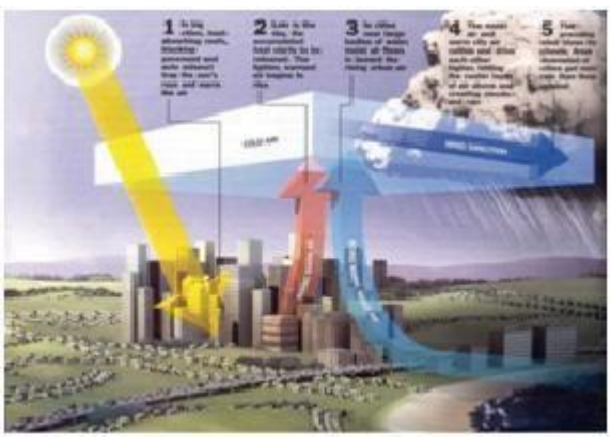

Figure 3: Possible impact of UHI on smog formation and increase rain at the city outskirt

Apart from enhancing ambient temperature, the UHI can bring forth secondary effects on the local weather and climate. This includes changes of local wind patterns, formation of fog and clouds, precipitation rates and humidity. The unusual heat caused by UHI contributes to a more intense upward wind movement that can stimulate thunderstorm and precipitation activity. The possible impact is presented in figure 3.

Mitigation of UHI:

Researchers reported that possible ways and means for reduction of UHI are as follows: a. Use of appropriate materials and methods in reducing absorption of incoming solar radiation. The use of light-colored concrete and white roofs has been found to be effective in reflecting up to 50% more light and in cutting down the ambient temperature. Black and dull colors absorb copious amounts of solar heat resulting in warmer surfaces (Fig. 4). The use of light-colored concrete and white roofs can as well reduce the overall air conditioning demands. In addition to this rooftop integrated photovoltaic (RiPV) systems in conjunction with green roof surface can be a useful method in reduction of UHI (Fig. 5). b. Green roofs and vegetation cover. Green roofs present a great method in reducing the impacts of UHI. Green roofing is the practice of planting vegetations on a roof.

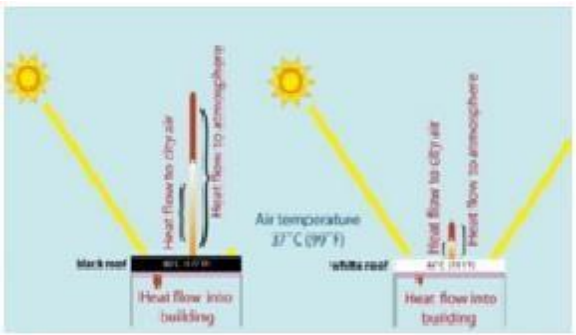

Figure 4: Impact of Solar INSOLATION onroofing materials

Plants on the roof are excellent insulators during summer and decrease the overall UHI effect. Plants also cool the surrounding environments thereby reducing air conditioning demands. Furthermore, air quality is improved as the plants absorb CO_2 and produce fresh air.

Figure. 5: Integration of green roof and RiPV system

Introduction greeneries in the cities.

The greeneries within and around cities provide an incredible way of reflecting solar radiation while at the same time decreasing the UHI effect. The trees provide shade, absorb CO_2, release O_2 and fresh air, and introduce cooling effect. d. Green parking lots.

Green parking spaces utilize green infrastructure strategies to limit the impacts of UHI effect. Impact of green roof in reducing the rooftop temperature is presented in Figure 6.

Figure 6: Thermal mapping of rooftop with greeneries & black coating

2 . 5 Implementation and sensitization of heat reduction policies and rules.

The state implementation of environmental policies such as Clean Air Act, Low carbon fuel standards, uses of renewable energy, and electrical vehicles can impressively regulated the anthropogenic inducers of UHI effect. Education and outreach activities can also help in bringing the awareness on economic and social benefits.

3. Results of Studies:

It was mentioned that built-in- systems are the major players in contributing UHI effect. Thus, proper care require to be taken at the built-in-systems to reduce UHI and one of such care should be the introduction of PV power in the built-in-systems. The radiation balance over PV module is presented in Figure 7 and PV module can act as the reflect surface to reduce UHI effect through balancing of long wave (LW) and short wave (SW) radiation by absorbing and emitting.

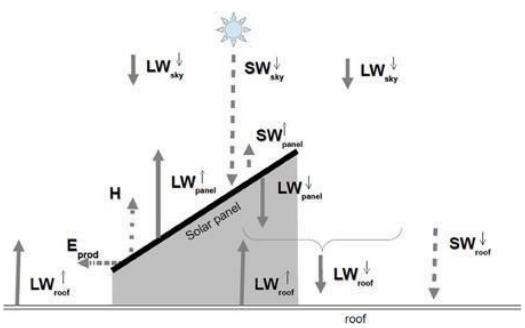

Figure 7: Radiation balance below PV module

The PV power in the built-in-systems can be introduced as a building component. The countries located in between the tropic of Cancer and Capricorn is rich in sunshine and at the same time they have the power shortage problem. Thus, power from PV has the possibility to emerge as meeting the peak load demand in these countries. The rooftop PV power has introduced in these countries normally in roof mounted PV (RmPV) mode, but roof integrated PV (RiPV) mode is more versatile than that of RmPV mode.

The result showed that minimum roof temperature is in case of RiPV system. Apart from this RiPV systems have other advantages like i. introducing additional building space,

ii. Protecting the rooftop from external corrosion and erosion, iii. reducing the cooling load of the

building and iv. generating additional power.

4. Concluding Remarks:

From the studies in the previous sections it has been observed that UHI effect cannot be reduced to zero as it is an anthropogenic effect.

The UHI effect is predominating effect at the mega-cities but adoption of proper measures can reduce its effect. In reducing the heat gaining effect in the built-in systems results showed that introduction of RiPV system is one of the possible measure in this context. Thus, proper design of RiPV systems can reduce a substantial heat gain in the built-in system which ultimately reduce the UHI in mega cities and address sustainability.

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Conflicts of Interest

The author declares that there is no conflict of interest.

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Technical Education in India – Present Status and Quality Assurance

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Abstract. Technical Education is one of the most noteworthy parts of Human Resource Development range with incredible potential for enhancing items and administrations and for adding to the national economy and improving personal development of the individuals. Quality issues in technical education are significant perspective since it bears an immediate effect on the improvement of the education procedure. The successful future for Higher education institutions depends on Quality assurance in Technical Education in the country. There is a strong move globally towards internationally recognized quality assurance processes. The accreditation of academic programs is very much essential in order to maintain the quality and the status of technical workforce in the country. The Govt. of India and state governments have been making constant efforts for qualitative improvement and quantitative expansion of the technical education system consistent with rapid changes taking place in the socioeconomic, industrial and technological scenario.

Keywords. Technical education; National economy; Quality assurance; Accreditation;

1. Introduction

Quality issues in technical education are very important aspect since it bears a direct impact on the improvement of the education process. Quality is not a science; it is a way of thinking. The development of technician education before independence till 1947 was slow and haphazard. Constitution of the Technical Education Committee of the Central Advisory Board of Education (CABE) was done in the year of 1943. Preparation of the Sergeant Report was done in the year of 1944. Formation of the All India Council for Technical Education (AICTE) was done in the year of 1945 by the Government of India. AICTE is responsible for planning, formulation and maintenance of norms and standards, quality assurance through accreditation, funding in priority areas, monitoring and evaluation, maintaining parity of certification and awards and ensuring coordinated and integrated development and management of technical education in the country.

2. Progressive Development

2.1. Literature Review

Since the mid-eighties, with proliferation in industrialization and financial development, engineering and technical education in India have been growing faster than anyplace else in the world, and India currently has the second biggest number of graduates on the planet [1].To cater the need of the rapid growth in industry private engineering colleges and universities have already started to come in the picture in larger number. Unfortunately, most of them fail to keep the level of standard intact due to policy and also some in lack of well-trained educators.

2.2 Present Scenario

Engineering education in India has got impulse with the set-up of All India Council for Technical Education (AICTE).The Ministry of Human Asset Development takes into account programs at

undergrad, postgraduate and research levels that incorporate courses in building, innovation, the executives, engineering, drug store, and so forth. The specialized instruction is imparted by chief establishments containing:

- Indian Institutes of Technology (IITs) – 23 Nos.
- Indian Institutes of Management (IIMs) - 20 Nos.
- Indian Institute of Science (IISc), Bangalore
- National Institutes of Technology (NITs) – 32 Nos.
- Indian Institutes of Science Education and Research

The number of AICTE approved institutes that offer engineering courses in India is – 10987 around 5502 institutes in India offering diploma courses in engineering as per the data published in AICTE portal.

2.3 Need of Quality Culture in Technical Education

The status in Table-1 clearly suggests why quality culture is an important aspect in Technical education. From the inception of technical education, it was always inclined towards employability orientation. Hence placement is always a major parameter to gauge the gradient of the technical education, as seen in Table 2. Though there are other parameters too to measure the performance, yet placement scenario speaks louder than the rest. Not only that also the rate of clearing examinations like Graduate Aptitude test in Engineering (GATE) after graduating is a matter of serious concern. In 2017, number of students appeared in GATE is 922,167 and cleared 129,149 which was only 16% of the appeared candidates (see Fig. 1).

2.4 Objectives of Technical Education System

The primary and secondary objectives of the technical education system may be sequentially enumerated herein below:

1. To develop and arrange and have a decent notoriety.
2. To improve satisfaction of the stakeholders.
3. To utilize the inventiveness of personnel for by and large establishment improvement.
4. To give career improvement chances of employees.
5. To provide job satisfaction to all levels of employees
6. To be an example to other institutions of same category.
7. To look after modernization by removal of obsolesces at all levels.
8. To undertake Quality Assurance.

2.5 Institutional Accreditation and Internal Quality Assurance

There are various factors which directly or indirectly influence the effectiveness (quality) in technical education under the following broad heads viz.,

1. Administration
2. Infrastructure
3. Teaching Effectiveness
4. Students
5. Interaction with Industry and Society
6. Extra Curricular Activities
7. Research and Development

Internal Quality Assurance Cell has to be established at institute level for overall quality enhancement and sustenance.

2.6 Present Quality Problems in Technical Education In India

To improve the quality and standard of technical education system particularly development and curriculum development plays an important role. The present technical education system of the country is not able to keep pace with the industrial development and technological advancements. The problems/issues are identified that were hampering technical education in the country, as listed here:

1. Shortage of competent and in quality.
2. Practice of engagement of temporary (ad-hoc) or daily teachers is hampering quality of education.
3. Large drop-outs and failure rates.
4. Fast out of date quality of educational programs and course substance because of rare update and much deferred reaction to market demands.
5. Retention of faculty due to promotion policies, absence of incentives for quality performance, and non-development policies in most institutions.
6. The teachers are straightway recruited without assessing their ability to teach.
7. Most of the self-financed institutions are not offering salaries as per AICTE.
8. The institutions do not pay adequate attention to faculty development.
9. Significant efforts are not made to self-learning skills or industry needed “soft skills” to the students.
10. Knowledge and skill acquisition by students thereby lowering their employ ability (only 25% at present).
11. Close links need to be fostered between technical institutions and industry.
12. Lack of Good Administrators
13. Problem of Practical Field Work and Laboratories
14. Lack of co-operation between Government, Industry and Educational Institutions
15. Basic specialized instruction arrangement must be confined all through the nation
16. Improvement in institutional infrastructure
17. Improvement in teaching methodology
18. Uniform examination system
19. Mismatch between Qualifications and Industry needs.
20. Legitimate use of library benefits by the staff and understudies.
21. Lack of monitoring of educational programmes

There has been a rapid growth in the number of private self-financed institutes across India in the last20 years [2]. The significant changes in supply and demand make it increasingly important to ensure that technical education systems and institutions are effectively and efficiently governed and managed to meet the needs of industry and society.

Table 1: Overall status in engineering education in India in last 3 years available

Total Technical Institutes	**Academic Year**	**Intake**	**Enrolment**	**placement**
10426	2018-2019	3392965	1840693	765043
10400	2017-2018	3552377	1840693	714864
10365	2016-2017	3702582	1840693	722517

Table 2: Overall status in engineering institutions in India last 3 years available

Year	Total Institutions	New Institutions	Closed Institutions
2019-20	10987	912	78
2018-19	10426	548	53
2017-18	10400	548	53

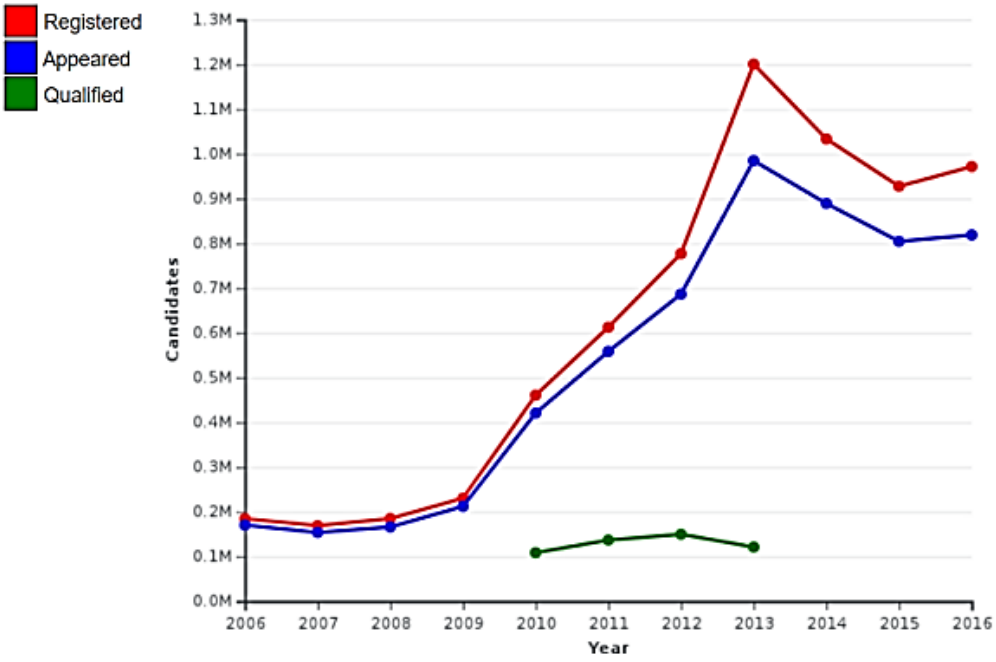

Figure 1. Number of students appeared, registered and cleared GATE

4. Conclusion

The primary objectives of technical education are to maintain quality and appropriate standard. The institutions need to develop a standardized approach to most aspects of quality assurance for engineering programmes. Each engineering college and polytechnic ought to characterize their quality strategy and understandable their duty to accomplish quality in the entirety of their exercises and execute the strategies properly.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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Soft Ground Improvement by Granular Reinforcement for Transport Infrastructure

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Abstract. Structures founded on soft ground are likely to be exposed to disastrous consequences due to possible undrained failure or excessive settlement unless proper ground improvement is undertaken. Soft soil improvement by granular reinforcement has numerous benefits in terms of strength and stiffness as well as accelerated consolidation. Foundation soil supporting transport infrastructures are in addition subjected to cyclic loading initiated by traffic movement. This paper presents the load-transfer and consolidation characteristics relevant to stone column reinforced soft ground supporting transport infrastructure.

Keywords. Soft ground; granular reinforcement; stone column;

1. Introduction

Soft ground improvement by granular reinforcement, especially by installing stone columns, has numerous benefits including increased bearing capacity due to significant column-to-soil stiffness ratio and accelerated consolidation due to higher hydraulic conductivity [1]. Foundations supporting transport infrastructure are subjected to cyclic loading resulting from traffic movement. Such load reversals induce progressively building up of excess pore water pressure which is capable to produce disastrous consequences [2]. The aims of this paper are to illustrate the load displacement and consolidation characteristics, optimizing column installation and studying influence of high frequency cyclic loads.

2. Theoretical Analysis

The theoretical analysis was done using advanced analytical and numerical modelling. The load transfer and consolidation characteristics of stone columns are captured based on unit cell analogy and free strain hypothesis [3]. The vertical stress distribution in soft soil has been quantified by the following equation:

$$w_r = w_{r_e} + (N - r/r_c)^2 F \quad (1)$$

where, r = radial coordinate, r_c &r_e = column and unit cell radii, F= An algebraic function of r_e, r_c and stress concentration ratio. The radial consolidation characteristics of soft ground are governed by Barron's radial consolidation Equation coupled with modified Cam-clay theory [4-6]. The basic differential equation is given by [7]:

$$[\nabla_r^2 - \nabla_t]u = 0 \quad (2)$$

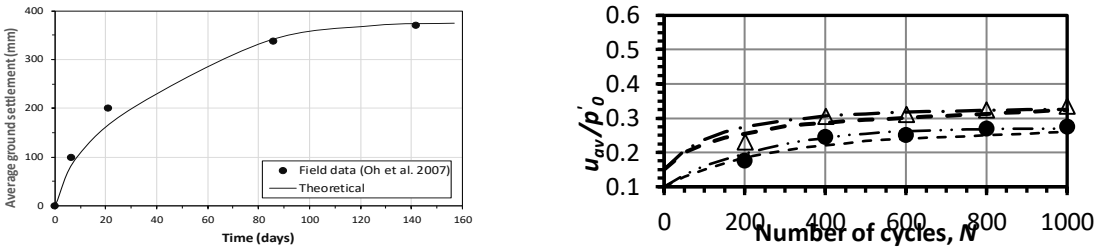
The arching, clogging and smear effects have been included in the analysis. The lateral column deformation is quantified by the stress-induced deformation (ρ_z^e) plus the barreling component (ρ_z^s), as detailed in by the author elsewhere [8-9].

The effects of cyclic loading on reinforced soft ground has been incorporated using the modified Cam-clay model applying cycle-by-cycle analysis (Basack*et al.*[10-11]. Comparison of computed results with field data (Fig.1) indicates accuracy of the analysis.

3. Laboratory Experimentations

Large-scale one-dimensional consolidation tests on instrumented single stone column in soft kaolin clay were conducted (Fig.2). The soft clay was prepared by mixing dry powder of kaolin with water to form slurry. A pre-consolidation stress of 65 kPa was applied to achieve 95% degree of consolidation. The model stone column was installed via the replacement method to minimize the disturbed zone [12]. To measure the column lateral deformation, two fibre-glass strips with strain gauges were inserted into the sides of the column.

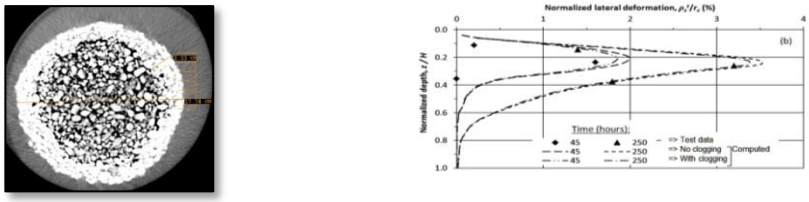
The stress concentration ratio was found to be influenced by time and particle size distributions. Post-consolidation exhumation of the column followed by CT-scan image processing quantified the lateral deformation as well as intrusion of fines (Fig.3). The reinforced soft soil performance was found to be largely dependent on particle morphology and reinforcement geometry.



(a) (b)

Figure 1. Comparison of theoretical results with: (a) field test data for static loading, and (b) laboratory test data for cyclic loading

Figure 2. Large-scale one-dimensional consolidometer.



(a) (b)

Figure 3. (a) CT scan image of clogged column section, and (b) theoretical and experimental results

4. Field Test

With the initiative of Centre of Excellence for Geotechnical Science and Engineering (Australian Research Council), a group of test stone columns were installed at the Australia's national geotechnical field-testing facility at Ballina, New South Wales. The site consists of soft, compressible marine clay and the columns were installed by Keller Ground Engineering. The columns have been instrumented with inclinometers, extensometers, piezometers, pressure cells and settlement plates. Above the reinforced soft ground, an embankment was constructed in stages. A photographic view of site is given in Fig.4. More details of the field test have been published elsewhere [13].

Figure 5. Photo of site.

The factor of safety against undrained failure has been computed using current method and other existing methods and presented in Table 1 [8]. The load-settlement response of the ground in the vicinity of the central column is depicted in Fig.5. As observed, the computed factor of safety is close to the existing methods, with an average deviation of about 21%. The value obtained using the current method is higher, compared to those evaluated by the other methods. From Fig.5, it is observed that the average soft ground settlement obtained from the present numerical modelling is in proximity with those obtained from the field measurement.

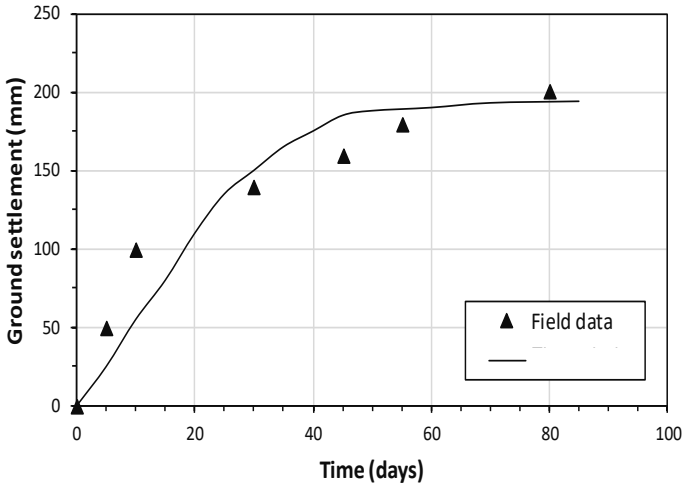


Figure 5. Load Settlement response.

Table 1: Factor of safety against undrained failure

Method of computation	Time (days)			
	2	**10**	**30**	**50**
Cao *et al.*[14]	8.3	3.6	2.1	1.9
Frikha and Bouassida[15]	9.2	4.3	3.2	2.4
Present analysis	10.7	5.3	4.1	3.3

5. Conclusions

- Soft ground improvement for transport infrastructure by stone column reinforcement is quite effective technique. To study the load transfer mechanism, consolidation characteristics and the influence of high frequency cyclic loading, advanced theoretical modelling, laboratory experimentations as well as instrumented field tests have been performed.
- The theoretical results were found to be in close agreement with the laboratory experimental data and field observations.
- The laboratory experimentations were conducted using a one-dimensional consolidometer. The CT scan image processing was done to visualize the clogging characteristics. The instrumented field trial, on the other hand, was done with earthen embankment being constructed in stages on the reinforced soft ground and the field data were recorded.

Acknowledgements

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Conflicts of Interest

The authors express that there is no conflict of interest.

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Emerging Trend in Power Generation and Utilization

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Abstract. Power generation technology has been evolving ever since Edison put up his first generating station. It started with generation near the load center. To capitalize on the economics of scale large power plants were set up near the energy centers like the coal mine heads. This led to development of long distance transmission lines and the grids. Then came the restructuring of the rules and regulations governing the power system. With the issues of pollution and Global warming coming to the fore a paradigm shift is noticed in the generation of electrical power. Large number of renewable energy sources (RES) based small generators started getting connected to the distribution system. The concept of microgrid evolved to control and regulate the RES based generations. In order to effectively use these RES based generation and to capitalize from the electrical energy trading the concept of Virtual Power Plant and Community microgrid have started taking shape.

Keywords. Centralized Generation; Distributed Generation; Microgrid; Virtual Power Plant;

1. Introduction

Economic development of a country depends on the energy consumed by the people. More energy available means shorter working days, higher agriculture and industrial production, better transportation and healthier and balanced diet. Thus, there is a close relation between the per capita energy consumption and the standard of living. Larger the average amount of electricity consumed by the people of a country better is their living standard and higher is the per capita income of the country.

Early Power Generation was near the source of power like hydro power generation at the Niagara Falls in north America and utilization was also done close to generation centers like in case of Edison's steam power station.

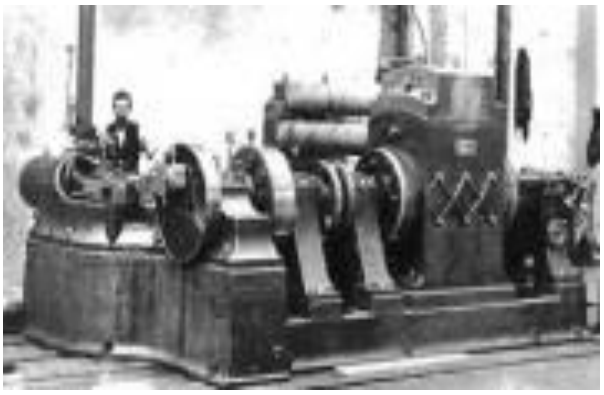

Figure 1. Edison's Jumbo dynamo (Source:https://artsandculture.google.com/asset/pearl-street-station-jumbo-dynamo-edison-electric-light-company/2wFauEbLa90a-Q?avm=3)

Momentous year 1882 saw on September 4th the inauguration of Thomas Edison's power station on Pearl Street in New York City. All the land close to the falls was occupied by industries needing ready access to the falling water for their source of energy. Landowners and industries began looking into ways of moving some of the immense amounts of energy that could be developed at the falls to locations farther afield. Moving the energy would, in one stroke, make better use of the crowded and expensive land near the falls and increase the value of energy by using it in land more remote from the falls.

1. Centralized Power Generation

Winning combination was to generate electricity on the scarce land close to the source of energy and distribute that electricity to where it could be put to better use. With the development of transformer by Westinghouse in 1886 people started thinking of generation at the energy center and evacuating the electrical energy through long distance transmission lines at higher voltage.

To capitalize the economics of scale people started developing larger and larger generating machine. Considering the Indian Electricity generation scenario, it was in 1970s BHEL that was manufacturing 210 MW Generators. By 1975 NTPC was set up and India started contemplating of setting up Super Thermal Power Stations (STPS) with more than 1000 MW capacity using generators of 500 MW capacities. By 2000 people in India started thinking of setting up Ultra Mega Power Projects (UMPP) which had capacity of 4000 MW or more.

2. Distributed Generation

Thus as planners of the economy were thinking of larger power stations away from utilization centers of electricity, long distance transmission lines at higher and higher voltages (latest being 765kV) started coming up to reduce the transmission losses.

As the above was going on in one hand another group of people were busy harnessing the vast renewable resource available in the country. Prof. Bhim Singh et al. started experimenting with Induction Generator, Self Excited Induction Generator (SEIG) [1-5] and Doubly Fed Induction generators (DFIG) for micro/ mini hydro and Wind renewable energy resources (RES) [6].

Another group of researchers was working on generation of electricity from solar energy. Two areas emerged: solar thermal [7] and solar Photo Voltaic [8]. Still another group was working on smart buildings using solar energy [9].

The development of RES based electrical power generation got a fillip from the development on the Power Electronics front. This produced the Custom Power Devices [10,11] and the FACTS [12,13] which resulted in controlled generation/ absorption of reactive power and elimination Harmonic, flicker and other power Quality issues that cropped up with the generation of electricity with RES and use of heavy duty loads and nonlinear loads.

These RES are being used to generate power in small quantities or in bulk. Large RES power parks were created in remote location and were connected to the grid through transmission lines. On the other hand, large number of small RES, called the Distributed Energy Resources DER, was either directly connected to the distribution system or was used to feed local loads in autonomous mode. Fig.2 shows the schematic connection of the DERs to the Distribution System.

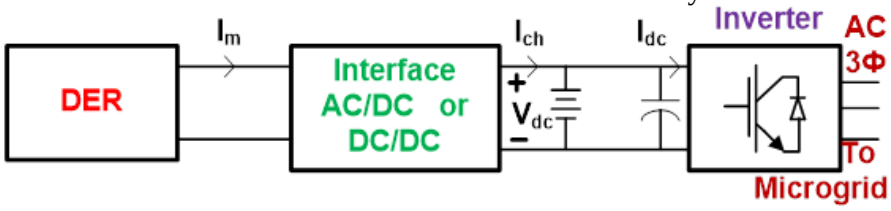

Figure 2. Connection of DERs to the Distribution system.

At times it was felt that these small RES being connected to the distribution system created more problem than they solved. The exiting protection system of the distribution system went haywire because of more power being directly fed into the distribution system.
Then the issue of global warming harming the earth's ecology came to the fore front. United Nations Framework Convention on Climate Change (UNFCCC) declared a moratorium on fossil fuel plants that are polluting the atmosphere and leading to global warming.

3. Present Scenario

Thus the present scenario of power generation is Centralization Power Generation with fossil fuel and some bulk RES Generation connected to the Grid with ever increasing small RES based generation being connected directly on to the Distribution system.
The power System and its rules and regulations were restructured to allow this scenario to sustain. In India, Electricity Act 2003 started this restructuring. Any person can now generate electricity for his own consumption and even sell it to the grid.
On the load front a lot of power system polluting loads like the arc furnace, smps, very large motors etc. started to evolve. Need for providing quality power along with the benefits of the grid to the sensitive loads started getting felt. The series compensator DVR and the shunt compensator DSTATCOM were introduced to mitigate these pollutions in the power system. This also led to the evolution of the microgrid. A schematic diagram of the microgrid is shown in the Fig. 3.

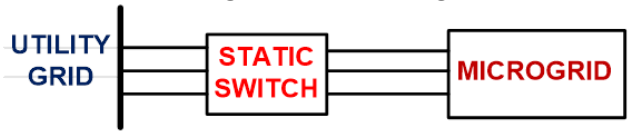

Figure 3. Schematic diagram of the microgrid

4. Microgrid

The Microgrid has RES based generation, local electrical power storages and local loads and is connected to the distribution system by a static switch. It presented itself as a single entity to the distribution system. The microgrid had its local grid control & operation mechanism and provided quality power to its sensitive loads. It islanded itself from the utility grid, through the operation of static switch, whenever there was disturbance on the utility grid and maintained the supply to its load in an autonomous manner. Fig. 4 shows the schematic diagram of microgrid providing Quality power to its local sensitive loads [14-17].

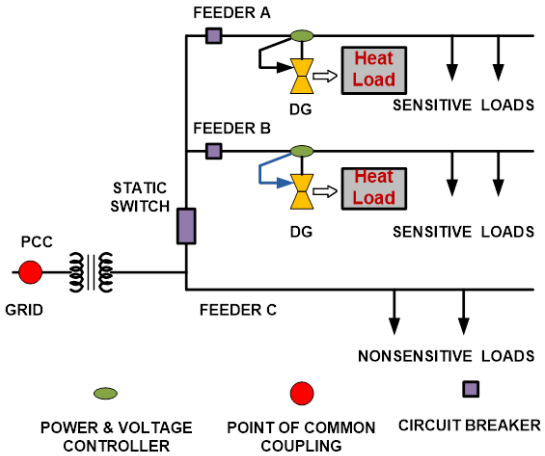

Figure 4. Schematic diagram of microgrid providing Quality power to its local sensitive loads.

At some places the human habitats are quite far apart, like in Australia, microgrids are formed in those habitats and connected to the main grid through long tie lines.
Some of the RES like solar PV generated DC power and some generated AC power. Similarly some of the loads operated with dc voltage while many operated on ac voltage. To avoid converting and reconverting the concept of dc and ac microgrid evolved. Further the ac and dc microgrids are sometimes interlinked through power electronic converters to transport power from one side to the other, giving to the formation of a Hybrid Microgrid [18].
With large centralized power station generating power at a fixed rate the loads were made to match the generation: 'concept of load following the generation.' With small RES based generation which can be switched on or off very fast or can be made to store the generated electrical energy in a storage system the concept has now shifted to 'Generation following the Load'. Generate as much as the load demands.
The loads can be categorized into two parts. In colder regions of the world a significant part of the generated energy is used for heating and in tropical part it is used for cooling/ bringing down the ambient temperature. The other part is used to operate the electrical appliances. Thus the generation can follow the heat load or the electrical load or a mixture of the two i.e.follow a hybrid load [19]. Fig.5 shows the schematic diagram of a generation system following different types of loads.

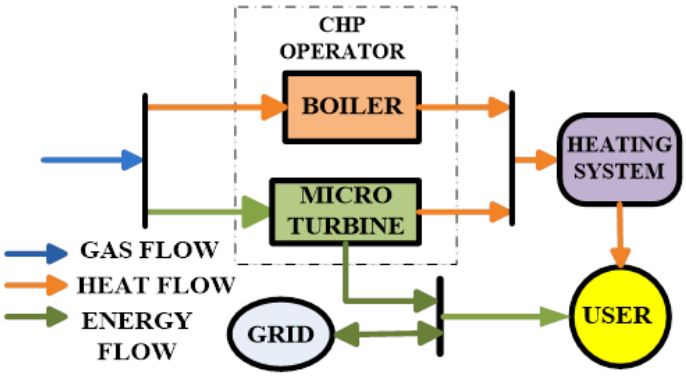

Figure 5. A schematic diagram of generation system following different types of loads.

The owners of small RES based generation (like roof top Solar) who are now being called Prosumer (Producer + Consumer) started thinking about generating profit from the sale of a part of the electricity their small plant generated. The need for measurement of the power sold and bought from the grid caused the concept of smart net metering to get introduced into the power system [20]. Fig. 6 shows the schematic diagram of electrical energy trading between the prosumer and the utility Grid

With the coming up of the Electrical Power Exchanges the prosumers of the microgrid felt the need for trading the power generated by them on the exchange to increase their profits. However, the amount of power a microgrid could offer for trading was too small for viability of the trading on the power exchange. They felt the need of an aggregator to bundle the requirement / surplus of several microgrids to make the magnitude of power requirement /surplus significant to make it viable for trading on the power exchange. There in came the concept of Virtual Power Plant and the community microgrid.

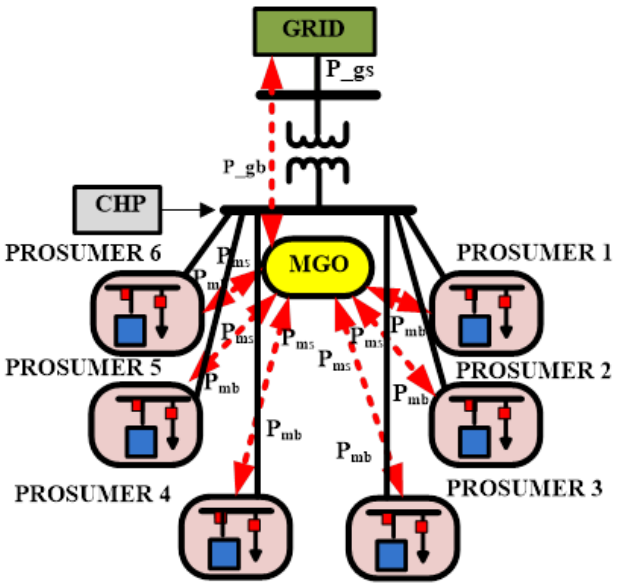

Figure 6. Schematic diagram of electrical energy trading between the prosumer and the utility Grid

5. Virtual Power Station

Distributed energy resources (DERs) in the distribution network, such as wind turbines (WTs), photovoltaics, (PVs), combined heat and power generators (CHPs), energy storage systems (ESSs), heating, ventilation, and air conditioning systems (HVACs) have much potential of flexibility in electrical power generation. However, the characteristics of DERs like small size, heterogeneous and distributed, make them very difficult to manage and utilize their power generation flexibility. The concept of virtual power plant (VPP) is introduced to efficiently manage these DERs in a group [21]. The VPP operator aggregates the flexibility of power generation of DERs and provides energy and auxiliary service to the grid. Thus scientific decision making can be done for dispatching power in the power system operation and for participating in the power market. Using optimization methods, the DERs can be aggregated into a virtual generator and virtual storage and the operation management platform of the virtual power plant is designed for dispatching power and for power market actions [22]. Fig.7 shows schematic diagram of Virtual Power plant and electrical energy trading between it & utility Grid

6. Community Microgrid.

Multiple microgrids in the neighborhood are linked via interlinking converters to form a community microgrid. Each microgrid will maintain their connection to the main utility grid while have an interconnection with the microgrids in the neighborhood [23]. Each microgrid maintains its autonomous nature and can have their own specific frequency and voltage requirements. Each microgrid is able to cooperate with microgrids in the community by providing backup power to enable them to overcome the emergencies and also for economic aim. Further a community microgrid cause the advantages of both ac and dc microgrid to merge and also enhance the reliability and economic performance of each microgrid. Thus, bringing about all the benefits of the main grid within the community microgrid.

A hybrid microgrid is basically a blend of ac and dc configurations in a single microgrid with the ac side having a link with the main grid. In contrast a community microgrid is a cluster formed by interlinking various ac and dc microgrids in the neighborhood without affecting the autonomous nature of each microgrid. A community microgrid maintains the power exchange within the

participating microgrids while maintaining the community as island. Power exchange allows the participating microgrids to optimally reduce their installed capacity which is highly beneficial in a congested area like a metropolitan neighborhood. A possible configuration of the community microgrid [24] is shown in the Fig.8

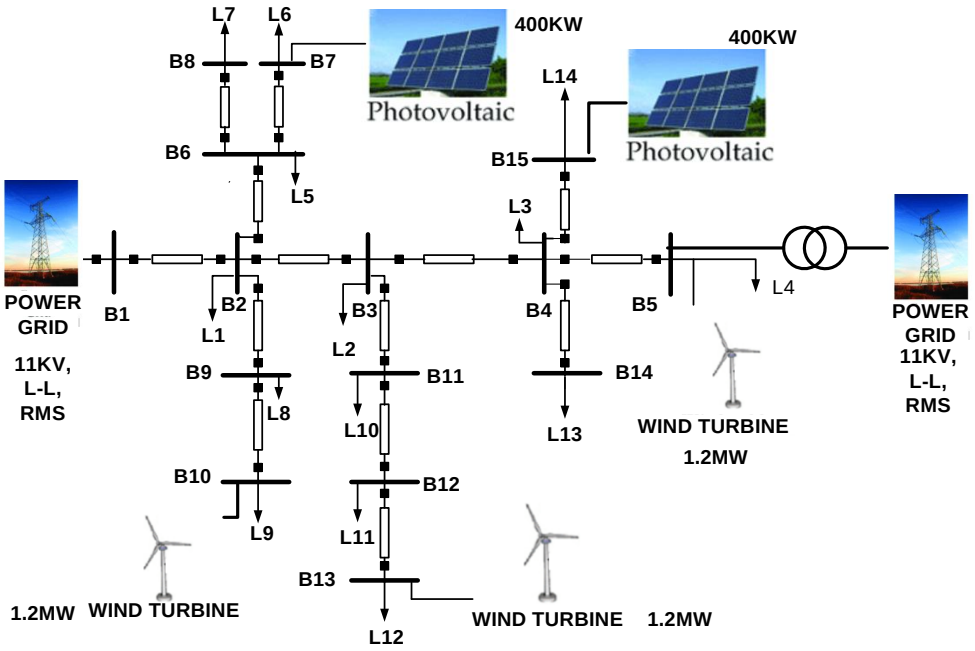

Figure 7. Schematic diagram of Virtual Power plant and electrical energy trading between IT& utility Grid

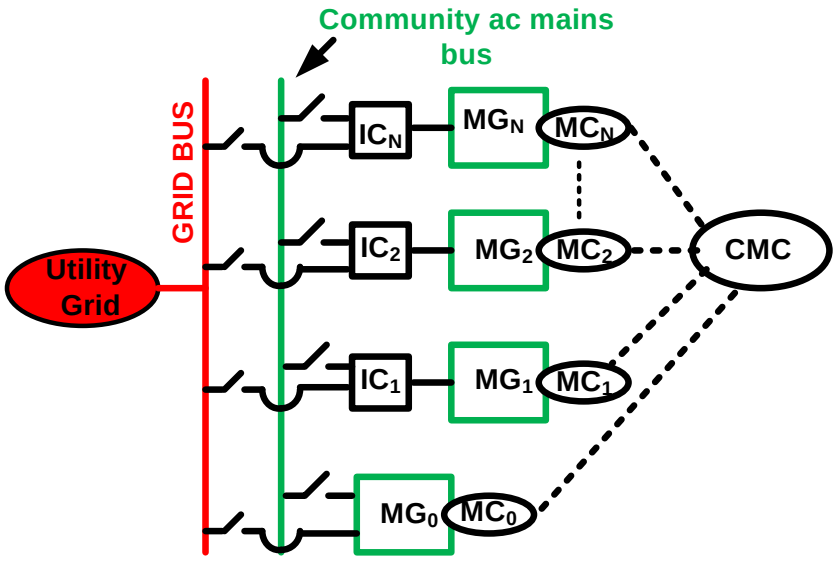

Figure 8. Schematic diagram of the community microgrid.

MG_0 is the slack microgrid and is directly connected to the community bus or grid bus. MG_1 to MG_N are the other microgrids in the community. They are coupled to the community bus or the grid bus by their respective interlinking converters (IC1 to IC_N). Each microgrids have their own connection to utility grid and are also linked with each other through community ac mains bus they can exchange power and provide emergency backup through community ac mains bus. Each microgrid is controlled by its own microgrid controller MC (MC_0To MC_N). This Microgrid Controller is centrally supervised by Community microgrig Controller (CMC), which controls the overall operation of the community. The ICs are basically a buffer between the microgrids to allow them to operate in autonomous manner. The IC is an dc-ac converter in case of dc microgrid and an ac-ac or ac-dc-ac converter in case of ac microgrid. The presence of MG0 and community ac mains bus improves reliability by providing each microgrid with backup access to the utility grid in case of unintentional islanding.

7. Conclusion

Concluding we may say that there is a paradigm shift in the way the power is generated and transmitted to the load- from large centralized generating stations to small renewable based generation connected to the distribution system. With the development of power electronics and enhanced computing power harnessing the renewable energy resources and generation of power from them have got further impetus. Accordingly, the grid and the protection system are becoming smarter. The transmission and distribution losses are getting reduced. The restructured environment of the power system has benefited both the customer and producer of the electrical power. It has brought healthy competition in the power generation transmission and distribution. The cost per unit is likely to get reduced. This is going to help in the development of mankind and in the improvement of the economy.

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CONTRIBUTORY ARTICLES

ENGINEERING EDUCATION

Online Mode of Engineering Education during Pandemic: Merits and Demerits

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Abstract. The epidemic COVID-19 has forcibly transformed the manner of teaching and learning in India's higher education from face-to-face to online, resulting in new experiences and practices for many professors and students. In this context, this research examines the benefits, problems, and tactics of online and offline education in India's higher education during and after COVID-19. The study found that online education is beneficial in terms of time management skills, as well as more freedom for professors and students. However, obtaining reliable internet access at work is one of the most difficult tasks. According to the findings, practitioners who want to participate in online education must be technologically proficient and computer literate. In the context of India, only online teaching and learning cannot be effective, hence blended learning is a preferable alternative in terms of technical education. According to the conclusions of the study, online education can be a viable alternative to traditional education. Thus, in environments such as India, a hybrid approach would make the educational process more effective and successful.

Keywords.COVID-19, Offline Education, Online Education

1. Introduction

Digital transformation has been accelerated by the mandatory lockdown of organizations due to COVID-19. Many educational institutions have started using different distance education systems and tools. The flexible use of these digital learning management systems has turned into a necessity transforming educational organizations, educators, and students' habits [1]. The COVID-19 pandemic and lockdown profoundly altered our view of the normal. It has had a massive impact on the field of education, resulting in a significant shift away from traditional four-walled classrooms. The ambiguity of the lockdown generated confusion and a lack of productivity among the children. After COVID-19, academic institutions around the world encouraged school and college professors to complete the remaining curriculum through virtual instruction. Many professors were hesitant to adopt online platforms for teaching. However, as they gained experience with video platforms such as Zoom and Google Classrooms, the outcome was ultimately favorable [2]. The IIMs use a computer-based test paradigm for their annual Common Aptitude Test (CAT) and AICTE decided to conduct Graduate Aptitude Test in Engineering (GATE) since long back. CBT examinations can be taken at any of the specified test centers around an area, while online tests are taken from students' computers.

2. Merits and Demerits

While online education is not a new phenomenon, its importance came to light after the pandemic. While it has immensely helped in the continuation of education despite the closure of many educational institutions, there is considerable debate between online education and offline education. Table 1 highlights the main differences between online education and offline education.

Table 1. Comparison between online and offline exam

Particulars	Online Education	Offline Education
Method of Teaching	Digitalized tools and methods of teaching	Traditional tools and methods of teaching
Cost and Time	Cost-effective and timesaving	More expensive than online education and consumes more time
Location	Virtual classrooms	Physical classrooms
Flexibility	Online classes have a flexible schedule	Offline classes have a fixed and strict schedule
Pace of Learning	Students largely determine the pace of learning	Teachers largely determine the pace of learning
Level of Commitment	Students are less likely to remain serious and committed to their studies	Students remain more serious and committed to their studies
Accessibility	Students can access study materials from the comfort of their own homes by logging in from anywhere.	Students may have to travel a long distance to get to their respective educational institutions, which might be inconvenient.
Time Management	This mode can cause them to search the web for distractions or check their social media pages instead of focusing on the material they are studying.	In this mode, they are less distracted within the confines of a physical classroom and learn to do their assigned work more efficiently.
Student-Teacher Interaction	there is less interaction between students and teachers in online education	There is face-to-face interaction in the case of offline classes, especially because teaching is synchronous. it allows students to immediately address their doubts and receive quick feedback
Technical Issue	Access to proper electronic equipment such as webcams, microphones, headphones, and computers along with a proper internet connection is a mandatory requirement for online classes.	Students and teachers are not required to be exceptionally tech-savvy and since most learning occurs within the physical classroom
Practical Learning	This scarcely allows students to take part in the practical aspects of learning which is an equally important part of engineering education	Unlike online classes, offline classes provide a stimulating setting that incorporates both academic and practical components of learning. Practical learning enables you to adapt quickly to daily obstacles and settings, as well as have a better grasp of teachings.

3. Exams

3.1. Online Exam

Online exams are the best substitute for traditional exams, and they come with a variety of processes and features that make it easier to accomplish all of the tasks associated with giving exams in an online environment [3]. Online learning, web-based learning, blended learning, e-learning, learning management systems (LMS), computer-assisted instruction (CAI), massive open online courses (MOOCs), virtual learning environments (VLE), and other terms have emerged as a result of the widespread use of digital technology in various educational contexts [1, 4]. The advantages of online tests are presented in Table 2. Online tests, on the other hand, are not appropriate for everyone. They

do have certain disadvantages. For example, (a) internet access limitations, (b) typing abilities limitations, and (c) limitations linked to creating figures or diagrams.

Table 2. Advantages of online exams

Particulars	Online Exam
Location and time	The online exams are created especially for home-based education which is not restricted to any particular location.
Exam security	Security features such as secure browser, suspicious object detection, audit logging, chatbots, etc. also provide additional security. Remote proctoring mechanisms such as image-based, audio-based, and video-based do not allow candidates to cheat during an online exam.
User-friendly and error-free	The exams are very easy to conduct and to appear for. Even the candidates or teachers who are not much techno-savvy can operate the software and can appear or evaluate the online exams quite easily.
Question Bank Management	A question bank is a virtual space where questions are created, saved, and edited by an examiner, paper setter, or subject matter expert. Only a few selected people have access to this question bank. The questions created and saved in the question bank are further added in the exam.
Onscreen Evaluation System	A special tool known as Onscreen Evaluation System is developed to make the process of answer sheet checking easier. Candidates can appear for the exam from anywhere and examiners can evaluate the answers from any location. The identity of the candidate is also masked in the system
Cost-effective	Adopting online classes and exams can help cut down the costs spent on infrastructure such as classrooms, question papers, answer sheets, exam invigilators, etc. The candidates and supervising faculty do not need to travel to the exam center which again helps in saving their expenditure.
Performance analysis	After every exam, schools/colleges need to analyze the performance of candidates. Performance analysis is made easy with the help of online exam platforms. Online platforms offer tools that can be used to collect data and perform calculations. It can also generate reports based on different filters showing different results.
Data management	The question papers, answer sheets, and other documents related to the candidate's identity are stored on the Cloud. Every document presented by the student is scanned and stored during the registration of the exam. This type of data management system is helpful not only to the candidates but also to the educational institutes

3.2 Offline Exams

Conducting exams in classrooms is the traditional way which is being followed since ancient times. But it is necessary to change the methods of giving exams with the changing times. There are a few issues related to offline exams shown in Table 3.

Table 3. Disadvantages of offline exams

Particulars	Demerits
Investments in infrastructure and logistics	Offline exams cannot be conducted in the absence of classrooms. Institutions need to find a proper examination hall or center to conduct offline exams. These exam centers must be well-equipped with facilities needed by students and invigilating faculty. The institutes are responsible for transporting question papers and answer sheets to the exam center.
Issues related to identity verification	In offline exams, candidates need to carry their hall ticket and identity proofs every day to the exam center. The supervisors check each identity proof individually before allowing them to start the exam. Changing names, photographs, and signatures or creating fake documents has become easy due to technology

4. Online Degree vs Campus Degree

Since they are poles apart in terms of their approaches to learning, cost, and other issues, the debate

between an Online Degree and a Campus Degree is a popular one. The following are the benefits and drawbacks of an online degree versus a traditional degree. Distance learning has been available for around 60 years. Students who are unable to enroll in full-time courses due to a number of reasons can benefit greatly from part-time and remote learning programs. For many years, online degrees have been undervalued due to the emphasis on traditional learning. When the pandemic struck in 2020, however, online learning proved to be the most effective approach to acclimate to the lockdown without foregoing school or college education. The pros and cons are discussed in Table 4.

Table 4.Online vs. Offline degree

	Pros	**Cons**
Online Degree	Cost-Effective, Flexible, Easy access, No geographical barriers, Available in short-term and long-term options.	Lack of practical exposure, Restrained to textual study materials, fewer subject options, Lack of interaction.
Campus Degree	Enhances social skills, Holistic Development of students, Practical exposure, Access to resources on campus, In-person support, and acknowledgment.	Expensive, Rigid schedules, No flexibility for those pursuing a job or facing other restraints, Admission process, and eligibility requirements can be complicated.

5. Conclusion

Candidates can appear for the exam from any location and answer sheets can be evaluated at any time. Online exams use Cloud technology to save the questions papers, answer sheets, and other data. The identity of the candidate can be verified using different methods which are secure and reliable. The use of remote proctoring options increases the security of online exams. Even the tiniest risk of cheating is eliminated, and the exam's integrity is 100% guaranteed. As a result, online tests are multifunctional and may be utilized for any form of examination. Online mode of education provides a plethora of advantages that are just unavailable in the case of offline mode. Online exam creating is one of the best alternatives to be implemented because it addresses all issues associated with offline exams. Thus, online modes of education are somewhat superior to offline mode for any educational institution as far as theoretical subjects are concerned. However, skill development and practical understanding can be gained through offline mode of education only.

Conflicts of Interest

The authors declare no conflict of interest.

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National Education Policy-2020 and the Prospect of Technical Education in India

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Abstract. National Education Policy or the NEP has become a very important topic of discussion since its arrival in the year 2020. Like rest of the world, India is also fighting against the fierce pandemic situation for the last two years. In spite of that, Government of India is trying honestly for the implement of this policy throughout the country. It is necessary to aware the common people of this NEP and the Government is looking forward on this issue. NEP brings lots of changes in every level and field of education. Technical Education is not at all an exception. But what was the necessity of this change and what is the significance of it? These are vital questions and this paper will throw light on that direction. In short, this is an attempt to focus on the nexus of NEP and the technical education in India.

Keywords. New Education Policy; Technical Education ; AICTE

1. Introduction

As stated by Swami Vivekananda, "Education is the manifestation of perfection already existing in a human being." [1] This statement of Swamiji clearly reveals the original portrait of an ideal education system. Unfortunately, modern education system of India did not follow this ideology in many respects. Existing Indian education system was following the colonial structure and it was imitating the British or the western school of thought blindly. Though India became independent, yet the Indian students were studying various subjects according to the opinions of western scholars i.e., our students were learning their thought and it was just from their point of view. There lies the problem of the Indian education sector so far.

Indians have no dearth of meritorious students and teachers. But the problem is that, in India, the students are generally being trained to look at each and every aspect through the views of the foreigners (especially, from the west). No doubt, this is also essential but not at all sufficient. Every nation follows such an education policy which is appropriate for the culture, society by at large and history of its own. Hence, a nation follows mainly the ideas. Which are given by the scholars of that particular nation. Every developed and developing country follows this principle and India was the only exception. In every field of knowledge, it used to teach students with the foreign inputs and ultimately, students became almost unaware of the facts, culture and history of knowledge of our own. Finally, the outcome is nothing but some highly educated Indian-foreigners who have no respect for the country and for the countrymen. Certainly, there are exceptions, but they are very few in number.

Besides, the old education system was not at all appropriate for the need of time. At this 21stcentury world, we should have such an education policy which will fulfill the need of the students. Here comes the National Education Policy or the NEP [2].

2. Goals of NEP

In this section we are briefly mentioning the main objectives of NEP. They are as follows:

1) Every learner is different and each of them has different ability or power. Education system should take care of the same.
2) Education process must be flexible in accordance with the need of the students.
3) There should be no barrier of knowledge by identifying the subjects like arts, science and commerce.
4) Multi-disciplinary subjects will be taught so that, a student can gets ideal education which will make perfect citizen. Choice based credit system (CBCS) is another important feature of NEP.
5) Creativity as well as creative thinking will be encouraged and the aim of learning will be not only to get higher marks, but higher values.
6) Mere bookish knowledge is not at all enough, hence, teaching of moral values, ethics, respect for the country and our glorious cultural heritage are very important.
7) Sense of responsibility, equality, scientific thinking, respect for women and the senior citizens will be the subjects for teaching.
8) Lectures will be given on Indian values, Indian culture, glorious past of Indian history and common Indian lifestyle. The basic point will be 'unity in diversity' that Indians are maintaining for the ages.
9) More emphasis will be given on continuous assessment. Focus on vocational and practical training has been increased.
10) This education policy stresses on 'multilingual teaching'.
11) Digital and online process of learning will be encouraged a lot than before.
12) Continuous learning process for the teachers is a vital objective of NEP.
13) Highly enriched research is another important characteristic feature of NEP. Moreover, NEP aims at the establishment of 'Higher Education Institutions' of excessively higher standard.
14) Indianization of colonial education system is very much needed.
15) So far, technical education was considered as separate identity from the general higher education. But, according to the NEP, this attitude should be changed.
16) Private individuals as well as organizations will be encouraged more than before to extend hands in the education sector for the sake of humanity with a vision of service of mankind, not for profit only.

3. Focus on Technical Education

In this section, very briefly focus of NEP on technical education will be discussed. No doubt, vocational asn technical education was considered as a separate chapter or section of education so far. Hence, they were considered as different domain from the general higher education system.

Indeed, this cannot be an appropriate attitude towards the higher education. Moreover, in many case, it is seen that somehow an inferior approach has been taken for the vocational students. NEP- 2020 is different from all these drawbacks.

According to a survey, number of students (age group less than 24 years) who are learning vocational education is less than 5% while it is 52% in USA, 75% in Germany and more than 96% in South Korea. The difference is quite evident. Hence, expansion of vocational education is very important. NEP announces that, it will be made as mandatory for the schools to included vocational training in the mainstream education. Further, in higher education institutions also, vocational education will be included. Learners will be encouraged for being self-dependent or to begin start-up with the help of Government of India or various NGOs. B.Voc degree at the higher education level will also be awarded. ITI, Polytechnic, institutes etc., will be more modern and they will be directed towards job creation and job-oriented education. The proper authority will help to expand apprenticeship and soft skill development programs also. Moreover, vocational and technical education will be of international

standard and for this reason, so many MOUs will be signed among various institutions of both national as well as international importance.

As vocational and technical educations are part of professional education system, hence, it is the need of time for more professionals. This means not only the increase in numbers but also enhancement or the upliftment in the quality also. NEP emphasizes on that. Besides, it ensures to made Indian students as per international standard with absolute latest modern training i.e, digital education. Society has changed a lot and today digital or online teaching-learing has become as an inseparable part of education. So, NEP looks at it and announces to upgrade the standard of teaching process. It will help to make teachers technically efficient and hence more experienced with modern methodologies.

All India Council of Technical Education (AICTE) has commented on NEP as–"..... marching towards a new era of professional and technical education". Now, focus will be made on three specific features of NEP regarding technical education.

Firstly, it allows students to attain higher technical knowledge in their mother-tongue or the regional languages which is indeed a revolutionary attempt.

Secondly, NEP announces multi-disciplinary studies in technical education. IIT-Delhi has already started online course on 'Upanishads–A Scientific Approach'. Various other famous institutions also have started taking initiatives regarding this. For example, architectural history of ancient India is included in the syllabus of some reputed institutions. These are certainly steps to learn India and Indian culture coupled with modern infrastructure and technical efficiency. It will help students to apply the ancient unimaginable knowledge in the modern age, because our ancient knowledge has deep significance in 21st century World also. This has been appreciated and accepted by various countries. It is because of that; they want to study Indian cultural heritage.

Thirdly, close connection or collaboration between industries and educational institutions is very important in NEP. This is significant not only for employment, but also for innovative research and development of the society by at large.

4. Conclusion

Definitely, this is a brief discussion on National Education policy– 2020 and the future of the technical education in India because, there are lots of words to tell on this theme which is not at all possible in this short space. Yet, it is an attempt to draw a picture of the future of Indian education sector with a glimpse to the technical education. Indeed, according to the technical experts, NEP will help to organise the system in such a way that a student of today will become a leader of tomorrow. Thus, the country will pave the way towards advancement. For this reason, AICTE has already taken steps like NEAT or National Educational Alliance for Technology which is promoting high level online and modern training to the students. Indeed, this NEAT have several other features also. Definitely, this is the first step towards the implementation of NEP. Recently, the Union Budget, 2022 has been presented. In this budget, allocation in education has been increased and allocation for AICTE has been certainly increased than the previous year. Moreover, Digital University will also be established in future to expand online education for all. So, in short, NEP is working to make India as the leader of the world as well as for sustainable development also. So, National Education Policy-2020 will definitely bring a ray of light in the field of professional and technical education (which are integral part of higher education also), it is hoped.

Conflicts of Interest

The author declares that there is no conflict of interest.

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Efficient Management of Technical Educational Institution in India

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Abstract. The present technical education system of India currently focuses on role learning which helps just memorization skills of students rather than focusing on conceptual understanding and applications. the government department on education should look after to promote innovation, Research & Development in addition to provide affordable education to all; making Indian Technology globally acceptable and look forward efficient, flexible and empowered manpower, sensitive to the Industry's expectation. In this paper a case study of the Elitte Institute of Engineering & Management (EIEM) is proposed.

Keywords. Technical education; Government policy; Education; Case study

1. Introduction

India the country from where approx. 1.5 million engineering graduates are produced from around 10,345 institutions including Govt. and Private Sectors in the discipline of diploma, degree, post graduate degree etc. etc. The country ranks for producing Engineering Graduates according to the US-based national Science Foundation's report of 2018. Although we know the Technology is touching every aspect of life and society with a view to develop and offering opportunities for education & training, but surprisingly to mention that only 25% of the 1.5 million Engineering Graduates from India are employed and rest are either unemployed or under-paid according to the recent study. All of this affects country's growth and economy. It happens due to lack of proper required infrastructure and qualitative curriculum that can fulfill industry standard and job production. As a matter of fact the need for industrial education in our country is no longer a subject of debate.

2. The Scenario

2.1 Technical education scenario in India in current decades

The present technical education system of India currently focuses on role learning which helps just memorization skills of students rather than focusing on conceptual understanding and applications. The present situation changes the mindset of students from solving problems to get good grades and job as well. The AICTE (All India Council of Technical Education), a statutory body under the administrative control of Govt. of India, was set up for responsible to formulate, maintain norms and standards, quality assurance through accreditation. Also AICTE is monitoring and evaluation, maintaining partly of certification and awards in various levels. It appears, the engineering curriculum except the premier institutes like – IITs, NITs, IIITs etc. looks very much old and as a result it failed to

meet the current industry standards. Change of standard of technologies, development in teaching ability with experienced faculties, adequate infrastructures based on industries requirement are needed. Focus must be given for world engineering scenario to establish more skills & improve the quality of technical education to look forward talent students. The quantitative growth of engineering education in India has undoubtedly increased but the opportunities for engineering aspirants however, the maintenance of quality becomes the victim this growth phenomena.

2.2 Government Policy

As far as govt. Policy towards technical education in concern, the Central Government, State Government, Union Territories have played a vital role in human resource development of the country by establishing a large number of fully funded and aided technical institutions, providing adequate policy support and still creating skilled manpower, enhancing industrial productivity and improving the quality if life of its people[1]. Technical education covers programs in engineering, technology, management, architecture, pharmacy applied arts & crafts, hotel management & catering technology. The essence of Ministry of HRD is education, which plays a significant and remedial role in balancing the socio-economic fabric of the country. The department should look after to promote innovation, Research & Development in addition to provide affordable education to all; making Indian Technology globally acceptable and it should also look forward for efficient, flexible and empowered manpower, sensitive to the Industry's expectations [2]. It would be appreciated if cooperation be developed to make it balance between Government, Industry and Technical Education Institutions, as and when needed. Focus should be given towards education which is an important investment in building human capital and future of the nation. Care has been taken by the Govt. for web-based digital learning through various platforms including NPTL etc. and some more likely to be initiated.

3. Current Status

3.1 Present Curriculum

The present curriculum being followed in most of the institutions of the country are way too old. To improve the gap for required need and to gain adequate knowledge by the students professional skills are found poor that proves inadequate job opportunities and higher studies in the specialized fields. In addition students should be trained properly to make their place for desired placement. It is to mention that the changing economy would is throwing new challenges to the Managers. The management concepts and practices are shaping "tomorrow's history". A number of changes are taking place which are influencing the work of Managers like – quality management, work force diversity, innovation, empowerment & teams, downsizing, contingent workers etc.

3.2. Effective Solutions for Quality Improvement

By improving the curriculum matching with the changes of technologies from time to time, skill building is very much needed. The Academic institutions should close touch with the top or higher level Universities, be it in-house or abroad by way of exchanging knowledge of technology and for joint collaboration and research work. Besides these, teaching profession should be more attractive, exciting with research oriented. Good administration, strong management, well equipped facilities, various platforms with qualitative cultural activities, sports and games, and finally teaching improvement are to be established for effective solutions. To be more successful, innovative ideas and its implementation with project work, industrial training, and entrepreneurs are the added points to improve its effectiveness. There is a tremendous chance to play a role in promoting entrepreneurship which has already taken place in so many technical institutions. Appreciable initiatives taken by the NSIC (National Small Industries Corporation), a Central PSU, MSME (Ministry of Micro Small and Medium) towards various development and effective role for the students [3].

3.2. Case studies in "EIEM"

Elitte Institute of Engineering & Management (EIEM) situated at Karnamadhabpur, Ghola, North 24-Parganas, Kolkata, India has been established in a most convenient and beautiful location and running with its flying colors for the last couple of years, by having its strong Managerial capacity, well secured & equipped all round facilities like – updated labs with sufficient computers, Smart Classroom, playground, own transport, social events, a good number highly qualified and experienced faculties and supportive staff and reputed with strong Placement Department. Apart from courses on B. Tech. in various streams, EIEM is having adequate students' strength where students of different religions and cultural backgrounds study and work together, in its various streams like – Electronics & Telecommunications, Computer Science & Technology, Science & Humanities, Civil, Electrical, and Mechanical Engineering in addition to Hotel management. Besides this, Industrial Training Institute having its two important Sections has been started recently. The institute (EIEM) has been awarded the best Polytechnic for relentless efforts especially mission & vision in Technical Educational Grade. EIEM is affiliated by the West Bengal State Council of Technical Skill & Vocational Education (A Government. of West Bengal Authority) and approved by the All India Council of Technical Education (A Government of India Authority) including Directorate of Technical Education & Training, Govt. of India. We all are proud for the institution (EIEM) goal and there lies in its capacity to orient our students to become job ready under the guidance of higher competent, motivated and energetic faculty, trainers, officers and staff. Students feel the difference owing to the ambience to develop them in a disciplined manner for enhanced and successful career growth.

4. Conclusion

With a view to improve the standards of technical educations and to promote and provide competent technical manpower for the Make-in-India campaign, the AICTE has approved various packages of measures to be implemented by all the Technical Institutions. The Department of HRD Ministry, Govt. of India has taken appropriate steps like- induction training, revision of curriculum, Mandatory Internships, industry readiness towards development of various fields in Technical Education so as to build career of students and to avail more job opportunities in their fields[4].

Needless to mention that at this juncture more of the developed countries in the world including USA, Italy, France, Britain and finally Indians are still very much suffering for the last few months from COVID-19 pandemic. A huge no. of people in all over the world have lost their lives through COVID-19 for which lockdown is forced to apply to stay home in order to stay safe. Many countries are still fighting to overcome from COVID-19, but no positive results are found till date. The dangerous disease has taken lots of innocent lives. So many mothers have lost their children; man has lost their near and dear once. The people who are poor but not beggar, this worst situation has made them beggar. They were hard-working people after returning from work they take food in their house and rest without any tension. But this "CORONA" has made them bound to beg in spite of self respect. It is not only very pathetic, but also bad affects towards various fields. People, who are no more now, please God keep them rest in peace in heaven which is your kingdom. We must salute the people who are found dedicated in service like – doctors, nurses, paramedical staff; staff attached to Govt. & Non-Govt. Hospitals/Nursing Homes including Police Officers with their entire team including Civic volunteers and social workers towards handling various COVID-19 adding affected patients and finally extending help many other people.

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Conflicts of Interest

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ENGINEERING PRACTICES

Civil Engineering

Provision and Scope of Rainwater Harvesting at Elitte College of Engineering

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Abstract. As the population of world increases, the demand for quality drinking water is also increasing. Therefore, the saving of water became very essential. Many nations adopted rainwater harvesting which is an old practice as a viable decentralized water source. The definition of rainwater harvesting is the technique of collection and storage of rainwater at surface or in sub-surface aquifer before it is lost as surface run off. Due to depletion of groundwater resources, the only way to solve the water problem is rainwater harvesting. The rainwater will be not only useful, but also helps to improve the quantity and quality of water. Here our focus is to construct an underground water reservoir to store the rooftop rainwater and use the water for washroom purpose. The methodology includes collection of rainfall data, finding out the area on which rainwater can be harvested for storage, calculating the volume of storage tank, quality analysis of rainwater, treatment for rainwater, how to reuse the water for college purpose.

Keywords. Rainwater; Treatment; Harvesting; Reservoir

1. Introduction

The basic need of life is water. Now days there is a increase in demand for good quality of water in every sector like industries, irrigation, domestic purpose. Of the total water on earth, only 2.7% constitutes freshwater which is largely (77%) locked up in the polar icecaps and mountain glaciers and only 1% of the total water is available as surface water which is flowing in rivers, streams, etc. and 22%of the total water locked up as underground water [1]. Due to massive misuse, the quality of water is deteriorating everywhere, particularly of underground water. Every part of the ecosystems is under massive pressure. As per the report by the United Nations Environment Programme (UNEP) that by the year 2050 more than 2000 million people would live under conditions of high-water stress and water would be a limiting factor for all development activities in most of the regions of the world. As per the present trend continues, it is presumed that by the year 2010, more than 50% of the world population will live in the state of urban areas. As the overall global population growth is slowing down, the number of people living under water-stress condition is expected to increase, to nearly 2 billion people by the middle of next century [2]. These reports show that there is increasing pressure on the world's freshwater resources.

Because of the increasing water demand, alternative sources such as storm water and treated effluent reuse of water need to be considered. Rainwater harvesting is an old practice that is adopted by many nations. Among many tools, individual rainwater harvesting systems helps to meet the growing water demand. Rainwater harvesting is an environmentally effective solution to address issues brought forth by large projects utilizing centralized water management approaches. Growing population all over the world is causing similar problems and concerns of how to supply quality water to all. Rainwater harvesting may be one of the best methods which is available to recovering the natural hydrologic cycle and enabling urban development to become sustainable [3].

2. Site Description

B Block of Elitte College of Engineering was chosen for rooftop rainwater harvesting. Total height of the building is 14.85 meter. Total number of people including students and faculty in the B block is 600. Total per capita demand per day for toilet purpose is 20 liters per capita per day (lpcd). Total rooftop area of block B is 1122.43 square meter (see Fig.1).

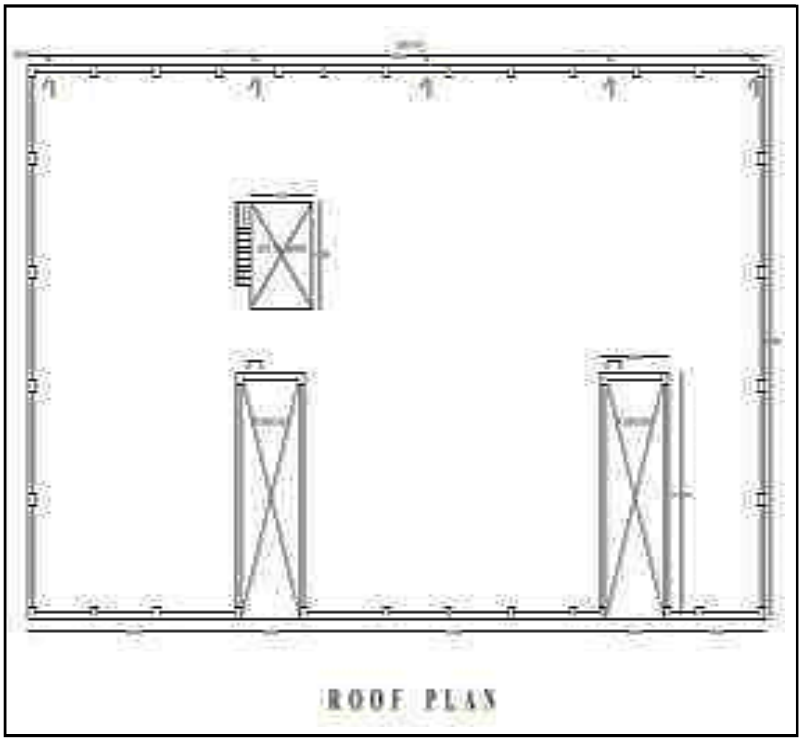

Figure 1. Roof plan of block B ECE Campus

3. Methodology

3.1 Climate

The annual temperature is about 270C, monthly mean temperature ranges from 190°C to 300°C. Sodepur, that is the area, is dominated by three seasons, summer, monsoon and winter. In summer the area is hot and humid with mean temperatures about 30°C but during dry spells the maximum temperatures often exceeds 40°C, during April-May there is a frequent event of severe thunderstorm/thunder during afternoon/evening hours that causes relief from the humid heat.

3.2 Collection of rainfall data

The rainfall data for 11 years (2009– 2019) was collected from IMD. The storage capacity of the tank can be calculated for these events using the maximum, minimum and average rainfalls, and it can be related to the optimal size of the storage tank which is based on cost benefit analysis.

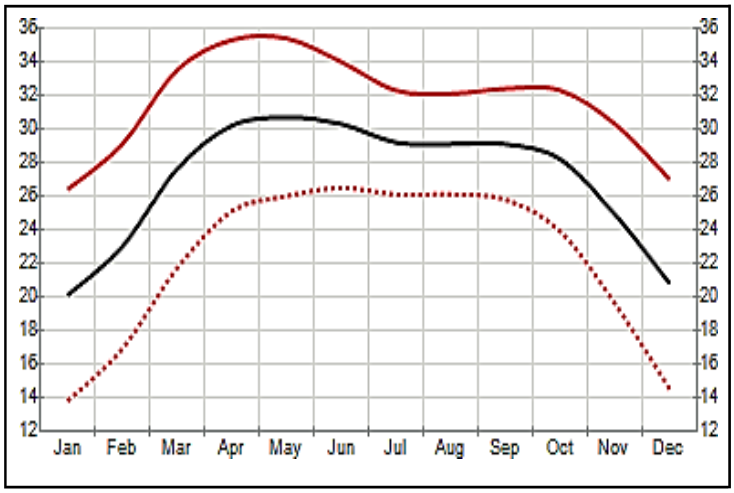

Figure 2. Average temperature per month in ^{0}C

3.3 Calculation of amount of rainwater

The amount of rainfall which can be harvested on a given rooftop area can be calculated using by the Rational formula which is,

Q = c*i*A

Where,

Q = amount of discharge from the roof (inm3) A = Area of the rooftop (in m2)

i = depth of annual rainfall received on the roof (in m) c = runoff coefficient (no unit)

Runoff coefficient plays an important role in assessing the runoff availability. This coefficient depends on catchment characteristics. It is the fact, which accounts for the fact that total rainfall falling on the catchment cannot be collected or stored. Some of the part of rainfall will be lost from the catchment by evaporation and retention on the surface itself. The value of c depends on the material used to make the roof. This value varies for different materials and is given in Table 1.

4. Observation and Analysis

4.1 *Analysis of rainfall data*

Table 2 shows the average annual rainfall at the study area.

Table 1: Value of *c* for different catchments

Type of roof catchments	Runoff coefficient
Roof catchments	
Tiles	0.8-0.9
Corrugated metal sheets	0.7-0.9
Ground surface coverings	
Concrete	0.6-0.8
Brick pavement	0.5-0.6
Untreated ground catchments	
Soil on slopes less than 10%	0.0-0.3
Natural rocky catchments	0.2-0.5
Green area	0.05-0.1

Table 2: 11 years average annual rainfall data

ANNUAL DATA IN cm												
MONTH	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	10 YRS AVG
JAN	0	0.1	0.6	42	0.3	0	48	0.6	0.3	0	0	8.4
FEB	0	8.1	1	7.8	11	38	3	104	0	0	156	29.9
MAR	36	4	23.2	0	1.1	16.2	42.2	15	34	0	100.3	24.7
APR	0	17	56.2	58.2	70.7	0.2	108.5	0	13	180.1	26.8	42.6
MAY	302.7	181	177	63	155.6	131	30.9	126	72.7	143.6	94	134.3
JUNE	8304	175.7	366.4	44.7	298.7	297.7	181.6	122.2	185.4	151.3	71.7	179.9
JULY	221.5	216.4	295.1	369.1	294.1	235.6	938	403.2	592.2	488.8	87.2	367.4
AUG	377.3	177.9	518.2	220	392.9	231.1	244.5	130.8	300.4	146.1	367.7	308.7
SEP	298.7	281.7	233.2	185.2	222.7	233.6	170.3	196.1	269.7	180.3	303.1	234.1
OCT	80.2	74	47.1	43	309.5	42.1	21.1	69.7	289.6	46.2	154.2	107
NOV	41.8	0.3	0	43.2	0	0	0	25	67.5	0	113.2	26.5
DEC	0.7	20.2	0	25	0	1	5	0	15	6	6	7.2
YEARLY AVG	120.16	96.37	147.17	83.43	146.38	101.79	149.43	99.38	153.32	111.87	123.35	
MONTH	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
JUNE	83.4	175.7	366.4	44.7	298.7	297.7	181.6	122.2	185.4	151.3	71.7	
JULY	221.5	216.4	295.1	269.1	294.1	235.6	938	403.2	592.2	488.8	87.2	
AUG	377.3	177.9	518.2	220	392.9	231.1	244.5	130.8	300.4	146.1	367.7	
SEP	298.7	281.7	233.2	185.2	222.7	233.6	170.3	196.1	269.7	180.3	303.1	
YEARLY AVG	245.23	212.93	353.23	179.75	302.1	249.5	383.6	213.08	336.93	241.63	207.43	

4.2 Analysis of data collected on sites

The total area available for rainwater harvesting is 1122.43 square meter (rooftop area). The total amount of rainfall that can be harvested in the area is calculated by using rational formula where the average annual rainfall in the area was taken as 1533.2 mm and the value of c was taken to be 0.85. After analysis, it is found that in the entire campus a lot of water is used, which cannot be substituted entirely with harvested rainwater. If a rainwater structure is made at the campus, then its capacity can be calculated by using rational formula and it can also be used for calculating the storage volume of the tank [5].

Thus, Q comes out to be 0.027 m^3/s

The dimensions of the storage tank of this capacity, if the depth is kept 4.5 m, length 20 m and breadth 8m, and then structural design and economic aspects can be worked out as a civil work by appropriate consulting organizations. 8 numbers of rainwater pipe of diameter 100 mm should be provided at the rooftop.

4.3 Quality analysis of Rainwater

Rainwater was collected at ECE campus, and the quality was analyzed at Environmental Engineering Lab of ECE. Table-3 shows the quality of the rainwater collected at ECE campus.

Table 3: Quality of Rainwater

Name of the Test	Test Value
HARDNESS: Total hardness Calcium hardness	 244mg/ltr 121mg/ltr
TURBIDITY	7.2 NTU
pH VALUE	7.75

5. Rainwater Harvesting Structure

The rainwater harvesting structure proposed, is a very simple underground structure having basic components. The rain tank contains an inlet from a first-flush pit through a mesh filter; a low water level monitor, and there is also water supply outlet and a pipe-conveying overflow to the sewage drainage pipe. Rainwater collected from roofs flows via storm water pipes through a “first-flush” pit into the rainwater storage tank. If the capacity of rain water tank is exceeded, overflow is occurred directly through a pipe, which joins with the sewage pipe [6]. If a more sensitive structure is required, then dual strategy could be adopted. In it, there are two water tanks, one for the supply water tank and other for rainwater tank. These two water tanks will be separate units but they will be inter-connected by a simple DMS such that when the rainwater tank is empty, potable water will be pumped into it to a pre- determined level and the water will be used for non-potable uses. The operation of both these tanks will ensure that potable and non-potable requirements are fully satisfied. The inflow pipe from the distribution tank should be at least 15 cm above the top water level of the rainwater tank so that no black flow can take place.

6. Conclusions

In our study, we have collected rainwater, analyzed the quality of rainwater and suggested to construct a storage tank and use the water as sanitary purpose in the college campus. For sustainability, rainwater harvesting technique is highly recommended. The harvested rainwater would only substitute only a small portion of the demand but still it is essential. One more point that was noticed was, if the campus is big, then more water is harvested as compared to the needs but, if the campus is highly commercialized and must provide to people of higher living standard then, even the comparatively more harvested water will substitute less percentage of the total demand [7].

During the study, the biggest problem was the time. As we had to collect the rainfall during the rain to analyze the quality. Water harvesting is a very simple way to ensure availability of water in water stressed areas and seasons but it not the only solution to the problem. It is needed for a more comprehensive integrated approach for water management with traditional structural approaches that combine construction of dams and reservoirs, and rainwater projects for multipurpose use elements of a non- structural approach, along with suitable changes in other sectors like law, policy, governance and a stress on monitoring and modeling of the existing structures and techniques. Water harvesting is not applicable in all situations for example, in extremely low rainfall areas. Prevention of local and downstream pollution of water bodies has also emerged as a big area of concern and steps must be taken to ensure that.

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Membrane Based Ultrafiltration of Toxic Effluent to Combat Groundwater Crisis

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Abstract. The paper observe and tries to evaluate the character of effluents generated from fabric bleaching and dyeing factories positioned at Kalikapur region beneath the Maheshtala region, West Bengal, India and to offer a sustainable control of surface water sources thru putting in CETPs with 0 liquid discharge plants. Effluents from medium, small and tiny factories of this place are producing 2000 MLD. Studies with forty small scale units for 4 years (2012—2016) positioned on this region exhibited following implied values of various physic-chemical variables: pH: 9, BOD: 608 mg/l, COD: 1824 mg/l, TDS: 6410 mg/l, TSS: 926 mg/l and hazardous metals which include Pb: 0.43mg/l, Cr : 0.031 mg/l, Zn: 0.74 mg/l, Ni: 0.07 mg/l and Cd:0.03 mg/l. These values exceeded the usual permissible limits stipulated through FAO (1985) and WHO (2003). The wastewater encumbered with poisonous hint metals is adversely affecting the surroundings and human fitness and additionally degrades the best quality of each surface and groundwater and constantly lowering the level of underground water aquifer.

Keywords. Wastewater; Textile, Treatment; Membrane; Ultrafiltration

1. Introduction

The most important purpose of the study is to evaluate the character of wastewater generated and to offer a sensible and sustainable groundwater control through putting in common effluent treatment plant [1] with 0 liquid discharge device thru implementation of membrane primarily based totally on ultra-filtration, opposite osmosis with recourse (Agarwal et al. 2010) to recycling of bleaching and dyeing effluent at Kalikapur, West Bengal, India to keep groundwater, surroundings and human fitness of a thickly populated region and 15 KM from Calcutta. The research work carried out in Chatta and Kalikapur region (1.85 sq.km) which belongs to Maheshtala fabric hub (44.67 sq.km), an city region having administrative head zone at Alipore of South 24 Parganas district of West Bengal (see Figures 1 and 2). The region lies among 10.450 N latitude to 75.900 E longitude having more than one thousand small and tiny bleaching and dying factories as according to Economic Survey (2014), West Bengal Government where groundwater level shrinks each day according to SWID, West Bengal Government.

Figure1. Map of Maheshtala Region

Figure 2. Map of Chatta Kalikapur

2. Methods

Samples had been accumulated from SSI units within the observe region at periodical intervals in 2012-2013. Samples have been taken to the laboratory and analyzed as per the usual methods described and suggested by American Public Health Association [2]. Temperature and pH had been measured through a mercury thermometer having variety from 00C-1000C and with transportable pH meter respectively at site. Total dissolved solids, dissolved oxygen, salinity and turbidity had been decided through Water Quality Analyser PE- 371 (Systronic). Alkalinity of samples had been assessed through titrimetric apparatus. For evaluation of COD, samples had been stabilized through acidifying with H2SO4 under 2 and it became measured through dichromate titration approach [2]. The awareness of nitrate within side the samples become decided through UV spectrophotometric screening approach with Zuconyl indicator. Sodium, potassium and calcium had been measured through Flame- photometric approach. Heavy steel samples had been analyzed after filtration through Whatman filter–paper no. forty after which acidified samples had been digested with focused HNO3 (0.1%) acid. The metals had been measured with atomic absorption spectrophotometer (OMA and 300 system analyzer).

3. Results and Discussion

The pH suggests the effluent is alkaline, heavy chemical substances and dyes available in TDS, and presence of trace metal suggests that the untreated effluent is bad for ecological imbalances within site the place and required instant treatment. The physicochemical parameters of wastewater generated from the bleaching and dyeing units after initial treatment observed the parameters as pH(7.7), BOD(20 mg/l), COD(120 mg/l), TDS (2234 mg/l), TSS (22 mg/l)) lower than the parameters of WHO, 2003 and FAO, 1985 ; Hazourdas metals Pb (0.33mg/l), Cr(0.021 mg/l), Zn(0.54 mg/l), Ni (0.00 mg/l) and Cd (0.02 mg/l may be cleaned after membrane and primary treatment named as advanced treatment plant facilities (ATP) depicted in Table-1.

The present review clearly highlights the fact that the role essayed by these membrane-based treatment procedures in producing reclaimable textile effluents is quite physical. This technique is being practiced in CETPs working in 800 m3/day CETP at Ramtek textile cluster near Nagpur, 1.5 MGDCETP at Pali textile hub, Rajasthan. The careful selection of the appropriate membrane based method is, however, inclined by the quality of the treated process stream wanted, characteristics of the membrane and the rheological heterogeneity of the effluent at hand, as well as the position of the process in the cost range. For instance, the quality of water recuperated through microfiltration or ultrafiltration usually does not fulfil the criteria for reuse in acute processes such as dyeing offibres; this reclaimed water is regularly recycled in rinse vats or as wash water in textile industries. Subsequent NF and/or RO processes are therefore necessary for producing best quality treated effluent that can be directly recycled in the primary textile stages such as dying, which claim clean and

constant supply of softened water. Additionally, NF and RO concentrates from membrane based single or hybrid treatment systems, can be treated further using moderately energy efficient membrane crystallization units and/or membrane distillation monitored by burning of the MD concentrates so as to take about successful effectuation of the concept of zero liquid discharge (ZLD). CEPT process flow chart of 500MLD capacity depicted in Figures 3 and 4, respectively

Table-1 : Efficacy evaluation of enhance remedy strategies (ATP) after primary treatment:

Sl.No.	Parameters	Feed	Perametar from Reverse Osmosis Ultrafiltration	Reverse Osmosis	Concentrate from
1	Appearence	Clear	Clear	Clear	Muddy
2	pH	7.7	7.7	6.0	7.8
3	Alkalinity	345(±15.2)	325(±14.1)	12(±1.4)	1100(±51.7)
4	Suspended solids	22(±1.6)	ND	ND	ND
5	Total dissolved solids	2234(±57.7)	2196 (±53.0)	40(±1.8)	7584(±195.4)
6	COD	120(±1.6	20(±1.2)	ND	ND
7	BOD	20(±1.2)	3(±1.2)	ND	11(±1.2)
8	Total Kjeldahl nitrogen	ND	ND	ND	ND
9	Phosphate	1.1(±0.08)	0.066(±0.05)	ND	0.22 (±0.06)
10	Sulphides	1.6(±0.20)	ND	ND	ND
11	oil and grease	1.4(±0.20)	<1(±0.1)	ND	3.3(±0.40)
12	Chlorides	494(±29.1)	483(±28.4)	12(±0.80)	1653(±97.8)
13	Calcium	330(±11.1)	325(±11.0)	3(±1.1)	1125(±112.90)
14	Magnesium	164(±14.6	143(±12.7)	2(±0.60)	493(±42.5)
15	Sulphate	350(±37.0)	307(±32.7)	ND	1070(±114.1)
16	Sodium	289(±14.0)	264(±12.9)	3(±0.9)	917(±122.9)
17	Potasium	15(±2.00)	<1(±0.20)	<1(±0.20)	1(±0.200)

-All values are expressed in mg/l except pH ; values in parenthesis are standard deviation; ND: not detectable; [a]Tertiary treated effluent from feed tank of ATP , Source : [3]

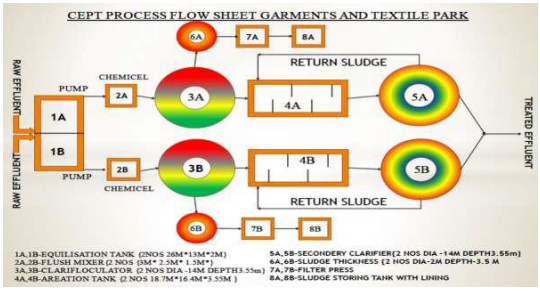

Figure 3. CEPT Process Flow Sweet Garments and Textile Park

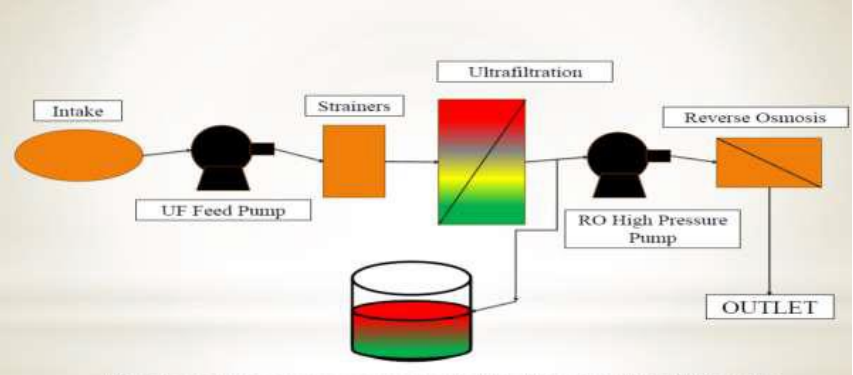

Figure 4. Flow Chart of Wastewater remedy with Ultrafiltration UF and RO device

4. Conclusion

The CETP facilities can consequently store ground water from depletion and degradation. Transfer of contaminants to agro-horticulture produces thru the food chain could be curtailed and consequently human health hazard could be minimized. The entire treatment and reusing of treated water will help to preserve 2000 MLD underground water in the cluster area to save water and save life as the entire India & World is moving towards water paucity due to climate change.

Acknowledgements

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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A Laboratory Investigation on Flow Traits in Saturated Clay

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Abstract. The properties of flow through saturated soil are complicated. When the head is low, the flow is virtually linear, and Darcy's rule applies. The flow is nonlinear at the increasing head and is mathematically known as Forchheimer's flow. Several factors, including soil and fluid properties, influence the critical flow velocity for this transition and the corresponding Reynold's number. An experimental examination was carried out in this paper using a falling head permeameter and a locally accessible soft soil sample. The test findings were subjected to a careful analysis and interpretation to identify the linear and nonlinear flow characteristics, and key conclusions were obtained as a result

Keywords. Aquifer, Ground water, Saline water intrusion.

1. Introduction

Water is extremely important to humanity, and it is also one of the most pressing concerns of our time. Freshwater availability is a major factor in determining a country's population's standard of living [1]. Existing sources of freshwater (lakes, reservoirs, rivers, and so on) must also be developed and managed scientifically to maintain a high level of life and a healthy environment, as the need for freshwater grows daily owing to population growth [2]. The prospects for coping with population demand on the water include groundwater recharge, inter-basin water transfer, and water re-use. In coastal areas, groundwater is the principal supply of freshwater for both household and agricultural purposes. Many hydrological processes are regulated by horizontal and vertical hydraulic conductivity of the soil [3, 4]. Engineers and hydro geologists will benefit from this research because it will address flow characteristics through saturated soft clay. Basic principles on diverse soil properties are reinforced through a series of experiments to better comprehend the complexity of flow characteristics.

2. Experimentations

2.1. Determination of Specific Gravity

The ratio of the weights of an equal amount of distilled water at the same temperature both weights were taken in the air is known as specific gravity (G). The main goal of this experiment is to get basic information on soil parameters such as degree of saturation, void ratio, and so on. A density bottle is used to determine the specific gravity of soil passing through a 4.75 mm I.S. sieve. The test is carried out in accordance with IS-2720 [5]. The specific gravity (G) was found to be 2.51, 2.61, and 2.55. as shown in Figure 1.

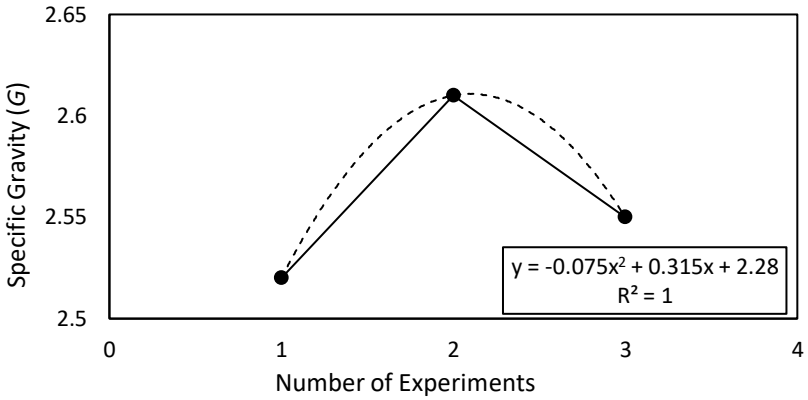

Figure 1. Results of different specific gravity experiments.

2.2. Standard Proctor Test

The standard proctor test is conducted as per IS-2720 [6] to determine the relationship between the moisture content and dry density of the soil sample compacted in a specific mold with a hammer weighing 2.5 kg dropped from a height of 30 cm. the results are shown in Figure 2.

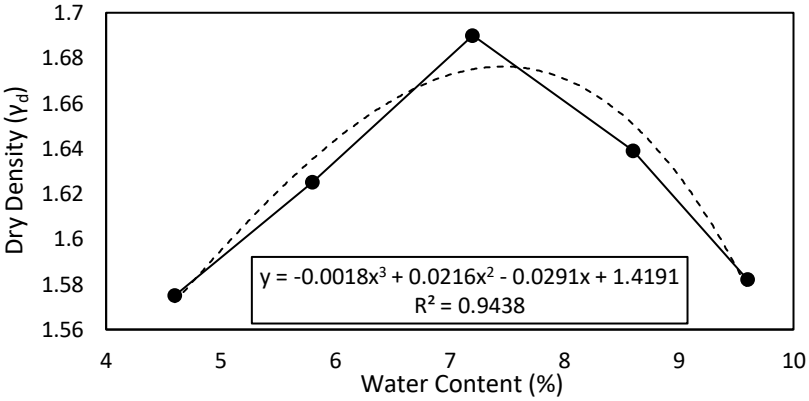

Figure 2. Dry density for Water content

2.3. Liquid Limit

The Liquid Limit of soil is the determination of water content present in the soil due to which there is a small resistance against the flow. This test is done as per IS-2720 [7]. The results are shown in Figure 3.

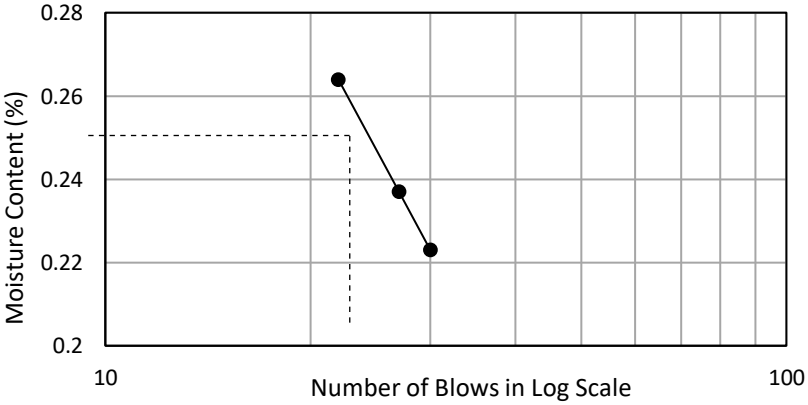

Figure 3. Comparison of water content with the number of blows

2.4. Plastic Limit

The limit of water content at which soil loses its plasticity is defined as the Plastic limit. The difference between liquid limit and plastic limit is defined as the plasticity index, which is considered as one of the major indexes of soil. The experiment is performed as per IS-2720 [7] Observations are Moisture content of sample 1 is 16.8 %, Moisture content of sample 2 is 16.2 % and Moisture content of sample 3 is 14.8 %. (Moisture content is determined using an Infrared moisture meter).

2.6. Falling Head Permeability Test

A falling head permeability test is done to obtain knowledge about hydraulic gradient and coefficients of permeability. These two properties of soil play a very important role in solving the problem related to seepage control, the yield of water-bearing strata, and coastal groundwater management. The test was performed as perIS-2720 [8].The results are shown in Figure 4.

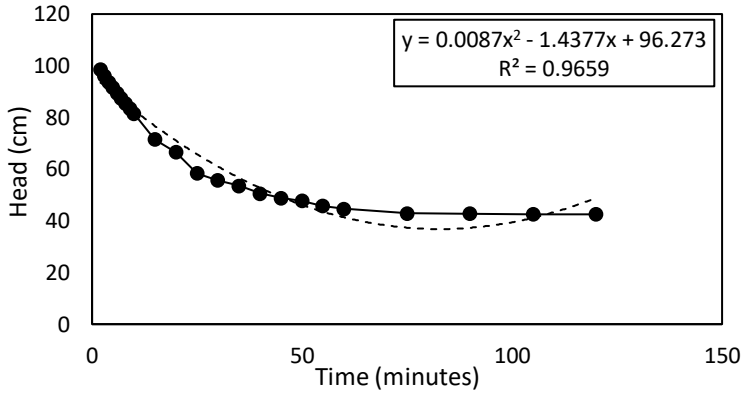

Figure 4. Falling of head for the time

Now the average flow velocity through soil can be calculated by using this expression. $v = \frac{h_{j-1} - h_{j+1}}{t_{j+1} - t_{j-1}}$. Where h is the true head expressed in meter and t is the time expressed in second. Table 1 shows the results of average flow velocity.

Table 1. The calculation for average flow velocity

Time in minutes	Time in second, t = T x 60	Apparent head in cm, (H)	True head in m, h=(H–42.5)/100	Hydraulic Gradient, i= h/L	Average flow velocity through soil in m/s,
2	120	98.5	0.560	4.39906	
3	180	96.2	0.537	4.21838	0.000400
4	240	93.7	0.512	4.02200	0.000392
5	300	91.5	0.490	3.84918	0.000367
6	360	89.3	0.468	3.67636	0.000342
7	420	87.4	0.449	3.52710	0.000325
8	480	85.4	0.429	3.36999	0.000325
9	540	83.5	0.410	3.22074	0.000333
10	600	81.4	0.389	3.05577	0.000333
15	900	71.5	0.290	2.27808	0.000247
20	1200	66.6	0.241	1.89317	0.000218
25	1500	58.4	0.159	1.24902	0.000182
30	1800	55.7	0.132	1.03692	0.000082
35	2100	53.5	0.110	0.86410	0.000085
40	2400	50.6	0.081	0.63629	0.000078

45	2700	48.8	0.063	0.49489	0.000048
50	3000	47.7	0.052	0.40848	0.000052
55	3300	45.7	0.032	0.25137	0.000052
60	3600	44.6	0.021	0.16496	0.000023
75	4500	42.9	0.004	0.03142	0.000010
90	5400	42.8	0.003	0.02357	0.000002
105	6300	42.5	0.000	0.00000	0.000002
120	7200	42.5	0.000	0.00000	0.000000

3. Conclusion

The flow characteristics through the soil under the variable head are quite complex. For the lower hydraulic gradient, the flow pattern is linear. On the other hand, the flow pattern for higher hydraulic gradient exhibits nonlinear features. To carry out an in-depth study on the linear and nonlinear flow characteristics, a set of laboratory experimentations have been conducted with locally available saturated soil. The study reveals that the hydraulic gradient gradually reduced following a curvilinear pattern with increasing time with ascending slope and diminished at 4500 s. At lower hydraulic gradients, a linear correlation between the parameters i and v were served, which implies Darcy's flow. For higher values of hydraulic gradients, a parabolic correlation of the order of 2 was noted, conforming to Forchheimer's flow. The value of the critical Reynolds Number was evaluated as 1.11×10^{-2}.

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Implementation of Water Science and Technology

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Abstract. Get admission to a enough quantity of excessive satisfactory water is vital for improving fitness and economic livelihood of human beings living in developing international locations. The purpose of this paper is to discover a number of the technical, economic, and social boundaries to enforcing ingesting water technologies in those nations. The cause is to provide steering to practitioners concerning the boundaries and to assist development of strategies for successful implementation. Four consultant regions and six water purification technology have been decided on for this study. Information on engineering attributes and fee for these technologies had been amassed and evaluated. A hit implementation of generation in growing international locations requires it's culturally and economically appropriate. Also, it's far very vital to offer water and sanitation training to nearby communities earlier than imposing the technologies so families apprehend the interplay between easy water, sanitation and advanced fitness.

Keywords. Ground Water Recharge; Replenishment, Bonar char; Solar; Bicycle filter; Chlorine;

1. Introduction

Water is not simplest vital for human beings, plants and animals for maintaining life however is likewise equally important for agricultural, commercial and other purposes. The critical resources of water are floor water, underground water and rainwater. The increasing population in city regions outcomes in focused discharge of huge portions of water into rivers, lakes and estuaries. This effects within the purifying potential of the receiving water being overtaxed, resulting in gross pollution, excessive nuisance and a way attaining monetary and health outcomes. The priority is proven no longer only by using professionals and organizations managing the problem of pollution however by the public at huge. Water is one of the considerable available substances in nature. Water forms about 75% of the problem on earth's crust. It's miles a crucial component to both plant and animal existence. Moreover, it additionally enjoys a unique role in industries.

1.1. *Ground Water Replenishment*

Groundwater replenishment happens via direct recharge and in-lieu recharge. Water hired for direct recharge extra regularly than now not comes from flood flows, water conservation, recycled water, desalination and water transfers [1-2]. At some point of the hydrologic cycle, replenishment happens evidently while rain, storm water and the glide from rivers, streams and creeks filter into an aquifer. Water also receives into the floor as farmers irrigate fields and orchards. Replenishment within the context of groundwater controls completed via recharge at rate that exceeds natural conditions, maintaining or enhancing groundwater elevation levels. Two recharge manners are used: direct

spreading and aquifer injection.

Managed aquifer recharge is the intentional recharge of water to suitable aquifers for next restoration or to reap environmental blessings. Managed aquifer recharge takes place via injection wells or the use of ponds and infiltration basins. Property of controlled aquifer recharge encompasses flood water and dealt with wastewater. Natural remedy procedures within the aquifer can improve the quality of the water, through a few pre-treatment of the source water can be required to make sure that the satisfactory of the receiving groundwater is maintained or progressed. India has made significant progress in developing its water resources and the supporting drinking water infrastructure. In fact, it has met the water target for its MDG commitment and in doing so has contributed significantly to the global achievement of this target [3].

There can be moreover in-lieu recharge in which an alternative supply is provided to customers who generally might use groundwater, thereby leaving groundwater in area for later use and increasing the ability to beautify groundwater levels. Institutional and regulatory issues get admission to floor water, water quality, conveyance device operations and capacity, monetary feasibility and environmental sustainability are limitations to increased recharge activities.

1.2 ***Water resource management:***

Water Resources Management is the action of planning, growing, dispensing and dealing with the maximum beneficial situations use of water assets. It's miles a sub-set of water cycle management. The area of water sources management will preserve to residence to cutting-edge and destiny problems dealing with the department of water. With the growing doubting of global climate alternate and the long-time influences of control movements, the selection-making will be even more hard. It is perhaps that ongoing climate alternate will manual to conditions which have no longer been breasted. As an end result, opportunity management techniques are looked for so as to avoid setbacks in the department of water assets [4].

Preferably, water aid management making plans has discretion to all of the competing demands for water and demands to allocate water on an equitable foundation to gratify all uses and demands. As with other useful resource control, that is from time to time possible in exercise.

One of the maximum worries for our water-primarily based sources within the future is the sustainability of the current and even destiny water resource allocation. As water turns into more scare, the really worth of way it's far managed grows extremely. Discovering stability among what is wanted through human beings and what is needed inside the environment is a sizeable step inside the sustainability of water assets. Attempt to create sustainable freshwater systems have been visible on a country wide stage in international locations along with Australia, and such guarantee to the surrounding sought to set a best for the relaxation of the arena [5].

1.3 ***Low Cost Water Purification***

Having money facilitates, but easy water solutions for in spiring nations don't should be high-priced. Celebrities like Bill Gates, Matt Damon and a superstar to us, Susan Davis, to call some, have helped easy smooth clean rivers, dig wells and installation pumps, pipes and particular hardware to supply easy water. Their time and money are true spent because the trouble is huge. As we've indicated earlier than, as many as 1.8 million humans die each year from diarrhea a blended to terrible water and sanitation, most of them underneath age 5.

Network-extensive water infrastructure is as properly as it gets. But until all of us have it, there are other, common place easy water solutions for uplifting countries. Boiling water over a timber fireplace is one of the most massive used strategies, however it is also a fitness hazard for once suiting in wicked ventilated kitchens, and it complements deforestation. Instead, we've rounded up low-fee procedures to treat water, and not one calls for boiling.

1.4 *Bone char filtration*

No longer all filters scouse borrows heavy metals or different pollution from the water, however overwhelmed and burned animal bone can. In locations wherein pollution leaches into the water, stealing them is a good concept. Persistent arsenic publicity, for example, can cause skin cancer, bladder, kidney and lung cancers, gangrene and likely diabetes, high blood strain and reproductive problems. Uranium within the consuming water is linked to nephritis-infection of the kidneys. As they inflame, the kidney's dump proteins that the body wishes into the urine circulate, a situation that may be deadly. The structural properties and binding affinity of fluoride ions from different water sources encompasses bone char and the effect of experimental conditions on enhancing the adsorption capacity of fluoride ions using bone char samples can be found out in Alkurdi et al. [6]. In some areas, bone char may face cultural aversions to eating cow merchandise.

1.5 *Solar sterilization*

If cost is a larger issue than time or convenience, the cheapest manner to deal with water is to go away it in a plastic bottle in the daylight. Depart clear bottles in the sum for some hours and UV radiation and warmth kills the microbes that reason diarrhea and particular water bone infection. The Solid techniques end up deployed in a few components of Haiti after the earthquake in 2010 and it's a much carried out in emergencies and impoverished areas international. The principles of thermo siphon solar water heating are applied to create an overflow area in vacated tube and flat-plate solar energy collectors and produce hot water at temperatures near boiling [7].

It is jerry-can-like field with a built-in thermal indicator that lets drinkers recognize while the water is secure to drink. The Solvatten box opens like a book to the water inside to daylight through clean plastic panels. Its black backing allows it take in extra daylight. The amount of solar outpouring that a bottle desires varies by using the amount of daylight to be had. To take the wager exercise session of the solar approach, a disinfection indicator can degree mild exposure and signal when the germs are lifeless.

1.6 Bicycle filter

Bicycles in all their wonderful versatility and ease have given to be one among our favourite devices, and we have been thrilled to find not just one, however two bicycle-powered water filters. Nippon Basic Co. invented Cycle smooth, a bicycle rigged with a pump to attract water from a river or properly and a sturdy, 3- clear out device to purify the water. The filters are deliberate to closing without alternative for two years, and the tires are puncture-evidence. It is able to riddle three lots of water in 10 hours. Then there's the Aqueduct, which is like Cyclo's whimsical little brother. It's a tricycle with bubbly curves and a sky-blue paint task that pumps up to two gallons of water via a filter even as the rider pedals. Cyclo handles plenty greater bulks of water, however Aqueduct's one gain is that it could do its process on the pass.

1.7 Chlorine

We preserved the maximum reliable remedy technique for last. Chlorine can provider in the network water deliver to kill microbes earlier than it enters human's jerry cans or home water resources. And it keeps the water safe from new contaminations long after its miles delivered.

2. Water Conservation

Water conservation is the exercise of using water efficiency to reduce needless water usage. Consistent with Fresh Water Watch, water conservation is crucial due to the fact clean smooth water is strained resources, In addition to a luxurious one. As an owner of a house, I'm possibly already aware of the economic prices of inefficient water use. Conservation of this natural useful resource is troublesome for the surroundings-and our wallets [8-10]. India and United Kingdom's population has doubled during the last half of century, and our name for water has tripled. Water conservation is greater good sized than ever, and the sector is searching pointers on saving water.

2.1 *How to save water*

The most people of family water use comes from lavatories, washing machines, showers, baths, faucets and leaks, however what we will do to keep water in all fairly easy. Those water-saving pointers will be placed on the course to retaining water in our household.

- **Positioned a brick in our bathroom's water tank:**
  Our flush an average of 20 gallons of water an afternoon down the bathroom. If we don't have a high-performance rest room, attempt filling our tank with something which will displace a number of that water, together with a brick.
- **Use the proper quantity of water for each load of laundry:**
  Typically, 15-40 percent of indoor home water use appears from doing laundry. Save water means of making sure to modify the settings on our gadget to the proper load length.
- **Select our washing system wisely:**
  When thinking about top-load vs. front-load washers, front-loading washing machines usually use much less water.
- **Water flora accurately:**

Water our lawn or lawn early in the morning or overdue inside the night, so the water lasts and is not right away evaporated through the new sun.

- **Set up a low-waft showerhead:**
  With a low-float showerhead, we will save 15 gallons of water all through a ten mins shower.
- **Check for and repair leaks:**
  An average of 10,000 gallons of water is misused each year due to household leaks. One of the first-rate tactics to reduce our water footprint is to restore leaky faucets and bathrooms.
- **Use a dishwasher:**
  Dishwasher bills for much less than 2 percent of indoor water use, however using a system is simply more water green than hand washing, particularly if we run complete loads. Strength celebrity dishwashers keep approximately 1,600 gallons of water over its life of use.
- **Turn off the water:**
  Educate our entire family to turn off the faucet while brushing enamel or shaving. Each little bit of water conservation allows.
- **Defrost food in the fridge:**
  In place of walking frozen foods under hot water from the faucet, build in time to permit them defrost within the fridge.
- **Manage outdoor water use:**
  Don't forget about water conservation outdoor as nicely. Equip all hoses with shut-off nozzles that may save hose leak.

2.2. Rain water harvesting

Rainwater harvesting is the accumulation and garage of rainwater for reuse on-internet web site, as an alternative permitting it to expire off. Rainwater may be accrued from rivers or roofs, and in many locations, the water gathered is redirected to a deep pit, aquifer, a reservoir with percolation, or amassed from dew or fog with nets or different gear. It makes use of embody water for gardens, cattle, irrigation, home use with right remedy, indoor heating for homes, etc. The harvested water can also be used as consuming water, longer-time period garage, and for one-of-a-type goals alongside aspect groundwater recharge. Rainwater harvesting is one of the smooth and ancient strategies of self-deliver of water for households typically financed by using the patron.

2.2.1 History of rainwater harvesting

The development and use of cisterns to save rainwater may be dealt with returned to the Neolithic Age, while waterproof lime plaster cisterns had been built inside the floors of homes in village locations of the Levant, a huge place in Southwest Asia, South of the Taurus Mountains, tied by way of the Mediterranean Sea within the west, the Arabian Waste land within the south, and Mesopotamia in the east. By way of the late 4000 BC, cisterns had been crucial factors of outgoing water control abilities utilized in dry-land farming. Many ancient cisterns had been also observed in a few components of Jerusalem and the complete Land of Israel.

2.3. New approaches

In area of behaving the roof for catchment, the Rain Saucer, which appears as an upside-down umbrella, raises rain immediately from the sky. The decreases the capability for contamination and makes Rain Saucer a capability utility for potable water in growing international locations. Other

programs of this loose-standing rainwater gathering manner are sustainable gardening and small-plot farming.

A Dutch discovery called the Groasis Waterbox is also powerful for growing bushes with harvested and amassed dew and rainwater.

Customary, storm water, management using obstruction basins enforced an unmarried reason. Even though, optimized real-time manipulate permits this infrastructure double as a supply of rainwater harvesting without accommodating the present obstruction potential. This has been used inside the EPA headquarters to evacuate stored water prior to hurricane occasions, as a result decreasing wet climate for even as making sure water availability for later reuse. This has the advantage of growing water exceptional opened and reducing the extent of water launched for the duration oflinked sewer overflow occasions.

Typically, test dams are built sooner or later of the streams to decorate the percolation of floor water into the subsoil strata.

2.3.1Rainwater harvesting by solar power panels

Proper quality water aid, in the direction of populated areas, is becoming scare and luxurious for the consumers. In addition to sun and wind strength, rainwater is primary renewable resource of any land. Large region is being overacted via solar PV panels each year in all components of the world. Sun panels also can be used for harvesting maximum of the rain water declining on them and drinking exceptional water, clean from bacteria and suspended depend, may be generated via simple filtration and disinfection tactics as rain water could be very low in salinity. Exploitation of rain water for value added products like bottled drinking water, makes sun PV flora profitable even in excessive rainfall regions via the augmented earnings from price brought consuming water generation. Recently price powerful Rainwater collection within the already dug wells determined to be especially effective within the bringing ground water level up in India.

Advantages:

Rainwater harvesting give the loose water supply throughout nearby water limitation, and in evolved nations, is broadly speaking used to help out the primary supply. It offers water when a drought takes place, can help mitigate flooding of low-lying regions, and reduces demand on wells which may permit groundwater ranges to be sustained. It additionally enables within the availability of potable water, as rainwater is drastically freed from salinity and different salts. Packages of rainwater harvesting in urban water gadget gives a sizeable advantage for both water supply and wastewater subsystems by reducing the need for clean water in water distribution structures, less generated storm water runoff polluting freshwater our bodies.

2.3.2***Application of rainwater harvesting***

2.3.2.1 Agriculture

- Missions to 5 Caribbean nations have shown that the capture and storage of rainwater runoff for later use is in a position to significantly lessen the risk of dropping some or all of the year's harvest because of soil or water poverty. Further, the dangers associated with flooding and soil erosion all through high rainfall seasons might lower. Small farmers, mainly the ones farming on hillsides, should benefit the maximum from rainwater harvesting due to the fact they're capable to taking runoff and reduce the results of soil erosion.
- Many countries, particularly those with dry environments, use rainwater harvesting as a less high priced and dependable source of smooth water. To growth irrigation in dry environments, ridges of soil are built to entice and obstruct rainwater from jogging down hills and slopes. Nearly during periods of low rainfall, enough water is raised for crops to grow. Water may be culled from roofs, dams and ponds can be built to seize massive amounts of rainwater in order that even on days when little to no rainfall occurs, enough is to be had to irrigate crops.

2.3.2 Domestic Use

In China, Argentina, and Brazil, rooftop rainwater harvesting is used tom provide eating water, domestic water, water for cattle, water for small irrigation, and a manner to pinnacle off groundwater degrees. Gansu countries in China and semiarid northeast Brazil have the most rooftop rainwater harvesting tasks taking region. About forty% of Thailand's rural population utilizes rainwater harvesting. Rainwater harvesting become promoted heavily with the aid of the government in the Nineties. That is one of the greatest examples of self-supply of water global. Rainwater harvesting is obligatory for brand new houses. Texas offers an income tax exemption for the purchase of rainwater harvesting gadget. Each Texas and Ohio allows rainwater harvesting to be used even for potable purposes.

2.3.3 Industry

Frankfurt Airport has the maximum rainwater harvesting machine in Germany. The gadget allows defend nearly 1 million cubic meters of water consistent with 12 months. The fee of the machine turned into 1.5 million dm in 1993. This machine take outs water from roofs of the new terminal which has an area of 26,800 square meters. The water is raised inside the foundation of the airport in six tanks with a garage capacity of 100 cubic meters. The water is especially used for bathroom flushing, watering flora and cleaning the air conditioning gadget. Rainwater harvesting changed into followed on the Velodrome- The London Olympic Park- with a purpose to boom the sustainability of the facility. A 73% loss in potable water demand via the park was allotted. In spite of this, it become remembered that rainwater harvesting was a less skilled use of financial sources to enhance sustainability than the park's black water recycling software.

2.3.4 Ground Water recharge

Ground water recharge is a hydrologic technique, in which water steps downward from floor water to groundwater. Recharge is the main manner through which water thrust into an aquifer. This procedure normally takes place inside the vadose region underneath plant roots and, is broadly speaking expressed as a flux to the water table floor. Ground water recharge also encompasses water shifting away from the water desk farther into the saturated area. Recharge takes place each obviously and through anthropogenic approaches, in which rainwater and reclaimed water is routed to the subsurface.

2.3.5 Estimation methods

Costs of groundwater recharge are tough to quantify in view those unique associated techniques, together with evaporation, transpiration and infiltration processes should first be measured or expected to decide the steadiness.

2.3.5.1 Physical

Physical techniques use the ethics of soil physics to calculate recharge. The direct physical strategies are people who attempt to clearly degree the extent of water going under the foundation zone. Oblique physical strategies rely upon the dimension or estimation of soil physical parameters, which along with soil physical standards, may be used for estimating the ability or real recharge. After months without rain the extent of the rivers beneath moist weather is low and describes handiest drained groundwater. As a consequence, the recharge can be calculated from this base flow if the catchment place is already regarded.

2.3.5.2Chemical

Chemical techniques use the presence of noticeably inert water-soluble materials, collectively with an isotopic tracer, moving through the soil, as deep drainage takes vicinity.

2.3.5.3 Numerical models

Recharge may be calculated behaving numerical techniques, employing such codes as Hydrologic Rating of Landfill success, UNSAT-H, SHAW, WEAP, and MIKE SHE. The 1D-application HYDRUS1D is to be had online. The codes normally use weather and soil information to seem at a recharge estimate and use the Richards equation in some form to devise groundwater water within the vadose region.

2.3.5.4 Making saline water potable

Clean water is the maximum critical thing someone needs to continue to exist. It's far viable to move weeks without meal show ever just a few days without water will kill maximum healthy humans. Via the earth is protected with the aid of 70% water, best 3% of that water is clean. Water shortages affect many networks each year and some scientists speculate that there might be severe international water shortages if the weather adjustments notably. Answer a manner to make ocean water drinkable could certain that peoples have all the easy water for consuming and agriculture that they used.

- A stove or a Bunsen burner
- A tumbler distilling flask
- A drinking glass
- A four quart sauce pan
- A huge leaf from a non-toxic plant
- Gather approximately two liters of salt water from the sea or we make our very own by using adding 70 grams of spoon salt to 2 liters of sparking water.
- Accumulated water boiled for 5 minutes to kill the microscopic life within the water.
- Taste the salt water which isn't always important to drink it. We spited it out after tasting.

- Price the saltiness of the water on a scale just like the one beneath.
- Document remark on what the water smells like.
- Report observations on what the water seems like.
- Flavour fresh water from a bottle. Rate the saltiness of the water.
- File observations on what then water seems like.
- Area an amount of the salt water in a glass distilling bottle.
- Vicinity an ingesting glass in role to preserve the distilled salt water because it cools.
- Boil the salt water until we've sufficient to flavour.
- Flavour the distilled salt water which isn't important to drink it. We spited it out after checking out.
- Charge the saltiness of the water.
- Record observations on what the water smells like.
- Document observations on what the water seems like.
- Place an amount of salt water into a four quart sauce pan.
- Catch the leaf above the sauce pan and attitude it right into a easy drinking glass.
- Boil the water, retaining the leaf above the steam and directing the droplets into the glass.
- Taste the distilled salt water which isn't important to drink, spited it out after checking out.
- Charge the saltiness of the water.
- Record observations on what the water smells like.

3. Innovation in irrigation practices

The innovation in irrigation practices of water is especially:

3.1 Sprinklers and Modern Technology

These days, Expert Irrigation Systems are being designed with more sophistication that will use generation to truly assist families and different centers to preserve water. These revolutionary modifications involve capabilities like moisture sensitivity controls. This means a system is able to locate the moisture sensitivity controls. This indicates a machine is able to come across the moisture degree within the soil. It could switch off, saving water and electricity if it trace there's moisture present. Irrigation structures also may be related to WIFI so controlling them at distance may be facilitated. This additionally permits maintenance assessments to be finished remotely.

This isn't always best vital for our financial bottom line, however additionally want to consider the carbon footprint that is felt via manufacturing them. So, buying a gadget that has better lifetime is likewise properly for the surroundings. In line with sizable Professional testing, The Grow Green and Melnor Lawn Sprinklers are each a number of the fine.

3.2 Moisture Sensing Technology

For farmers, irrigation is a huge problem and wishes to be dealt with efficiently. In-subject moisture sensors can degree how much water soil is retaining and what kind of its miles to be had for vegetation. This enables farmers to calculate exactly how much water is needed in a certain area and to manage irrigation as the crops grow. The sensors measure the water availability at exceptional depths in the soil and transmit the facts to computers and cellular devices.

3.3 Effect of this work on gaining knowledge of student

The new technologies bring about the pace of change that has critical impact at the manner human beings stay, work, and play in the global. New and outgoing technology mission the customary technique of coaching and learning, and the manner schooling is managed.

This assignment will provoke work in Kolkata. This could be a terrific realistic gaining knowledge of ground for college students.

4. Conclusions

Now, it is a terrific time to inspect irrigation control systems and water sensors, in particular if we are concerned in maintaining big landscapes or in agriculture. Water conservation is an innovative idea for the duration of the sector and one that have to not be taken slowly. New tendencies in generation are supporting to make this procedure a great deal less difficult than ever before.

Conflicts of Interest

The authors indicate that they have not received any research funding, direct or indirect financial support, or any other assistance. They also declare that there is no conflict of interest.

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Assessment of Water Quality Parameters in Kamle District, Arunachal Pradesh, India

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Abstract. In the Kamle District of Arunachal Pradesh, rapid constructions, road cutting, excavation, and indiscriminate use of chemical fertilizers and pesticides in agriculture practices are causing a variety of pollution in the aquatic environment, resulting in deterioration of water quality and depletion of aquatic biota. Humans contract water-borne infections such as typhoid and diarrhea as a result of drinking this contaminated water. As a result, it is required to monitor water quality at regular intervals to evaluate if it is suitable for human consumption or other uses such as irrigation, industry, and so on. The results of investigations on various water quality indicators from various water sources in Kamle District, Arunachal Pradesh, are described in this study paper for both the post-monsoon and pre-monsoon periods. pH, temperature, dissolved oxygen, turbidity, total dissolved solids, nitrate, and phosphate, among other physical and chemical water parameters, were tested and researched. The National Sanitation Foundation (NSF) technique was then used to calculate the water quality index. Based on these data, the water from different sources is classified as very bad, bad, medium, good, and excellent. Overall, the quality of water indicates good status as per the study.

Keywords: Multi-meter; Water quality index; Water quality parameters

1. Introduction

Arunachal Pradesh is India's most remote and least explored state. This huge swath of green on the map of the country is pollution-free, therefore water is conserved in its purest form in most parts of the state. In the Kamle District of Arunachal Pradesh, rapid construction of roads and indiscriminate use of chemical fertilizers and pesticides in agriculture are producing heavy and diversified pollution in the aquatic environment, resulting in deterioration of water quality and depletion of aquatic biota. Humans, particularly children, contract different water-borne diseases such as typhoid, diarrhea, and malaria as a result of the usage of contaminated water. As a result, it is vital to monitor the water quality frequently. The evaluation of the physical, chemical and biological characteristics of water concerning human consequences, intended uses, and natural quality is known as water quality assessment [1]. Water quality index (WQI) is a metric that summarizes information about water quality in a single number based on some factors [2]. The results of studies on water quality from various sources in Kamle District, Arunachal Pradesh, for the post-monsoon and pre-monsoon seasons of 2019 and 2020 are presented in this study report. The major goal of this study is to assess the water quality parameters pH, Temperature, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Nitrate (NO3-), Phosphate (PO43-), and Turbidity in Kamle, Arunachal Pradesh. (Note: The above-mentioned parameters were required for the NSF technique to determine WQI) [3].

WQI, designed by the Canadian Council of Ministers of the Environment, has been explained by

Sushmitha [4]. The method was tested on Hebbal Lake in Mysore, Karnataka, India, to see how it affected aquatic life, livestock and to see if it's safe to use for enjoyment, irrigation, or drinking. The water quality had been assessed as bad overall. By integrating the water quality factors in a small lake in South Gujarat, India, Tandel [5] evaluated the water quality index in a single number that indicates the quality of water. It was discovered that the quality of the lake's water decreased marginally from winter to summer due to an increase in pollutants concentration caused by water evaporation.

2. Methodology

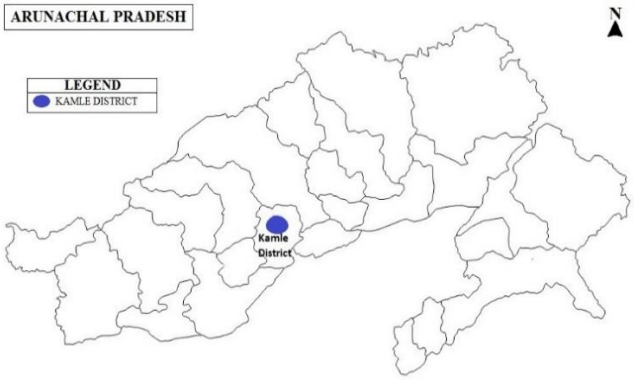

Figure 1. Map showing the location of the water sample source.

Sampling location: 1. Pujupen, 2. Belakyallo, 3. Raga, 4. Murimugli, 5. Muri, 6. Liguvillage, 7. MachDong, 8. Don, 9. Gepen, 10. Gepen2, 11.Gemi, 12. Gemi2, 13. Puchigeko, 14. Bopi, 15. Godak, 16. Pucku, 17. Kamporijo, 18. Bamvillage, 19. Dugu, 20. Pamluk, 21. Atas, 22. Yatap, 23. Buscamp, 24.Boasimla, 25. Tayasimla1, 26. Tayasimla2, 27. Pakoro, 28. Buyaso, 29. Goyu, 30. Goyu2, 31. Atum, 32. Atum2, 33. Sippu, 34. Potingoyu, 35. Paro, 36. Kerbari, 37. Tathkoro, 38. Dollungmukh, 39. Dollungkoro, 40. Sonikoro,

For both the post- and pre-monsoon periods, water samples were taken using the following protocols. Only 40 water samples, each containing 1.5 liters, were taken during both the post-monsoon and pre-monsoon seasons due to the lack of roads in remote places, road connectivity issues, and deep forest regions. The samples were collected in polypropylene bottles. The majority of the samples were taken from the nearby population center. Water samples were gathered from portions of rivers such as the Kamle River in Tamen and the Subansiri River in Ligu hamlet. State/District/Source/number is used as the sampling name; for example, AP/K/SW/001. Spring Water (SW) and River Water (RW) are the two sources. AP is Arunachal Pradesh, K denotes Kamle district, and 001 denotes the source number. The data collected using the device was written down. pH, Dissolved Oxygen (DO), Nitrate, Phosphate, Water Temperature, Turbidity, and Total Dissolved Solids (TDS) are just a few examples.

2.1 eXact@ Micro 20.

It's a high-performance dual-wavelength photometer. It's great for testing drinking water, pools, and spas, as well as environmental and educational purposes. This equipment measures parameters like alkalinity, hardness, nitrate, phosphate, sulfate, chloride, and fluoride. The readings of the parameters are presented on the screen automatically. The time requirement for reagents in eXact® Micro dual wavelength photometer is given in the manual book of *eXact* [6]. A multimeter is to measure the pH, Temperature, Oxidation-Reduction Potential, Dissolved Oxygen, Conductivity, and Total Dissolved Solids. Turbidity Meters are instruments that measure the turbidity of a liquid sample using the NTU (Nephelometric Turbidity Unit) unit.

3. Water Quality Index (WQI)

The WQI provides information on water quality in a single number. Water can be categorized as excellent, good, acceptable, or unfit for usage based on a single value [3]. Microsoft Excel was used to compute the WQI for the 40 samples collected during the post-monsoon and pre-monsoon seasons. Dissolved Oxygen, pH, Temperature, Phosphate, Nitrate, Turbidity, and Total Dissolved Solids are the parameters used. Due to unforeseen conditions, other parameters such as Fecal coli and Biological Oxygen Demand (BOD) were eliminated.

3.1 WQI Calculation

The WQI was calculated using the NSF (National Sanitation Foundation) approach in this study [3]. For both the post-monsoon (2019) and pre-monsoon (2020) periods, the values for WQI were calculated using the selected parameters, which included dissolved oxygen, pH, temperature, phosphate, nitrate, turbidity, and total dissolved solids. The following WQI values were calculated with the help of an online calculator [7]. Since seven tests are conducted, two tests, Fecal Coliform, and BOD are not included. If less than nine tests are done, the overall WQI can be approximated by dividing the sum of seven subtotals by the sum of their weighting factors [7]. The various ranges of WQI and their accompanying status of water quality, as well as their potential use, are summarized by Brown [2].

4. Result and Discussions

Table 1. Water Quality Index obtained for post-monsoon (2019) and pre-monsoon (2020)

Sample No.	WQI Post-Monsoon	WQI Pre-Monsoon	Sample No.	WQI Post-Monsoon	WQI Pre-Monsoon
AP/K/SW/01	79.45	79.45	AP/K/SW/21	83.56	82.19
AP/K/SW/02	76.71	79.45	AP/K/SW/22	71.23	67.12
AP/K/SW/03	71.23	71.23	AP/K/SW/23	87.67	87.67
AP/K/SW/04	73.97	73.97	AP/K/SW/24	84.93	84.93
AP/K/SW/05	84.93	82.19	AP/K/SW/25	83.56	83.56
AP/K/SW/06	83.56	82.19	AP/K/SW/26	76.71	75.34
AP/K/SW/07	71.23	69.86	AP/K/SW/27	83.56	84.93
AP/K/SW/08	72.60	73.97	AP/K/SW/28	76.71	76.71
AP/K/SW/09	84.93	84.93	AP/K/SW/29	80.82	80.82
AP/K/SW/10	83.56	84.93	AP/K/SW/30	84.93	86.30
AP/K/SW/11	83.56	83.56	AP/K/SW/31	87.67	87.67
AP/K/SW/12	82.19	84.93	AP/K/SW/32	83.56	82.19
AP/K/SW/13	83.56	83.56	AP/K/RW/33	82.19	82.19
AP/K/SW/14	82.19	83.56	AP/K/SW/34	80.82	78.08
AP/K/SW/15	78.08	82.19	AP/K/SW/35	83.56	83.56
AP/K/SW/16	60.27	64.38	AP/K/SW/36	87.67	84.93
AP/K/SW/17	75.34	82.19	AP/K/RW/37	78.08	76.71
AP/K/SW/18	73.97	72.60	AP/K/SW/38	73.97	73.97
AP/K/SW/19	83.56	82.19	AP/K/RW/39	82.19	82.19
AP/K/SW/20	80.82	73.97	AP/K/RW/40	82.19	83.56

Based on NSF's method, the various ranges of WQI and their corresponding status of water quality are summarized in Table 1.It is observed that out of a total of 40 samples, most of the sample comes under a good rating. The distribution of water samples based on the Water Quality Index and its range for the post-monsoon (2019) and pre-monsoon (2020) season is described in Figure 2 as shown below.

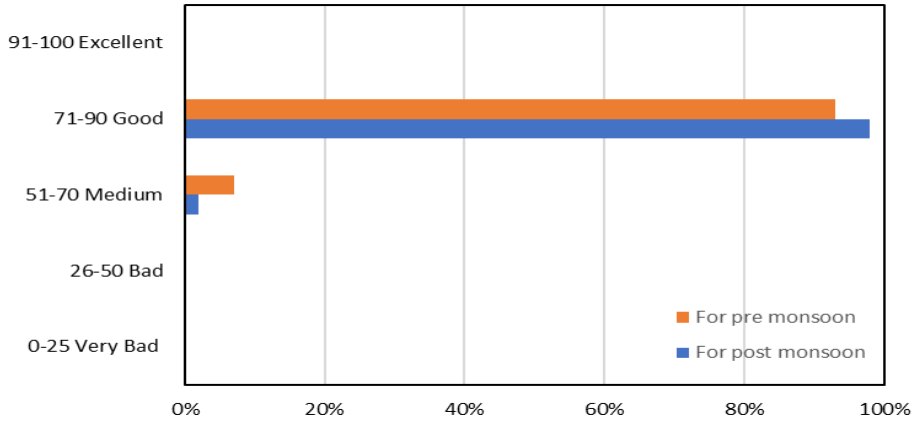

Figure 2. Percentage water samples as per water quality status for pre- and post-monsoon seasons

The average WQI value for the post and pre-monsoon season is 80.03 percent and 79.99 percentage respectively, which indicates a good water quality state.

5. Conclusion

According to WQI calculations and observations, the quality of spring water flowing from the forest is far superior to river water. Samples were taken from Pujupen, pucku, and Yatap villages that have a low WQI, preventing them from being used for any purpose until they are properly treated. Most of the water sources in the Kamle district are found to be in good condition, with most of the Physico-chemical water parameters being within BIS's acceptable range. For the post-monsoon period of 2019, 98 percent of its water sample sources are suitable for drinking, whilst for the pre-monsoon period of 2020, 93 percent of its water sample sources are suitable for drinking, with spring waters accounting for the majority. Almost all of the water sources evaluated are suitable for irrigation without further treatment. In Arunachal Pradesh, variations in WQI are primarily due to unpredictably high rainfall. The post-monsoon period's average WQI is higher than the pre-monsoon period's average WQI. Above 90-98 percent of water, sample sources examined using the NSF Method of WQI are assigned a "Good" water quality status.

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Experimental Investigation on the Impact of Sulphate and Chloride on High Volume Fly Ash Concrete

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Abstract. High weathering action in the corrosive and chemically active environment can significantly affect the strength characteristics of the concrete and also excessive utilization of sand as fine aggregates in building construction enhances degradation of the environment and urges the need for an alternative source in the scene of sustainable construction. Fly ash has generally used an alternative of cement, such as an admixture in concrete, and production of cement. As per the literature it has been found that concrete containing fly ash as partial to complete replacement of fine aggregate has been found to increase strength on a long-term basis. An experimental investigation was carried out to evaluate the strength and durability characteristics of concrete building blocks by replacing fine aggregates with fly ash at 10% to 100% by weight of fine aggregate and subjecting it to chloride attack and sulfate attack. Various tests were conducted for the properties of fresh concrete. Compressive strength and flexural strength were determined at 28 days. Test results indicate significant improvement in strength properties of plain concrete by the inclusion of fly ash as partial replacement of fine aggregate (sand), and increase in resistance to sulfate and Chloride attacks and can be effectively used in structural concrete.

Keywords. Chloride attack; Sulfate attack; Fly ash.

1. Introduction

Fly ash is a waste product that is produced in thermal power plants. In India each year 250 million tons of fly ash is produced and its utilization percentage is well below 13%. Class F type fly ash is the most abundantly produced. Fine aggregates area natural resource and to meet the growing demand for concrete in the construction field we are exploiting them gradually. In this project, we will be using concrete that is made by using fly ash as a replacement for sand. In this way, we can save the natural resource by reducing its usage by using an alternative product. The demand for building materials like cement, sand, and coarse aggregate is increasing in the country due to the increase in the growth of population, economy, and living standards of the people. It has been some time now that some cement companies have started utilizing fly ash in the production of cement, known as 'Pozzolana Portland cement', but the overall percentage of utilization remains very low, and the majority of the fly ash ends upin landfills. It has been noted that concrete containing fly ash as partial replacement of cement has problems of delayed early strength development and concrete containing fly ash as partial replacement of fine aggregate will have no delay in early strength development, but would rather improve its strength on a long-term basis. This project is designed to explore the possibility of replacing fine aggregate with fly ash and evaluate the characteristic strength when subjected to sulfate and chloride attack. The behavior of high-volume fly ash concrete in response to the various chemical

attacks such as Sulfate attacks and Chloride attacks is studied in this paper. The sulfate attack happens when sulfates combine with calcium hydroxide generated during the hydration of cement and forms calcium sulfate (gypsum). The aluminate compounds from the Portland cement will further react and form ettringite, which is very harmful to concrete. Chloride enters the concrete and builds up massive corrosive products on the reinforcement which expands and cracks the surrounding concrete. Fly ash binds with the free lime radicals in cementitious compounds, making it unavailable for reacting with sulfates.

2. Methodology

In the experiment, Ordinary Portland (43 grades) cement was used and has been tested as per Indian Standard Specifications corresponding to IS: 8112-1989. Fine aggregates of natural sand with a 4.75-mm maximum size were used as a fine aggregate conforming to Indian Standard Specifications IS: 383-1970. Coarse aggregate used in the project was 20-mm nominal size and was also tested as per Indian Standard Specifications corresponding to IS 383:1970. Class F fly ash has been employed in the project. To control the demand for water in the field while mixing the concrete super plasticizer were used. Super plasticizers are also called High Range Water-reducing admixtures because of the ability to reduce 3-4 liters of mixing water in a given concrete mixture compared to normal water-reducing admixtures. Super plasticizer Fosroc Conplast SP430 DIS (Sulphonated Napthalene Formaldehyde) was used in the project. To ensure that the concretes are subjected to different weathering conditions, the concretes are cured in acidic water to simulate the condition that they are subjected to acid attacks. The main acid attacks are sulfate attacks and chloride attacks. The concretes are subjected to mild acid attack which is maintained at the pH of 5. A pH test is carried out to determine the amount of concentrated acids required to bring the pH of the water to 5. Mix design of concrete confirming to IS 456:2000 and IS 10262-2009 is prepared.

Eleven different mixes of M30 grade namely Conventional Aggregate Concrete (CAC), concrete made by successively replacing sand by 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% respectively by fly ash are to be prepared. Firstly, sand is placed on the ground, then Cement and fly Ash is poured onto them. Finally, the Coarse Aggregate layer is placed on the top. These are then mixed properly. After the dry mixing, the mix is then evenly spread through and water with super plasticizer mix is sprinkled onto them. These are then mixed within 5 minutes of pouring of water. The Slump Test and compaction factor test are carried out as soon as the mix is complete. After this, the concrete is placed in the molds. The cube molds are of dimensions 150 x 150 x 150 mm and the beam molds are of dimensions 700 x 150 x 150 mm. A total of six beams and six cubes are to be cast for each % replacement. The cubes and beams are demolded after 24 hours. Half of the molds (3 cube molds and 3 beam molds) are placed in the curing tank containing H_2SO_4 at a pH of 5. The other half is placed in the curing tank containing HCl at a pH of 5. They are placed in the curing tanks for 28 days and removed. After the end of 28 days of curing, the concrete cubes and beams are kept to dry for some time and then put to testing. The concrete cubes are subjected to testing for compressive strength while the concrete beams are subjected to a flexural strength test. The testing apparatus is started and the values in which the concrete gives in are noted down. All the test readings are noted and the values are analyzed.

3. Results and Discussions

The slump test and Compaction factor test are conducted after the mixing of concrete. The data obtained by this test are as shown in table 1. From the given table it has been found that compaction factor value increases with the increase in slump value of the concrete and gradually decreases with the decrease in slump value. The compaction factor value reaches the peak value of 0.84 with a slump value at 56mm at 30% replacement of fine aggregates by fly ash. Thus, there is the highest workability at 30% replacement of fine aggregates by fly ash.

The graph is plotted by observing the values obtained by conducting the compressive and flexural strength tests, as shown in Figure 1. In the figure, it can be observed that Compressive strength and Flexural strength continued to increase with the increase in fly ash percentages up to 30% replacement of fine aggregates. This is believed to be due to the large pozzolanic reaction and improved interfacial bond between paste and aggregates. Thus, showing more resistance to Sulphate and Chloride attack.

Table 1: Slump test value and Compaction factor value.

Percentage replacement of fine aggregates by fly ash	Slump value (mm)	Compaction factor
0	50	0.8
10	52	0.81
20	54	0.83
30	56	0.84
40	44	0.83
50	40	0.82
60	38	0.82
70	34	0.81
80	30	0.81
90	25	0.8
100	22	0.8

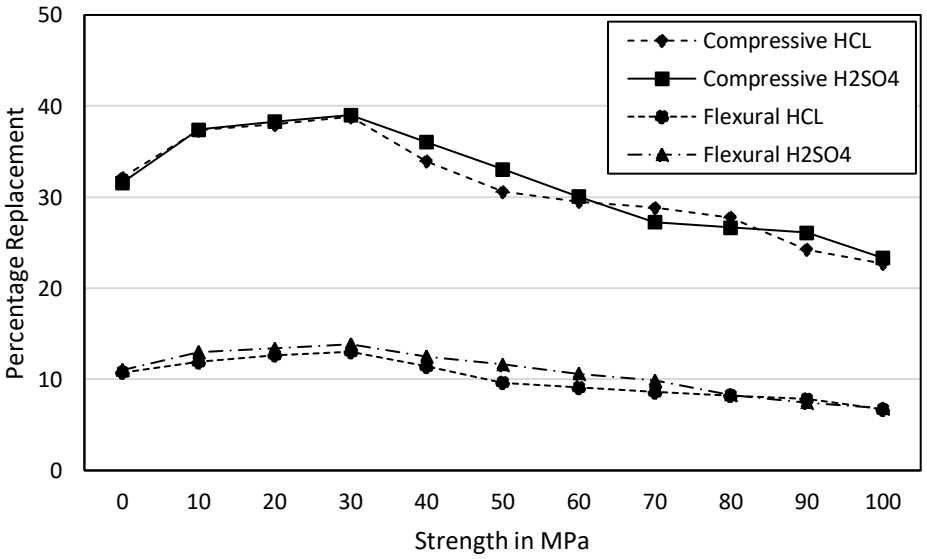

Figure 1. Percentage replacement of fine aggregates by fly ash vs. Characteristics compressive and flexural strength of concrete (MPa).

4. Conclusion

Compressive strength and flexural strength of fine aggregate (sand) replaced fly ash concrete continued to increase up to a certain extent and then decreases with a further increase in fly ash content. The characteristic strength is found to be maximum for both the cases (Sulphate attack and Chloride attack) at 30% fine aggregate replacement. The maximum compressive strength under chloride attack is at 30% replacement of fine aggregates with 38.83MPa.The maximum compressive strength under sulfate attack is at 30% replacement of fine aggregates with 39.01MPa.The maximum flexural strength under chloride attack is at 30% fine aggregate replacement with 13.03MPa.The maximum flexural strength under sulfate attack is at 30% fine aggregate replacement with 13.85MPa.It can be observed that High volume fly ash concrete with partial replacement of fine aggregates by fly ash has more resistance to sulfate attack than chloride attack. Results from this project suggest that fly ash can be used conveniently as partial replacement of fine aggregates up to 30% in structural concrete.

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Conflicts of Interest

The authors declare that there is no personal relationship or competing financial interests that could have influenced the work that has been reported in this paper.

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Leachate Characteristics and its Treatment Techniques - A Review

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Abstract. The issue of waste management has existed since the dawn of time. The remark discovered in Old Testimony is most likely the first written guideline on waste management. Municipal waste land filling is a key problem in the waste management system. Before being discharged into the environment, the generated leachate must be properly treated. There are mainly two types of leachate treatment technologies: (i) Biological methods, (ii) physical and chemical methods. Here's a brief overview of the basic procedures for treating landfill leachates that are currently in use.

Keywords. Waste management; Leachate; Biological methods; Physical and chemical methods

1. Introduction

Our environment is deteriorating day by day as a result of fast industrialization and population growth. Sanitary landfill leachate is a polluted effluent that is extremely complicated. Its quality is determined by biological, chemical, and physical processes in landfills, as well as the waste composition and water regime in the landfill. Leachate treatment efforts rise in tandem with rising leachate effluent quality criteria. Liquid waste leachate is formed during the stabilization of a landfill by the dynamic breakdown of wastes and infiltration of water into the landfill, primarily through precipitation [1]. Leachate is a complicated effluent with a high potential for pollution, causing serious environmental issues such as soil and groundwater pollution, as well as human health threats [2].

1.1 Factor responsible for the Generation of leachate

Leachates from landfills are generated by a number of factors, such as:

- Infiltration of leachate into the ground (potential pollution of the groundwater may occur).
- Rainfall (precipitation).
- Infiltration of groundwater.
- Evaporation from the site.
- Water from the deposited waste, mainly due to the static pressure.

1.2 Effects of leachates on human health

If local governments do not take the necessary efforts to line landfills and drain off leachates, residents living near landfills risk suffering a variety of health concerns. When water travels through inadequately placed waste and percolates to the ground, harmful compounds taken from the waste contaminate the groundwater.

1.3 Composition and Characteristics of leachate

Leachate typically contains substantial volumes of organic matter (biodegradable but refractory to biodegradation), as well as ammonia, nitrogen, heavy metals, chlorinated organic and inorganic salts, all of which pose a significant risk to the surrounding soil, groundwater, and even surface water. The pollutant components of leachate can be categorized into four categories. COD (chemical oxygen demand) and TOC (total organic carbon), as well as specific organic molecules, inorganic compounds, and heavy metals, are all examples of organic matter. The organic content of leachates, on the other hand, is frequently determined by a combination of metrics such as COD, BOD (biochemical oxygen demand), TOC, and dissolved organic carbon. All of these elements are taken into consideration using a simplified water balance equation, which allows designers to estimate the quantity of leachate that will be produced by the landfill. [3] created this equation in particular: $L = P - R - DUs - ET – DUw$. Where L is leachate production, P is precipitation, R is a surface run-off, Usis changing in soil moisture, ET is the actual evaporative losses from the bare-soil, *Uw*is the change in the moisture content of the refuse components.

Landfills are divided into three categories: young (less than five years), intermediate (5-10 years), and old or stabilized (more than 10 years). Table 1 shows the usual features of leachate based on landfill age. The typical chemical concentrations in young and old landfill leachates compared with sewage and groundwater are also shown in Table 2 adopted from [4].

Table 1: Characteristics of leachate at different ages of landfill

Parameter	Young	Intermediate	Old
Age (years)	< 5	5-10	>10
pH	6.5	6.5-7.5	>7.5
COD (mg/l)	> 10,000	4,000-10,000	<4,000
BOD5/COD	> 0.3	0.1-0.3	<0.1
Organic compounds	80% volatile fat acids (VFA)	5-30% VFA+ humic and fulvic acids	Humic and fulvic acids
Heavy metals	Low-medium	Low	Low
Biodegradability	Important	Medium	Low

Table 2: Typical concentrations in landfill leachate compared with sewage and groundwater

Parameters	Young leachate concentration	Old leachate concentration	Typical sewage concentration	Typical groundwater concentration
COD	20,000-40,000	500-3,000	350	20
BOD5	10,000-20,000	50-100	250	0
TOC	9,000-25,000	100-1,000	100	5
Volatile fatty acids	9,000-25,000	50-100	50	0

2. Methodology

2.1 Leachate control and Treatment

It is exceedingly expensive to clean up contaminated groundwater. The Department of Water Affairs and Forestry's Minimum Requirements for Waste Disposal by Landfill provides detailed information on landfill liner designs for various landfill types. Leachate collection systems are installed above the liner and usually consist of a piping system sloped to drain to a central collection point where a pump is located. Once the leachate has been collected and removed from the landfill, it must undergo some type of treatment and disposal [5].

Biological and physical/chemical leachate treatment processes are the most common. Landfill leachate can be mixed with incoming wastewater and treated biologically, physically, and chemically at a

sewage treatment plant. Because the best overall treatment efficiencies are generally achieved by removing the inorganic constituents first, and then the organic constituents, biological treatment can be preceded by physical or chemical treatment of the organic constituents to make the liquid more acceptable for biological processing [6].

2.2 Biological treatment processes

Biological treatment involves maintaining the conditions required for optimal growth of the microorganisms involved, regardless of the kind of wastewater. Microorganisms transform colloidal, dissolved carbonaceous organic materials and inorganic elements like N, P, S, K, Ca, and Mg into cell tissue or/and gases. The standard treatment strategy for industrial effluents or leachate. Different process design and/or operational control factors must be considered depending on the wastewater and the standards that must be satisfied [7].

2.2.1 Anaerobic treatment

During the period of high organic concentrations in leachates from a landfill's acidogenic phase, an anaerobic treatment step could be used to reduce major quantities of degradable organics. The main benefit of the anaerobic treatment method is that it requires very little energy because no oxygen is required. Temperatures of 35° C to 55° C are required for technical anaerobic operations [8].

2.2.2 Aerated lagoons and activated sludge plants

Aerated lagoons are a simple solution for treating leachate. The underlying idea is that the leachate's detention period is long enough for as many bacteria to grow per unit of time as were transported out of the lagoon with the effluent. Long retention times are also required to oxidize ammonia nitrification, which is particularly important at low temperatures. The costs of maintenance and operation are low. The required detention periods are in the range of 50 to 100 days [3].

In activated sludge plants, the detention time is typically much shorter than in aerated lagoons. The reason for this is that the sludge content (amount of bacteria) can be managed, but in aerated lagoons, it is several times higher. Installing a settling tank behind the aeration tank and re-circulating the sludge into the activated sludge tank accomplishes this [5].

2.2.3 Rotating biological contactors (RBC) and trickling filters

The bacteria are linked to the material of the spinning contractors or the fillers in the trickling filters, which distinguishes these plants from activated sludge plants. The rotating contactor is partially in the air and partly in the water. Air can be vented naturally or through a trickling filter. This kind of treatment uses a small quantity of energy. Treatment of high-organic-polluted leachates may result in blockage due to organic precipitates and/or biomass production. However, because to the high sludge age, nitrification processes are often more effective in fixed film reactors. As a result, these treatment approaches are better suited to treating leachate from existing landfills. RBCs are compact and usually coated, temperature impacts are easier to control [1].

2.3 Physico-chemical techniques

When the biological oxidation process is inhibited by the presence of bio-refractory materials, Physico-chemical techniques are employed in conjunction with biological methods to improve treatment efficiency.

2.3.1 Coagulation–flocculation

Several studies focused on coagulation-flocculation for the treatment of landfill leachates with the goal of improving performance, such as selecting the best coagulant, determining experimental settings, assessing the pH effect, and investigating flocculent addition. Coagulants such as aluminum sulfate, ferrous sulfate etc, are often employed, and adding flocculants to coagulants improves the floc-settling rate [1]. In addition, Adsorption and Membrane processes are some of the physio-chemical techniques that are also employed to improve the treatment efficiency.

3 Conclusion

The problem of leachate treatment has persisted in various countries for some time, but no uniform solution has been established. The following are the different types of leachate treatment technologies: (i) biological processes, (ii) chemical and physical processes. However, in order to achieve stringent quality standards for direct leachate discharge into surface water, integrated treatment systems, which include a combination of chemical, physical, and biological stages, must be developed.

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Conflict of Interest

The author declares that there is no conflicting interest in the paper.

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Computer Science and Engineering

Handwritten Devanagari Digits Recognition Using Residual Neural Network

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Abstract. Handwritten digit recognition is a highly evolved research domain of pattern recognition. It is used to classify pre-segmented handwritten digits. The Devanagari script is one of the writing systems of various Indian languages including Sanskrit and Hindi. In this paper, an efficient handwritten Devanagari numeral digit recognition using ResNet is proposed. Deep learning is a recent research trend in this field. Architectures like Residual neural Networks (ResNet) are being used. ResNet is an architecture that is computationally expensive and normally used to provide high accuracy in classification problems. The structural design of the network consists of sacks of two convolutional (Conv2D) layers with Batch Normalization and an activation function called Relu. We evaluated our scheme on 16000 handwritten samples of Devanagari numerals from the UCI machine learning database and from the experiment we have achieved 99.40% recognition rate

Keywords. CNN; ResNet; Handwritten digits recognition; Devanagari; Hindi; Sanskrit; UCI

1. Introduction

In the area of image processing, Computer Vision and Pattern Recognition (CVPR) is a major growing field, where pattern recognition is one of the most important needs in Natural language processing (NLP). Handwritten digit recognition is a system that can recognize the characters from a digitalized or scanned handwritten document. This system has become an important part of various applications like office document automation, signature authentication, handwritten postcodes, cheque automatic, immigration data processing, health data record into digital format and many other applications [1]. This system, becomes complicated because of challenges like characters written by the different writer are not identical in different aspects such as font, size, shape, and styles. Most of the previously proposed models are based on traditional pattern recognition where human expertise is required for feature engineering [2], [3]. The recent success of deep learning, specially Residual Neural Network (ResNet) for computer vision [4], [5], [6] [7] is used to recognize handwritten characters and digits as a computer vision problem. This ResNet is a deep Convolutional Neural Network (CNN) based model [8]. This is one of the current state-of-the-art deep learning models for image classification.

2. Literature review

2.1. Several approaches in current decade

In the recognition of handwritten digits, various approaches have been proposed with very high accuracy rates [1, 9-12]. Various sets of classification techniques have been applied to this problem like Linear K-Nearest neighbour, Random forest, Decision Tree, SVMs, Neural Network, and

Convolutional Neural Network [9]. A deep learning technique for recognition of Arabic handwritten digits is proposed by Ahmed et.al [1]. The method uses CNN with LeNet-5 is trained and tested on the MADBase database that consists of 60000 training and 10000 testing images. U. Pal et.al [14] proposed a method where off-line Bengali handwritten numerals were recognized which are unconstrained. This method is applied on their own collected dataset of size 12000 and obtained an accuracy of 92.80%. An approach for isolated Digit Recognition system is proposed by Vijay Kumar et.al [10]. In this approach features from digit image are extracted using Geometrical and Hosts pot features. This method used MNIST database which contains 60,000 training and 10000 testing samples.

3.Proposed Method

The proposed method consists of 4 steps. In the primary step, we have collected the numerals data from the UCI machine learning database. After collecting the data which is in grayscale we used normalization techniques to convert the gray level values to the range of 0 to 1 values. In the second step, we reshape it from 2 dimensions to 3 dimensions. In the third step, we used a residual block which consists of 3×3 convolutional layers with the same number of output channels followed by a batch normalization layer and a ReLU activation function. In the residual block, we skip two convolution operations and add the input directly before the final ReLU activation function shown in figure 1. In this step, we extracted the features of image data atomically and used the algorithm for recognition of handwritten numerals. Finally, in the last step, we applied an optimization technique to get promising results. The proposed method block diagram is shown below in figure 2.

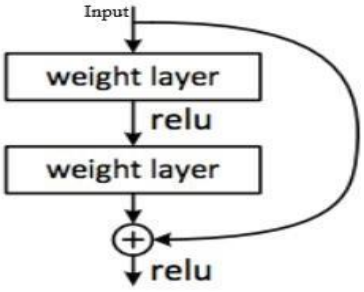

Figure1: ResidualBuildingBlock.

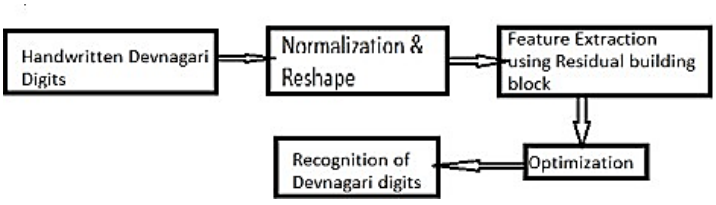

Figure2: BlockdiagramofProposedMethod.

3.1.Collection of Devnagari Dataset

The different handwritten digits of Devanagari numerical datasets are taken from UCI Machine Learning repository databases of centre for machine learning and intelligent systems [15].

Figure 3: Different samples extracted from UCI database

In this dataset we have collected 10 classes of numerical characters with total 16000 examples. These

images are in grayscale and resolution size is 32 x 32. Where the actual character is centered with 28x28 pixels with padding of 2 pixels on all four sides of the actual character. Sample of digits from the UCI machine learning database is shown in figure 3.

3.2. Residual Neural Networks(ResNet)

Computer Vision and pattern recognition is a major growing field in the area of image processing. ResNet plays a major role in computer vision. ResNet consists of convolution layers which are the core of most computer vision and pattern recognition systems today[16].To understand ResNet we have to think of it as various residual blocks where each block contains a convolutional layer followed by batch normalization and Relu activation function. There is also a skip layer in ResNet which helps us to overcome the vanishing gradient problem [17]. We have used Keras API with Tensor flow as a backend. In this model we have used 50 layers where after the first layer we used maxpool(Maxpool2D)shown in figure4.Then three residual blocks are used and the output is added with the output of the first layer which is also called skip connection and finally activation function Relu shown in figure 5, is used on the output. We continued this setting until the last layer where we used Flatten layer and connected dense layer with total no of classes. In our case it is 10.

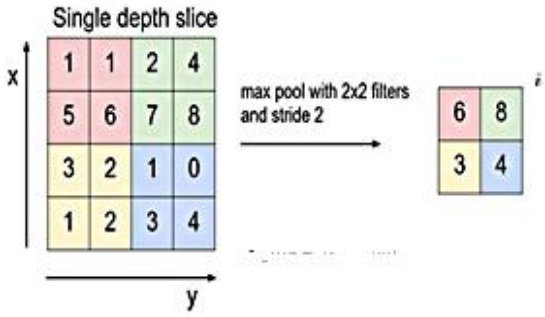

Figure4: Maxpool.

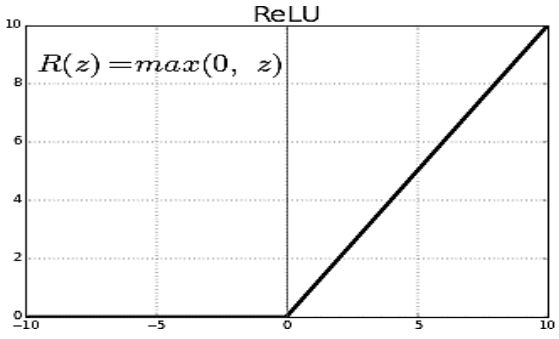

Figure5: Reluactivationfunction.

3.3. Softmax classifier

It is a Logistic Regression classifier which is a simplification of the binary form of like hinge loss or squared hinge loss. It is used at the last dense layer. Mapping function is derived using

$$f(x_i;W) = Wx_i \qquad (1)$$

Where x is input data items and w is weight [18].

Cross Entropy loss has the form

$$L_i = -\log\left(\frac{e^{f_{y_i}}}{\Sigma_j f_j}\right) \text{ or equivalently } L_i = -f_{y_i} + \log\sum_j e^{f_j} \quad (2)$$

Probabilistic interpretation can be defined as

$$P(y_i Ix_i;W) = \frac{e^{f_{y_i}}}{\sum_j e^{f_j}} \qquad (3)$$

Final loss function is yield form a single data point

$$L_i = -\log\left(\frac{e^{f_{y_i}}}{\Sigma_j f_j}\right) \qquad (4)$$

Cross-entropy loss is compute over a total dataset is done by taking the average

$$L = \frac{1}{N}\sum_{i=1}^{N} L_i \quad (5)$$

3.4 Adam optimizer

In our model we have used Adam optimizer [19]. It is an adaptive learning rate method, which means, it computes individual learning rates for different parameters. Adam uses estimations of first and second moments of gradient to adapt the learning rate for each weight of the neural network. N-th moment of a random variable is defined as

$$m_n = E[X^n] \quad (6)$$

Where m is the moment and X is a random variable. The first moment is mean, and the second moment is uncentered variance. To estimates the moments, Adam utilizes exponentially moving averages which can be defined as

$$m_t = \beta_i m_{t-1} + (1-\beta_1) g_t \quad (7a)$$

$$v_t = \beta_2 m_{t-1} + (1-\beta_2) g_t^{\,2} \quad (7b)$$

Where m and v are moving averages, g is gradient on current mini-batch, and β is new introduced hyper-parameters of the algorithm.

3.5Proposed algorithm

The proposed algorithm follows as:

Input: Devnagari Numerical image
Output: Devnagari Numerical image recognition
Method: Handwritten Devanagari Digits Recognition Using Residual Neural Network
Step 1: Gray scale images of fixed size is taken.
Step 2: Pre-processing the gray scale images.
Step 3: Normalize the gray scale images i.e. from 0 to 255 into 0 to 1.
Step 4: Reshape the images from 2D to 3D.
Step 5: One hot encoding is done. i.e. 1 is represented as [0100000000].
Step 6: Proposed model is used with Flatten layer and Fully connected layers.
Step 7: Input image is classified into suitable class using softmax classifier.
Step 8: Adam optimizer is used to improve accuracy.
Step 9: Augmentation technique is used to increase number of training data.
End

4. Results and Discussion

The Performance comparison with existing work has been given in Table 1. We also evaluated the performance of our model on a UCI Machine Learning repository dataset. We have selected 10 classes of numerical with a total 16000 images from the repository dataset. Further the data set was split into a training set and a test set where 12800 images selected randomly for the training set and 3200 images

selected randomly for testing. Our model reaches 99.40% accuracy on the validation dataset after 32 epochs. In our model total no of trainable parameter is 23,555,082 and non-trainable parameter is 53,120. Loss and accuracy curves for training and validation is given below in Figure 6 & 7.

Table-1: Performance comparison with existingwork.

Authors	SampleSize	Rec.Rate(%)
Dongre,V.Jet.al[20]	3000	93.17
Singh,P.Ket.al[21]	6000	95.02
C. Vasantha Lakshmiet.al[13]	9800	94.25
G. G. Rajput et.al [26]	13000	97.85
Ujjwal Bhattacharya et.al [13]	18794	99.04
U. Pal et.al [14]	22546	98.36
Proposed Method	16000	99.40

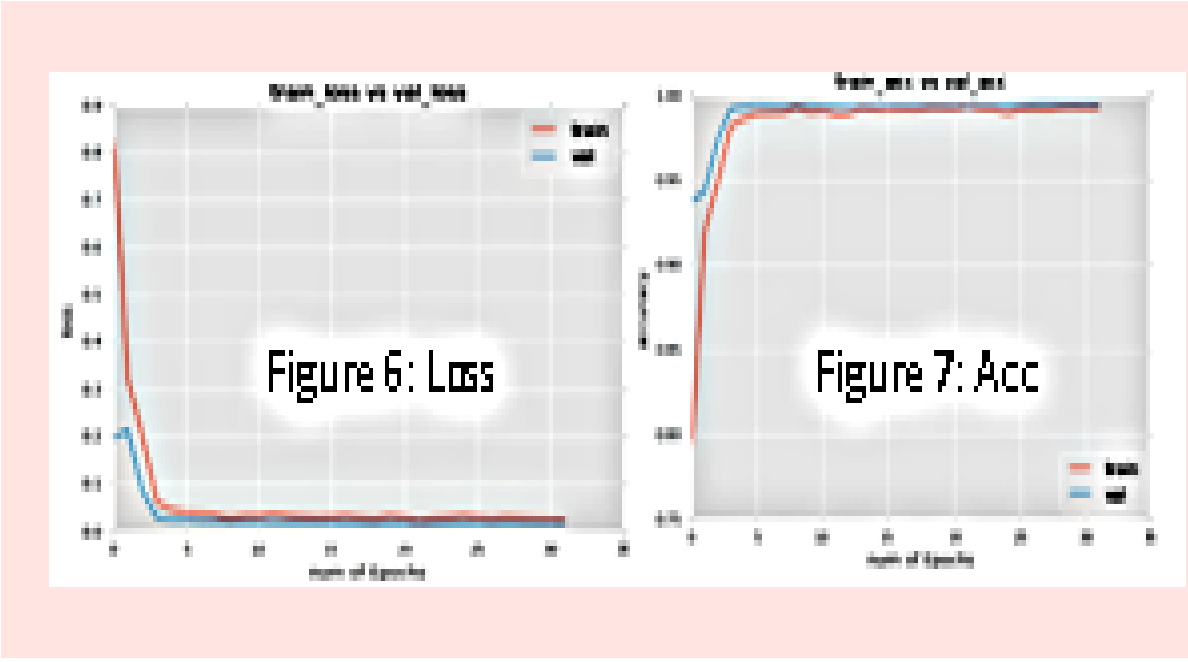

Figure 6: Loss. **Figure 7**: Accuracy curves.

5. Conclusions

A deep learning approach for **Devnagari Numeral Digit Recognition** has been proposed in this paper. We evaluated the performance using ResNet on a standard UCI Machine Learning repository dataset. From the results, it is observed that ResNet yields the best accuracy for **Devnagari Numeral Digit Recognition** compared to the alternative techniques. Our method achieved 99.40% recognition rate.

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Conflicts of Interest

The authors indicate that they have not received any research funding, direct or indirect financial support, or any other assistance. They also declare that there is no conflict of interest.

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Bitcoin and Ethereum: The Crypto Currencies

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Abstract. Here we discuss about different crypto currencies those are very much important in network security market. As we know crypto currencies are digital assets which can be designed to work as exchange that can use strong cryptography to protect all the transactions, here the main Two aspects of those: Bitcoin and Ethereum, is discussed with their all functionalities, their methods of work, their advantages over each and other and more over their concepts of architecture.

Keywords. Crypto currency; Bit coin; Etherum; SHA algorithm; ETHASH algorithm

1. Introduction

A crypto currency is a digital or virtual currency that is secured by encryption. Because of this security feature, counterfeiting a crypto currency is difficult. Block chain technology, a distributed ledger created by a distant network of computers, was supported by various crypto currencies and decentralized platforms. The organic aspect of a crypto currency, which is probably its most appealing feature, is that it is not issued by any central authority, making it in principle immune to government intervention.

Bitcoin was the first block chain-based crypto currency, and it is still the most popular and valuable. There are thousands of different crypto currencies available today, each with its own set of features and specs. Some of them are Bitcoin clones, while others are forks, or new crypto currencies that split from an existing one. Crypto currencies are online payment systems that are denominated in terms of a virtual "token" that represents ledger entries within the system itself. The term "crypto" refers to the use of various encoding algorithms and cryptography techniques, such as elliptical curve encoding, public-private key pairs, and hashing functions. In the next parts, we will go through two commonly used Crypto currencies.

2. Commonly Used Crypto currency

2.1 Bitcoin

Bitcoin is a digital money that was first introduced in January 2009. It is based on the principles expressed in a white paper by Satoshi Nakamoto, whose genuine identity has yet to be established. Bitcoin, unlike government-issued currencies, guarantees low transaction costs and is controlled by a decentralized authority. There are no real bitcoins; instead, balances are maintained on a cloud-based public ledger, which, like all Bitcoin transactions, is validated by a tremendous amount of processing power. Even though it is not legal cash, Bitcoin is extremely popular, and it has sparked the creation of rival virtual currencies known as Altcoins.

2.2 Ethereum

Ethereum, which was launched in 2015, is one of the world's most popular programmable block chains. It's a decentralized, distributed, and open-source computing platform with a Turing complete contracting language that lets us build smart contracts and decentralized apps. Well known, VitalikButerin, Mihai Alisie, Anthony Di Iorio, and Charles Hoskinson made up the first Ethereum development team. Ethereum, like other crypto currencies, has its own virtual money token called Ether.

There are three basic layers that make up Ethereum: The framework/backbone layer is made up of a wide network of computers that execute transactions and keep a shared database up to current over time (the block chain).On top of that, there's the software layer. It aids with the execution of "smart contracts" on the Ethereum block chain, which are written in a JavaScript-like programming language known as "Solidity." The uppermost layer is a collection of all the applications that provide Ethereum users with various services. The advantage of utilising Ethereum is that the applications created with it are totally decentralized. As a result, they lack a core point of connection, and the odds of failure are small to none, if at all. It is also free of government control because the ledger is present on each node independently.

2.2.1. Ethereum layers: Block chain

Almost every website on the internet is hosted on a server in a data centre somewhere around the world. When we try to connect to a website, our computer establishes a connection with the servers and downloads the content that we have requested. When the internet was designed to connect a single host to multiple things, such as our computers, this worked perfectly. However, we now demand client computers to be directly connected to other client computers (Web 2.0). A peer-to-peer network is a huge network of connected computers that exchange information. The Ethereum hardware layer is a peer-to-peer computer network that computes transactions and keeps them in order in a shared ledger. A node is a machine in this network that validates new transactions and organizes them into blocks that are broadcast to the Ethereum network as a whole. Both value and information can be included in the transaction. The value component is Ether, the Ethereum platform's digital currency. And the data is in the form of code that can pass data and initiate operations.

2.2.2. Software Layer: Solidity

The Ethereum software layer was created to solve Bitcoin's currency-based constraint. Ethereum can be used in a variety of transactions, from currency exchange to home purchases. To do this, a new programming language called Solidity was created to create Smart Contracts, which specify the logic or flow of a specific transaction (s). Solidity is a programming language for the Ethereum Virtual Machine that is inspired by C++, Python, and JavaScript (EVM). A smart contract is a programmed agreement that executes automatically and is stored on the Ethereum block chain.

"Smart contracts are apps that execute exactly as planned without the risk of downtime, censorship, fraud, or the Ethereum Foundation," according to the Ethereum Foundation.

Ethereum makes it simple to create new digital currencies, known as tokens, that can be traded over the Ethereum network. This simplifies and secures transactions at retail malls. All of Ethereum's source code is open source, making it easily accessible to the general public. This has aided in the development of a community of users/developers who can resolve errors and add new features. As a result, the procedure is completely transparent. An ever-evolving platform, the codebase is constantly being changed to make it better.

Every smart contract's code is open to the public, thus we can always be sure the transaction will go well. The fact that it is open to the public and free of government control makes it a very attractive choice for enterprises, as it eliminates large transaction fees.

2.2.3. Application Layers: DApps

Third-party apps run on the Ethereum network's hardware and software layers. As previously said, DApps are not solely focused on finance. As of this writing, there are approximately 2200 DApps, with about 1500 of them live. Because of the open and transparent nature of the Ethereum platform, many developers are working on DApps. Since last year, the number of DApps has nearly doubled.

There are a few things to remember with Ethereum:

- It is Transparent in the First Place: Anyone, from anywhere, can look at the codebase. All transactions, as well as the method in which they occurred, are made public and tracked.
- It's Resilient: It's nearly impossible to shut down all of the Ethereum platform's computers/nodes, and because it's a shared ledger, shutting down the entire Ethereum network is unrealistic.
- Malleable code: Ethereum's code is far more changeable due to its open-source nature. Because the code is publicly available, any bug or exploit must be patched right once, as it makes it much easier to be exploited. Hackers are always hunting for exploits, and having the code readily available to them only makes their job easier.

2.3 Advantage of both Bitcoin and Ethereum

There are several advantages of Bitcoin and they are as follow:

- **Freedom**

  Bitcoin was designed with freedom in mind. Most importantly, freedom from governing authorities controlling the transactions, imposing fees and overseeing people's money. When it comes to buying things, crypto currency became just as legitimate as flat currency in recent years, and considering the existence of numbers deep-web markets that only accept Bitcoins, you may be able to buy some things easier with BTC than any other currency.

- **High portability**

  One of the main characteristics of money is it can be used and hold everywhere where we want. As Bitcoin is totally digital, practically any sum of money can be stored in a flash drive or online.

- **Choose your own commission**

  Another indisputable advantage of the Bitcoin network is possibility of choosing the transaction fee amount , or choosing not to pay it at all. The miner received the transaction fee after a new block is generated with successful hash. Usually, the sender pays the full fee, while deducting this fee from the recipient could be considered an incomplete payment..

- **Safety and Control**

  Bitcoin users are capable to monitoring their transactions; no one can withdraw money from my account without my knowing and agreeing to it, like sometimes happens with other ways of payment, and on one can steal your pay information from merchants.

- **Transparent and neutral**

  Every transaction or piece of information about all of them can be made available to everyone in a block chain that can be used in real time. Because the BTC protocol is secure, no one can change or control the data with the organizations, and the network is already decentralized. As a result, Bitcoin is always neutral.

- **It can't be counterfeited**

  In the digital era, one of the most common ways to simulate is to use the same money twice, making both transactions false. It's known as a 'double spend.' To combat this, Bitcoin, like most other crypto currencies, makes use of Block chain technology as well as numerous consensus processes built into the BTC algorithms. Apart from providing the general benefits that an ordinary block chain possess, Ethereum has more to offer. Here are some benefits that are listed below.

- **Immutable**:

  Once the data has been confirmed and recorded into the ledger, all transactions on the Ethereum block chain are unchangeable. After data or transaction information has been posted, no one is allowed to change it..

- **Decentralized**:

  The transaction's validity is determined by the consensus mechanism that allows block chain to survive. This implies that the acts must be carried out without the use of a trusted middleman. Smart contracts are self-executing, and before being published to the Ethereum block chain, each transaction is confirmed by a validator. The proof of stake method, which will be deployed as a

hard fork in Ethereum 2.0 or Ethereum Constantinopole, is expected to decentralize the block chain network. It's a completely new method that, ideally, overcomes various disadvantages of the Proof-of-Work algorithm, which is utilized in Bitcoin..

- **Fast Transactions**:
  There is no block limit on the Ethereum block chain. The quantity of transactions written into a block is determined by the miners' efforts. Currently, each block in Ethereum takes 10-20 seconds to mine, and there are roughly 15 transactions per second..
- **Currency and much more**:
  While Bitcoin and Ether are both digital currencies, unlike Bitcoin, the primary purpose of the Ethereum block chain is not to establish itself as a payment alternative. The Ethereum algorithms are used by developers to build and run DApps or Decentralized Applications. These applications run on distributed computing systems and are popularized by distributed ledger technologies.
- **Secure:**
  On the Ethereum network, all transactions are cryptographically secure. Ethereum has almost three times as many nodes confirming transactions as Bitcoin. A node is a machine that is linked to the Ethereum network and is responsible for enforcing Ethereum's consensus rules. As a result, there are nearly three times as many miners available to verify transactions on the Ethereum block chain.
- **Turing Completeness**:
  Ethereum is programmed in a way that ensures Turing completeness. If a piece of software or a program that can run any universal code given enough resources, it is said to be Turing complete/computationally universal. This eliminates the need for specialized software or computers that can only run specific programs. As a result, Ethereum has an advantage over Bitcoin because Bitcoin uses a Turing-incomplete system that can only perform a limited range of tasks.
- **Rich Statefulness**:
  VitalikButerin describes Ethereum's ability to remember and maintain more state at the block chain level by using this term. Bitcoin is considered stateless as it is only able to deal with transactions. On the contrary, Ethereum can deal with contract code and data on top of keeping a balance..

3. Explanation of SHA Algorithm and Ethash Algorithm

3.1 Encryption Technology

SHA 256 algorithm, a part of encryption technology is used in block chain to get a constant hash of 256 bits every time. In the figure below, we see the prototype of algorithm containing some data called IV which is of 256 bits.

The very large input will be break in size of 512 bits which will always be not a perfect multiple of 512 bits, so some part of input will be left. We concatenate the left input with 10* bits before padding

it. So now we have a perfect multiple of 512 bits input, which is added to 256 bits IV for a total of 768 bits, which is then compressed using the 'c' function to get an output of 256 bits only.

This 256-bit output is combined with the 512-bit input from block B2. To get a 256-bit output, the sum is again processed through the compression method. This loop continues until the last block is reached (block n).

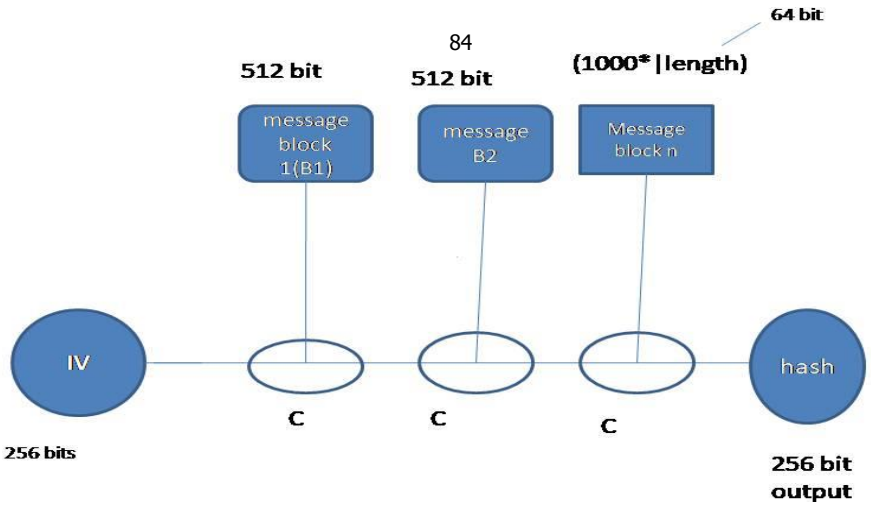

Figure 1. Protype of the Algorithm

3.2 Characterization of Bitcoin-Decentralization

The network's independence from any regulatory body was one of Satoshi Nakamoto's key goals when he created Bitcoin. It is set up in such a way that every individual, business, and computer involved in mining and transaction verification becomes a part of a large network.

3.3 Characterization of Bitcoin-Anonymous

Banks nowadays know practically everything about their customers, including their credit histories, addresses, phone numbers, and purchasing habits. Bitcoin is a little tricky because the wallet isn't meant to be linked to any personal information. While some people simply do not want their finances to be managed and tracked by any authority, others may argue that the drug trade, as well as other unlawful and unhealthy activities, will be divided in this relative support.

3.4 Characterization of Bitcoin-Transparent

Every single BTC transaction is recorded on Blockchain for future reference. When our wallet address was made public, we were able to figure out how much money was in it by looking at the blockchain ledger. However, tracking a Bitcoin address to a specific individual is extremely hard. Those who prefer to remain anonymous during their transaction might take steps to do so. The sorts of wallets that

prioritise convenience over security and cryptography, such as those that can be used by several addresses and don't allow large sums of money to be sent to a single wallet or record.

3.5 Characterization of Bitcoin-Fast

The Bitcoin payment process is almost so quick, it generally takes few minutes for someone to receive the money from the other side of the world, but general bank transfers can take few days.

3.5 Characterization of Bitcoin-Non-reputable

Once we send our Bitcoin to someone, there is no way of getting them back, unless the recipient would want to send them back to us. This ensures the reception of a payment, meaning that whoever we're trading with can't scam us by claiming that they never got the money.

3.6 Characterization of Ethash Proof work Algorithm

ETHASH is based on a Proof-of-Work Algorithm constructed by the Ethereum network and crypto currency based on Ethereum. In spite of being formed over the previous Dagger-Hashimoto algorithm, it has advanced enough to be considered an entirely new algorithm. See Figure 2 below.

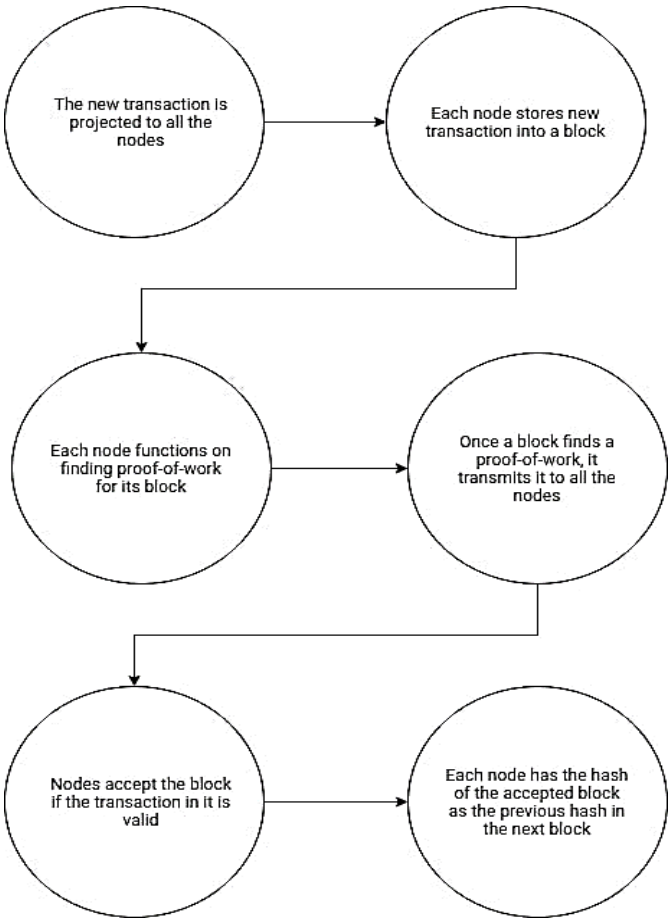

Figure 2: ETHASH algorithm working procedure.

ETHASH uses Keccak-256 and Keccak-512 hash algorithms, and it creates confusions over the simultaneous development of SHA-3, also known as the Secure Hash Algorithm. SHA-3 is a standard part of Keccak. With ETHASH, the output created during the hashing procedure must result in a hash value, which is below a particular threshold. This system is known as difficulty, and its purpose is to increase or decrease the threshold of the Ethereum network in order to control the rate of the number of blocks that are mined on the network. Therefore, if too many blocks are mined in a short amount of time, the network automatically increases the difficulty, i.e., it will lower the network threshold, resulting in reducing the number of valid hashes that can be found. Precisely the opposite happens when the rate of mined blocks decreases. The network threshold increases to produce increasing numbers of correct hash values that can be found. This system of difficulty is important for getting rid of an ideal situation where the time required to create new blocks drastically decreases, thus proportionally increasing the rate of payouts in the reward system. With the Ethereum Algorithm, the difficulty gets dynamically adjusted in such a way that, on an average, one block is generated by the network every 12 seconds.

Ethereum is advancing towards a major upgrade around January 2020, named as Ethereum 2.0, which is expected to radically change the way how the billion-dollar network produces blocks and verifies transactions. Dubbed as phase Zero, the first phase is supposed to launch Ethereum's new Proof-of-Stake algorithm strictly. Proof-of-Stake is based on consensus algorithms for public blockchains that rely on validator's economic stake in the network.

3.6.1 Explanation of ETHASH ALGORITHM

The ETHASH algorithm is dependent on a randomly generated 1GB Dataset known as a DAG(Directed Acyclic Graph). The DAG is updated once every epoch (30000 blocks). The size of the DAG will continue to grow as the blockchain keeps increasing.

The block header which is derived from the latest block and the current nonce are combined using the Secure Hashing Algorithm to create the 128-byte mix.

The mix is used to compute which 128-byte page from the DAG needs to be retrieved. It is represented by the Get DAG Page block.

Then the mix is combined with the DAG page that has been retrieved. This is achieved using a specific mixing function of ethereum to generate another mix. Let's name it as mix 1.

The steps two and three are repeated 64 times on mix 1, which yields another 64-byte mix.

The 64-byte mix is further processed into a shorter 32-byte mix. This is the final mix. This mix is compared to the predefined 32-byte target threshold. If the final mix is less than or equal to the target threshold, the current nonce is considered successful, and it will be broadcasted onto the ethereum network. Otherwise, the current nonce will be held invalid, and the algorithm will be rerun using a different nonce, either by increasing its value or by picking a value at random.

3.7 Significant features for New Algorithm

Stake – Only a select number of people who deposit money as a security deposit in the Ethereum

network will be allowed to work on checking transaction blocks.

Therefore, the more money potential validators deposit into the Ethereum network, the higher his/her chances to be allocated a block that needs to be verified. The block rewards are to be delivered in proportion to the amount of money staked. The only way to increase the reward is to increase the stake deposit.

Penalty– The validators will receive a penalty if their work is found to be fraudulent, which will be deducted from the money they deposited. This helps the users of Ethereum to find trust in the working of the network and also the validators.

Decentralization – As the algorithm is not up and running yet, we still do not know how decentralized it can make the network, but to launch a 51% attack, the people planning on that have to rely on extreme monetary holding instead of computational power. The more money kept as a stake in the network, the higher the chances to be selected as a validator. It is yet to uncover how the factor of penalty plays in stopping such attacks. It is believed that the code can be modified to create economic incentives that discourage the formation of groups that can launch the 51% attack. It is yet to be understood how the introduction of penalty plays into stopping such attacks, as any fraudulent activity will be detected in the network and result in loss of ethers, and the only way to launch attacks is to acquire new ethers.

Cheap – If appropriately decentralized, this can prove to be a much cheaper way to mine/validate ethers than the traditional Proof-of-Work algorithm, as expensive mining equipment will not be required.

Backup – In case a validator fails to turn up for the job, it can easily be assigned to anyone from a number of backup validators available.

3.8 Advantages of one currency over other

When it comes to the crypto currencies that we are discussing today, extra emphasis should be paid to how mining works for each. Bitcoin mining uses a proof-of-work algorithm, whereas Ethereum mining uses a proof-of-stake algorithm. In PoW, each miner competes for computational power against other miners, but in PoS, the block validater earns the network fees and there is no other competition.

Ethereum has a faster block time than Bitcoin, which takes a little longer. Bitcoin has also outperformed Ethereum in the crypto currency market.

4. Conclusions

As we can see, there is a lot to learn about both Bitcoin and Ethereum, the two most popular crypto currencies at the moment. When it comes to crypto currencies, it's critical to understand the underlying differences, characteristics, architectures, and benefits. They are currently two of the most well-known networking projects on the market, with over two thousand different ones and its unique identification. There are currently a variety of restrictions in place, with Bitcoin's legal status varying greatly from country to country. The usage and exchange of BTC is encouraged in some nations, while it is prohibited in others.

There has been a lot of concerns regarding Bitcoin's appeal to criminals, some news outlets have even stated that its popularity rests entirely on the ability to spend it on illegal goods. When the Silk Road was shut down, Bitcoin's value plummeted. However, we continue to strive to collect all of the information we can from all sources and books. We want to assist all students who, like us, will be able to use this data in their study. As a result, we compile a list of all the details that can assist the reader and reviewer with future projects or help them expand their knowledge.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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Analysis of Learning Based Cervical Cancer Data

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Abstract. Cervical cancer is one of the most common causes of mortality in low-income countries. Examining a patient based on the results of multiple doctors' preferred tests for any automated system to decide if the patient is cancer positive gets fairly complicated. We'll try to apply machine learning algorithms to figure out whether the patient has cancer based on a variety of factors in the dataset. Cervical cancer can be detected early if the presence of the disease can be predicted.

Keywords: **Cervical Cancer; Learning; Concepts; Key-Hold Algorithm; K-Nearest Algorithm**

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1. Introduction

Cervical cancer is a type of cancer that develops in the cervix. It develops as a result of aberrant cell proliferation and spreads to other places of the body. The majority of the time, it is fatal. The majority of cases are caused by HPV (90 percent). The data is cleansed and visualizations of the data are displayed in Phase I. Cigarette smoking is also one of the leading causes of cervical cancer. Oral contraceptive pill use over a long period of time can lead to cancer. Cervical cancer can also be caused by several pregnancies. Cancer is notoriously difficult to detect in its early stages. In the early stages of cancer, there are no symptoms. Symptoms do not occur until late in the course of cancer. Machine learning algorithms can be used to predict whether or not a person has cancer and can be referred in the following articles [1-2]. Smoking, pregnancies, behaviours, and other characteristics can all be used to predict cancer along with machine language[3-4].

The first process involves cleaning the data and displaying visualizations. The methodology is demonstrated in Phase 2. On the dataset, many models are tested. The parameters have been fine-tuned. Different models' performance is compared. Finally, the most effective models for cancer prediction are suggested.

2. Methodology

Three distinct classifier techniques are employed for modeling. Random forest, decision tree, and K-

nearest neighbor. It is discovered in step 1 that the dataset is skewed.

As a result, k-fold cross validation is performed. The dataset for k-nearest neighbour is split 50-50. The features are chosen, and the features are then used to make predictions. The data is split 25-75 for decision tree and random forest. Parameter tuning is carried out in order to provide the best predictions with the highest possible assessment scores. For feature selection, we also used the Hill Climbing Algorithm. In the felid of Artificial Intelligence, the algorithm is a mathematical optimization that uses heuristic search. The stages for how the algorithm selects features are listed below.

Step1:-After analyzing the initial state, make it the current state.

Step2:-Run the loop till there are no features present which can be applied to current state.

a) Select a feature that has not been yet applied to the current state and apply it to produce a new state.

b) Perform these to evaluate new state

   ii. If it is better than the current state, then make it current state and proceed further.

   iii. If it is not better than the current state, then continue in the loop until a solution is found.

Step3:- Exit

Different models are evaluated using the confusion matrix, classification error rate, recall, and F1 score. The AUC curve is used to assess the model and to choose the optimal model through parameter adjustment.

3. Results of Studies:

After finishing the analysis, all of the models, including k-nearest neighbour, decision tree, and random forest, were judged to be good. K-nearest neighbour appears to be the strongest model, with a higher AUC of 0.822 compared to 0.52 (Decision tree) and 0.532 (random forest), which are both quite low. The nearest-neighbor model has a high precision recall and f1 score.

When compared to decision tree (0.88) and random forest (0.94), nearest-neighbor has a high f1 score of 0.94. (0.90). We may also see from the confusion matrix that false negative is zero, implying that a cancer patient will have a prediction that he does not have cancer. It will be a dreadful situation if a person who has cancer is told he does not have cancer. It's possible that by the time symptoms appear, it'll be too late. In some circumstances, such as ours, it is critical to select a model with very low false negative rates. One of the model's strengths is that the k-nearest neighbour model has the best accuracy and AUC value. As a result, the k-nearest neighbour algorithm will be utilised to make predictions.

The dataset is skewed because it contains a large number of zero values, indicating that the patient does not have cancer for the target variable. We would have gotten better models and more accurate predictions if the dataset had been less skewed. The employment of a simple climbing technique has some drawbacks.

It's tough to tell if the hill discovered is the highest one possible. The local maxima are states that are excellent for their neighbors' but may not be the greatest for states further away.

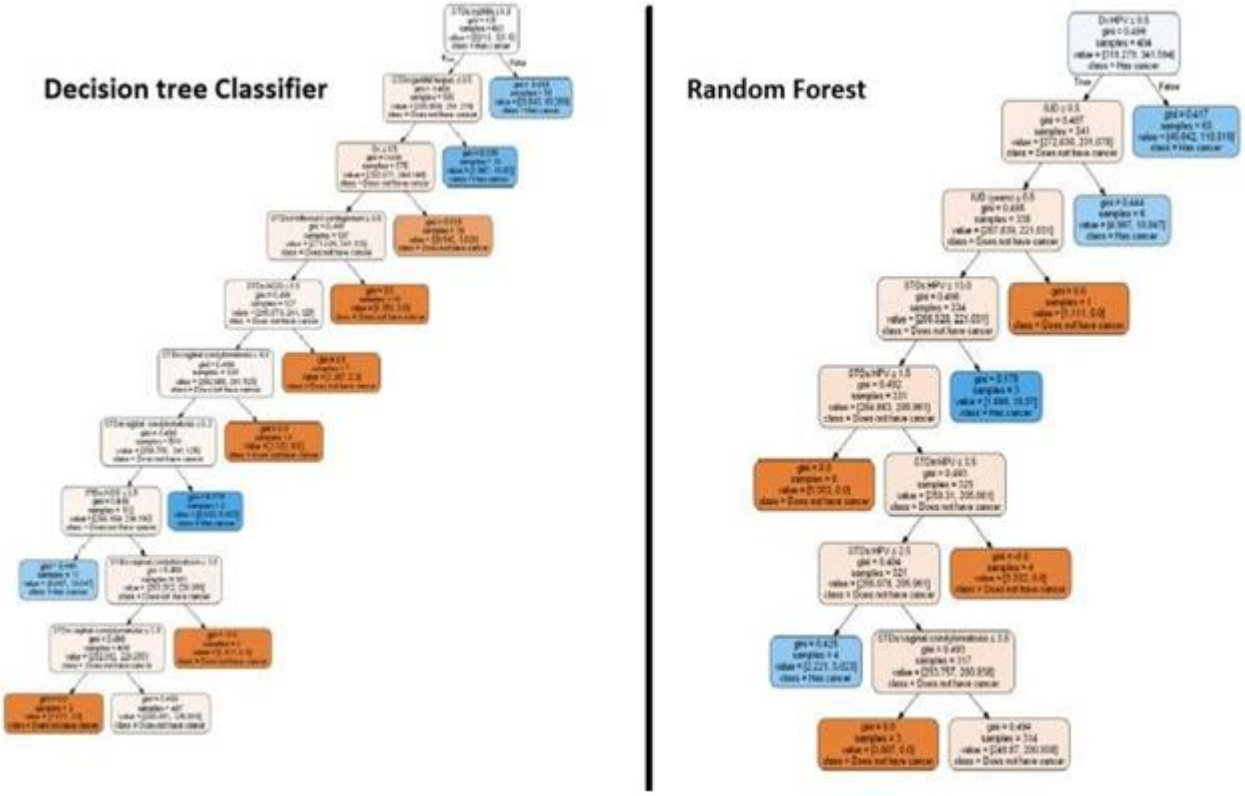

Figure 1: Tree created after pruning by Decision tree and Random

4. Concluding Remarks:

- Following the cleaning of the dataset in phase 1, we moved on to the modeling portion of the phase 2.
- Our dataset is biased, as we discovered in phase one.
- Modeling is done using k-fold cross validation.
- K-nearest neighbour, decision tree, and random forest are the three types of models employed, and all three are fine-tuned to achieve the best accuracy.
- All models are deemed to be satisfactory.
- The k-nearest-neighbor model, on the other hand, has greater accuracy, precision, recall, and AUC value.
- Herpes virus was also found to be capable of fighting cancer cells in the study. This observation was made based on the data provided, and more scientific analysis is needed to validate it..

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Conflicts of Interest

The author declares that there is no conflict of interest.

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Aeronautical Communications

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Abstract. Aeronautical communications is a discipline covering the highly specialized and mission critical communications such as aircraft-to-ground, aircraft-to-aircraft, and aircraft-to-satellite. Recent changes in this field include: advanced satellite communications installations in aircraft, and very high frequency digital radio, and data link applications reporting aircraft position in transoceanic operations, as well as airline, air traffic, and passenger services. Because of such rapid changes in this field, it is critical to aviation safety that we have an expertise in satellite and data link communications, data link and aircraft surveillance applications, aeronautical communications network, HF and VHF data link, circuit mode and packet mode communications.

Keywords: satellite communications; high frequency digital radio; aeronautical communications network; packet mode communications

1. Introduction

Continuing growth in regional and global air travel has resulted in increasing traffic congestion in the air and on the ground. The resulting congestion, which constrains expansion of the air transportation industry, inflicts schedule delays and decreases overall system efficiency, creating a pressing need to develop more efficient methods of air traffic management (ATM). As these methods become more advanced and increase in complexity, the requirements for information generation, sharing and transfer among the relevant entities in the ATM system increase dramatically. However, current aeronautical communications systems will be inadequate to meet the future information transfer demands created by these advanced ATM systems. Therefore, the NASA Glenn Research Centre is undertaking research programs to develop communications methods and key technologies that can meet these future requirements. As part of this process, studies, workshops, testing and experimentation, and research and analysis have established a number of research and technology development needs. The purpose of this paper is to outline the critical research and technology needs that have been identified in these activities and explain how these needs have been determined.

2. Wireless Aircraft Cabin Management

The application that this research builds on is the Cabin Management System (CMS) of an aircraft, which is the network of most of the electronic devices inside the passenger section of an aircraft cabin. It is present in every airliner and is a major system in the aircraft. The complexity varies from reduced features in single aisle aircraft, for instance the A320, to complete systems like those in the A380 with section control, enhanced climate control or flight status displays. To follow the approaches in this research, this chapter describes the CMS and the need to develop a wireless CMS. The wireless aircraft cabin system operating in the 2.4 GHz ISM band and uses cognitive radio techniques to

increase system robustness by actively and dynamically avoiding interfering signals in the same frequency band. The implementation of the basic cognitive radio functions spectrum sensing, policy enforcement and decision making, as well as their integration on a software defined radio platform together with the communication functions [1].

The network topology of a commercial aircraft uses a hierarchical structure. From the CMS server several main lines stretch throughout the cabin. Two types of main lines exist, the Passenger Line, which serves passenger related services and the Crew Line, which only handles crew and aircraft systems. The schematic of the Wireless Cabin architecture is given in Figure 1.The hardware and software for both lines is nearly identical. Both use 10 Mbit/s Ethernet full-duplex transmissions and a proprietary MAC protocol. This is due to the variation in expected traffic of the different end device types. The Passenger Line forwards mostly data from the server to the end devices; most significant are the audio channels. The Crew Line is designed to support additional end devices and a greater amount of bidirectional traffic, for instance crew intercom phones. There is usually more than one Passenger Line and Crew Line, depending on the aircraft size. A large aircraft can have two Passenger Lines for the left, centre and right cabin area, which is in total six Passenger Lines. Each line has a number of switching nodes, which are called in this work PAX-SN for the Passenger Line and CREW-SN for the Crew Line. **CMS trends** In current aircraft, the electronic equipment in the cabin requires three types of networks: the CMS network, a separate In-flight Entertainment System (IFE) network and the power distribution system. All networks have different DAL categories.

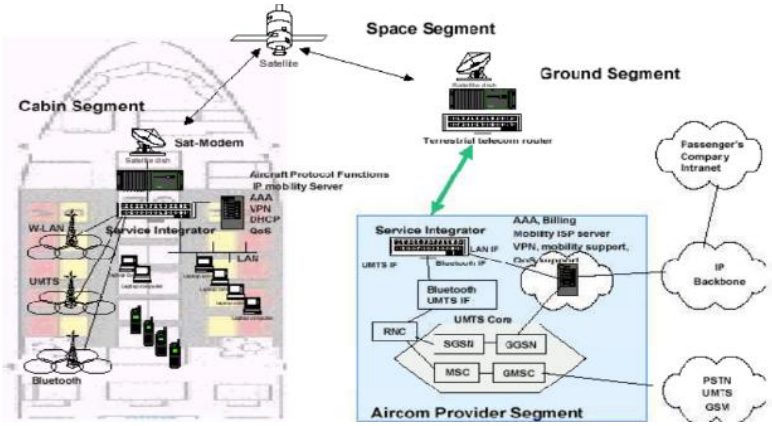

Figure 1. Wireless Cabin architecture.

Full-IP The possibility of using Ethernet and Internet Protocol (IP) com10 communication with an event-based application protocol is being investigated. An event driven approach requires much less network utilization and additional services can be included in the network.

Hybrid The hybrid approach is an extension of the existing implementation to support IP packets. Instead of using a 10 Mbits/s interface, a 100 Mbits/s will be used.

Power-over-data: Combining the communication network and power distribution network reduces the complexity, maintenance effort and weight of an aircraft.

Data-over-power Same reasons as for power-over-data, but it is technologically more challenging.

2.1 Wireless communication

Reductions of cable harness, flexibility of cabin design and device localization are only some advantages of wireless communication. The different approaches can be combined, especially the full-

IP and wireless concept with power-over-data or data-over-power. All approaches, including the existing system, have in common a server at one end of the aircraft and several main communication lines along the aircraft. A number of switching nodes are placed along each line, which connects to the end devices. For a wireless enhancement this basic infrastructure with a server, backbone lines and switching units can be assumed.

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2.2 *Wireless system requirements, criteria and policies*

As the use of wireless networks on-board aircraft is a new field, the capabilities and risks of the technology still need to be worked out. No strict requirements catalogue exists. The research is done in close cooperation with Airbus and the requirements definitions are part of the project. Wireless technology is the most astonishing area in Communications and Networking. Emergence of a variety of standards for Wireless Communication Networks in culmination with advances in Radio Access Technologies offer better range, greater capacity, improved Quality of Service (QOS) and many more things, while reducing energy consumption and deployment costs, paving the way for new applications and services in mobile broadband access [3].

However, the project has two fundamental objectives. The first one is to get the certification for the wireless system. This is a must. It has however proven to be very difficult to get details on the requirements that make a system certifiable. In the past, systems with at least DAL-C classification were completely deterministic, at least for the cabin communication. It had to be shown that for a worst-case scenario the system will not fail.

There is a strong tendency from aircraft designers and airlines to use standard products and components, for example IP protocols or standard Ethernet devices. This often is in direct conflict with the determinism demands from the certification. The strategy of this work is to use as many standard components as possible to create a reliable and robust wireless communication system. However, these are not part of this work.

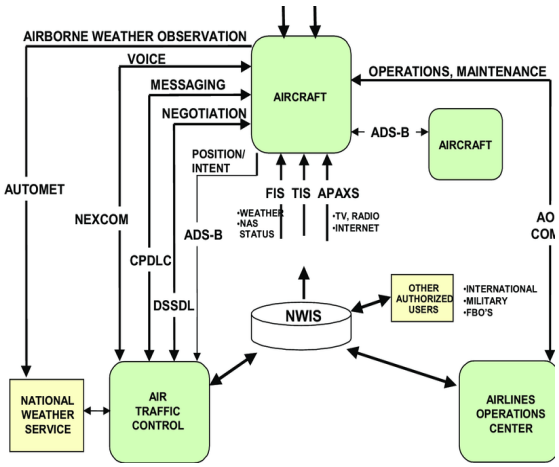

Figure2. Functional-aeronautical-communication-system-architecture.

The second target is to have the same performance for the wireless system, as for existing wired CMS. So the design goal of the wireless performance is to match the existing systems. The functional-aeronautical-communication-system-architecture is described in Figure 2. Further, the use of fly-by-wire technology for aircraft flight controls have resulted in an improved performance and reliability along with achieving reduction in control system weight. Implementation of full authority digital engine control has also resulted in more intelligent, reliable, light-weight aircraft engine control systems. The first step towards fly-by-wireless control systems is likely to be the introduction of wireless sensor networks (WSNs)[2].

2.2.1 Address Space

In the current CMS with a proprietary time deterministic protocol each single sign or button is seen as a port. In a mid-size aircraft with about 190 PSUs with 16 ports each and 15,118 light modules and some extra devices, the system support more than 18,400 ports. However, for the new CMS a new application protocol and an IP protocol is assumed. Thus, many components will be grouped with a common address. A rough estimation for this case can be seen in Table 1. From Table 1 one can clearly see that the number of wireless devices becomes very large. An A380 or A350 cabin has dimensions of about 60 × 6 m. Even without IFE there would still be 1000 nodes on 360 m^2. The A380 has two decks, thus the node density and interference become even worse.

Table:1 Number of devices for an A350 like aircraft

Unit type	Number	Description
PSU	190	170 seat groups, 20 additional for crew rest, galley, lavatory, etc.
Cabin sensors	200	Estimation; currently an aircraft has seventy smoke detectors
Cabin illumination	400	Estimation; single deck aircraft has about 300 illumination units for the cabin without door area and galley lighting
Video surveillance cameras	25	
Crew adapters	20	Crew related devices
FAPs and mobile devices	20	
Extra devices	50	Various signs, buttons, etc.
In-flight entertainment	555	One per seat
Total:	**1460**	

2.2.2 Delays

There are strict constraints on the delays in the CMS. This is due to two reasons: undistracted passenger announcements and synchronized playback.

Table:2 Delay requirements for the CMS

Unit type	Number	Description
PSU	190	170 seat groups, 20 additional for crew rest, galley, lavatory, etc.
Cabin sensors	200	Estimation; currently an aircraft has seventy smoke detectors
Cabin illumination	400	Estimation; single deck aircraft has about 300 illumination units for the cabin without door area and galley lighting
Video surveillance cameras	25	
Crew adapters	20	Crew related devices
FAPs and mobile devices	20	
Extra devices	50	Various signs, buttons, etc.
In-flight entertainment	555	One per seat
Total:	**1460**	

The first reason requires a short delay between speaking into the microphone and the actual playback in the speakers. The second reason requires a synchronized playback of the speakers in the cabin to obtain a clear voice and no hall effect. Table shows requirements on timing delays specified in.

2.2.3 Ultra-Wide-Band Technology

UWB is a signal form first used for radar applications in the late 1960's. At that time there was work done on UWB communication systems, but they did not become widely used until some years ago. In 2002 the Federal Communications Commission (FCC) (regulatory agency in the US) has specified the signal characteristics and power limits of UWB for communication. The frequency range and power levels from UWB and other technologies is presented in Figure 3.By definition an UWB signal has an emitted signal bandwidth of at least 500 MHz or 20% of the center frequency. Compared to other systems, such as Wi-Fi or mobile phone networks, which usually have cohesive bandwidth of less than 100 MHz, UWB has much more frequency resources but also brings with it new challenges.

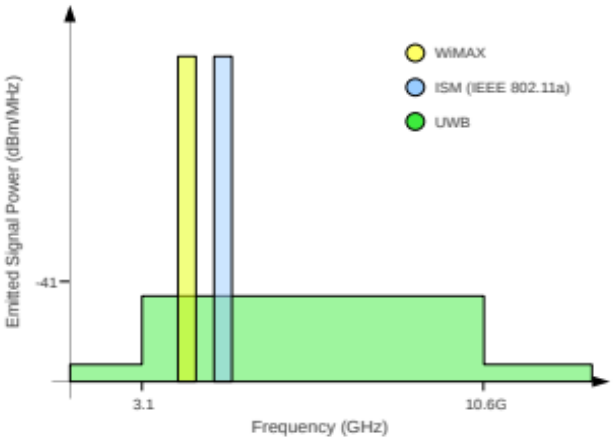

Figure 3. Frequency range and power levels from UWB and other technologies.

3.Overview of Wireless Communication Standards

3.1Transparent wireless communication

As pointed out in the previous paragraph, the wireless components need to be compatible with wired components. The additional devices or protocols from the wireless system shall not effect the application layers. No differences for the system or users must be perceptible.

3.2 Fail-safe and redundant

Since the speakers are DAL-C components, the wireless system must be fail-safe and redundant. The exact requirements are not defined, but the maximum possible reliability shall be implemented.

3.3 Overview of wireless communication standards

Space internet protocol SCPS-TP was used in satellite communication system Based on the Vegas congestion control used in space internet protocol SCPS-TP, learning from the congestion window growth strategy in slow-start phase of TCP Hybla protocol, modifying the threshold changes of congestion window and slow start when occurring packet loss and timeout, an improved Vegas strategy that is more fit for satellite communication [4]. SCPS-TP is a transport protocol for space communications, and it is suitable for satellite networks. Theory analysis and simulation experiments have been made to evaluate the performance of SCPS-TP in LEO satellite networks[5].Many common standards with respect to their transmission range and maximum data rate.

As the standards exist in many variations, a clear categorization is not easy. The most common range and data rate parameters of common systems are shown. The planned audio and video content requires a standard with moderate data rates. The low data rate technologies, such as Bluetooth, DECT, ZigBee or other wireless sensor network protocols do not provide capabilities for several video and audio channels in the aircraft scenario. The remaining technologies are summarized in the following, with focus on the aircraft related environment:

ECMA-368

The ECMA-368 standard, defined by the WiMedia alliance, is an UWB technology supporting up to 1024 Mbit/s. It has 14 non-overlapping channels and uses a Time Division Multiple Access (TDMA) channel access. The transmit range is about 10 m and no infrastructure is required to operate the network.

UMTS and LTE

The modern cellular phone networks can also provide good data rates. The maximum transmission range of the technologies is larger than needed, but pico or femto cells have shown, that they can also be used in small areas. One problem with this technology is the frequency management, since it requires dedicated bands for the aircraft usage.

IEEE 802.11a/g

The Wi-Fi technology, commonly known from wireless networking with laptops, achieves up to 54 Mbit/s in the 2.4 GHz and 5 GHz ISM bands; hence it is free of any frequency regulation. The infrastructure and ad-hoc modes allow easy and flexible usage with transmit ranges of 40 m indoor and 140 m outdoor. Originally IEEE 802.11a/g had 11-13 channels (depending on the country), but for IEEE 802.11g the channels are overlapping with only three non-overlapping channels available.

IEEE 802.11n

It is the most recent Wi-Fi standard. It uses Multiple Input, Multiple Output (MIMO) techniques and achieves up to 600 Mbit/s, thus it has similar data rates as WiMedia. But still it works in the ISM bands and requires a large amount of the total available resources when operated with 600 Mbit/s.

	ECMA-368	IEEE 802.11n	IEEE 802.15.3c
Traffic density (Mbit/s/m^2)	2.4	1.4	16
Product availability in about 3 years time (from 2006)	Good	Very good	Products are likely
Signal characteristics	Good propagation in aircraft; many resources available	Good propagation in aircraft; few resources	Requires LOS
Expected interference	Little interference due to spatial containment	Many interference from other systems on ISM bands	Little interference due to spatial containment

Figure4. Study of wireless protocols for aircraft

IEEE 802.15.3c

The protocol is one of the first 60 GHz standards. It achieves up to 3 Gbit/s and has a transmit range of 10 m. The disadvantage of 60 GHz communication is that it is strictly Line of Sight (LOS). Obstacles and moving objects can heavily influence the signal quality.

WiMAX

It is an emerging technology that has similar capabilities as cellular phone networks in terms of range and data rate; but the focus is on data packets, not phone calls. For the aircraft scenario it suffers from the same problems as UMTS or LTE. Furthe 95 e, the availability of this technology and the availability of any future mass market production.

3.4 Wireless CMS Architecture

A wireless cabin network can be implemented in different ways. This section describes the design of the UWB network and the design of the complete aircraft cabin network. The aircraft cabin network is a large system composed of multiple sub-networks.

3.4.1 Architecture concepts

With ECMA-368 as the protocol of choice two general approaches for the network topology are possible. The first approach (full-wireless) would have a completely wireless network and infrastructure. Near to the aircraft server one or more gateways provide the access from the server, or wired aircraft network, to the wireless network. The wireless network can either be a fully meshed topology, just composed of the end devices themselves. Transmissions are routed on multiple hops from the gateways to the end devices. Alternatively, it would also be possible to create an overlay network with relay nodes that have two UWB transceivers: one to communicate to the end devices and a second to build an overlay network between the relays and gateways. The second approach (AP-based) is a combination of a wired backbone network and several Access Points (APs) throughout the cabin. The APs serve as gateways from the wired backbone to the wireless network. The concept is similar to the usage scenario of Wi-Fi APs for office environments. The first approach has some drawbacks. First of all it provides a bottleneck close to the gateways. All traffic must be routed over the gateways, which will have the highest traffic density. With the AP-based solution, the APs will serve some wireless end devices and are connected to a high speed wired network, which could be a Gbit/s connection or optical fibre. Thus, the highest data density would be in the wired network, which is assumed to have higher capacities. Second drawback is the frequency management for the full-wireless concept. The completely meshed topology requires all nodes to operate on the same channel, which results in more nodes per channel and a low bandwidth per end device. With the wireless relay topology frequency diversity can be used, but one channel must be reserved for the relay channel (or wireless backbone). Both solutions are less efficient than the AP-based approach, where neighbouring APs can have different channels. The overall throughput of the network increases; hence the AP-based approach is preferred and used as a foundation of this work.

3.4.2 Backbone based system

Wireless communication systems inside aircraft cabins can be disturbed more easily than wired systems. This can be natural interference from the devices in the environment, blocked frequencies in specific countries, devices with the same technology or even hostile attacks. To increase the availability and reliability of the wireless communication a second independent interface is foreseen. It should use a different physical transmission scheme. Possible candidates are optical or 60 GHz systems.

3.4.2.1 Node density

When defining a new wireless transmission standard there will always be conflicts as parameters have to be agreed and fixed. This will result in hard limitations to the performance. Dynamic parameters will increase the complexity and indeterminism of the protocol. An example of dynamic mechanisms

is the use of Carrier Sense Multiple Access (CSMA). The nodes can access the channel when it is free, without any coordination. The disadvantage is the possibility of collisions. In a coordinated time Division Multiple Access (TDMA) network collisions hardly occur since the access is coordinated. Therefore, decisions such as timing the access, number of data slots or number of reservations have to be harmonized. The ECMA-368 uses a TDMA access with a beaconing mechanism. Several fixed parameters create a strict limitation for the number of nodes in the network. For the aircraft scenario a high node density can be expected, depending on the amount of systems using wireless connections.

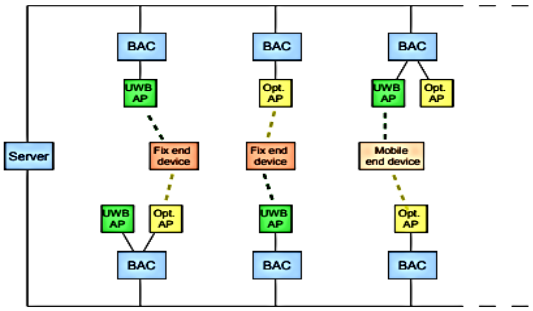

Figure 5. Wireless CMS system. The BACs are connected to the server by backbone lines. The UWB and optical Apps are linked to the BACs. End devices have an UWB and optical transceiver

3.4.3 Communication with ATC

Controller–pilot data link communications (CPDLC), also referred to as controller pilot data link (CPDL), is a method by which air traffic controllers can communicate with pilots over a data link system.

The standard method of communication between an air traffic controller and a pilot is voice radio, using either VHF bands for line-of-sight communication or HF bands for long-distance communication (such as that provided by Shanwick Oceanic Control).

One of the major problems with voice radio communications used in this manner is that all pilots being handled by a particular controller are tuned to the same frequency. As the number of flights air traffic controllers must handle is steadily increasing (for instance, Shanwick handled 414,570 flights in 2007, an increase of 5% - or 22,000 flights - from 2006), the number of pilots tuned to a particular station also increases. This increases the chances that one pilot will accidentally override another, thus requiring the transmission to be repeated. In addition, each exchange between a controller and pilot requires a certain amount of time to complete; eventually, as the number of flights being controlled reaches a saturation point, the controller will not be able to handle any further aircraft.

Traditionally, this problem has been countered by dividing a saturated air traffic control sector into two smaller sectors, each with its own controller and each using a different voice communications channel. However, this strategy suffers from two problems: (i) Each sector division increases the amount of "handover traffic". That is the overhead involved in transferring a flight between sectors, which requires a voice exchange between the pilot and both controllers, plus co-ordination between the controllers. (ii) The number of available voice channels is finite, and, in high density airspace, such as central Europe or the Eastern US Seaboard, there may not be a new channel available.

***3.4.4** Use of CPDLC*

Controller–pilot data link communication (CPDLC) is a means of communication between controller and pilot, using data link for ATC communication. At the highest level, the concept is simple, with the emphasis on the continued involvement of the human at either end and the flexibility of use.

The CPDLC application provides air-ground data communication for the ATC service. This includes a set of clearance/information/request message elements which correspond to voice phraseology employed by air traffic control procedures. The pilot is provided with the capability to respond to messages, to request clearances and information, to report information, and to declare/rescind an emergency. The pilot is, in addition, provided with the capability to request conditional clearances (downstream) and information from a downstream air traffic service unit (ATSU). A “free text” capability is also provided to exchange information not conforming to defined formats. An auxiliary capability is provided to allow a ground system to use data link to forward a CPDLC message to another ground system.

The sequence of messages between the controller and a pilot relating to a particular transaction (for example request and receipt of a clearance) is termed a ‘dialogue’. There can be several sequences of messages in the dialogue, each of which is closed by means of appropriate messages, usually of acknowledgement or acceptance. Closure of the dialogue does not necessarily terminate the link, since there can be several dialogues between controller and pilot while an aircraft transits the ATSU airspace.

All exchanges of CPDLC messages between pilot and controller can be viewed as dialogues.
The CPDLC application has three primary functions: the exchange of controller/pilot messages with the current data authority, the transfer of data authority involving current and next data authority, and downstream clearance delivery with a downstream data authority.

Simulations carried out at the Federal Aviation Administration's William J. Hughes Technical Center have shown that the use of CPDLC meant that "the voice channel occupancy was decreased by 75 percent during realistic operations in busy en route airspace. The net result of this decrease in voice channel occupancy is increased flight safety and efficiency through more effective communications."The current trends in the area of aeronautical passenger communication toward personal and wireless in-cabin communications and multimedia data networks. Technological challenges are summarized as well as market potentials and regulatory issues [6]. The current trends in aeronautical spectrum management followed by the major applications and contributions of cognitive radio in solving the spectrum scarcity crisis in the aeronautical domain. Also, to cope with the evolving technological advancement, researchers have prioritized the issues in the case of cognitive radio that needs to be addressed depending on the domain of operation. The proposed cognitive aeronautical communication systems should also be compliant with the Aeronautical Radio Incorporated and Aerospace Recommended Practice standards [7].

4. Conclusion

Current trends are towards high data rate communication services, in particular Internet applications. In an aeronautical scenario global coverage is essential for providing continuous service. There-fore satellite communication becomes indispensable, and together with the ever- increasing data rate requirements of applications, aeronautical satellite communication meets an expansive market. Wireless Cabin (IST -2001-37466) is looking into those radio access technologies to be transported via satellite to terrestrial backbones.

The project will provide UMTS services, W-LAN IEEE 802.11 b and Blue tooth to the cabin passengers. With the advent of new services, a detailed investigation of the expected traffic is necessary in order to plan the needed capacities to fulfill the QOS demands. This paper will thus describe a methodology for the planning of such system.

In the future, airliners will provide a variety of entertainment and communications equipment to the passenger. Since people are becoming more and more used to their own communications equipment, such as mobile phones and laptops with Internet connection, either through a network interface card or

dial-in access through modems, business travelers will soon be demanding wireless access to communication services.

Conflicts of Interest

The authors indicate that they have not received any research funding, direct or indirect financial support, or any other assistance. They also declare that there is no conflict of interest.

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Electrical Engineering

Harmonics Suppression of AC Source Current of a Single Phase Source Fed Induction Heating System

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Abstract. Any high frequency Induction heating system while undergoing through very high frequency switching operations, produces Electromagnetic Interference (EMI) noises or very high frequency harmonics within the system. These high frequency EMI noises conductively propagate towards the input AC source and distort the sinusoidal input AC current and make it non-sinusoidal. The desired performance from the induction heating cannot be anticipated. As such, it is inevitable to eliminate such EMI noises from the input AC source current to get the desired performance. Here, a specially designed ring type LC low pass passive filter is proposed which can accomplish to suppress these high frequency EMI noises up to satisfactory level and can restore the sinusoidal shape in the input AC source current waveform and thus improves the power quality of the AC supply for the induction heating system. The impact of the induction heating system without and with incorporating the proposed filter will be compared in this study.

Keywords. Induction Heating, EMI noises, resonant inverter, switching frequency

1. Introduction

During recent years, Induction heating process is regarded as one of most significant heating process that can provide a very fast heating method[1]. Induction heating process is also regarded as one of the energy efficient controllable process. In various domestic, commercial and industrial applications it can be utilized[1]. In this process no toxic gasses are produced and thus it is gradually gaining popularity due to its eco-friendly nature and thus induction heating process does not cause any health hazards to the consumers.

Induction heating method can provide faster heating due to the generation of very high frequency electromagnetic field produced by a working coil. The working coil produces this high frequency magnetic field, whenever a very high frequency current is sent by a 'Resonant Inverter'[2] produces it. The resonant inverter works as a very high frequency ac current generator. So far, various resonant inverter topologies have been developed, which can be selected in accordance to various applications with distinct power ranges. The mostly cheap and frequently used resonant inverter topologies are single switch based quasi-resonant inverter topology, the half-bridge inverter topology [2, 3], full-bridge inverter topology, hybrid inverter topology etc [4]. Any induction heating system demands a utility frequency AC supply, which must provide a pure sinusoidal voltage and current at the input of the induction heating system. However, regarding the very high frequency switching operations of the

resonant inverter and non-linear tendencies of the inductive load up to a certain level, very high frequency Electromagnetic interference (EMI) or high frequency noises within the resonant inverter [5]. These high frequency noises have a tendency to be conducted towards the input AC source and superimpose on the input AC source current, distorts it and makes it non-sinusoidal in nature. This will cause adverse results on the normal conventional operation of the induction heating system. As such, to accomplish normal operation of the induction heating system to get desired performance, these high frequency EMI noises must be blocked up to allowable level [5]. Suitably designed and passive filters are suggested in various electrical systems for harmonics suppression [5, 6]. In this paper, the performance of an *LC* type passive filter is analyzed, which can suppress high frequency conducted EMI noises in the input AC source current in a high frequency full-bridge series resonant inverter fitted induction heating system fed by Asymmetrical Voltage Cancellation (AVC) technique. It will be proved that the proposed filter can suppress high frequency EMI noises up to satisfactory level and improves the performance of the induction heating system to a great extent.

2. Operational Principle of the Proposed Induction Heating System

The following Figure 1 is depicting the proposed induction heating system fitted with the proposed low pass EMI filter.

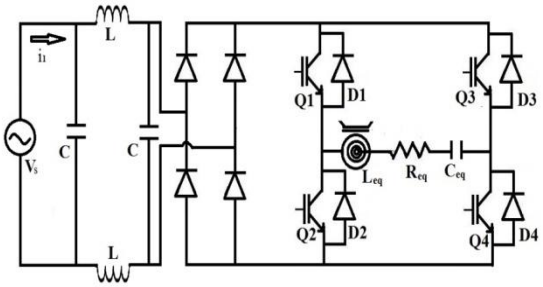

Figure 1. Proposed Induction Heating System fitted with Filter.

It consists of a series resonant load carrying an equivalent resistance R_{eq}, equivalent inductance L_{eq} and resonant capacitance C_{eq} respectively. Four IGBTs (Q1-Q4) are the main power semi-conductor high frequency switches which conduct the main load current. The four anti-parallel diodes (D1-D4) provide the path for the load current during the reverse conduction in the freewheeling period. Each IGBT can undergo the zero voltage switching (ZVS) condition during the turning process ensured by each freewheeling diode..The utility frequency AC voltage (50 Hz) is at first rectified by uncontrolled rectifier unit, the rectified DC voltage is held constant by a DC link incorporating a large capacitor. Such DC voltage is converted to very high frequency AC voltage by the proposed full-bridge series resonant inverter, which sends a very high frequency AC current through the working coil that results a very high frequency electromagnetic field and it will cause the generation of heat in the work-piece. The high frequency AC current produced by the resonant inverter is continuously controlled by the by the asymmetrical voltage cancellation soft-switching techniques. But, regarding high frequency switching operations of all the IGBTs and due to non-linear behavior the series resonant load, very high frequency harmonics are generated which will super impose on the main sinusoidal AC waveform and will distort it and will force it to be non-sinusoidal. Such high frequency harmonic

current is known as Electromagnetic Interference (EMI). A suitably designed *LC* filter has the capability to suppress this high frequency harmonic current and can maintain the input AC source current sinusoidal.

3. Asymmetrical Voltage Cancellation (AVC) Technique

Among various fixed frequency soft-switching techniques, AVC technique is considered as one of the effective and reliable fixed frequency control technique and can be used to regulate output power over wide range ensuring the ZVS (Zero Voltage Switching) condition throughout both on and off state conditions. This control technique possesses higher flexibility regarding the existence of three basic control parameters, which are α_+, α_- and β respectively as shown in Figure 2 in the typical output voltage waveform.

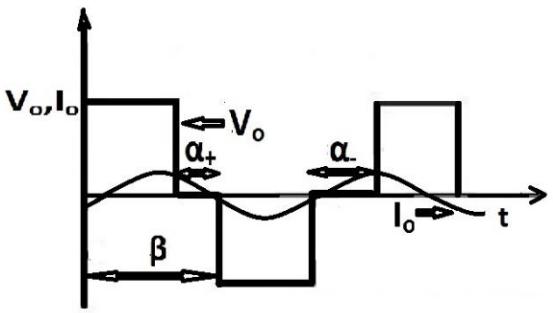

Figure 2. Typical Output Voltage and Current Waveforms under AVC Control Scheme.

The output power under AVC control scheme can be expressed as follows

$$P_o = \frac{V_{o1}^2}{2R_{eq}\left[1+Q_l^2\left(\omega_n - \frac{1}{\omega_n}\right)^2\right]} \quad (1)$$

Where, V_{o1} is the fundamental output voltage, R_{eq} is the equivalent resistance of the system including both working coil and work-piece and Q_l is the load quality factor.

$$Q_l = \frac{\omega_o L_{eq}}{R_{eq}} = \frac{1}{\omega_o R_{eq} C_{eq}} \quad (2)$$

and the expression of the normalized switching frequency is as follows

$$\omega_n = \frac{\omega_s}{\omega_o} \quad (3)$$

Where, ω_s is the switching frequency and ω_o is the resonant angular frequency and can be expressed as

$$\omega_o = \frac{1}{\sqrt{L_{eq}C_{eq}}} \quad (4)$$

where, L_{eq} and C_{eq} are equivalent inductance and capacitance of the series resonant load.

4. EMI Filter Design for Harmonics Suppression in AC Source Current

An ideal low pass filter is a network, which passes signals within a certain specific frequency band, and blocks the signal higher than that frequency band. The following Figure 3 depicts the proposed low pass filter.

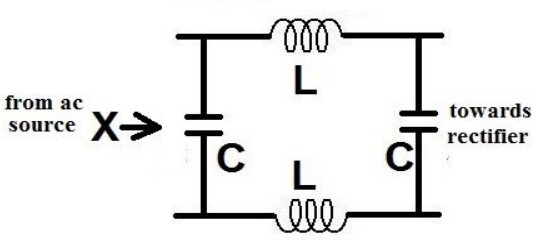

Figure 3. Proposed LC type Passive Low Pass Filter.

This low pass filter can be fitted with a line impedance stabilizing network (LISN) to suppress the unwanted high frequency harmonics in the input source current.

The following expression gives the equivalent reactance of the filter network from the AC supply

$$X = \frac{\frac{2L}{C} - \frac{1}{\omega^2}}{2j\left(\omega L - \frac{1}{\omega C}\right)} \tag{5}$$

At resonant frequency, X will be very high which is

$$\omega = \omega_1 = \frac{1}{\sqrt{LC}} \tag{6}$$

Here, $L = 200\mu H$ and $C = 0.1\mu F$ and as such the cut-off frequency regarding the filter is $f_1 = 35.6\ kHz$ and the filter can block the high frequency current waveform with fundamental frequency of 40 kHz which is also the fundamental frequency regarding load current.

5. Simulation Results

The overall analysis is realized through Power System Simulator (PSIM) software. At first the performance of the proposed induction heating system is analyzed and thereafter, the performance of both the low pass filter and the induction heating system is investigated. The following Figure 4 is representing the PSIM simulated circuit diagram of the induction heating system without the incorporation of the filter. The selected switching frequency is 40 kHZ, whereas, the selected equivalent load parameter values are $R_{eq} = 1\Omega$, $L_{eq} = 50\mu H$ and $C_{eq} = 0.6\mu F$ respectively.

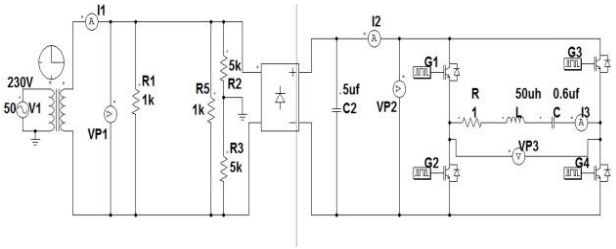

Figure 4. PSIM Simulated Circuit Diagram of the Induction Heating System without Filter.

The following Figure 5 is depicting the input AC source current waveform following the PSIM simulation of the proposed induction heating system without using filter.

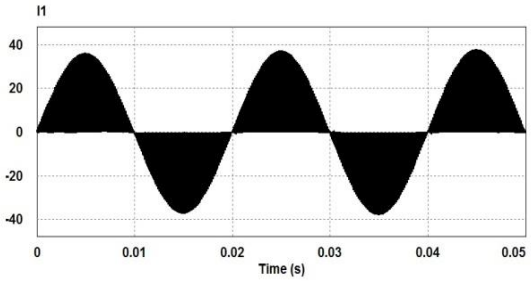

Figure 5. Input AC Source Current Waveform for $\alpha = 30^\circ$ without incorporating the Filter.

Now, Figure 6 is depicting the PSIM simulated circuit diagram of the proposed induction heating system incorporating the proposed low pass filter.

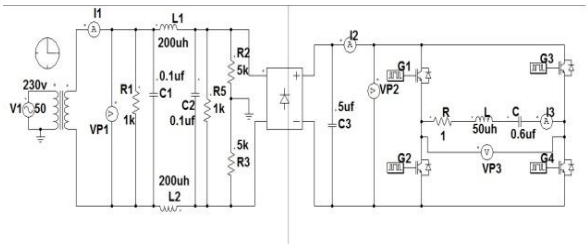

Figure 6. PSIM Simulated Circuit Diagram of the Induction Heating System with incorporating Filter.

The following Figure 7 is depicting the input AC source current waveform following the PSIM simulation of the proposed induction heating system incorporating the filter.

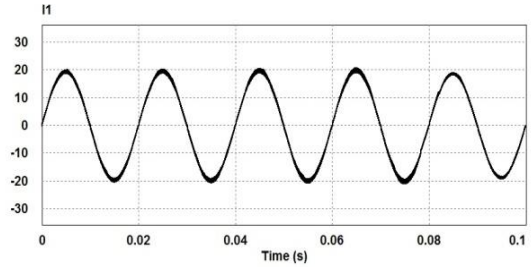

Figure 7. Input AC Source Current Waveform for $\alpha = 30^\circ$ with incorporating the Filter.

6. Results and Discussions

From the software simulations as obtained from Figure 5 and Figure 7, two different results are achieved. In the first case, as obtained from the simulation of the circuit depicted in Figure 4, the input AC source current waveform is non-sinusoidal containing a large amount of very high frequency EMI noises, which are produced due to very high frequency switching operations. A suitably designed low pass filter can suppress all these high frequency EMI noises, which is incorporated in the induction heating system as shown in the PSIM diagram in Figure 6. Following the simulation of that circuit, the

input AC source current obtained in this case as shown in Figure 7 is almost sinusoidal, which indicates that the low pass filter suppresses the high frequency noises up to a satisfactory level.

7. Conclusions

Due to high frequency switching operations and due to the presence of non-linear load, high frequency EMI noises are produced in the induction heating system, which is conducted towards the input AC supply and superimposes on the main sinusoidal AC waveform of line frequency. This causes distortion in the input AC source current waveform and converts to be a non-sinusoidal waveform. After the incorporation of the proposed LC ring type low pass filter, the conducted EMI high frequency noises are suppressed up to a satisfactory level and the input AC source current waveform becomes almost sinusoidal and improves the power quality of the single phase AC supply.

Acknowledgements

Authors wish to thank the **University Grants Commission**, India for granting the financial support under Major Research Project entitled "Simulation of high frequency mirror inverter for energy efficient induction heated cooking oven using PSPICE" and also they are grateful to the Under Secretary and Joint Secretary of University Grants Commission, India for their active co-operation.

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A Comparative Study in Different Structures of Microstrip Patch Antenna Design

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Abstract. Microstrip antenna consists of a metallic patch on a grounded substrate. It may be rectangular or circular patches. MSA become very popular for its ease of analysis and in fabrication, attractive radiation characteristics and low cross polarization radiation. In this paper, the proposed antennas are selected as UWB self-complementary Monopole antennas. I represent here the comparative study of Microstrip rectangular and hexagonal Patch antenna and their characteristics like Radiation pattern, VSWR vs. frequency, s-parameter vs. frequency, Impedance vs. frequency, current density etc.

Keywords. Antenna; Hexagonal structure; Microstrip

1. Introduction

In self-complementary antenna, the complementary structure of antenna is identical with its original structure. UWB means very low energy level for short range and high bandwidth of the radio spectrum. At present UWB technology put more importance on small printed antennas because fabrication procedure is very simple and it can be easily integrated with other components on the same PCB. The monopole microstrip antennas are studied to demonstrate the enhancement technique of bandwidth.

According to literature survey of several articles [1-7] the author have analyzed here different matching techniques by simulation. These matching techniques provide better frequency response characteristics curve within ultra-wide band. The impedance matching performance of simulated antennas are improved and gain also enhanced and perfect impedance matching leads to the rejection of narrow band of frequency, i.e., antenna functioning as a band reject element. Better band rejection improves the notching performance. So, the antenna used as a notch filter. The structures of the proposed antennas are constructed on Ansoft simulation software, high frequency structural simulator (HFSS).

2. Design and Structure of Proposed Antenna

Schematic design for Hexagonal structure of antenna is given below in Figure 1.

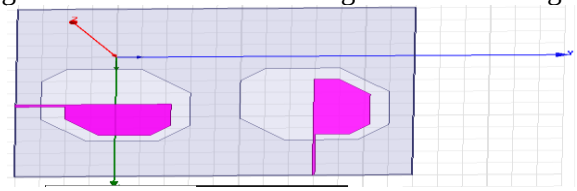

Figure 1. Structure of antenna [Hexagonal patch]

Table 1a. Different measured parameters of proposed Hexagonal patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch	Dielectric	FR4				
2 element	Substrate		1.6	-20	-20	0

Table 1b. Different measured parameters of proposed Hexagonal patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch	Dielectric	FR4				
2 element	Substrate		1.6	70	80	1.6

Schematic design for Square patch structure of antenna is given below in Figure 2.

Figure 2. Structure of antenna [Square patch for 2-element].

Table 2a. Different measured parameters of proposed Square patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch	Dielectric	FR4				
2 element	Substrate		1.6	-20	-20	0

Table 2b. Shows the different measured parameters of proposed Square patch

Configuration	Parameter	Name	Thickness	x (mm)	y (mm)	z (mm)
Hexagonal patch	Dielectric	FR4				
2 element	Substrate		1.6	70	80	1.6

3. Results and Analysis

3.1. VSWR vs. Frequency

The figures should be clear and they should be numbered as Figure 1, Figure 2, Figure 3, etc. There should be annotations behind each figure as following:
After simulation, different characteristic curves of proposed antennas are given below.

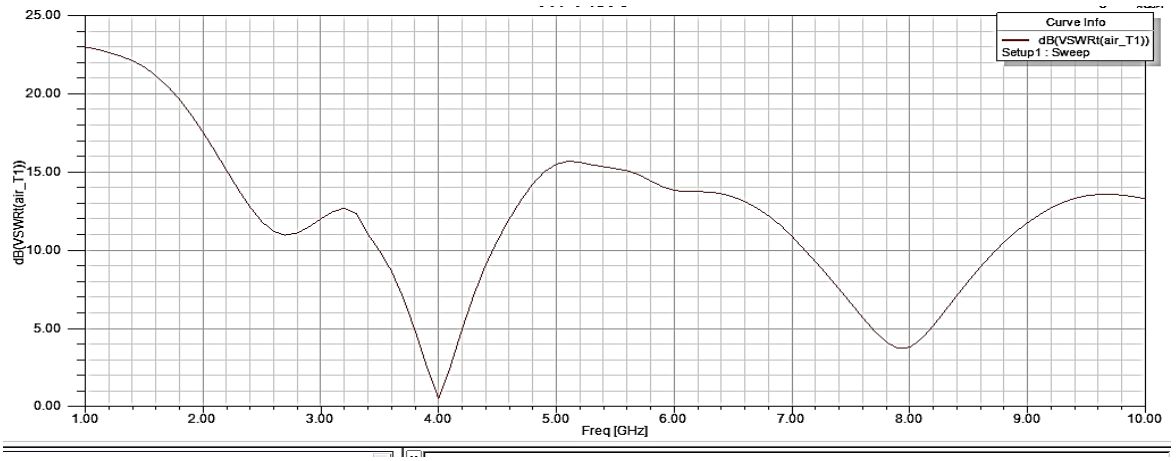

Figure 3.VSWR vs. Frequency of the Hexagonal structure for 2-element patchAntenna.

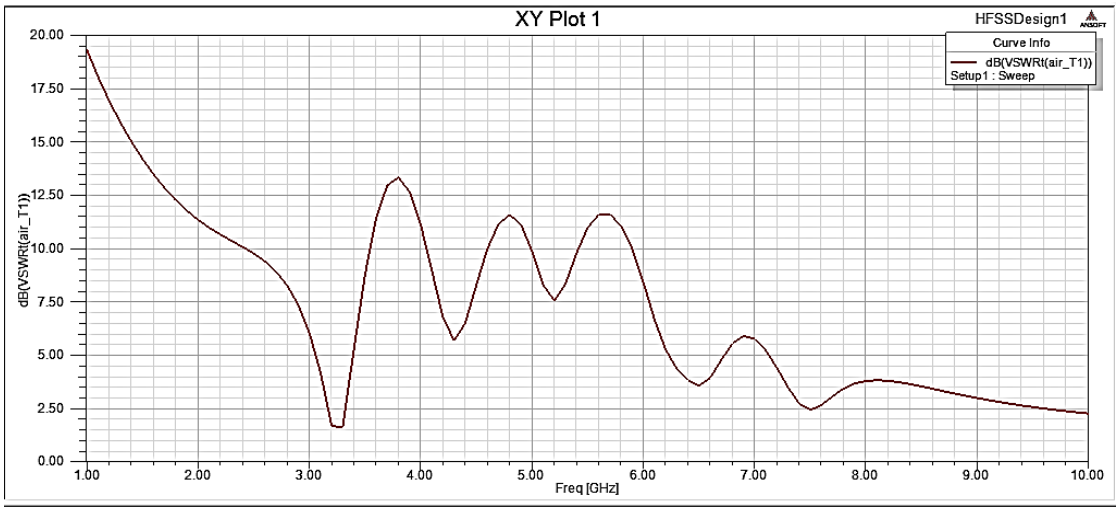

Figure 4.VSWR vs. Frequency of the Square structure for 2-element patch Antenna.

3.2. S11 vs. Frequency

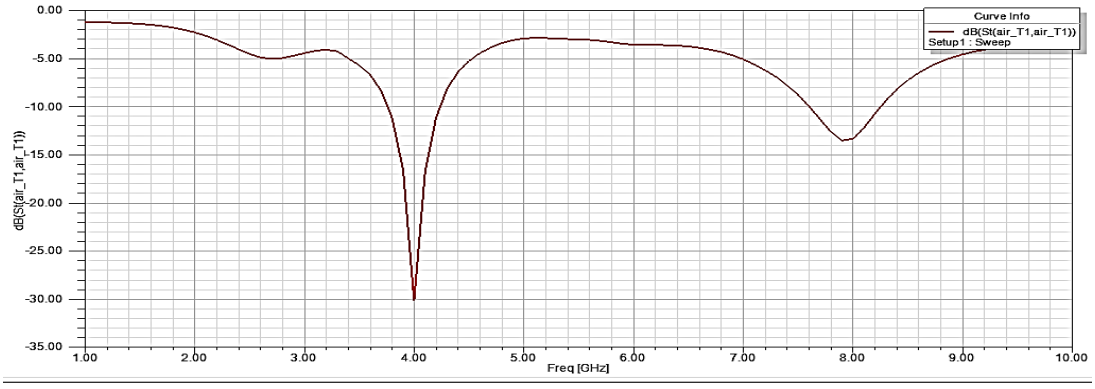

Figure 5..S11 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

Figure 6.S11 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

3.3. S12 vs. Frequency

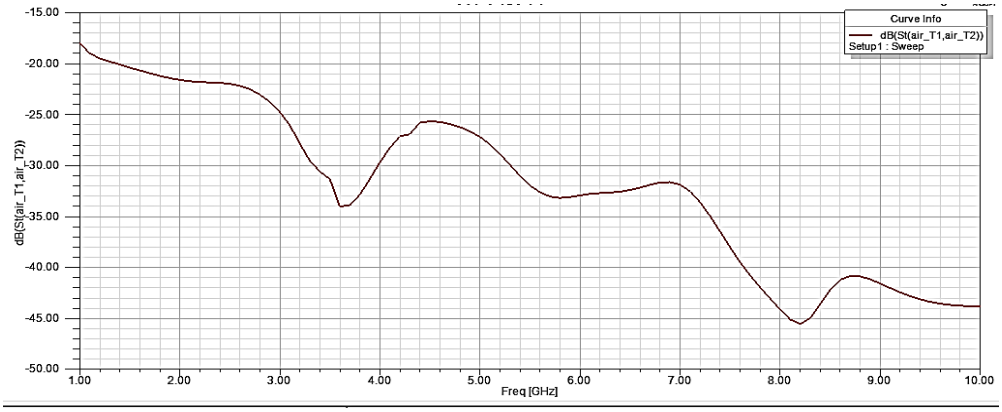

Figure 7.S12 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

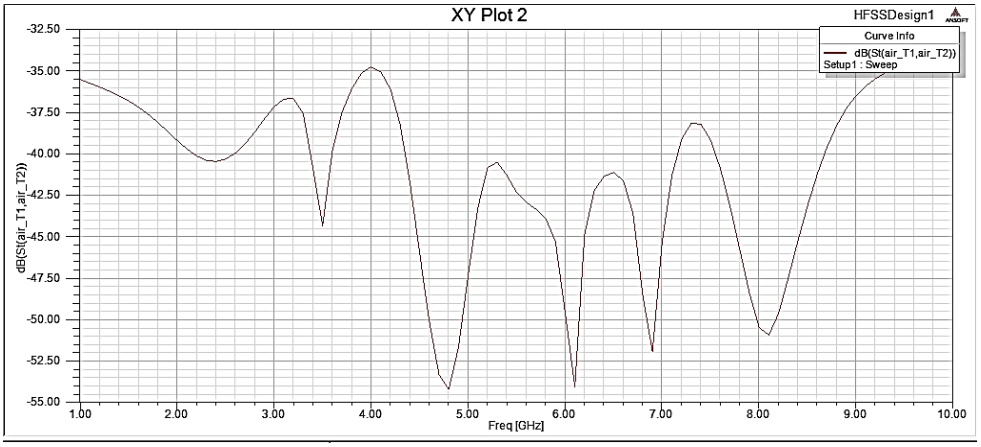

Figure 8.S12 vs. Frequency of the Hexagonal structure- 2-element patch Antenna.

3.4. Radiation Pattern

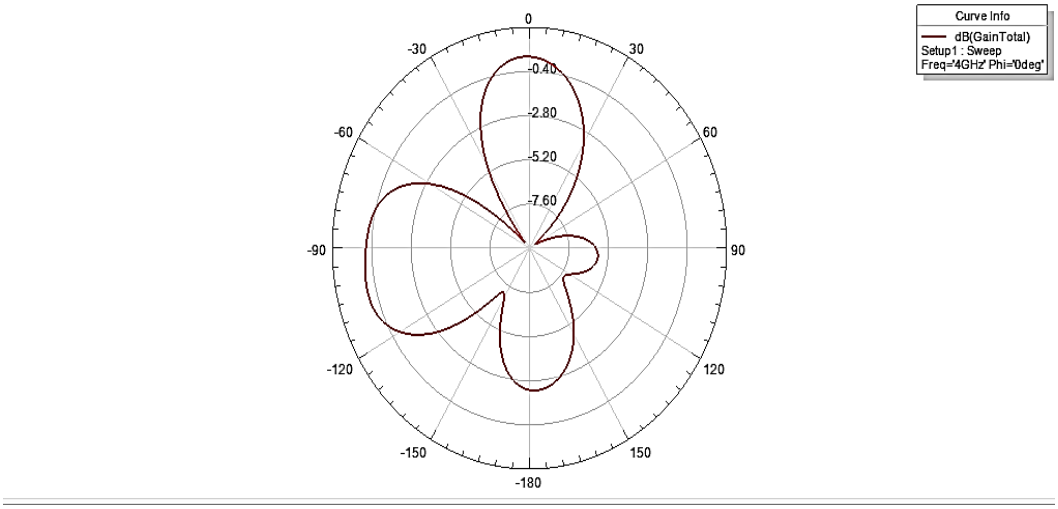

Figure 9. Radiation pattern Total gain of the Hexagonal structure for 2-element patch Antenna at phi 0 deg.

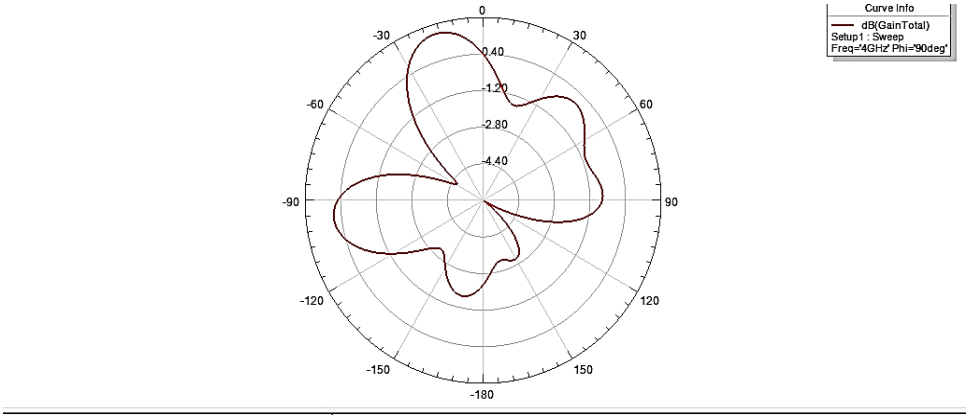

Figure 10. Radiation pattern Total gain of the Hexagonal structure for 2-element patch Antenna at phi 90 deg.

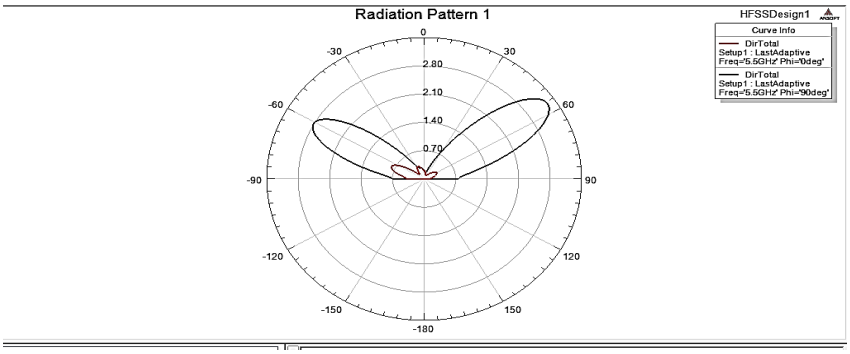

Figure 11. Radiation pattern of the Square structure - 2-element patch Antenna at phi 0 deg. & 90 deg.

3.5. Smith Chart

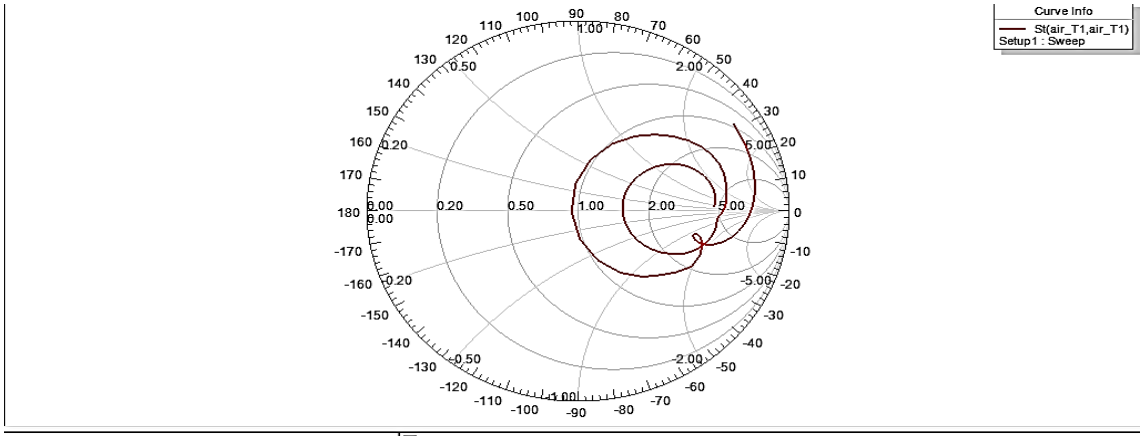

Figure 12. Smith chart of the Hexagonal structure for 2-element Patch Antenna.

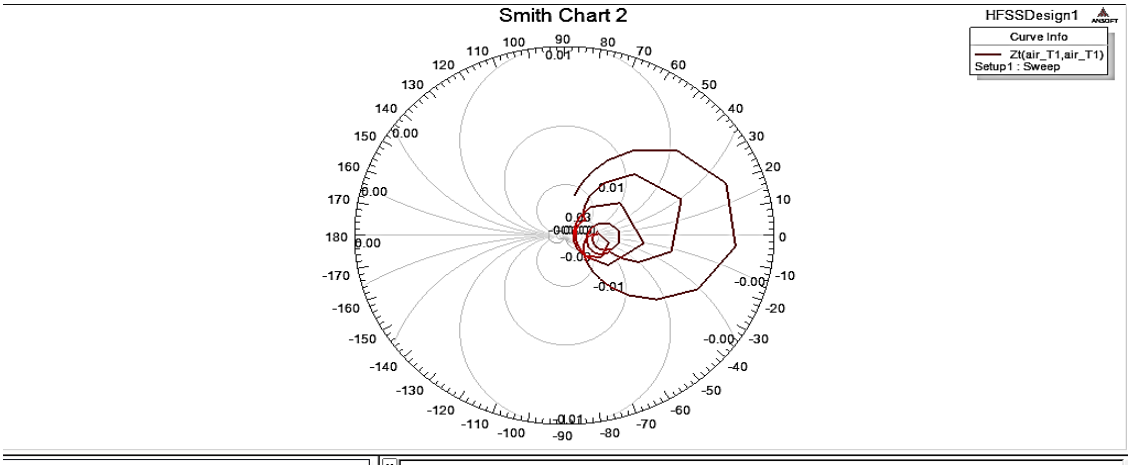

Figure 13. Smith chart of the Square structure for 2-element Patch Antenna.

3.5. 3D Polar Plot

Figure 14.3D Polar plot of the Hexagonal structure for 2-element patch Antenna.

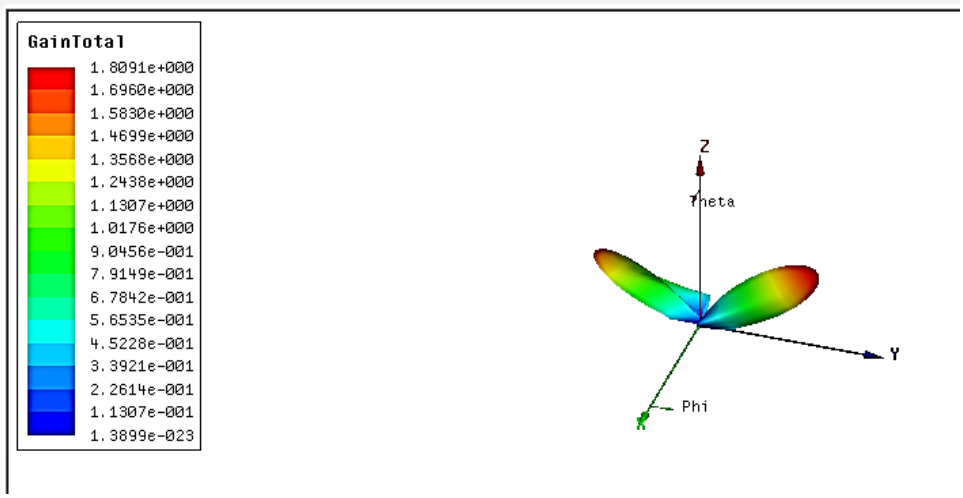

Figure 15.3D Polar plot of the Square structure for 2-element patch Antenna.

3.6. Current Density

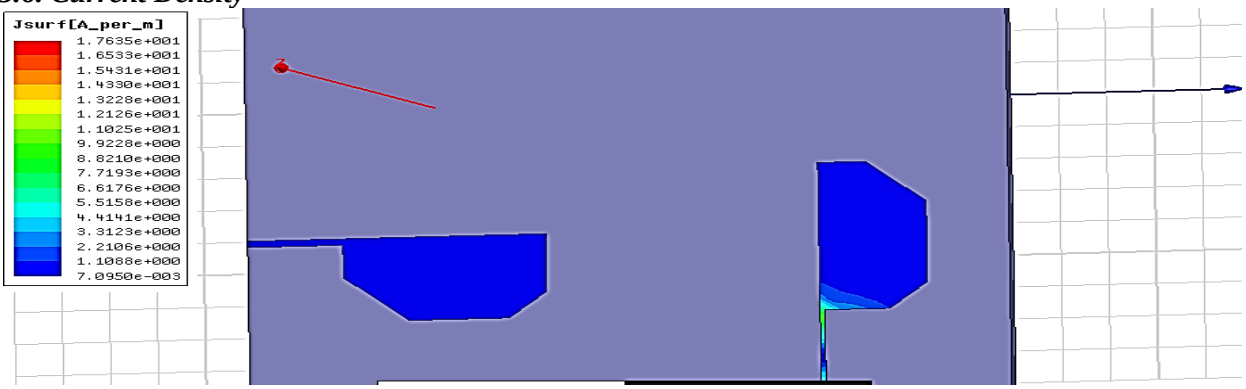

Figure 16. Current density of the Hexagonal structure for 2-element patch Antenna.

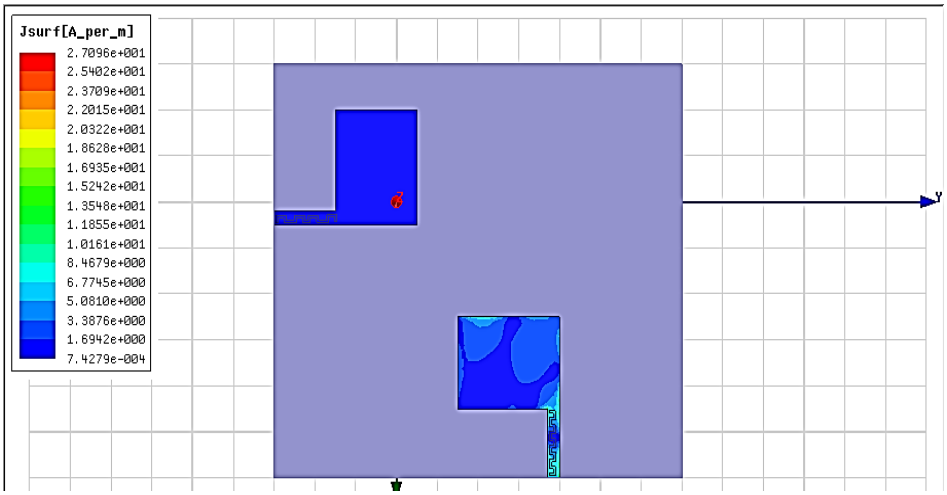

Figure 17. Current density of the Square structure for 2-element patch Antenna.

4. Results and Discussion

Figure 3 & Figure 4 shows VSWR vs. Freq. plot of the Hexagonal patch and Square patch antenna. Result shows that, proposed Hexagonal patch antenna consists wide bandwidth (VSWR<2) of (2.8 – 9.4) GHz. with band stop frequency of (3.3 – 5) GHz and (7 - 9) GHz. which allocated for WLAN, HIPER LAN technologies and Square patch antenna also consists UWB but range is less than Hexagonal patch. S11 vs. Frequency plot of Hexagonal patch [Figure 5], shows that S11 is at 30 dB. But, S11 vs. Frequency plot of Square patch [Figure 6.] is not better than Hexagonal patch. S12 of proposed Hexagonal patch antenna [Figure 7] also show below 30 dB. On the other side, S12 of Square patch antenna [Figure 8] is very poor. Figure 12 shows the Smith chart of proposed Hexagonal patch antenna and Figure 13 shows Smith chart of proposed Square patch antenna. From Figure 12 and Figure 13, designed square patch antenna obtained low impedance than hexagonal patch antenna due to self-complementary structure.

The resonating frequency is 4GHz which is working within the Microwave band (C band). The Radiation pattern of designed Hexagonal patch antenna is shown in Figure 9 and Figure 10, which shows omni directional nature. Radiation pattern of designed Square patch antenna is shown in Figure 11 which also provides high gain but less than Hexagonal patch antenna.

Current density of proposed Hexagonal patch antenna is shown in Figure 16. It shows that, surface current is highly concentrated in one part of 2 element Hexagonal patch. In another part, surface current slightly less concentrated in the corner of the patch and in the feed line. Current density of proposed Square patch antenna is shown in Figure 17. It shows that, surface current is highly concentrated in one part of 2 element Hexagonal patch. In another part, surface current slightly is very less concentrated in the top corners of the patch and in the feed line.

5. Conclusion

According to the Simulation study, we get, proposed Hexagonal patch antenna gives better result than Square patch antenna in impedance matching, better gain, and enhancement of radiation. The speed of response for UWB is very high in case of Hexagonal patch antenna than Square patch antenna.

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Development of Zero Energy Consumption Building an Approach towards Green Campus

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Abstract. The conversion of energy is the key objective of this paper. To achieve this installation of grid connected rooftop solar power plant is proposed at Elitte College of Engineering, Kolkata campus. The main purpose to choose rooftop power plant is to use un utilized roof space of the campus for generation green electricity to convert zero energy consumption building. This approach will help our country to reduce carbon foot print and also help in sustainable development. This paper also presents cost- benefit analysis of proposed roof top solar power plant for making a green campus.

Keywords. Roof-top Photovoltaic; Green Energy; Grid connected; Annual Energy consumption

1. Introduction

Sustainable development is important parameter for maintaining energy security and economic growth for any country [1-2]. Energy security is linked with seventeen sustainable energy goals. To be more precise, energy security now days depend on right energy mix between conventional and nonconventional energy application [3-5].India is currently focused on solar power by lunching the Jawaharlal Nehru National Solar Mission (JNNSM) with a target of 175 GW renewable energy additionsby 2022. Out of 175 GW, 100GW of energy production through solar energy, 60 GW of Wind and rest are other source of renewable energy. In 2020, union budget for India announced subsidy for Roof-top Photovoltaic (RPV) installation for all residential budding for more inductiongreen energy [6-8]. RPV technology is highly acceptable owing to easy installation, less maintenance, pollution free, environmentally friendly source of electricity [9]. The other important aspect of RPV is that it produces low cost electricity utilizing limited space of roof of any new or old established building [10-12].Considering this in this paper a roof top solar power plant is proposed to convert ECE campus a Zero energy green campus.

2. Methods

Methodology used in this work consists of following steps. Figure-1 depicts proposed method of research work done to accomplice the desire objective.

2.1. Environmental Parameter Analysis for ECE Kolkata Campus

ECE Kolkata campus is situated at 22.7144°North, 88.4175°East. It is under the climatic zone of Tropical wet and dry. Annual average global horizontal insolation is 4.0kWh/ m2 per day which is considered as the major input parameter for photovoltaic generation.

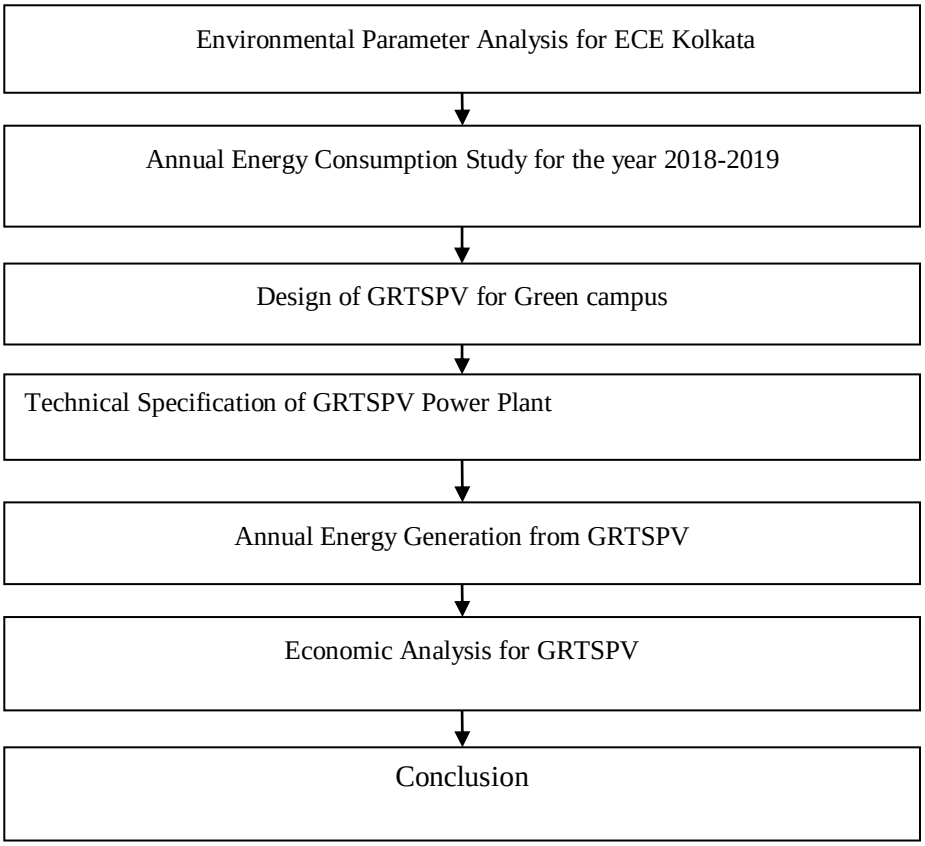

Figure 1. Methodology of the Current Research.

2.2.Annual Energy Consumption Study of ECE Kolkata Campus for the year 2018-2019

Energy consumption of ECE Kolkata campus for the year 2018-2019 is depicted in Figure-2. It is clear that the monthly energy consumption maximum is in the month of April with the value of electricity consumption8400 kWh. The total energy consumption for the entire year is 78000 kWh.

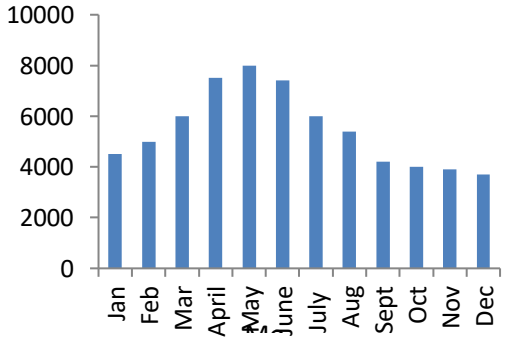

Figure 2. Energy Consumption of ECE Kolkata.

2.3. Design of GRTSPV for Green Campus

In case of Rooftop Photovoltaic Power Plant design first step is to calculate the available area for installation of PV plant. To fulfill this purpose all measurements of the rooftop of ECE Kolkata building were collected from Building roof Plan. The Photograph for ECEKolkata Campus is depicted in Figure 3.

Figure 3. Elitte College of Engineering model.

After analysis through PVSYST software the available shadow free roof top area of ECE Kolkata campus, is 1375m^2. The available shadow free area is sufficient for installation of 100 kWp GRTSPV power plant.

2.4. Technical Specifications of Component used for GRTSPV Plant

The Grid Connected Rooftop and off grid Solar PV Power Plant shall consist of following major equipment/components.

a. Solar PV modules
b. Module Mounting Structure and civil foundation
c. PV array Junction Box with Array isolator, Fuse and Surge Protection Device (SPD)
d. Grid interactive Power Conditioning Unit with web based data logger
e. Inverter Combiner Panel and Grid Isolation
f. Disconnection Isolator at Point of Coupling
g. Earthing protections.
h. Cables and wires

3. The details of Major Components are as follows

PV Module:

Table 1. Details of Solar Module

Sl no.	Item	Description
1	Type	Mono or poly crystalline
2	Rating at STC	Minimum 300Wp
3	Efficiency	Minimum16%
4	Fill factor	Minimum 70%
5	Withstanding voltage	1000V DC
6	Module Frame	Anodized aluminum

4. Module Mounting Structure and Foundation

Module Mounting Structure and Foundation shall be designed using anchor fastener for grouting of structure on the roof. The PV Module Mounting Structure shall be also designed satisfying that rain water is not logged due to installation of the same, the PV Array should be capable of withstanding a wind load as per IS:875 (180 km/hr after installation) with Design Factor of Safety :1.5.

5. PV Array Junction Box (AJB):

Table 2. Array Junction Box

Sl no.	Item Description	Desired Data
1	Degree of Protection	IP65 with UV Protected
2	Material	Polycarbonate.
3	Withstanding voltage	1000V DC
4	Withstanding Temp	100 ^{0}C
5	Type of Surge Protecting Device (SPD)	DC , Type B+C
6	Fuse Type	Glass fuse, for PV Use only
7	Rating	1.25 times the rated short circuit current

6. Inverter

The string inverter shall be used to convert DC power produced by SPV modules, in to AC power. Typical technical features of the inverter shall be as follows:

Table 3. Technical Features of Inverter

Sl. No.	Operating Parameter	Desired specification
01	Type	Grid connected String Inverter
02	PV array connectivity capacity	More than 10 kWp
03	MPPT Voltage range	Compatible with the array Voltage
04	Number of MPPT Channel	2 nos (Minimum)
05	Nominal AC Power output	Minimum 15 kW
06	Number of Grid Ph	3Ø
07	Adjustable AC voltage range	360V- 455V
08	Frequency range	47-53 Hz
09	THD	Less than 3%
10	Efficiency (Maximum)	95 %
11	Protection Class	IP 65 or higher
12	Operating ambient temperature	0 ^{0}C to 50^{0}C

Arrangement of Photo Voltaic (PV) Module of GRTSPV Power Plant:

Panel arrangements for RPV plants are indicated in Figure 4. In case of GRTSPV plant a spacing of 0.75m

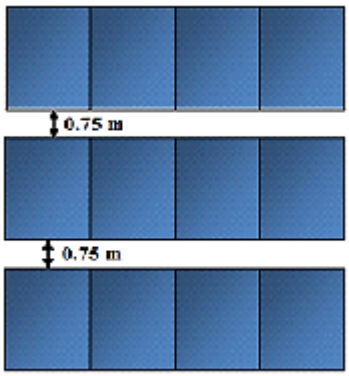

Figure 4. Arrangement of PV Module.

Integration of PV Power with Grid:
The output power from SPV will be fed into the inverter, which converts DC produced by SPV array to AC and feeds it into the 3-phase, 400V AC source. There will be two isolators for feeding power into the grid. The isolators shall be connected at the two ends of the main power supply cable, connected between the Inverter and Grid Power Source. In order to monitor performance of PV Power Generating System an import-export meter shall be provided at the output of the inviter depicted in Figure 5.

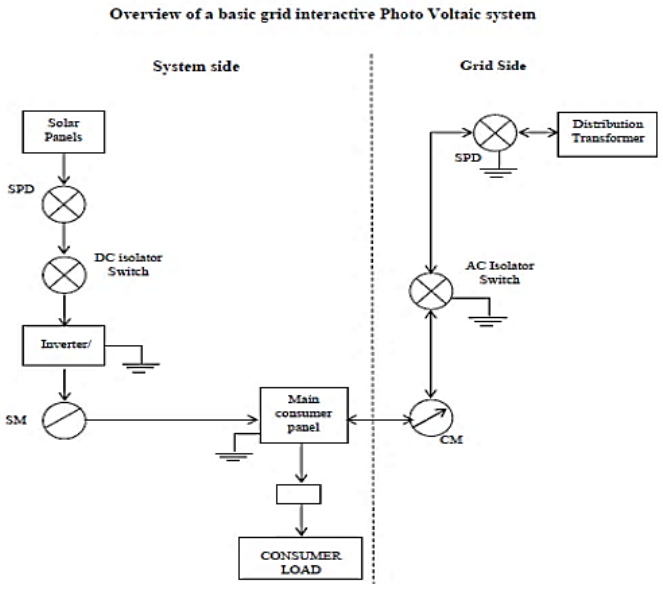

Figure 5. Connectivity with the Grid.

7. Annual Energy Generation from GRTSPV

Annual energy generations from RPV plant are calculated considering all the associated losses with Photovoltaic generation [11]. Considering the available shadow free area and need of energy campus of campus 80 kWp GRTSPV power plants is proposed. Consider the climatic condition of Kolkata 1 kWp power plant produce 4 kWh per day. If we consider 300 no sunny day per year then Annual Energy generation from proposed 70 kWp GRTSPV Power plant= 84000 kWh.

8. Economic Analysis for GRTSPV Power Plant

Considering the Ministry of New and Renewable Energy Benchmark cost for installation of Rooftop solar plant 1 kWp= Rs 45/Wp
Total cost associated with GRTSPV plant = INR 3150000.00
Annual energy supplied to the grid= Total Annual Energy generation of the plant- Annual Energy consumption of ECE Kolkata campus
Annual Energy supplied to the grid from RPV plant= (84000 – 78000) kWh= 2000 kWh
SOES=Annual Savings from own energy supply.=78000 kWh
CS= Cost of per kWh electricity purchased from the grid from PV plant. In this paper it is considered as INR 6.00/ kWh.
Annual Savings from RPV plant= INR 468000.
Simple payback period=
TC = Total cost associated with the plant.
SA= Annual saving from the plant.
Pay back= TC/SA=(3150000.00/468000)=6.51
Calculated simple payback period for around 6.5 years

4. Conclusion

Conclusions of the paper are presented below:

- Total shadow free rooftop area available in ECE campus for PV installation is 1375 m^2.
- Proposed GRTSPV plant capacity 70 kWp
- Annual Energy consumption of ECE campus for the year 2018-19 was 78000 kWh.
- Annual energy generations from 70 kWp RPV plant are 84000.00 kWh /Annum
- Cost Saving per year utilizing green energy is Rs. 468000.00
- Normal Plant life is 25 years for 25 years
- Payback period of Grid connected rooftop power plant around 6 years.

Utilizing the roof area ECE campus can be convert the entire campus to zero energy green campus and reduce the carbon footprint significantly.

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WSN based Forest Fire Detection System

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Abstract. Forest is a major part of the global, ecological, environmental, and recreational system. It has a huge impact on amount of greenhouse gases, atmospheric carbon absorption, and reduction of soil erosion. It directly modulates the temperature and regulates amount and nature of rainwater. To a large extent, forest fire is one of the most dangerous natural hazards that occur in practically in all countries worldwide affecting physical, biological, and environmental consequences. An advanced technology, Wireless Sensor Network (WSN), is nowadays getting more importance and has started application in forest fire detection. The Wireless nodes integrate on the same PCB, the sensors, the data processing, the wireless transceiver, and they all run by the same source- batteries. Unlike cell phones, WSN do not require recharging periodically. The sensors used here, are device for sensing their environment and computing data. The sensors sense physical parameters such as the temperature, pressure, and humidity, as well as chemical parameters such as Carbon Monoxide (CO), Carbon Dioxide (CO_2) and Nitrogen Dioxide (NO_2). The sensors operate in a self-healing and self-organising wireless networking environment.

Keywords. Wireless sensor; Network; Forest; Fire

1. Introduction

Global mankind is so unfortunate that the forest fire is commonly observed only when it has already spread abruptly over a large area, making its control and stoppage arduous, and often even nearly impossible. The result is a devastating loss of enormous lives and property and additional irreparable damage to the ecology (huge amount of smoke and harmful gases such as carbon dioxide (CO2), carbon monoxide (CO), etc. in the atmosphere). Some unavoidable dreadful consequences of forest fire are such long-term devastating effects on the local weather pattern, global warming, annihilation of rare species of the flora and fauna, etc. Most important problem of forest fire control is that the forests are usually remote, abandoned, unmanaged areas full of trees, dry and parching wood, and leaves etc. which form a highly combustible agent and represent the perfect medium for fire ignition and also as fuel for later stages of the fire. The fire ignition could be caused through human actions, like smoking or barbeque parties, or by natural reasons such as; high temperature in a hot summer day, or a broken glass working as a collective lens focusing the sun light on a small spot for a length of time thus leading to fire ignition. Once ignition starts then the combustible materials may easily fuel to feed the fire central spot. The spot then grows bigger and wider. The initial stage of ignition is normally referred to as 'surface fire' stage. This may then lead to gulp the adjoining trees and the fire flame grows rapidly.

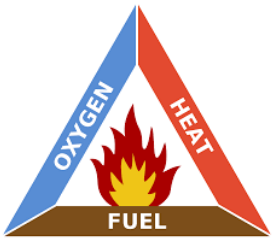

Figure 1. Fire Factors Triangle

According to Burati et al. (2009), a WSN can be defined as a network of devices, denoted as nodes, which can sense the environment and communicate the information gathered from the monitored field (e.g., an area or volume) through wireless link. The data is mostly forwarded via multiple hops, to a sink which can use it either locally or is connected to other networks (e.g., the Internet) through a gateway. The nodes may be stationary or moving and can be aware of their position or not. They can be homogeneous or heterogeneous [1]. Forest fire detection and prevention is another challenge in numerous countries. Different process for monitoring the emergence of fires have been proposed and initiated as well. The earlier methods were based on mainly watch towers, but this technique was inefficient and unsuccessful. Subsequently, camera surveillance methods and satellite imaging technologies were implemented but this also proved ineffective to efficiently monitor the ignition of the surface fire. For example, camera networks can be installed in different positions in the forests but these provide

only some sight pictures which again might be affected by weather situation and/or physical obstacles. Satellite images turn to be more efficient than camera surveillance, where images captured and accumulated by two satellites. The Advanced Very High Resolution Radiometer(AVHRR), launched in 1998 and the Moderate Resolution Imaging Spectro-radiometer (MODIS), launched in 1999 have been used for this purpose [2]. Unfortunately, these satellites can capture images of the regions of the earth every two days which is a bit longer time for fire scanning, besides the quality of satellite images can are dependent on present weather condition. The revolution of WSN technology in recent era has made it possible to use this technology with a potential for prior forest fire detection. These sensors required to be self organized and follow an efficient algorithm, interfaced with different technologies or networks. Several studies have been investigated using WSN in wood fire systems. Doolin et al. [3] experimented with 10 sensors provided with GPS device, to sense temperature, humidity, pressure and feed these data back to the sink. The drawback of this system is that the distance between sensors is too far (approximately 1km), in case of node failure a connection between some sensors and the sink may be lost and that could leave a gap in the network. Lloret et al. [4] suggested implementing a mesh network of sensors attached with internet protocol (IP) cameras. Here the sensors identify the fire at the beginning and transmit an alarm signal to the sink. The sink then sends a message to switch on the cameras in the same area of the detected fire to collect real images of the fire at any moment. Hartung et al. [5] used WSN for wood fire detection in hybrid mode with web cameras. The main objective of their studies was to investigate the fire behaviour in forests. They used WSN to gather live data for weather status and web cameras to provide the real images of the fire. Son [6] proposes a project for fire detection in South Korea using Camera surveillance with WSN in hybrid. They propose a clustered topology for the whole network. Each cluster a head node to do some calculations, for example, fire risk level by measuring temperature, humidity, and some other relevant parameters. Additionally, there are routing, and data aggregation tasks included within their algorithm. In this method power consumption rate increases in each head nodes, besides they do not count the power balancing issue, which may result in some sensors deactivating before others, leading to coverage gaps. Hafeeda et al. [7] presents a very smart system. They place their network action on fire weather index (FWI). This index covers the probability of fire ignition and fire spread rate as well. FWI provides the moisture content in relation with the weather observation where the fuel code explains the soil content of forest ground.

Let us concise a definition for fire forest [8]: Combustion is a complex process in which fuel is heated, ignites, and oxidizes rapidly, giving off heat in the process. Fire is a special case of combustion—self-perpetuating combustion characterized by the emission of heat and accompanied by flame and/or smoke. With fire, the supply of combustible fuel is controlled by heat given off during combustion (Scott 2012) [8].

2. Research aim

Evolving research interest is to find out the fast and low cost solution to build a network through distributed wireless sensors randomly spread in the forest and to create an automatic, self-organized and robust network between the sensors to cover larger areas.

The function of this sensor network would be to detect fire in the coverage area at regular intervals of short span of time (10-15 minutes) and to send a warning signal to a main server for further transmission to emergency services in the instant a fire is detected. When the fire is recognized, all of the sensors in the area of vicinity will become active and commence the mandatory start and routine tasks immediately. As the sensors are built up with small wireless range transmitters the data will be transmitted from one sensor to another until and unless the

signal reaches the sink. After receiving the data sink will start processing a routine and check whether the fire certainly represents danger through a measurement of the fire spreading rate. If the result of processing is positive and real danger exists, then the sink determines the position of the fire. Then the sink will send an alarm signal to the fire department to inform the exact location of the fire, the temperature, fire spreading speed indicating the fire behavior. Based on the information received, the fire department will then be able to assess the extent and gravity of the situation to arrive at an optimal decision to take proper action as soon as possible. In case of real danger, subsequent preventative action can be initiated to mitigate the situation through appropriate measure before the fire turns uncontrollable. The main aim for this research can simply represented by the following picture:

Figure 2: Research goal

A fire consists of different sections burning in different environments, such as wind direction, wind velocity, slope, moisture contents, wind speed, etc. This heterogeneity of fire environment might contain a very complex shape, even if each part of the fire spreads in elliptical shape [8].

Different sections of the fire are as follows [8]:

- A finger is a long, narrow extension of the main body of fire.
- A pocket is an unburned indentation of the fire perimeter surrounded by three sides by the fire.
- An island is an unburned area within a fire which is totally surrounded by burned area
- A spot fire is a fire ignited in outer region of the main fire by a firebrand.

3. Fire detection and decision making

The increasing demand of sensors to indicate and monitor the fire behavior has enriched the application of new technologies in the fire field. Sensors are able to sense certain dynamic and static variables such as humidity, the type of fuel, slope of the land, the direction and the speed of the wind, smoke, etc. They allow us to determine the direction and possible evolution of the flame front.

One of the popular wireless technologies is ZigBee which is a new industrial standard based on IEEE 802.15.4 radio specification and works in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz. This technology mainly emphasizes low cost battery powered application and small solar panels and is suited for low data rates and small range communications. Zigbee protocol has the ability to support mesh networking in which nodes are interconnected with other nodes so that multiple pathways connect each node. Connections between nodes are dynamically modified, updated and optimized through smart, built-in mesh routing table. Wireless Sensor Networks have gone through rapid developments in many applications. This type of technology has the potential

to be applied almost everywhere; hence the research interest in sensor networks is becoming higher and higher every year.

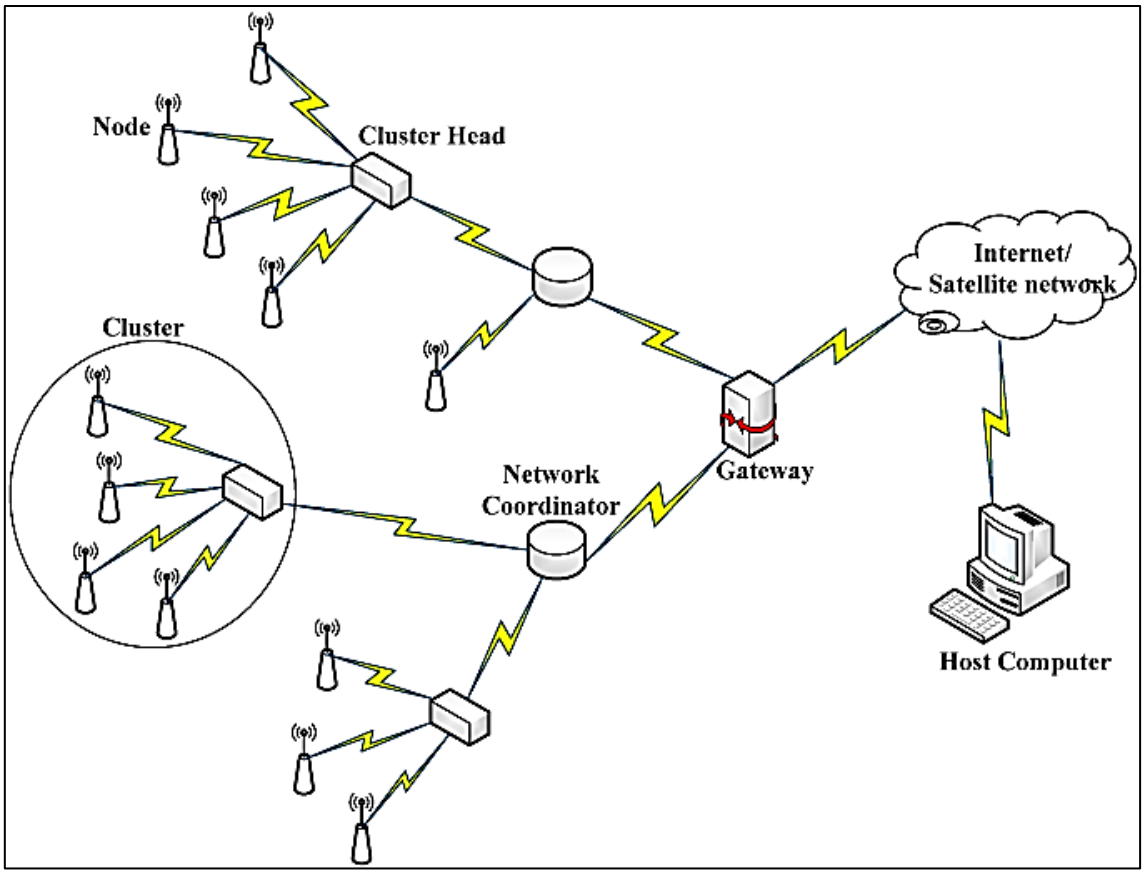

Figure 3. Sensor network for fire detection

The previous work was fully dependent upon images or databases such as Weather index, Fuel Index models, gas boards and intelligent sensors to make the decision. In this paperwork, all nodes belong to known location, and nodes only use temperature sensors, and they are programmed based on a certain threshold temperature, above it the node will send an alarm signal to the sink.

This concept solely depends on the node behaviour to alert of crises possibility using simple node components. This provides detection and information on whether this is a harmless fire, or the beginning of wild fire. The key in this method is to make decisions by tracking the fire propagation and check the logic behind it rather than using complicated databases or imaging technologies.

The most convenient solution is to monitor forests by using a GUI to represent the events and alerting signals on the monitoring screen using some logical evaluation to reach a decision as following figure 4. Once one of the nodes detect the fire all nodes in range of ±45 degrees wake up and start working as a router and a sensor, if they can do any sensing at that stage, every minute to track the fire spreading.

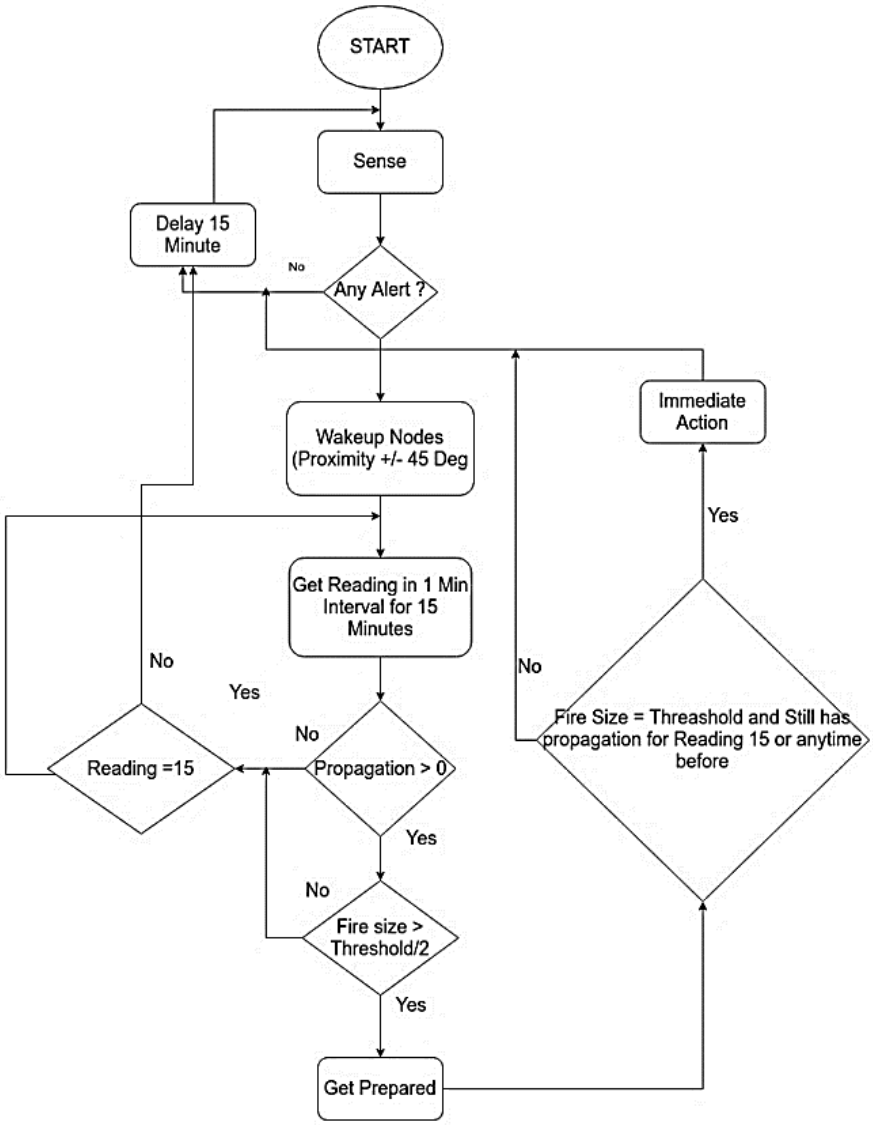

Figure 4. Fire detection method flowchart

4. Conclusion

A prototype of an advanced Forest Fire Detection system has been proposed to overcome the demerits of the Existing technologies of Forest Fire Detection. It can be ensured that the system can be implemented on a large scale due to its promising results. The system can also be improved to upgrade with low-power elements and solar power for effective application.

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Solar Photovoltaic Paint for Future: A Technical Review

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Abstract. An extraordinary methodology is needed to satisfy the need of financially suitable solar cell technology. By utilizing ongoing advances in semiconductor nanocrystal research, we have now invented a one-coat solar paint for planning quantum dot solar cell. The conversion behavior of this semiconductor film electrode was assessed in a photo electrochemical cell comprising of graphene–Cu2S counter electrode and sulfide/polysulfide redox couple. The efficiency of Power conversion exceeding 1% has been observed for solar cells developed utilizing the straightforward traditional paint brush approach under ambient conditions. Though further upgrades are important to develop procedures for huge region, all solid-state devices, this primary effort to make solar paint offers the benefits of simple design and financially suitable for next generation solar cells. The solar paint has shown the extensive possibility because of its flexibility, tunable size characteristics, and economically profitable nature in manufacturing. However, there is as yet a requirement for the improvement in the power transformation efficiencies of these paints, which elaborates further research to make the optimum materials for the paint. The point of this study is to discover the materials for the paint, which would have high electrical, thermal conductivities and higher efficiencies.

Keywords. Solar; Photovoltaic; Fill factor; Quantum dot

1. Introduction

This is the thought behind photovoltaic paint, a revolutionary new application for solar cells that is not difficult to apply, can be introduced anyplace, and is financially profitable. Sounds like something in the far off future, isn't that so? Not exactly. Various universities and researchers have been dealing with solar paint throughout the most recent 5 years, one in any event, going the extent that publicly supporting for business creation. Conventional solar cells use wafers made of light-sensitive silicon, a plentiful component tracked down all around the earth.[1] Unfortunately, refining of pure silicon from raw material is costly, laborious, and uses and creates various hazardous substances.

Eventually, however, this cycle is awesome, because silicon solar panel are genuinely efficient. The normal solar panel can change over about 18% of all the sunlight into usable electricity.[2]Right now, solar paint isn't pretty much as efficient as silicon-based solar cell and this is the single significant obstacle analysts should conquer before sun based paint is financially practical. Solar paint is generally stuck in the single digits – somewhere in the range of 3% and 11% depending upon its technology. When scientists figure out the economic way how to increase efficiency however, Solar paints going to popular with respect to silicon-based solar panels. Solar paint is needed to lower price

and require specialized instruments and no hazardous chemicals,so there are too much barriers to entry for potential solar paint manufacturers. In 2014, researchers at the University of Toronto explored with a solar paint known as colloidal quantum dots. These dots are made of semiconductor and are utilized in solar cells just as LEDs and PCs. While others have recently utilized these light sensitive dots for solar, the university tracked down another approach to apply the dots that is quicker and less expensive than the customary mechanical production system framework. The dots are basically sprayed, layer by layer (the thickness of each molecule in turn), onto a backing. When dry, this backing can be transported, and applied to any surface actually like wallpaper.[3] As of 2014, the solar cells were just about 8% efficiency, not awful thinking about how from the get-go in the advancement interaction it is, however many concur that solar paint should arrive at 10% efficiency before it's monetarily feasible. 10% isn't close to as efficient as solar cell, but since solar paint is a lot less expensive to create even at this lower effectiveness level it's actually cost-effective [4].Dr. Torben Daeneke, from RMIT University in Melbourne, Australia, discovered that the compound in with titanium oxide particles prompts a solar paint that produces hydrogen fuel from sunlight and moist air. In 2016, researchers at John Hopkins University are exploring with colloidal quantum dots, exploring different layers in a different manner to make the things more efficient [5].As of 2013, the University of Buffalo in New York is likewise chipping away at solar powered natural photovoltaics, a plastic-like substance dependent on chains of hydrocarbon atoms. The solar cells can be suspended in a paint-like substance and splashed. The following Figure 1depicts the schematic diagram of thin film photovoltaic paint.

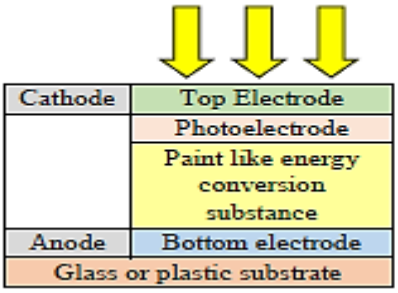

Figure 1. Schematic Diagram of Thin Film Photovoltaic Paint.

Likewise with the dots, the primary advantage of organic PV it is very lower cost to produce. In any case, though efficiency is lower than silicon-based PV module and below the 10% threshold.

2. Principle of Operation

The basic principle of photovoltaic paint with a thin film architecture can be defined as when sunbeam strikes the light absorbing substances (photo electrode), electrons of photo electrode gains energy and the drifted electron with high-energy into a layer of paint like substance, leaving behind an electron vacancy. Then the electrode collected the electron and power is produced using the energy from the electron. This drift of electron completes the circuit by combining with an electron vacancy as illustrated in Figure 1. The solar paint additionally can join the sensitizer and large band gap semiconductor in a single layer.

The power conversion of solar cells depends on the principle of photovoltaic impact. Photons of energies more than the band gap energy (Eg) are absorbed and accordingly, an electron energizes from the valence band to conduction band. Solar cells have inherent asymmetry which makes the electrons reach towards outside circuit utilizing an electrical potential. For getting better efficiency, we need stability on Open circuit voltage (Voc), Short circuit current density (Isc) and fill factor (FF). These parameters are directly related to improvement of efficiency.

$$PCE = I_{sc}V_{oc}FF / P_{in}$$

Where, V_{OC} : Open circuit voltage,

I_{SC}: Short circuit (photo) current,

FF: Fill factor (It is a ratio of actual maximum obtainable power to the product of the open circuit voltage and short circuit current.

$$P_{\max} = I_{\max}V_{\max}$$

and is defined as the product of I_{SC} and V_{OC} and is also a measure of the squareness of I vs V profile). Efficiently extraction of electrons and holes is the most important key parameter for highly efficient solar cells. Solar cell performance is determined by the measurement of current density as the voltage across the photovoltaic device is biased with the variable load during the insulation of device. Figure 2 depicts the plotting of energy versus temperature.

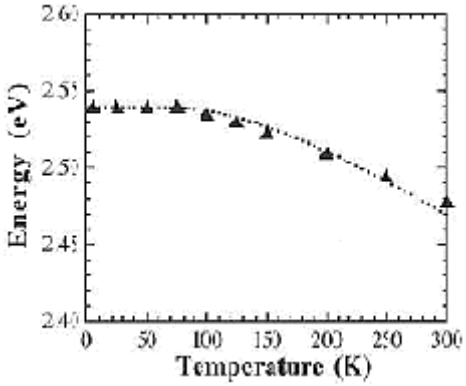

Figure 2. Plotting of Energy vs Temperature.

As the energy of photon is inversely proportional to the wavelength 1240/λ[nm]); Therefore, the value of short circuit current (ISC) depends on the value of band gap energy Eg . If the value of E is greater than the value of Eg and the solar spectrum is over the visible and infra-red regions, then generally the ISC factor increases with the increasing λ . Even though power conversion efficiency (PCE) increases with ISC, there is also an existence of optimum value of Eg for attaining significant PCE because of the trade-off associated with VOC. The band gap energy (Eg) required achieving optimum power conversion efficiency ranges from 1.0 to 1.6 eV for the crystalline silicon solar cell. However, photovoltaic paint requires band gap energy (Eg) ranging from 0.6 to 1.1 eV to achieve optimum power conversion efficiency through utilizing multiple excitation generation. With the increase of thickness of the film there is an exponential decrease in the absorption of light intensity. Therefore, thickness of the photoactive layer is a important parameter dominating the PCE for a solar cell as

compared to the absorption length (1/α), where "α" is the absorption coefficient in cm-1 and it is the distance over which 63% of the non-reflected light is absorbed. Mono crystalline or Poly crystaline solar cells have relatively low values of α, which results in the need of thicker photoactive layers of hundreds of millimetres and micrometers and this significantly causes an increase in the production cost of crystalline solar cells. Alternately, photovoltaic paints need thinner photoactive layers, which in turns bring about the decrease of material cost and production cost. The following Figure 3(a) and 3(b) are representing the plot of current density versus voltage of a solar cell and the plot of photon flux density and maximum attainable short-circuit current density.

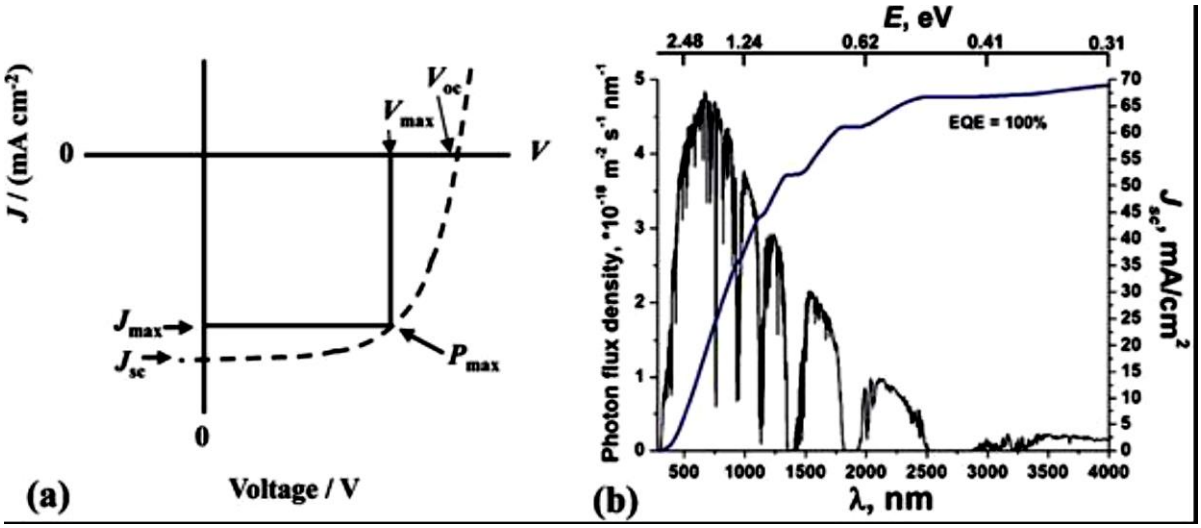

Figure 3(a). Current density vs voltage of a solar cell. **(b)**Photon flux density and maximum attainable short-circuit current density.

3. Results and Discussion

Table 1. Best Research Cell Efficiencies of Different Generation Solar Cell

Generation	Solar Cell	Efficiency (%)	Reference
First	Crystalline Silicon	26.7±0.5	[14]
First	Multi Crystalline Silicon	22.3±0.4	[15]
Second	Amorphous Silicon	14.0±0.4	[16]
Second	Micro Crystalline Silicon	11.9±0.3	[17]
Second	CIGS (cell)	23.3±1.2	[18]
Second	CdTe (thin film)	22.1±0.5	[19]
Third	Dye sensitized (cell)	11.9±0.4	[20]
Third	Organic (thin film)	11.2±0.3	[21]
Third	Perovskite (thin film)	22.7±0.8	[22]
Third	Quantum dot sensitized	9.56±0.12	[23]

The level of efficiency of the third-generation solar cells is lagging to achieve comparable with other generations (Table 1). Therefore, the materials which will be used for photovoltaic paint is a critical factor towards the enhancement of efficiency. Each material has its own attractive features. However, the selection of each material associates with the availability of raw materials and adequate manufacturing process. Most of the second and third generation materials are use to making photovoltaic paint.

Among the various models of materials, Tandem Solar cell consolidated with Quantum dot solar cell (QDSSC) has band-gap with tuning facility, which differs by changing their size. Then again, the decision of material makes the band gap fixed in mass materials (CIGS or CdTe). Additionally, QDSSC has higher absorption coefficient, tuneable band gap, capacity to create multiple electron-hole pair just after striking with one photon, huge size confinement, and higher doping abilities and have unique method without the necessity of high temperature and vacuum. These properties give QDSSC edge over dye-sensitized solar cell and make it a potential candidate for the efficiency enhancement of thin film photovoltaic paint.

A combination of quantum dot with perovskite likewise upgrades the charge carrier extraction in collecting layer of Quantum dot solar powered cell. Solar cell additionally give the adaptability of conveying high accuse transporters of the capacity to permit electrons to travel all the more longer distance absent a lot of loss of energy. A gathering of Organic solar cell likewise offers a lot less expensive and less complex photovoltaic with an impulse of activity solidness in high temperature climate. What's more, a material comprised of Copper zinc tin sulphide (CZTS) likewise satisfies the material prerequisite for arrangement of process able photovoltaic paints yet it utilizes Selenium, being a moderately uncommon component, which is not used properly. In any case, it can possibly give another leap forward in the productivity of slim film paints by conquering the restriction. The materials for photovoltaic paint could be QDSSC and perovskite, which offers special properties in comparison with different materials, and are appropriate to be researched to build the technology of increase of efficiency of solar paints.

Table 2. Material Requirement for the thin film photovoltaic paint

Material Requirement	Materials satisfying the requirement
Abundant material	CZTS, Perovskite.
Low-toxic material	CZTS, Quantum dot, Dye sensitized.
High temperature material	CIGS, CdTe, Quantum dot, Dye sensitized, Perovskite.
Solution processable	Organics, Perovskite, CIGS, CdTe, Quantum dots, Dye sensitized, CZTS
Suitable bandgap	CdTe, CIGS, CZTS, Dye sensitized, Perovskite.
Bulk heterojunction	Organics
Low-Cost synthesis	CdTe, CIGS, Perovskite, CZTS, Quantum dot, Dye sensitized.
Roll to roll	Organics, Perovskite, Dye sensitized, CIGS, CdTe, Quantum dot.
Mechanical Stability	Perovskite, Organic.

Thin film gives an approach to synthesize solution based photovoltaic paints. This innovation has been received because of its qualities highlights for example utilization of least material with promising efficiency. The point of thin film incorporation in solar oriented innovation is to satisfy the light weight, minimal expense and mass region processing.

Another significant parameter is drying rate of ink (preferably having more limited drying steps). Then again, substrates of high uniformity and favourable surface properties are additionally required. Every arrangement processable technique has its own appealing highlights. A few techniques give high efficiency of power conversion lack of manufacturability. Other gives bulk volume production but low in power conversion efficiencies. Various benefits of solar paint are recorded underneath.

- Photovoltaic paint is pollution free and makes no ozone depleting substances be radiated after utilized. The organic cells are coated from water onto recyclable plastic sheets, for example, PET and along these are totally harmless to the ecosystem. Non-conventional clean power is available each day of the year.
- Organic solar cells will use the same standard inverter technology used by conventional solar cells to connect the electricity grid network. Also have ability to live grid free if all power generated provides enough for the home / building
- Can be painted virtually anywhere; so chances of generating power are too high.
- Efficiency will be high with improving of technology, so the same material that is available today will become more efficient tomorrow
- Aesthetics are further developing making the solar paint more adaptable contrasted with more established and so forth.
- It can be printed at high speeds across enormous regions utilizing roll-to-roll processing strategies thus creating the tantalizing vision of coating every roof and other suitable building surface with photovoltaic materials at a very low cost.
- These solar paints will initially be put onto plastic sheets that can be replaced on the roof of a house. In the longer term, it may be possible to directly paint a roof or surface of the building.
- It consists of a newly developed compound that works as like silica gel, which is used in sachets to absorb moisture and keep food, medicines and electronics fresh and dry.

4. Conclusion

Thin film has given an approach to change over the idea of solar paint technology into the real world. In this paper, a brief study report on different advantages and disadvantages with respect to efficiency is discussed. The choice of material and deposition technique plays a important role in the development of efficient photovoltaic paint. Quantum dots and Pervoskite based thin film solar paints can provide a way to improve the efficiency. The new advancement of water-based NPOPV (nano particulate natural photovoltaic) coatings addresses a change in perspective in the improvement of minimal expense OPV (organic photovoltaic) devices. The future viewpoint for these materials is

incredibly promising, with device efficiencies having increased from 0.004% to 4% in less than five years Similarly, spin coating deposition technique seems to be more suitable for future studies for increasing performance efficiency.

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Solar Powered Water Quality Monitoring System Using Zig-bee

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Abstract. This work presents a solar power-based water quality monitoring wireless sensor network (WSN) technology, to screen water quality over various destinations as an ongoing application, an astounding framework engineering comprised by disseminated sensor nodes and a base station is proposed. The model and base station are associated utilizing WSN innovation like ZigBee. Modeling and implementation of a proposed model using one node powered by solar cell and WSN technology is the challenging work. Data collection by different sensing element at the node side like pH, turbidity conductivity, saltiness and temperature is sent by means of WSN to the base station. Information gathered from the distant site can be shown in visual organization too as it very well may be examined utilizing diverse reproduction apparatuses at base station. This original framework has benefits like no fossil fuel byproduct, low power utilization, more adaptable to send data at far off site, etc.

Keywords.WSN; conductivity sensor; salinity pH sensor; Turbidity; Zig-Bee, water quality monitoring; solar power;

1. Introduction

Water is a limited asset and it is fundamental for endurance on earth including horticulture, industry and creatures. Checking of water quality is important to control the physical, synthetic and organic attributes of water. It gives data about the ebb and flow strength of the water body, regardless of whether the water body meets the predefined use and how it has changed over the long run.

The data gathered can be utilized to pass on that the water body needs improvement to meet its expressed use and to lead activities to secure and reestablish the strength of the water body. For instance, drinking water ought not to contain any synthetic substance that is hurtful to wellbeing; the measure of sodium in water for horticultural water system ought to be decreased; some inorganic synthetics should contain less water for modern use [1]. Likewise, water quality checking can assist with identifying water contamination, release harmful synthetic compounds, and water tainting. Temperature, pH and turbidity are average gathered boundaries in water way, lake water quality observing frameworks.

Photovoltaic's (PV) is a technique for producing electrical power by changing over daylight into direct flow power utilizing semiconducting materials that show the photovoltaic impact. The photovoltaic (PV) impact is the electrical potential created between two divergent materials when their normal intersection is energized with radiation of photons. The PV cell, along these lines, changes over light straightforwardly into power. A French physicist, Becquerel, found the PV impact in 1839. It was restricted to the research center until 1954, when Bell Laboratories created the principal silicon cell. It

before long discovered application in U.S. space programs for its high force creating limit per unit weight. From that point forward, it has been widely used to change over light into power for satellites. Having developed in space applications, PV innovation is presently spreading into earthly applications going from fueling distant destinations to taking care of utility networks around the world [2]. A photovoltaic system utilizes sun-based boards made out of various photon cells to supply usable solar power. Power from solar PV has for quite some time been viewed as a clean maintainable energy innovation which draws upon the planet's generally abundant and broadly circulated sustainable power source – the sun. Making a preventive move for quality upkeepment. We got a thought that a framework ought to be carried out. Screen water quality in a simple manner so it very well may be done without any problem. Examine some significant and significant elements of water [3]. Different natural parameters like temperature, Water can cause pH, oxygen thickness, turbidity, etc. gathered by these systems utilizing different sensors.

WSN innovation furnishes us with a way to deal with constant information Acquisition, Transmission and Processing. Overall Users can get ongoing water quality information distantly, however the framework has a few nodes and a base station where every node has a bunch of sensors and nodes are dispersed in different water bodies. By those sensors Date gathered in water is shipped off base station by means of WSN Channel. Essentially a PC with realistic UI (GUI) is utilized as the base station for the user [4-5]. To break down, water quality information and when water quality is distinguished, underneath the foreordained level, the alert is naturally raised. Utilizing the Various instruments can record the information for future correspondence and works.

2. System Architecture of Photovoltaic Cell

PV cells consists of semiconductor materials, like silicon. For sun-oriented cells, a slim semiconductor wafer is uncommonly treated to shape an electric field, positive on one side and negative on the other. At the point when light energy strikes the sun-based cell, electrons are thumped free from the molecules in the semiconductor material. In the event that electrical conveyors are connected to the positive and negative sides, framing an electrical circuit, the electrons can be caught as an electric flow - that is, power. This electricity can then be used to different utensils. A PV cell can either be round about or square in development.

2.1. Photovoltaic Module

Because of the low voltage created in a PV cell (around 0.5V), a few PV cells are associated in series (for high voltage) and in equal (for high current) to shape a PV module for wanted yield. Separate diodes might be expected to stay away from invert flows, if there should be an occurrence of incomplete or absolute concealing, and around evening time. The p-n intersections of mono-translucent silicon cells might have satisfactory converse current attributes and these are excessive. Switch flows squander control and can likewise prompt overheating of concealed cells. Sunlight based cells become less proficient at higher temperatures and installers attempt to give great ventilation behind sun powered boards. Creating power from sun oriented PV has for quite some time been viewed as a clean practical energy innovation that draws in the world's generally abundant and broadly circulated sustainable power source - the Sun. The immediate change of electric daylight happens during activity with no moving parts or natural discharges.

2.2. Photovoltaic Array

The power that one module can deliver isn't adequate to meet the prerequisites of home or business. Most PV exhibits utilize an inverter to change over the DC power into converting AC current that can control the machines, loads, lights and so forth. The modules in a PV exhibit are typically first associated in series to get the ideal voltages; the individual modules are then associated in corresponding to permit the framework to create more current.

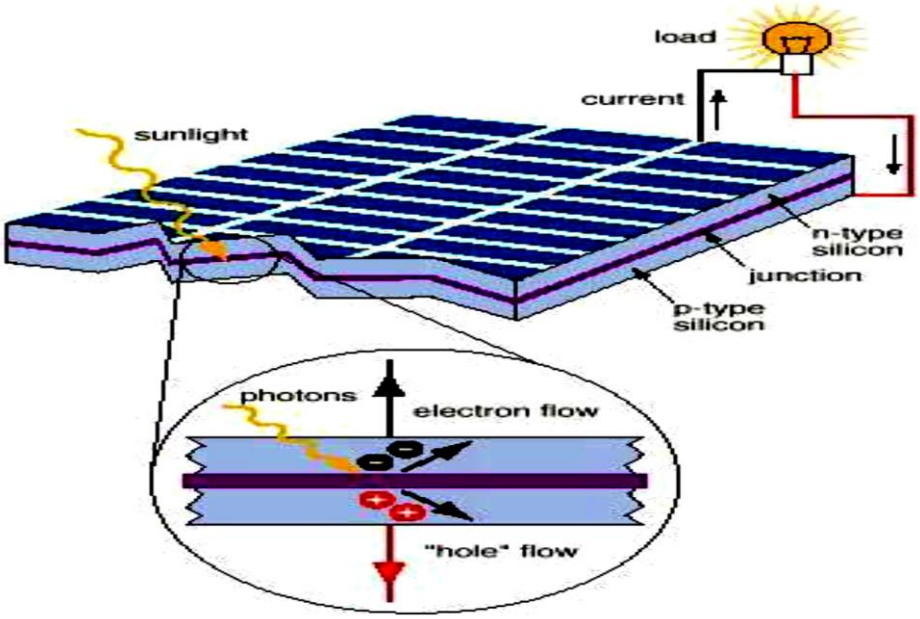

Figure 1. Basic Structure of PV cell.

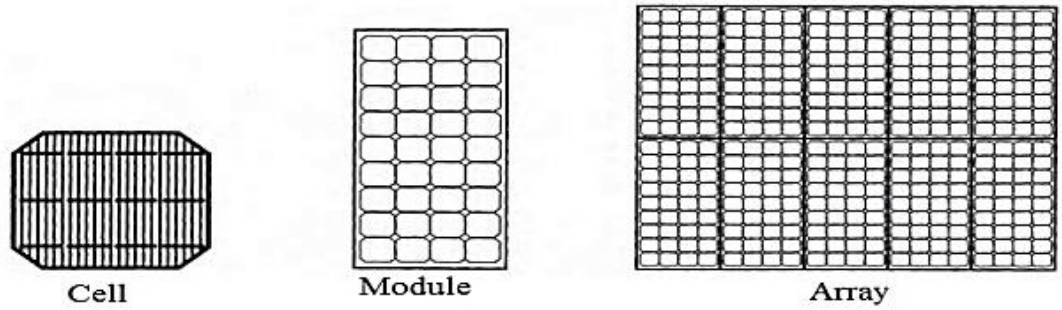

Figure 2. Several PV cell makes a module and several modules make an array.

2.3.Zigbee

ZigBee is an IEEE 802.15.4-based particular for a set-up of significant level correspondence conventions used to make individual region networks with little, low-power advanced radios, for example, for home automation and other low-power low-transfer speed needs, intended for limited scope projects which need remote association. Thus, ZigBee is a low-power, low information rate, and nearness (i.e., individual region) remote specially appointed organization. The innovation characterized by the ZigBee detail is planned to be less difficult and more affordable than other remote individual region organizations (WPANs, for example, Bluetooth or more broad remote systems administration like Wi-Fi. Applications incorporate remote light switches, home energy screens, traffic the board frameworks, and other shopper and mechanical hardware that requires short-range low-rate remote information move.

Its low force utilization limits transmission distances to 10–100 meters view, contingent upon power yield and ecological qualities. ZigBee is commonly utilized in low information rate applications that require long battery life and secure systems administration (ZigBee networks are gotten by 128 bit

symmetric encryption keys.) ZigBee has a characterized pace of 250 kbit/s, most appropriate for irregular information transmissions from a sensor or info gadget.

Figure 3. Zig-bee module.

Water is a fundamental asset of daily routine for each experiencing organic entity on the earth. Water quality, oxygen level check assumes a significant part in water. Human medical problems, Plants and living beings on earth rely upon water quality. Downpour, pools of streams is its fundamental sources water. Water streaming over the ground has numerous valuable just as destructive fixings, dissolvable or may insoluble. Salt and particles in soil decide corrosiveness water. An insoluble molecule gets blended in Water utility for unique application, where straightforwardness is the customary proportion of water quality.

To measure oxygen level, causticity, and aggravation of drinking water just as water that might happen. The primary intention is to use for farming and mechanical cycle. Water decreases the utility of water particularly for application. The primary target is to quantify pH, saltiness, conductivity, Temperature and turbidity of drinking water just as water utilized for horticultural and modern cycles.. Parameters to be analyzed and control oxygen levels to further develop water properties, PH and turbidity. Thought execution targets are as per the following:

- Measurement of pH, oxygen level and turbidity Water utilizing sensor at far off area.
- To take advantage of local power supply to sensor nodes using solar power.
- To gather information from different sensor hubs and send it to base station by remote channel.
- To control information correspondence among source and sink hub. (Synchronization utilizing time division)
- To simulate and analyzed quality principles for quality control. (Graphical and mathematical records utilizing VB and MATLAB) To distribute related records on the web for additional evaluation of public data and water assets.

The detailed block diagram of water quality monitoring system is shown in block diagram Figure 4.

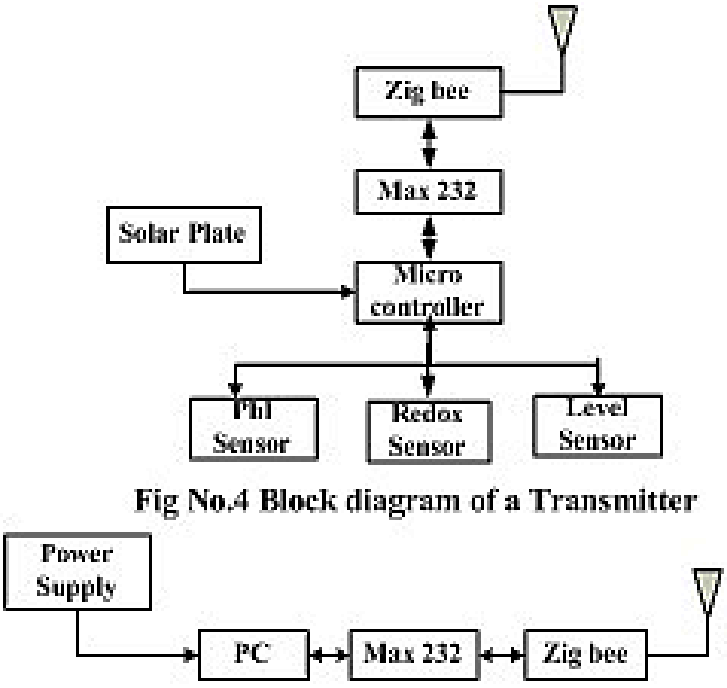

Fig No.4 Block diagram of a Transmitter

Figure 4. Block diagram of a receiver.

3. Software Design

Programming configuration approach for water observing framework depends on three sections, first is ARM programming, GUI design plan in VB and MATLAB recreation of results acquired from base module. Point by point flowchart for the working of entire framework just as programming configuration is displayed in figure6.This framework we utilized MATLAB graphical portrayal for estimating the different degrees of water quality like Ph, turbidity, oxygen level. our proposed flowchart portrayal is clarified as follows Figure 5.

4. Application and Future Scope

The objective of this undertaking is to plan and deal with a remote sensor Network (WSN) that helps screen water quality with the assistance of data by water inundated sensors, to portray water assets inside a standard Can be saved for To have the option to make essential moves to reestablish the health of homegrown use and debased water body. A powerful transmission with a WSN802.15.4 viable handset highlighting Zigbee-based innovation is picked as a result of its effortlessness of organization, minimal expense, low force utilization, dependability, and high scalability. This framework checks nature of water at where for the most part it is badly designed to step through continuous examinations physically.

The running water over specific land gets blended in with salt and different materials which change the pH worth and turbidity. It is not difficult to observed and control the water contamination by this cycle. The higher turbidity and imbalanced of pH in water supply utilized for drinking, farming and industry use is a major issue. At such spot the quality control should be possible by checking and important activity for quality improvement.

To screen nature of water in different destinations, future works can be centered around building up a framework with more sensor nodes and more base stations. Nodes and base stations are associated as WSN; the distinctive base stations are associated through Ethernet. The Ethernet can likewise be associated with web so the client can only login to the framework and get continuous water quality information distant. The remote information obtaining from distant spots and data set stockpiling is the supporting construction of the framework which can be utilized for additional exploration contemplates like soil content examination utilizing various test systems.

The simulation can be utilized for water contamination control in changing conditions and it can be utilized to figure strange minutes in ocean stomach by estimating the turbidity at the beach.

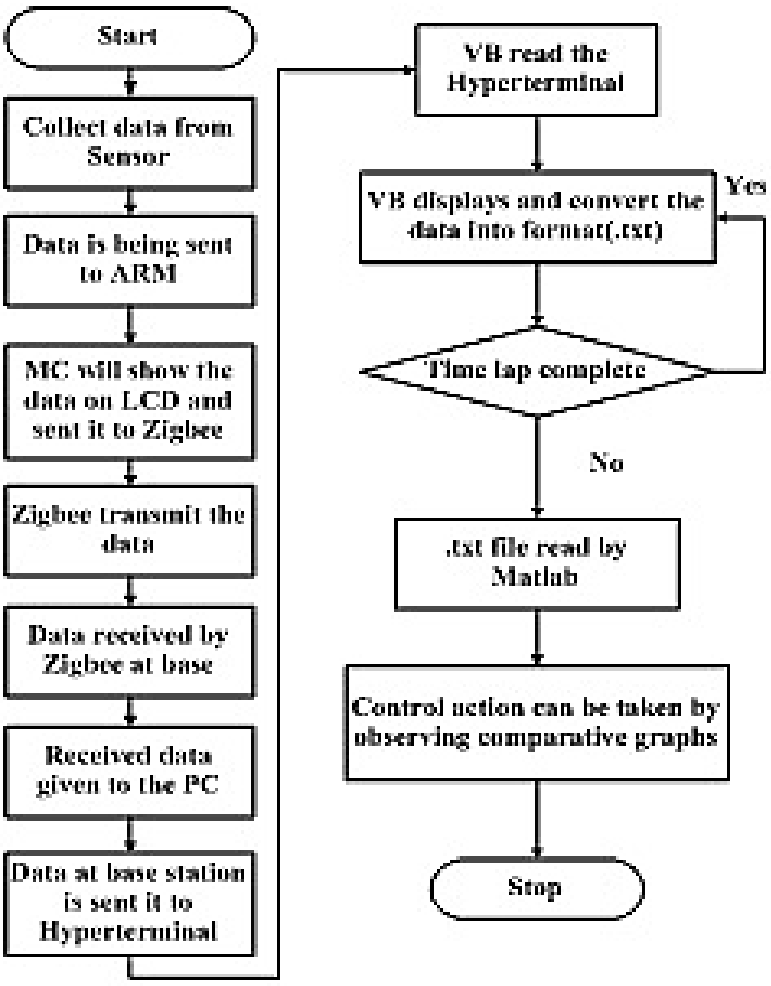

Figure 5. Flow chart for general water flow of water quality monitoring system.

5. Conclusion

Overall, the proposed model of a solar-powered water quality monitoring system using Zig-bee based WSN for water quality monitoring systems that provide minimal power consumption with high quality is presented. Performance modeling in different environments is an important aspect to be studied in

the future as different types of monitoring applications require different configuration during system installation. This framework gives exhaustive assessment of water climate as well as can rapidly find earnest water contamination mishaps or catastrophic events, moving the strange water quality data to observing focus by quicker correspondence communication and gives graphical references to the corresponding office to understand the situation of the disaster to build up the counteraction and fix strategy.

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Mechanical Engineering

Influence of Thermal Boundary conditions on Natural Convection Heat Transfer in a Wavy Walled Square Cavity with Adiabatic Block

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Abstract. The aim of the present study is to analyze heat transfer characteristics for natural convection flows in a square enclosure with wavy right wall filled with air(Pr=0.71) having uniform heating on bottom wall and adjacent cold walls with a adiabatic square block inside. This geometry and the following results can be used for analysis in heat management of building architecture, solar collection devices, having walls with surface roughness. The design/methodology/approach of these numerical solutions is the finite element analysis by a commercial software COMSOL Multiphysics version 5.6. The choice of consideration of sinusoidal heating gives a better analysis of heat transfer analysis in this square geometry with wavy wall and with adiabatic block inside has not been investigated by numerical or experimental basis before and therefore, it is this motivation that results in this numerical investigation.

Keywords. Natural convection; Finite element method; Nusselt number; Heat transfer

1. Introduction

Natural convection powered by buoyancy inside a closed cavity is a topic of interest and has been investigated numerically and computationally considering different designs of cavities and enclosed conduits like rhombic [1-4], quadrantal [5-9] recto-trapezoidal [10] and square enclosure [11] and complex enclosures [12-13] considering different boundary situations, enclosure fluid systems and other influencing parameters. While considering the heat transfer inside a closed conduit with a solid insulated rectangular or cylindrical object has several utilities and application in building and architecture construction powered by natural cooling. In such design structure there is a presence of stagnant core of the fluid which doesn't play a lead role while dealing with the convection heat transfer astride the vertical side wall of the cavities[14]. Merrikh and Mohamad [15] in their research article dealt with natural convection in a differentially heated enclosure considering the presence of solid bodies and put forward their conclusions stating that heat transfer might be augmented in presence of a solid body which has a lesser thermal conductivity than that of the fluid participating in heat transfer process and presentin the enclosure. Das and Reddy [16] carried out a finite volume

numerical analysis of natural convection heat transfer in a square cavity considering a block of square dimension and centered (the ratio of solid block to fluid thermal conductivities being taken to be 0.2 and 5.0) and is positioned at center and is also given sufficient inclination at various angles considering the range of 15° to 90° for $Ra = 10^3$–10^6. Another article by Bhave et al. [17] had also reported a natural convection lateral heating study with several numerical deductions and experimentation regarding choosing an best possible adiabatic block dimensions located interior the square enclosure and reported several estimation regarding augmentation of heat transfer considering those block positioning. Merrikh and Lage[18] reported a study on natural convection heat transfer considering a in a square enclosure considering the B.Cs as follow: Vertical walls are subjected to two different temperatures and the horizontal wall being at insulated conditions and with and without a conductive solid block in the center considering the range of $Ra=10^5$ -10^6. In another research article the same authors [19] investigated for an differentially heated enclosure heated and which had a presence of solid square blocks being equally spaced, and also conducting by utilizing continuum model. There were some more interesting work on natural convection and entropy generation involving double isothermal/ insulated square object by Mahapatra et al.[20] and fixed and disconnected solid blocks by Silvio et al.[21]. In another article Datta et al.[22] carried out a porous enclosure natural convection study involving adiabatic blocks comprising of different sizes for the *Da*-*Ra* range of 1–10,000 and with *D*a in the range of $10^{-2} \leq Da \leq 10^{-6}$.

1.1 Problem Description

From the literature analysis it is seen that there has been no study in a wavy walled enclosure considering a solid body with non-uniform heating. Accordingly, the square enclosure being considered is filled with air inside shown in Fig.1 The bottom wall is the hot-wall with non-uniform heating and all the remaining wall are subjected to cold temperature, and there is a adiabatic block inside the enclosure of size 0.25L where L is the size of the square enclosure Considering the effect of gravity which is acting in the downward direction (Boussinesq approximation), natural convection heat transfer process is studied numerically inside the complicated enclosure.

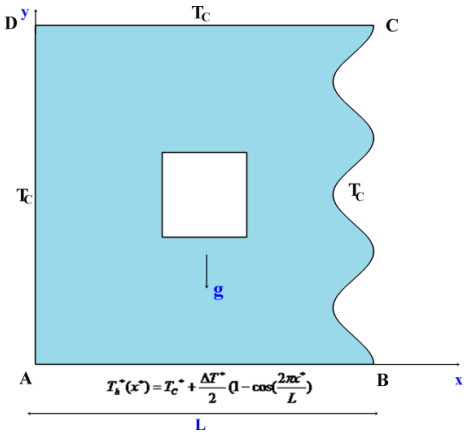

Figure 1. Schematic diagram of the physical model.

1.2 Boundary Conditions

The mathematical equation pertaining to the square enclosureright corrugated wall is:

$$y = \frac{a_n}{L} sin(\phi - \frac{\pi}{2}) sin(\frac{n\pi x}{L}) \quad (1)$$

In the above equation, The dimensionless wave amplitude (a = a_n/L) (dimensionless) is kept fixed at= 0.05For the enclosure of Figure 1, the boundary conditions as discussed earlier and no slip velocity flow condition is imposed on all walls. The incompressible fluid being presentinside this cavity is newtonian and the flow being also considered as in the laminar range and is steady. The cavity is heated non-uniformly from bottom wall AB, while all the other walls are cooled to a constant temperature. We can express the dimensional form of the non-uniform temperature distribution on the bottom heated wall and is adopted from Sarris et al. [23]

$$T_h^*(x^*) = T_C^* + \frac{\Delta T^*}{2}(1 - \cos(\frac{2\pi x^*}{L})) \quad (2)$$

where ΔT^*pertains to the temperature difference between the maximum and minimum temperatures of the heated wall, T_c^*pertains to temperatures confined to the cold wall, and L is the length of the enclosure. The dimensionless form of (Eq. (2)) can be re-written by utilizing scale parameters and is adopted from Dalal and Das and Bhardwaj et al.[12-13]and as follow:

$$\theta_w(x) = \frac{1}{2}(1 - cos(2\pi x), \theta_{For all other walls} = 0 \quad (3)$$

Also, $U = V = 0$ (along AB, BC, CD, DA) (4)

1.3 Governing Equations

We now present the continuity, momentum, and energy equations (Navier stokes 2d) in the laminar thermal flow region of an incompressible newtonian fluid in this section. There were some other important assumptions being made while representing the equations: (i) absence of viscous dissipation, (ii) the cavity wall being considered as impermeable, (iii) the gravity being active only in vertical (negative y)-direction, (iv) fluid properties being in a state of constant and the fluid density variations are neglected except in the buoyancy term (the Boussinesq approximation) and (v) radiation heat exchange being insignificant because of very small temperature difference.

$$\frac{\partial u^{\oplus}}{\partial x} + \frac{\partial v^{\oplus}}{\partial y} = 0 \quad (5)$$

$$u\frac{\partial u^{\otimes}}{\partial x} + v\frac{\partial u^{\otimes}}{\partial y} = -\frac{1}{\rho}\frac{\partial p}{\partial x} + \nu(\frac{\partial^2 u^{\otimes}}{\partial x^2} + \frac{\partial^2 u^{\otimes}}{\partial y^2}) \quad (6)$$

$$u\frac{\partial v^{\otimes}}{\partial x} + v\frac{\partial v^{\otimes}}{\partial y} = -\frac{1}{\rho}\frac{\partial p}{\partial y} + \nu(\frac{\partial^2 v^{\otimes}}{\partial x^2} + \frac{\partial^2 v^{\otimes}}{\partial y^2}) + g\beta(T - T_c) \quad (7)$$

$$u\frac{\partial T^{\otimes}}{\partial x} + v\frac{\partial T^{\otimes}}{\partial y} = \alpha(\frac{\partial^2 T^{\otimes}}{\partial x^2} + \frac{\partial^2 T^{\otimes}}{\partial y^2}) \quad (8)$$

Now we represent the equations in non-dimensional form.

$$\left.\begin{aligned} X = \frac{x}{L}; Y = \frac{y}{L}, U^{\otimes} = \frac{u^{\otimes} L}{\alpha}, V^{\otimes} = \frac{v^{\otimes} L}{\alpha}, \\ \theta^{\otimes} = \frac{T^{\otimes} - T_c}{T_h - T_c}, p = \frac{pL^2}{\rho\alpha^2}, \Pr = \frac{\nu}{\alpha}, \end{aligned}\right\} \quad (9)$$

$$Ra = \frac{g\beta(T_h - T_c)L^3 \Pr}{\nu^2} / = \frac{c_p \rho^2 g\beta T L^3}{\mu k}$$

$$\frac{\partial U^{\otimes}}{\partial X} + \frac{\partial V^{\otimes}}{\partial Y} = 0, \quad (10)$$

$$U\frac{\partial U^{\otimes}}{\partial X} + V\frac{\partial V^{\otimes}}{\partial Y} = -\frac{\partial P}{\partial X} + \Pr\left(\frac{\partial^2 U^{\otimes}}{\partial X^2} + \frac{\partial^2 U^{\otimes}}{\partial Y^2}\right) \quad (11)$$

$$U\frac{\partial V^{\otimes}}{\partial X} + V\frac{\partial V^{\otimes}}{\partial Y} = -\frac{\partial P}{\partial Y} + \Pr\left(\frac{\partial^2 V^{\otimes}}{\partial X^2} + \frac{\partial^2 V^{\otimes}}{\partial Y^2}\right) + Ra * \Pr * \theta \quad (12)$$

$$U\frac{\partial \theta^{\otimes}}{\partial X} + V\frac{\partial \theta^{\otimes}}{\partial Y} = \frac{\partial^2 \theta^{\otimes}}{\partial X^2} + \frac{\partial^2 \theta^{\otimes}}{\partial Y^2} \quad (13)$$

1.4 Nusselt Number

The heat transfer coefficient can be expressed in terms of local Nusselt number (Nu) and as follow:

$Nu = -\frac{\partial \theta}{\partial n}$ where n denotes the normal direction on a plane. $Nu_b = -\frac{\partial \theta}{\partial Y}$ (14)

The average Nusselt number on the different walls are given by the expression:

$$\overline{Nu_b} = \frac{\int_0^1 Nu_b dX}{X_0^1} = \int_0^1 Nu_b \, dX \, , \overline{Nu_l} = \int_0^1 Nu_l dS_1 \quad \overline{Nu_r} = \int_0^1 Nu_r dS_2 \quad (15)$$

2. Numerical Solution Methodology and Model Validation

The governing transport equations after converting into non –dimensional form (Eqs.10-13) and (Eqs2-3) as are solved bycommercial software COMSOL (finite element) Multiphysics. The galerkin weighted method is utilized for transforming the governing equations into a system of integral equation and can be look into for detailed description in Zienkiewicz et al.[24]. The convergence criterion is controlled in a manner that $\left|\phi^{n+1} - \phi^n\right| / \phi^n \le 10^{-6}$, where ϕ_t represents any transport variable. The results obtained from the present numerical scheme have been validated against the results of Bhave et al.[12] for a square cavity filled with a air (Pr=0.71) for the isotherms and streamlines when the left wall is uniformly heated and the right vertical wall is cold. Another validation of present Nu results with conducting block was carried out by comparing the published results of average N_u of House [1] and Merrick and Lage [18].It is found that results are very similar.

Table 1 : Comparison of Average Nu considering (block) thermal conductivity and Φ (solidity).

Ra	Φ	K	Present	House [1]	Merrick and Lage[18]
10^6	0.5	0.2	4.569	4.624	4.605
10^6	0.5	5.0	4.386	4.324	4.28
10^7	0.9	0.2	2.387	2.402	2.352

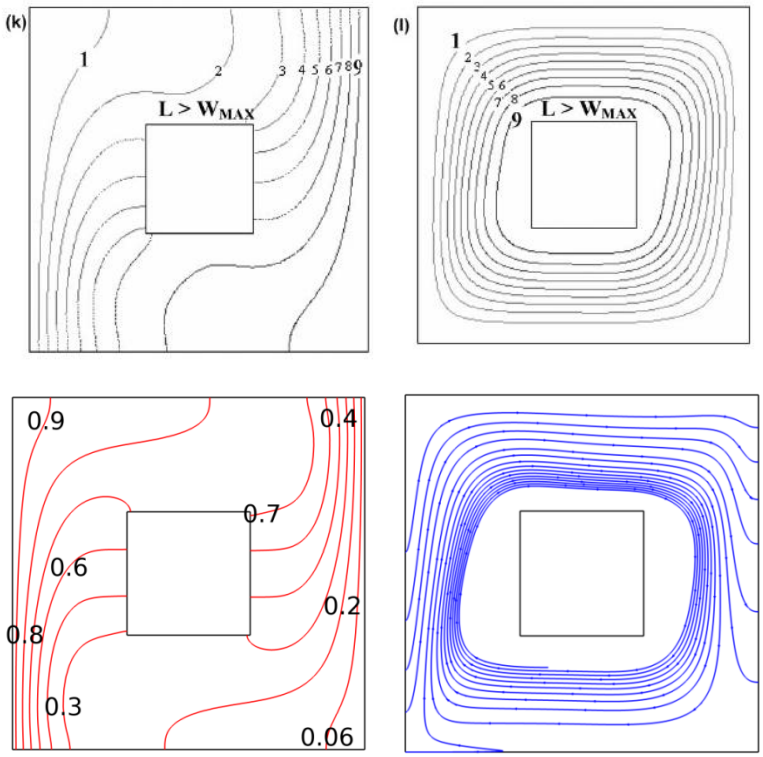

Figure 2: Validation results of Streamline isotherm comparison from (a) Published literature[17] (b) Present results.

Table 2: Comparison of ($\overline{Nu}$) on the bottom wall for different grid systems with [uniform heating of bottom wall] for same BC , square Enclosure.

Ra	No of elements			Relative Error % (max-min)/max
	5314	11300	28010	
10^3	1.4248	1.4273	1.4288	0.105
10^4	1.4999	1.5023	1.5039	0.106
10^5	2.9634	2.9601	2.9611	0.034
10^6	5.7295	5.7591	5.9245	2.79

A grid independence test has also been carried out to establish that the results are independent of the grid used for numerical simulation. The values of averaged Nusselt number ($\overline{Nu}$)on the uniformly

heated bottom wall for different grid systems are presented in Table 1. It has been proposed to use 11300 elements for numerical simulation, because of the fact that when the number of elements increase from 11300 to 28010, the maximum relative error recorded is 2.79%.

3. Results and Discussions

3.1Analysis of Streamlines and Isotherm

We now present the heat transfer and fluid flow characteristics in the following square geometry considering non-uniformly heated bottom wall. The flow distributions are presented via isotherms and streamlines. The Prandtl number of fluid is chosen to be 0.71. By, examining Figure 3 left and right panel plot which shows streamlines and isotherms obtained numerically for $Ra = 10^3$-10^6 we observe that streamlines (right panel plot) are forming straight lines emanating from the non-uniform bottom wall with very weak streamline strength of ψ_{max} =0.181. Increasing the value of Rayleigh number increase the streamline strength to ψ_{max}=1.93 and the cumulative nature of streamline is similar toRa=10^3. With further increase of streamline strength to Ra=10^5 and Ra=10^6 changes the complete orientation of streamline. A single cell of elliptical shape is seen to rotate along the insulated block and the value of positive streamline ψ_{max} =11.54 is observed. The negative value of streamline strength moving in clockwise direction has a strength of ψ_{min} =-23.52 For further increase of Rayleigh number to Ra=10^6 the primary roll breaks up into several secondary rolls and due to presence of strong thermal boundary layer the maximum and minimum value of stream line contour are observed to 100 (counter clockwise orientation) and 67 for clockwise orientation (as per sign convection). So, the magnitude of stream line contour shows the highest value in case of R_a=10^6. The left panel plots of Figure 3 show isotherms and they demonstrate several twisting and has a tendency of shifting towards the left cold wall and this tendency is more at higher R_a=10^5 and 10^6due to increase of natural convection effects with increase of Rayleigh number. At lower values of Ra=10^3 and 10^4 the isotherm patterns demonstrate conduction like effect with no twisting of isotherm and they only partially fill up of the enclosure.

3.2 Local Nusselt Number:

Local Nusselt numbers for left, top and right cold wall and bottom heated wall for different sets of Ra for presented for the case of non-uniform heating case. It's clear from these figures, that local Nusselt number for bottom wall.Figure 4(a) depict an increasing decreasing trend all along the length of enclosure, for all values of Ra number and its maximum value is around 12 (for dimensionless distance X=0.3) for R_a=10^6. Local N_u for the left, right and the top wall (Figure 4 c, d and b) are all negative values reiterating the factthat heat is transferred from the fluid to the wall in all these cases. The right wall has a very interesting local Nu profile as because of the imposed temperature profile in the right wall. The minimum value of Nu_r=7 forRa=10^6 (at X=0.95)for right vertical cold wall.

3.3Average Nusselt number

Average Nusselt number has been depicted in Table 2 and 3. Table 2 shows the values of for ($\overline{Nu}$)bottom wall, top wall left wall, right wall for different values of Rayleigh number with block whereas Table 3 depicts the ($\overline{Nu}$)for bottom wall for different values of Rayleigh number without block. It is observed that surprisingly the $\overline{Nu}$ for bottom wall without block is not distinctly different for the case with block. The values progressively increase with increase of R_a and all values of top wall left wall and right wall are negative and heat is transferred from the fluid to the wall in all these cases.

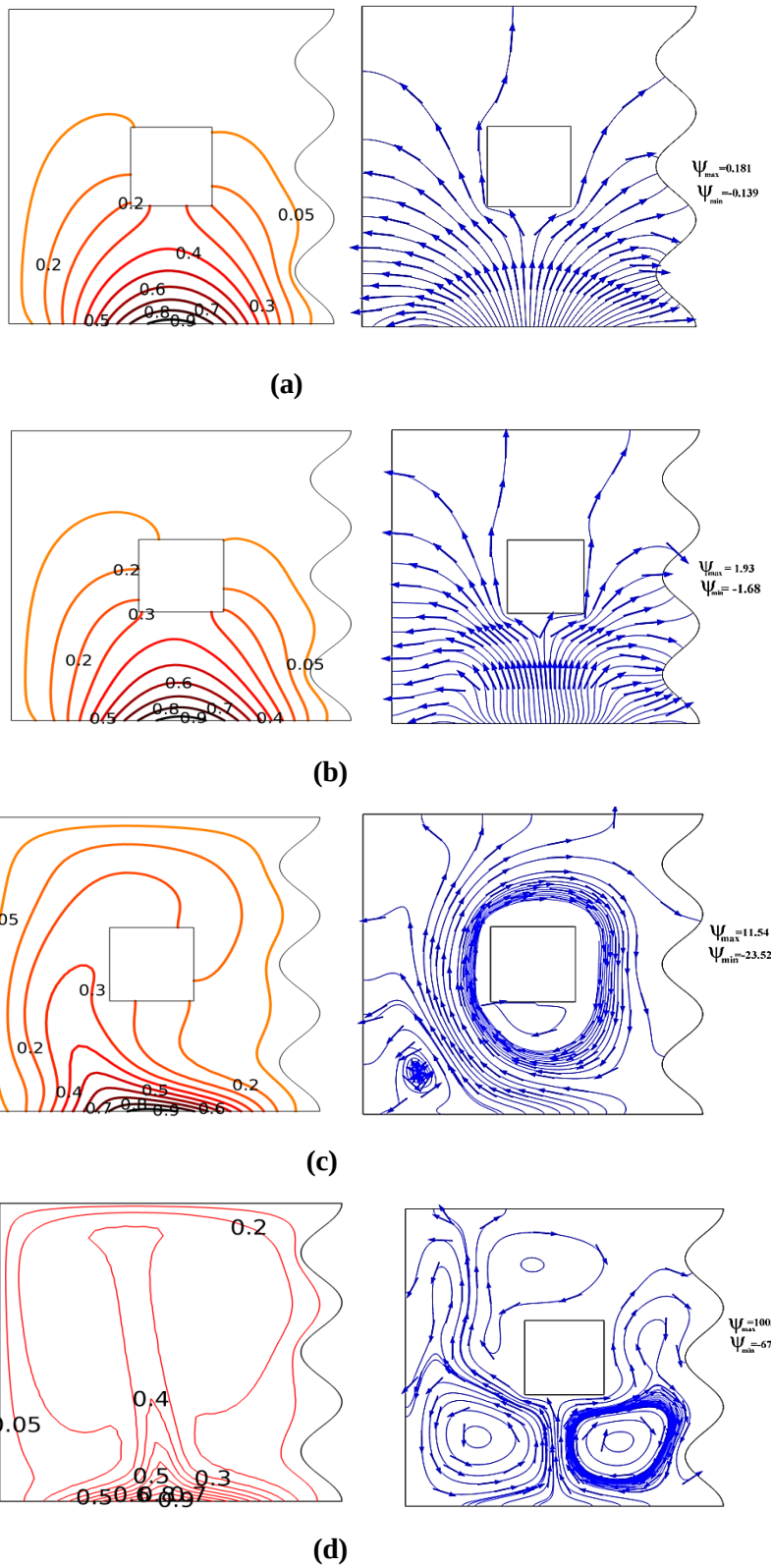

Figure 3: Isotherms (left); Streamlines (right) (a) Ra=10^3 (b) Ra=10^4 (c) Ra=10^5 and (d) Ra=10^6.

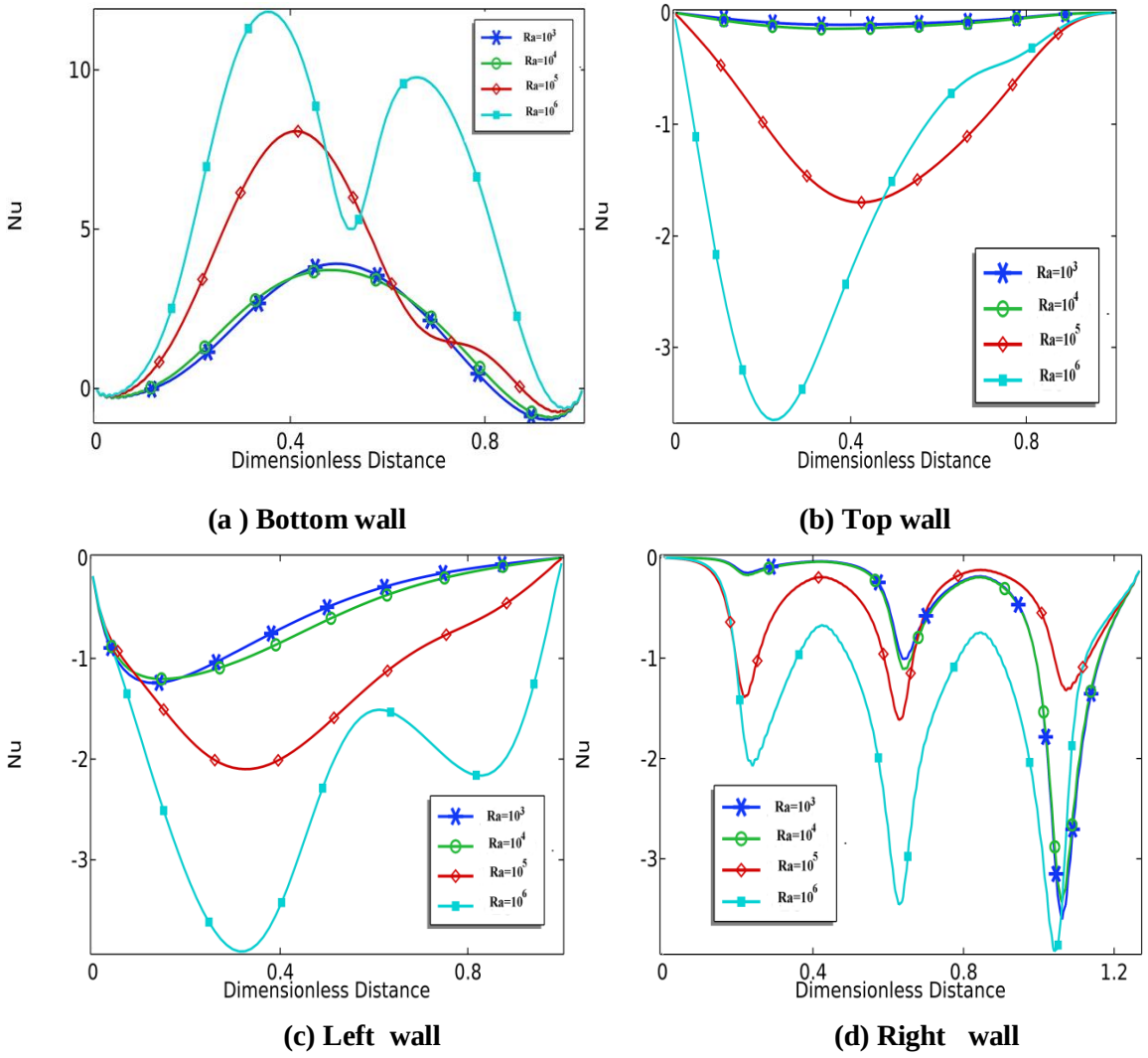

Figure 4: Local Nusselt numbers for different wall positions.

Table 2: ($\overline{Nu}$) for bottom wall, top wall left wall, right wall for different range of *Ra* with block.

Ra	$\overline{Nu_b}$	$\overline{Nu_r}$	$\overline{Nu_l}$	$\overline{Nu_T}$
10^3	1.4273	0.65728	-0.55458	-0.065806
10^4	1.5023	-0.65946	-0.60720	-0.084555
10^5	2.9601	-0.66092	-1.2247	-0.91692
10^6	5.7591	-1.6358	-2.2124	-1.4997

Table 3: ($\overline{Nu}$)for bottom wall considering different range of *Ra* without block.

Ra	$\overline{Nu_b}$
10^3	1.4964
10^4	1.6636
10^5	3.3767
10^6	5.7332

4. Conclusions

The study of buoyancy assisted heat transfer in a square enclosure filled with air has been studied numerically in a square cavity with adiabatic block. The effect of Rayleigh number on the heat transfer is examined. The results of the numerical analysis lead to the following conclusions:

1) The nature of isotherms has a pattern of shifting towards the left cold wall and this tendency is more at higher Ra=10^5 and 10^6due to increase of natural convection effects with increase of Rayleigh number.

2) The maximum value of magnitude of ψ is 100(+ve, anti-clockwise orientation) for non-uniform heating for Ra=10^6, and especially at higher $Ra \geq 10^5$ heat transfer occurs due to convection. At lower values of *Ra* heat transfer is primarily manifested in weak circulation strength and it this is due to effect of conduction at Ra=10^3.

3) Local Nusselt number shows an increase decrease trend and maximum value of local Nu is around 12 for Ra=10^6.

Acknowledgements

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Conflicts of Interest

The author indicates that there is no conflict of interest.

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The Jansen Walking Robot

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Abstract. The main purpose of this project is to make a versatile robot that can run-over any solid surfaces no matter the condition of surface. We are archiving this benefit by using Theo Jansen Mechanism. This is popular among legged robotics researchers due to its scalable design, energy efficiency, and low payload to machine load ratio, bio-inspired locomotion, and deterministic foot trajectory among others. It is an eight-legged robot which can walk in wet and dry soil, sand, any type of slope (up to 45^{o}) and also climb stairs. It is using simple mechanism to overcome obstacles, which height is below the maximum height of the leg path by our Theo robot. This mechanism is able to carry loads without any high forces applied to it. By including IOT to our project, we can achieve even more.

Keywords. The Jansen walking Robot; Walking Mechanism; Jansen Mechanism; Stair Climb

1. Introduction

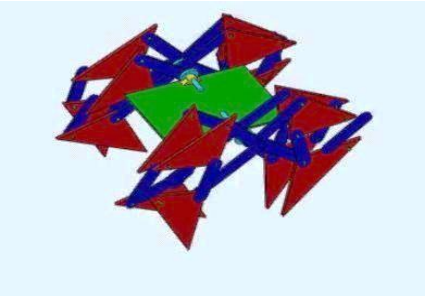

Figure 1. TheoJansen assembly in Solidworks version 2014

Theo Jansen mechanism as shown in Figure 1, is designed by Theodorus Gerardus Jozef. Because of its scalable architecture, energy efficiency, bio-inspired locomotion, low payload to machine load ratio, and deterministic foot trajectory, this is popular among legged robotics researchers. In this work, we present Theo Jansen's mechanism design in a novel approach. It is an 8 legged robot which can walk in wet soil, dry soil, sand any type of slope (up to 45 degree). It is using simple mechanism to make a path and the obstacle which height is below the maximum height of the path is overcome by our Theo robot. It has 8 legs for maintaining the CG. This gives the smoothest motion and is able to carry loads without any high forces requirement. Scientist Theo Jansen made this mechanism as an

Engineering Art piece and we are converting this art piece into real world working robot with Motor Power and Torque Calculation. Our robot's structure is made out of Acrylic sheet. Our designs have a lot of applications such as–Walk on any uneven surfaces easily and smoothly, climb stairs, remotely controllable. Our goal is to develop this mechanism into a proper robot which can carry weights, Replace wheels to move smoother and reliable, climb stairs ,military uses, rescue operations, autonomous robot for fire extinguisher, space missions etc.

2. Review of Literature

2.1.History

Theodorus Gerardus Jozef is a Dutch artist who was born on March 14, 1948. He began making gigantic PVC systems that can move on their own in 1990, and they are collectively known as Strand beest [7].

2.2.The Strandbeest

It is depicted in Figure 2. Since 1990, Jansen has been making strand beesten,that are moving kinetic structures that mimic walking creatures and are occasionally pushed by wind. Jansen refers to them as" artificial life"[7].

Figure 2.A strandbeest, exhibited by Jansen on the Linz city square during Ars Electronica, 2005[6]

3. Mechanism

Theo Jansen, a kinetic artist, created Jansen's linkage, a planar leg mechanism that generates as smooth walking motion. Jansen's mechanism has been employed in a number of kinetic sculptures known as Strandbeesten. Jansen's linkage is notable both for its artistic and mechanical merits in simulating organic walking motion with a single rotational input. Mobile robots and gait analysis both benefit from these leg processes [4].

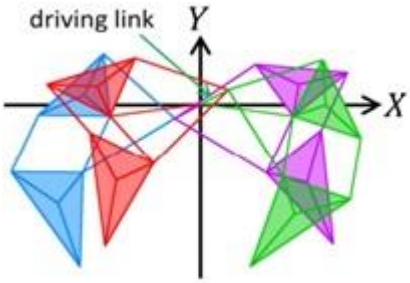

Figure 3. Schematic Figure of a four legged Jansen linkage mechanism.

The central 'crank' link is moved in circles by a rotary actuator, such as an electric motor. Because of the motion given by the crank, all other links and pin joints are punctured and move. The mechanism has just one degree of freedom since its locations and orientations are governed solely by the crank angle(1-DoF).Using the circle intersection method and bondgraphs (Newton–Euler mechanics),the kinematics and dynamics of the Jansen mechanism have been thoroughly characterized. These models may be used to calculate actuator torque and to build the system's hardware and controller [3]. Figure 3 shows the schematic figure of a four legged Jansen linkage mechanism.

4. Methodology

Any point of normal wheel makes a cycloid shaped curve (as shown in the Figure 4) but in the case of theo Jansen mechanism it use a special curve. The curve is called locus.

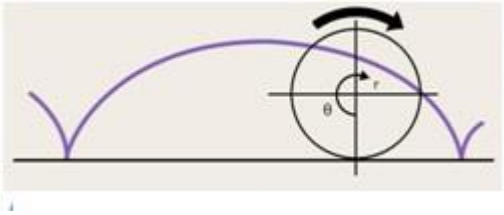

Figure 4. Cycloidal motion.

Locus has four parts i.e. drive, lift, return and lower. The foot is ideally in contact with the ground throughout the support phase. During the lift process the foot will move toward its maximum height in the locus. The foot achieves its greatest height off the ground and goes in the same direction as the walker's body, through out the return phase. Finally, at the lowest position, reduce its height until it touches the ground. While a wheel travels, each point on the circle has the same velocity, and when the wheel moves, each point encounters some resistance, resulting in energy loss [5].

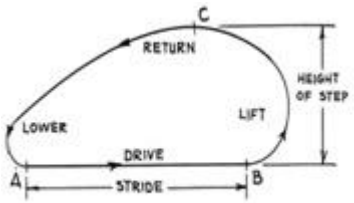

Figure 5. Graphical output of our leg mechanism[1].

But in case of the Jansen Local maxima and minima may be completely avoided by simply stepping over them. This results in less loss of energy during locomotion and allows the vehicle to maintain a constant velocity and height over variable surface. Figure 5 depicts the graphical output of leg mechanism, whereas Figure 6 depicts small prototype.

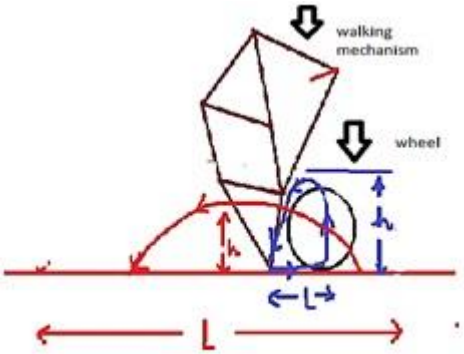

Figure 6. Small Prototype.

4.1. Theo Jansen figure

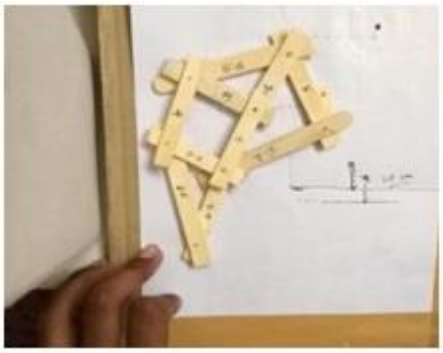

Figure 7. TheoJansen curved during walking.

This is the prototype of a single leg of the robot in Solid works. There will be 7 more legs to be made for our project as shown in Figure 7. We will then add two motors with this all legs and will add a controlling device such as micro controller (i.e. Arduino or Raspberry pi)with wireless module to run. Figure 8 depicts solid works drawing for a single leg. Figure 9.1 and 9.2 are representing the solid

works assembly of the robot.

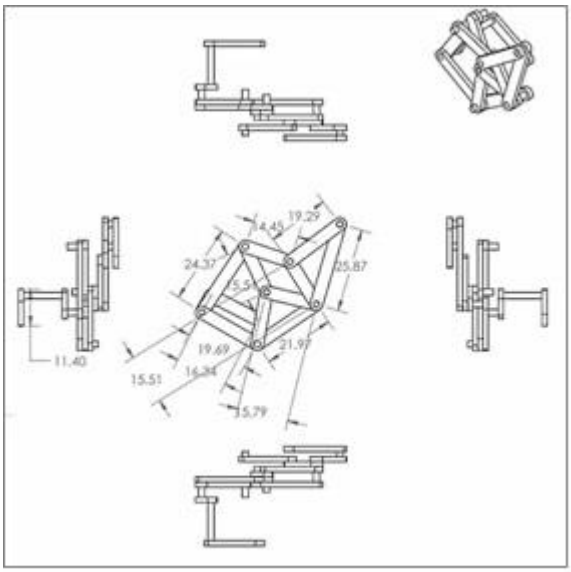

Figure 8. Solidworks Drawing for a single leg.

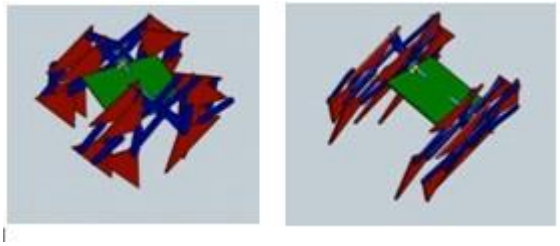

Figure 9.1 and Figure 9.2 Solid works assembly of the robot.

5. Results calculations and Discussions

We are using two motors in both sides to control 4+4=8 legs. Each motor is operating 4legs respectively. The different calculations follow.

5.1. Linear Torque and Power Calculation for Area of Segments

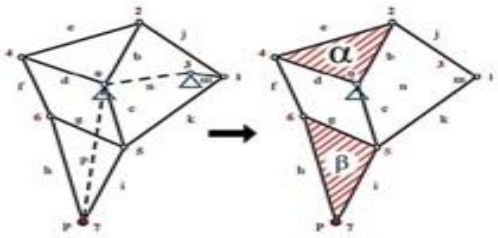

Figure 10. TheoJansen single leg analysis [1].

We can find from our solidworks design:

$$\alpha + \beta + j + k + f + c$$

$$= 0.1661 + 0.1831 + 0.06 + 0.072 + 0.0493 + 0.0394$$

$$= \mathbf{0.5699 m^2}$$

We know that the density of our acrylic sheet is $= 1051.1\ kg/cm^3$

Mass of segments:

$$\left(4 \times 0.5699 \times \frac{5}{1000}\right) \times 1051.1 = \mathbf{11.98 kg}$$

5.2. Mass of Cranks

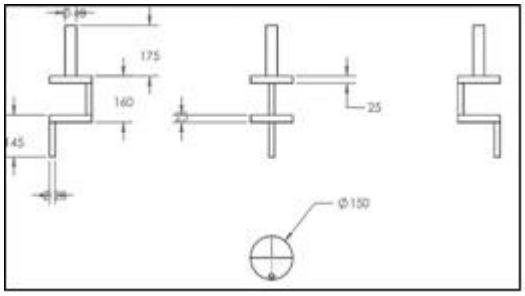

Figure 11. TheoJansen rotating crank.

Volume

$$\left[2 \times \left\{\pi \times \left(\frac{150}{1000}\right)^2 \times \frac{5}{1000} \times\right\} + \left\{\pi \times \left(\frac{20}{1000}\right)^2 \times \frac{140}{1000}\right\} + \left\{\pi \times \left(\frac{10}{1000}\right) \times \left(\frac{150+140}{1000}\right)\right\}\right]$$

$$= 9.73 \times 10^{-4}$$

$$\text{Mass} = 9.73 \times 10^{-4} \times 1051.1 = 1.02 kg$$

Total Mass (m) $= 11.98 + 1.02 = 13 kg$ (for 4 legs in one side)

Force calculation

$$F = ma$$

$$or, F = 13 \times 0.\frac{1m}{s^2}$$

$$or, F = 1.3N$$

The value of **acceleration and the angle** is taken from "KINEMATIC ANALYSIS AND SIMULATION OF THEO JANSEN MECHANISM by Mehrdad Mohsenizadeh, Jenny Zhou Department of Mechanical Engineering Lamar University Beaumont, Texas, USA"

Torque

$$\tau = F \times r \times cos\theta$$

$$= 1.3 \times \frac{150}{1000} \times cos180°$$

$= 0.116\ N - m$ [As we are just taking the magnitude of this value, not the directional value]

Power

Assuming the rpm of the motor, N = 50

$$P = \frac{2\pi N\tau}{60}$$
$$= \frac{2\pi \times 50 \times 0.116}{60}$$
$$= 0.60773kw$$
$$or, 607.71\ watt$$

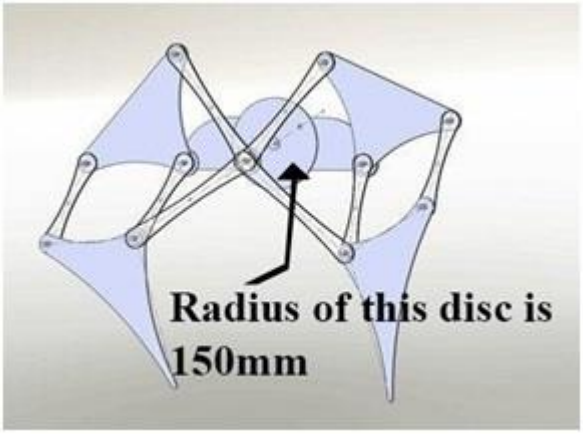

Figure 12. TheoJansen rotating disc diameter.

Total mass (M) = 13kg

Mass of the Disc:

Volume $= \pi \times 0.150^2 \times 2.5 \times 10^{-3}$
$= 0.1767 \times 10^{-3}\ m$
Mass $= 1051.1 \times 0.1767 \times 10^{-3} = 0.1857$

Total mass of one side $= 2 \times 0.1857 = 0.3715\ kg$

Moment of inertia

$$I = \frac{1}{2}mr^2\ [where\ r = 0.075m]$$
$$= \frac{1}{2} \times (13 + 0.3715) \times 0.150^2$$
$$= 0.1504\ \text{kg-m}^2$$

We know that Angular Torque

$$\tau = I\alpha$$

Now, $\alpha = \frac{\omega}{t}$

$$= \frac{\pi N}{t \times 30} = \frac{\pi \times 50}{3.15x30} = 1.6622$$

The value of "t" is taken from "KINEMATIC ANALYSIS AND SIMULATION OF THEO JANSEN MECHANISM by Mehrdad Mohsenizadeh, Jenny Zhou Department of Mechanical Engineering Lamar University Beaumont, Texas, USA"

Angular torque

$\tau = 0.1504 \times 1.6622 = 0.2499\ N-m$

Power required by the motor

$$P = \frac{2\pi N\tau}{60}$$

$$= \frac{2\pi \times 50 \times 0.2499}{60}$$

$= 1.309\ kw$

or, $1309\ watt$

6. Conclusion

Scientist Theo Jansen made this mechanism as an Engineering art piece and we are converting this art piece into real world working robot. This mechanism has a lot of applications such as it can run over any obstacles smoothly(i.e. sand or rocky surfaces)

The major things which we can archive:

- ✓ We can carry heavy weights very easily [8].
- ✓ Over come the limitations of wheels.
- ✓ Climbing stairs for various rescue missions.
- ✓ Military uses.
- ✓ Adding Advance robotics and IOTand many more.

The minor things which we can archive:

- ✓ Developing our project can lead to open a new field of Mechatronics R&D and applications.
- ✓ By adding advance technologies like Machine Learning (M.L.) and Artificial Intelligence (A.I.) these robots can handle complex tasks very quickly and these robots can be analyzed and find the most optimum solution of any chaotic scenario. Etc.

This mechanism has a lot of applications in the field and by further developing this mechanism we can archive more opportunities and innovativeness in the Engineering world.

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Multipurpose Wheelchair

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Abstract. Multipurpose Wheelchair is mechanically controlled devices designed to have self-mobility with the help of the user command. This reduces the user's human effort and force to drive the wheels for wheelchair and make it easier. It also provides an opportunity for visually or physically impaired persons to move from one place to another place. The wheelchair is also provided with obstacle detection system which reduces the chances of collision while on the journey and smart wheel chair has gained a lot of interests in the recent times for more benefit. These devices are useful especially in transportation from one place to another. The machines can also be in old age homes where the old age persons have difficulty in their movements. The devices serve as a boon for those who have lost their mobility.

Keywords. Multipurpose; Mechanically; Self-mobility; Wheelchair.

1. Introduction

After conducting an intensive literature review, it was found that wheel chairs with stair climbing capacities can be categorized into two types regularly; the battery powered, and the manual powered. Although there are plenty of powered wheel chairs available in the marketplace, there are limited scholarly reviews published on manual or battery powered wheel chairs. Instead, patent certificates, wheelchair descriptions, and operation manuals are available. Indeed, no peer reviewed literature was found for manual wheel chairs. Some researchers have built models or full-size prototypes of their designs but little documentations have been published on this type of wheel chairs.

2. Introduction

2.1 Statement of Wheelchair

A stair lift is a mechanical device for lifting people up and down stairs. Their cost is to-much to afford it and need more floor space to use regularly[1-2].

Figure 1. Stair Lift.

Electrically powered wheelchair runs with electric power. The redesign of manual powered wheelchair was considered in this project. It can't be affordable for its high price range.

Figure 2. Smart wheelchair price.

2.2. Literature Survey

After conducting an intensive literature review, it was found that wheel chairs with stair climbing capacities can be categorized into two types; the battery powered and the manual powered. Although there are plenty of powered wheel chairs available in the market place, there are limited scholarly reviews published on manual or battery powered wheel chairs. Instead, patent certificates, wheelchair descriptions, and operation manuals are available. Indeed, no peer reviewed literature was found for manual wheel chairs. Some researchers have built scale models or full-size prototypes of their designs but little documentation has been published on this type of wheelchairs.

Figure 3. Smart wheelchair.

2.3. Limitations

The wheelchair has limitations when it comes to overcoming architectural obstacles. Although it is required by the Public Works Department Act of 1995 to create an accessible environment in all public buildings, many in India are built without addressing accessibility for physically challenged and wheelchair users. Many Indian towns have addressed the issue by offering alternatives to architectural

barriers such as ramps at entrance thresholds, lowered kerbs, wheeled chair ramps, and lifts, among other things. Even so, a wheelchair user must overcome a few architectural obstacles.

Several studies have demonstrated that having access to a means of independent mobility, such as power wheelchairs, manual wheelchairs, scooters, and walkers, benefits both children and adults. Independent mobility expands job and educational prospects, lowers dependency on caregivers and family members, and fosters a sense of self-sufficiency. Independent movement is an important part of self-esteem for people and is critical to "ageing in place." For example, if it becomes increasingly difficult for older persons to walk or wheel themselves to the restroom, they may do it less frequently or drink less fluid to lessen urine frequency. If they are unable to walk or wheel themselves to the bathroom and support is not readily available in the home, they may need to relocate to a more enabling setting (e.g., assisted living). With an estimated frequency of 40 per 1,000 people, mobility issues are the major cause of functional impairments in adults [3].

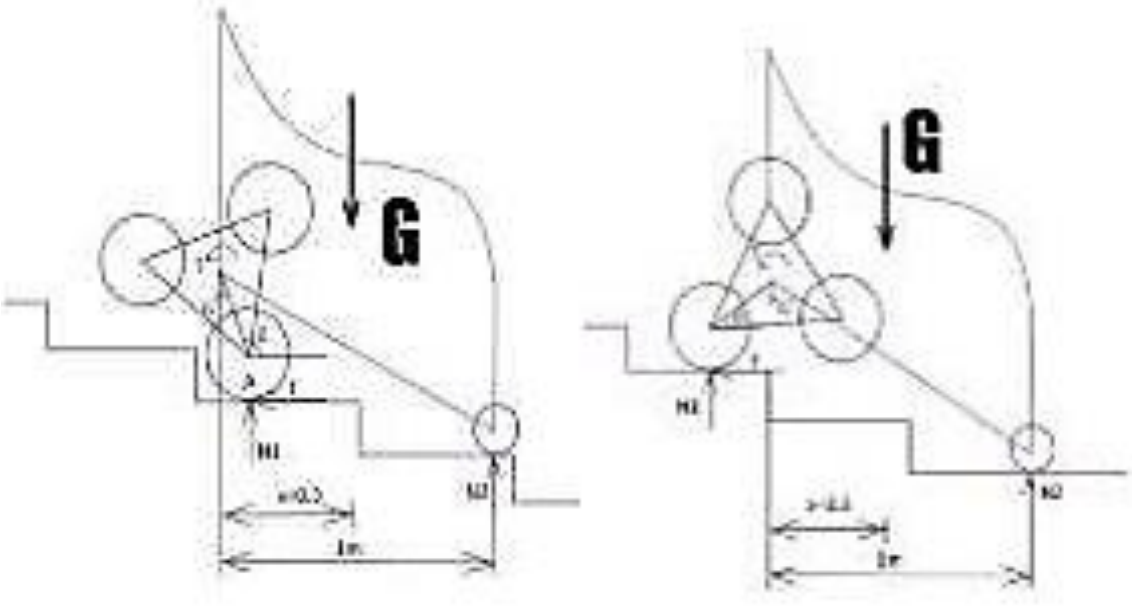

Figure 4. Details of dimension.

3. Methodology and Procedure

After performing a thorough literature analysis, it was discovered that stair-climbing wheelchairs can be divided into two categories: battery-powered and manual-powered. Despite the abundance of powered wheelchairs on the market, scholarly studies of manual or battery-powered wheelchairs are few and far between. Patent certificates, wheelchair descriptions, and operation manuals, on the other hand, are readily available. Indeed, no peer-reviewed literature on manual wheelchairs could be discovered. Although some researchers have produced scale models or full-size prototypes of their inventions, little documentation on this sort of wheelchair has been published.

3.1. Details

Our work aims to construct a stair climbing robot capable of ascending steps with a height at least

equivalent to the outer radius of the legged wheel, as stated in the thesis's objective. Experiments are used to confirm the robot's mobility performance. We put the robot through its paces on a stairwell with a variety of stair heights and widths. These tests were timed, and the results were analyses to determine the robot's performance. The robot is seen climbing a stairwell with a step height of 13cm and a width of 30cm in Figure 1. The robot's front wheel axle is slightly rolled in comparison to the rear wheel axle, as seen in the diagram.

The wheelchair's design is compact, allowing it to navigate practically all stairwells found in institutions, businesses, factories, and even some houses. The design is extremely safe, with no risk of the frame or wheels failing under typical conditions. According to the tests, the stair climbing wheelchair can handle a load of 100 kilograms on a flat area. It can carry a 55-kilogram load up a 35-degree incline set of stairs [4].

3.2 Analysis of the Figures and calculations

We had made this project for helping in medical science and this is a replica, due to funding problem we will upgrade and modify this project as a real size soon and do detail calculations and findings. [5]

Figure 5. Isometric view of the model.

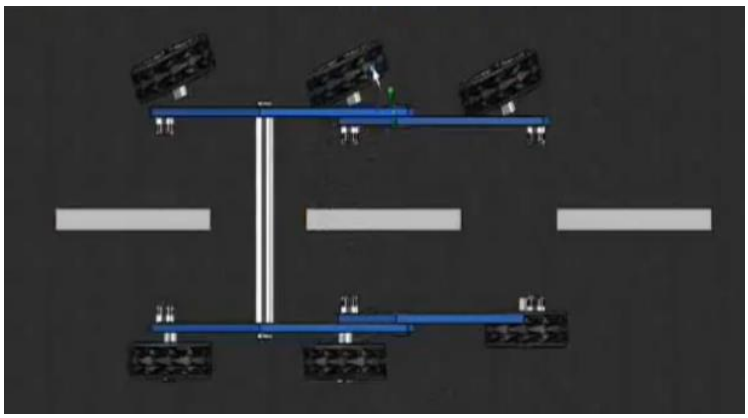

Figure 6. Top View of the model.

Wheel torque free body diagram is as per [6]:

$F_g = \underline{r} \cdot g$ (1)

$T_w = F_g \cdot r_w$ (2)

Equation (1) is the amount of force on the wheel due to the mass of the chassis is m_r. Each wheel will need $7.72N \cdot m$ of torque from (2), where r_w is the radius.

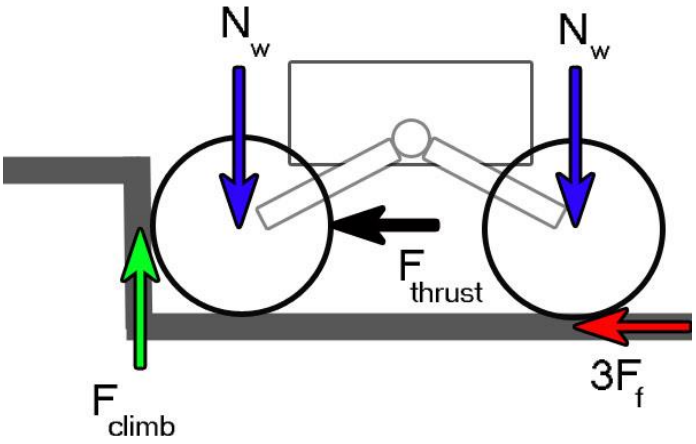

Figure 7. Wheel torque free body diagram.

$$v = \frac{W_r}{F_g \cdot 4}$$

Where W_r is the $30W$'s of power for mobility and F_g is the retarding force on a wheel. Using the speed from the following the total power needed for a day driving can be calculated.

$$W = \frac{W_{in} \cdot 1km}{V_r} (1 + W_{loss})$$

SR-II will need an average speed of 10.2cm/sand the solar panel must product about 89.9*W-hr* per six-hour/day. Equation 2 includes a 10% loss of power due to friction in the drive train itself.

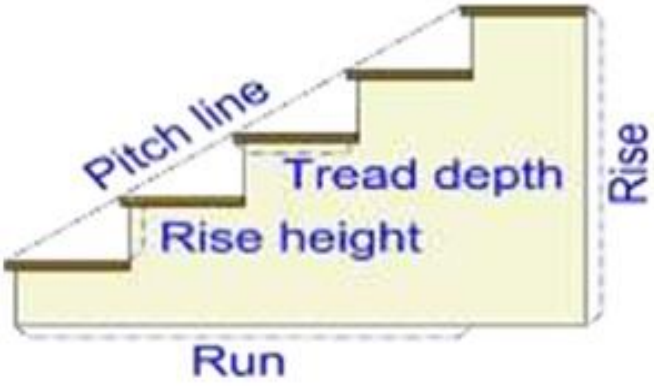

Figure 8. Details of pitchline

Wheel torque calculation based on earths gravity

$m_r := 30kg$

$r_w := 105mm$

$g = 9.807 \frac{m}{s^2}$

$F_g := \frac{m_r \cdot g}{4}$

$T_{wheel} := F_g \cdot r_w$

$T_{wheel} = 7.723\,N \cdot m$

Traversal Power requirements for obstacle traversal

$v_r := 10 \frac{cm}{s}$

$W_o := m_r \cdot g \cdot v_r$

$W_o = 29.42\,W$

Traversal power for 1 km using 30W power cap

$W_{in} := 30W$ $\quad$ $stint := 1km$

$v_{avg} := \frac{W_{in}}{m_r \cdot g}$ $\quad$ $W_{loss} := 10\%$

$v_{avg} = 0.102 \frac{m}{s}$

$t_{day} := \frac{stint}{v_{avg}}$

$t_{day} = 2.724\,hr$

$P_{supply} := W_{in} \cdot t_{day} \cdot (1 + W_{loss})$

$P_{supply} = 89.894\,W \cdot hr$

Figure 9. Details of Wheel torque and Power supply

4. Results Calculations and Analysis

Conducting an intensive literature review, it was found that wheelchairs with stair-climbing wheelchair capacities can be categorized into two types mainly; the battery powered, and the manual powered. The calculations are provided in Figure 9. Although there are plenty of powered wheelchairs available in the marketplace, there are limited scholarly reviews published on manual or battery powered wheelchair.

Table. 1 Load capacity of the vehicle.

Battery Power	Human loads (Kg)	Distance (Km)
Full	70	2
Full	100	1.5

5. Conclusion

- The work describes the design, modeling, simulation, fabrication and testing of a stair climbing chair based on a new design paradigm of the wheel which is called as “Wheeled-Leg”.
- Multidisciplinary design approach is applied to develop the chair.After MBD(Multi-Body Dynamics) and FEA (Finite element analysis)simulation we have concluded our design. The robot is structurally safe at applied loads and materials election and robot mechanism is capable of climbing stairs of a height up to the outer radius of the chair.
- So far, we have been successful in eliminating the slip of the wheels while climbing, which was successful after adding rubber tire with treads at the legs of the wheel. This allowed to better grip the surface and provided a higher coefficient of friction, needed to get the required frictional torque. The roll shaft mechanism has also been specifically allowed the front and rear leg-axles to roll about the robot body to get a “good “contact with the ground.
- The simulations and experiments were performed for three road shapes. In every case, the robot was able to move on the rough terrain by maintaining the horizontal position. This has allowed the wheels to develop independent wheel torques and thus avoid the slip when tested in different unstructured terrains.[7]

Acknowledgements

This modest project would not have been feasible without the invaluable help of many people to whom I am grateful, especially our project coordinator, Dr. Krishna Hazra of Elitte College Engineering.I'd also like to express my gratitude to Elitte College of Engineering's "Department of Mechanical Engineering" for providing us with the necessary components for our project. We also want to express our gratitude to all of the Mechanical Department lecturers who assisted us in numerous challenging project scenarios and gave us all with valuable advice.

I'd also like to express my gratitude to the Robotics Club at Elitte College of Engineering for providing us with a space to work on our project. Our professors and the Elitte family deserve special recognition for their moral assistance.

Conflicts of Interest

The author declares that there is no conflict of interest.

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Behaviour of Stress Strain Relationship of Few Metals

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Abstract. The aim of this study is to examine the uniaxial tensile strength of three specimens of mild steel, brass and aluminum. Tension tests enable the determination and prediction of the deformation/deflection response of the material properties and elastic modulus. The values of Young's Modulus for Elasticity (E) for mild steel, brass, and aluminum have been successfully determined from laboratory experiments. Also, the stress and strain of the materials were graphically shown to have good correlations between theory and experimental values and compositions. The results further show that steel is more suitable for structural application than brass and aluminum respectively, because of their high Elastic Modulus rating. It therefore implies that steel can withstand more tension. The result obtained from the study such as tensile strength, yield strength etc. have been recorded. Also, the related theory has been indicated.

Keywords. Stress; Strain; Steel; Aluminum

1. Introduction

Tensile tests of materials are executed to obtain various elastic and plastic material properties such as modulus of elasticity, initial yield strength, ultimate strength, plastic hardening exponent, strength coefficient, etc. A true stress - true strain curve for the required material, focused mainly on plastic properties, is essentially required in order for numerical analyses accompanying large strain and fracture problems such as ship collision, ship grounding [1].

Unfortunately, most engineers are interested in getting only a load-elongation curve from the tensile tests. Even with load-elongation data, however, it is impossible to estimate average true stress-logarithmic true strain data beyond the onset of the diffuse necking. Namely, an average true stress-logarithmic true strain curve estimated from a load-elongation curve is valid only until uniform deformation, viz., before the onset of necking [2]. For most engineering steels, a non-uniform deformation field, called plastic instability, starts to develop just after a maximum load. At the same time, flow localization, called diffuse necking, starts at the minimum cross section of the specimen. The stress state and deformation in the necked region are analogous to those in the notch of a circumferentially notched round tensile specimen. For most steels, the load continuously decreases during diffuse necking, which terminates in ductile fracture of the specimen.

Mechanical behavior of metallic type material, such as mild steel, brass and aluminum is generally established by means of uniaxial tension test. Such tension test protocol [3], which was primarily created only for use in comparison of different steels, establishes the engineering stress and the

engineering strain. Figure 1 shows a typical engineering stress-strain relationship for steel (solid line), where the engineering stress was calculated as load divided by the original cross-section area of the sample, and the engineering strain was calculated as change in length divided by the original gauge length. Such calculations, which do not recognize the area changes during increasing loads, are used for convenient of measurements of dimensions and will always show an elastic range (Region-I), strain hardening range (Region-III), and a necking zone (Region IV). However, the stress-strain relationship established on the basis of instantaneous deformed dimensions of the test specimen is known as the true stress-true strain relationship (dash line in Figure 1). For all practical purposes, the engineering relations and the true relations would coincide up to yield point; however, the two relations would diverge beyond this point. Figure 1 shows the qualitative differences between the engineering stress-strain relation and the true stress-strain relation.

Strain, defines quantitatively the degree of deformation of a material. It is measured most commonly with extensometers or strain gauges. During uniaxial deformation, nominal strain (*e*) can be generally expressed as the ratio of change in length to the original length of the specimen. The objective of this investigation is to develop true stress-true strain relationships for metallic materials.

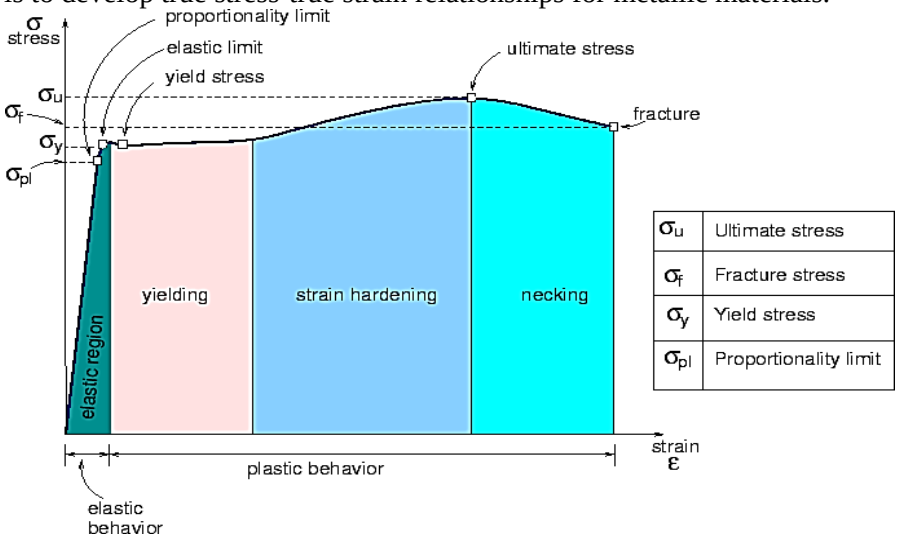


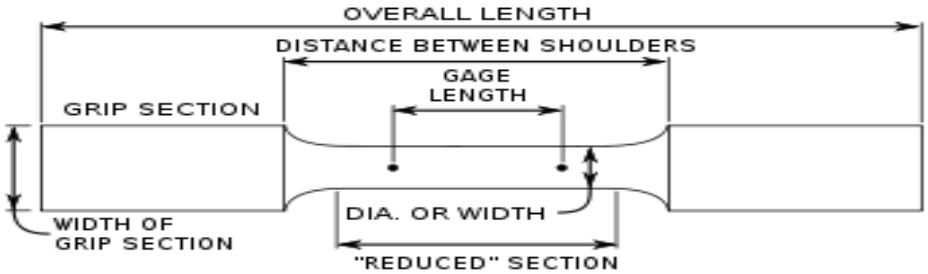
Figure 1. Typical Engineering Stress-Strain Relationship.

2. Materials and Method

The tensile test has been performed using Hounsfield Tensometer. The specimens have been tested made of the following material: mild steel, brass, and aluminum. The description of typical test standard specimen is shown in Fig. 2. It has enlarged ends for gripping. The substantial part of the specimen is the gauge section. The cross-sectional area of the gauge section is lesser relative to that of the remaining portion of the specimen so that the deformation and failure will be localized in this region. The gauge length is the region over which measurements are made and is centered within the reduced section. The distance between the ends of the gauge section and the shoulders should be sufficient so that the larger ends do not constrain deformation within the gauge section, and the gauge length should be long enough relative to its diameter. Otherwise, the state of stress will be more complex than simple tension.

The Hounsfield Tensometer is shown in Fig. 3. It is manually operated device and used for small test specimens [4].As the force is applied to the specimen, the material begins to stretch or extend. The Tensometer applies the force at a constant rate and readings of force applied and deformation are noted until the specimen finally breaks. The readings obtained can be plotted on a graph to show the overall behavior of the material. The shape of the graph is very important, and it helps to predict how the material will behave under different loading conditions.

Specimen is fit to the test machine. Maximum load is documented during testing. After fracture of the material, final gauge length and diameter is measured. Diameter should be measured from the neck. The necessary data for calculations will be recorded to the Table 1 given below.



Description	Standard specimen at nominal diameter		Small specimen at nominal diameter		
	0.500	0.350	0.25	0.160	0.113
Gauge Length	2.00±0.005	1.400±0.005	1.000±0.005	0.640±0.005	0.450±0.005
Diameter tolerance	±0.010	±0.007	±0.005	±0.003	±0.002
Fillet radius (min.)	0.625	0.25	0.3125	0.15625	0.15625
Length of reduced section (min.)	2.5	1.75	1.25	0.75	0.625

(Values are in inches)

Figure 2. Nomenclature of Standard Test Specimen.

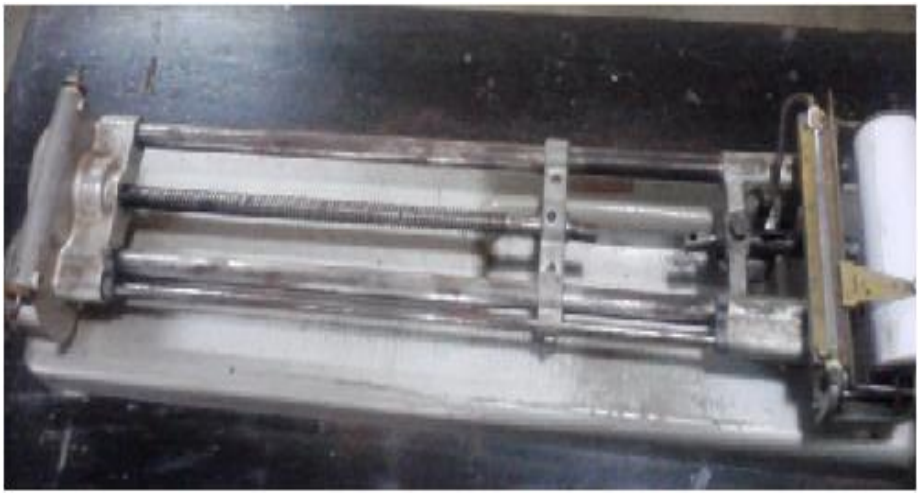


Figure 3. Hounsfield Tensometer

3. Results and Discussions

The tensile test has been performed on all material studies to determine the engineering stress-strain curve. The experimental results for each specimen are presented in Tables 1-3. The curve obtained from the test then was converted to true engineering stress-strain curve. Fig.4 shows the plotted stress strain curve for mild steel, aluminum and brass. From the graph, it is observed that mild steel has greater tensile strength compared to brass and aluminum. Aluminum has the least tensile strength. Also, it is observed that mild has shown maximum ductility property compared to brass and aluminum. Mild steel and brass have marginal difference in ductility property.

The curve obtained from the result of the test, was then converted to true engineering stress-strain curve. Fig.4 shows the stress strain curve for mild steel, aluminum and brass. From the graph, it is observed that mild steel has greater tensile strength compared to brass and aluminum. Aluminum has the least tensile strength. Also, it is observed that mild has shown maximum ductility property compared to brass and aluminum. Mild steel and brass have marginal difference in ductility property.

Fig.5 shows the typical tangent modulus curve for mild steel, brass and aluminum. The tangent modulus is advantageous in describing the elastic behavior of materials that have been stressed beyond the elastic region. When a material is plastically deformed there is no longer a linear correlation between stress and strain. The tangent modulus quantifies the "softening" or "hardening" of material that generally occurs when it begins to yield. The tensile test has been performed on all material to determine the engineering stress-strain curve. The experimental results for all specimens are presented in Table 3.

As stated earlier, Fig. 5 shows the typical tangent modulus curve for mild steel, brass and aluminum. The tangent modulus is very helpful in elucidating the behavior of materials that have been stressed beyond the elastic region. When a material is plastically deformed there is no longer a linear relationship between stress and strain. The tangent modulus quantifies the "softening" or "hardening" of material that generally occurs when it begins to yield.

Table 1. Specimen- Mild Steel

δ(m)	P(N)	e	ε	ε_p	H/E	slope	σ(MPa)	A(mm²)	L(m)	T/E
0	0	0	0	0	0	0	0	31.35	0.0481	1
0.00025	13.33221	0.005198	0.00518	0	1	1.53	0.42748	31.1879007	0.04835	1
0.001	59.58562	0.02079	0.020488	0	1	1.53	1.950051	30.5559271	0.04935	1
0.00175	98.21457	0.036383	0.03565	0	1	1.53	3.328236	29.5094912	0.0511	1
0.0025	129.9113	0.051975	0.050664	0	0.452274	0.691979	4.617737	28.1331157	0.0536	0.47648
0.0035	142.7845	0.072765	0.07023	0.019566	0.187315	0.286592	5.406728	26.408669	0.0571	0.241378
0.00475	136.0438	0.098753	0.094173	0.043509	0.150815	0.230747	5.58002	24.3805174	0.06185	0.200507
0.006	130.0396	0.12474	0.11755	0.066886	0	0	5.851172	22.2245394	0.06785	0
0.00725	117.363	0.150728	0.14037	0.089706	-0.0582	-0.08905	5.845056	20.079028	0.0751	-0.09455
0.0085	102.6538	0.176715	0.16272	0.112056	-0.18844	-0.28832	5.691131	18.0375	0.0836	-0.35526
0.01	83.04829	0.2079	0.18888	0.138216	-0.33414	-0.51123	5.154944	16.1104167	0.0936	-0.76777

Table 2. Specimen- Brass

δ(m)	load(N)	e	ε	T/E	ε_p	H/E	slope	σ(MPa)	A(mm^2)	L(m)
0	0	0	0	1	0	0	0	0	32.86	0.05116
0.000636	44.59735	0.012432	0.012355	1	0	1	1.729929	1.374086	32.456	0.051796
0.001273	75.17839	0.024883	0.024578	0.585073	0.012223	0.511045	0.884071	2.373246	31.6774572	0.053069
0.002122	93.01733	0.041478	0.040641	0.380292	0.028286	0.281773	0.487448	3.053802	30.4595129	0.055191
0.003183	99.38838	0.062217	0.060358	0.307299	0.048003	0.216008	0.373678	3.45115	28.7986257	0.058374
0.004033	105.7594	0.078831	0.075878	0.347318	0.063523	0.251204	0.434565	3.926098	26.9375387	0.062407
0.005306	110.8563	0.103714	0.098681	0.406519	0.086326	0.307175	0.531392	4.465202	24.8267094	0.067713
0.005943	114.6789	0.116165	0.109899	0.380292	0.097544	0.281773	0.487448	5.024588	22.8235443	0.073656
0.007641	117.2273	0.149355	0.139201	0.340687	0.126846	0.245232	0.424235	5.669074	20.6783888	0.081297
0.00849	115.9531	0.16595	0.153536	0.347318	0.141181	0.251204	0.434565	6.193051	18.7231	0.089787
0.009764	114.6789	0.190852	0.174669	0.353935	0.162314	0.257221	0.444974	6.791066	16.8867312	0.099551

Table 3. Specimen- Aluminum

δ(m)	P(N)	e	ε	T/E	ε_p	H/E	slope	σ(MPa)	A(mm^2)	L(m)
0	0	0	0	1	0	0	0	0	33.99	0.05197
0.000312	20.45362	0.006003	0.005986	1	0	1	3.478816	0.605367	33.78716	0.052282
0.000546	33.22936	0.010506	0.010451	1	0	1	3.478816	0.993762	33.4379553	0.052828
0.001092	59.88787	0.021012	0.020794	1.095246	0.010343	0.459498	1.598509	1.828037	32.7607622	0.05392
0.001638	61.79918	0.031518	0.031032	0.61904	0.020581	0.216465	0.753041	1.943683	31.7948864	0.055558
0.002262	63.7105	0.043525	0.042605	0.494911	0.032154	0.16586	0.576996	2.08538	30.5510256	0.05782
0.0028	64.98471	0.053877	0.052476	0.378123	0.042025	0.121948	0.424235	2.230094	29.1398928	0.06062
0.00351	62.43629	0.067539	0.065356	0	0.054905	0	0	2.266702	27.5449914	0.06413
0.004212	56.06524	0.081047	0.07793	-0.4856	0.067479	-0.12249	-0.42612	2.16909	25.8473603	0.068342
0.00499	45.87156	0.096017	0.091683	-1.1095	0.081232	-0.24181	-0.84121	1.90429	24.088533	0.073332
0.005772	33.12946	0.111064	0.105318	-1.92144	0.094867	-0.35581	-1.23778	1.483573	22.3308594	0.079104

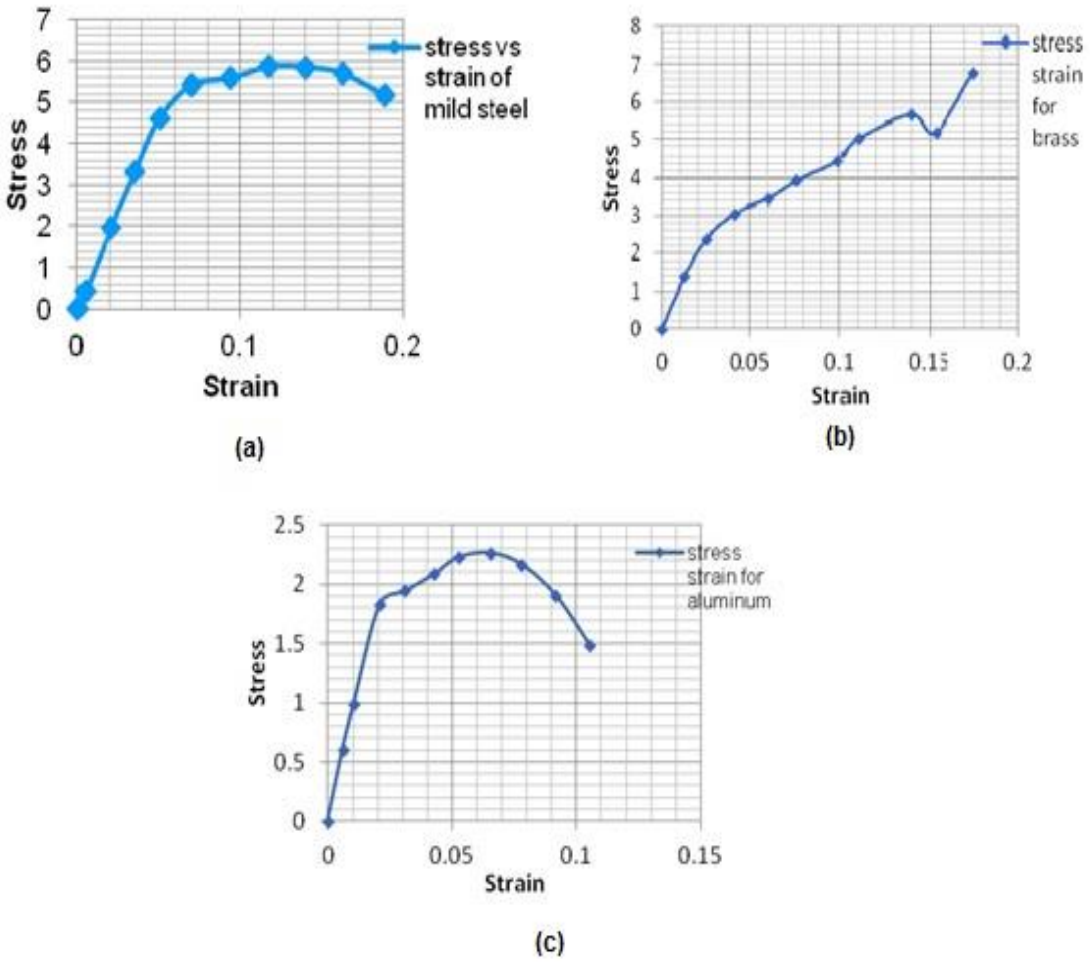


Figure 4. Typical Stress Strain Curve for (a) mild steel, (b) aluminum and (c) brass

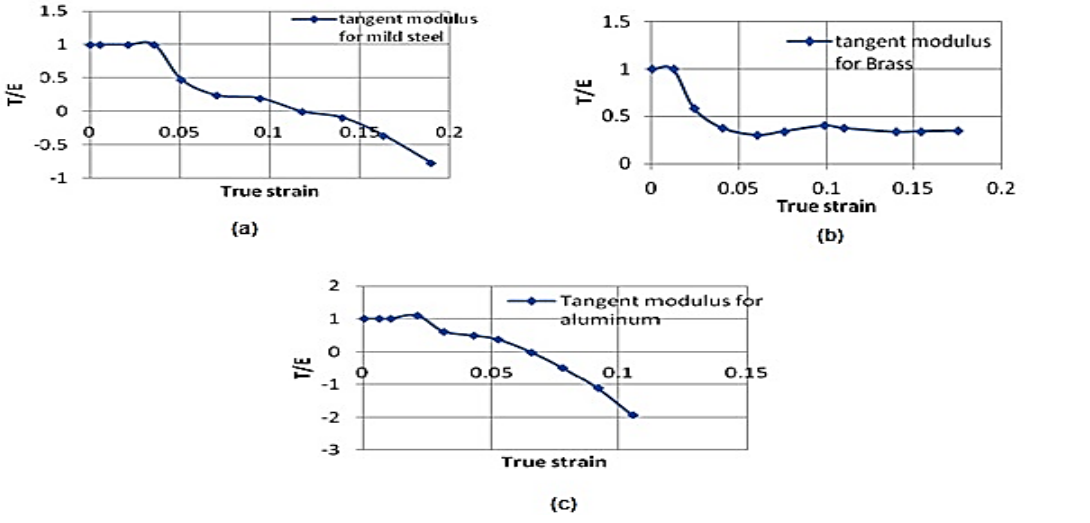


Figure 5. Typical Tangent Modulus Curve for (a) mild steel, (b) aluminum and (c) brass

4. Conclusion

The tensile tests were the methods of investigation of the mechanical properties of the different specimens in this paper. They are particularly interesting and allow a predictive approach of the behavior of the alloy in fraction. This test is the best known for material testing. It makes it possible to determine the tensile strength, one of the essential characteristic values of a material. The fracture point also makes it possible to measure the tenacity of the material. This work has allowed us to better know the tensile test for the various materials and the deformation operation, the elongation, the stresses, and we need to know them also of all the mechanical characteristics. It is also concluded that the mild steel is stronger than the materials tested by the tensile test, which indicates the fragility of the material and the Young's modulus on the strength of the materials. According to the results obtained it can be said that the higher the modulus of elasticity and the higher the tensile strength.

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