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Phone : 011-26963431, 26513542
E-mail : istedhq@isteonline.org
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Editorial

Deep learning is a subfield of machine learning helpful to carry out a variety of tasks including to draw conclusions from the voluminous data. It has received a lot of attention in recent years because of its capacity to automatically learn and provide output from large volume of data and making useful for identification of an image, recognition of voice, language processing, and so on. Deep learning can be applied in medical sector like medical image classification, genomic sequence analysis, surveillance cameras to continuously monitor patients in the hospitals to detect patient falls, signs of distress or unusual behavior enabling rapid response from medical personnel, in public sector like identifying tax-evasion patterns, tracking the spread of infectious cases, vehicle license plate number recognition and traffic monitoring and many more.

Population explosion and the industrial development across the country needs large quantity of water to meet various demands. Existing water resources are vanishing due to urban housing and other infra structure development, depletion of ground water level due to climatic changes need conservation of water. So, the watershed management is important in such situations. Geospatial tools like GIS, QGIS, Remote Sensing will play an important role to manage the water in watershed by prediction of Land use and land cover (LULC) changes and overall development of the area.

New Delhi **Editor**

30th June 2023

Contextual Curricula and Industry Institute Interaction for Technical Education

Ramesh L. Chakrasali
Professor & Dean
Department of E & E Engineering
SDM College of Engineering & Technology
Dharwad, Karnataka

ABSTRACT

It is well accepted fact that the curricula will set the right direction for the development of human resource in the Nation. The process of curricula development is ever existing issue that calls for discussion and deliberations. Normally curricula is revisited whenever there is a change in the National Education Policy or modifications in the policy based on the thrust. In the field of education, curricula speak broadly the totality of the students' impressions in educational process. The term curricula often refer to predefined sequence of instructions to meet the educational objectives or goals. The curricula include components like curricular, co curricular and extracurricular activities. It may be tightly standardized or may involve high level of teacher or learner autonomy. The curricula development will happen at regular interval of time and had several cycles at times by the concerted efforts of academicians and educationalists for the paramount cause of contributing the worthy technical man power to the National technical pool. The procedure of designing curricula was subjected to changes and now matured as a time tested procedure taking in to consideration the priorities, changed goals, parameters of focus at times.

KEYWORDS *: Education, Curricula, Industry, Institute, Technology.*

INTRODUCTION

The curricula design primarily considers the Nation's Educational Objectives and down the line the Vision and Mission of the Institution, Program Educational Objectives, Program Outcomes and Course Outcomes. Often, it is heard that the curricula shall be contextually relevant. What do we mean by the contextual relevance? The answer is quite simple that whatever taught in the academic institutions shall be practiced in the real world. This helps both the graduating students and employers to fetch more benefit. Now the question for the academia is how to ascertain the current requirement by the industries or organizations while designing the curricula to make it contextually relevant. Further, as applied to India, the technical man power development has to be with four categories of work force. Technology development work force to be taken up by premier institutes (Institutions of National Importance), technology interpretation and implementation work force to be taken up by the affiliated institutions offering Degrees programs such as Under Graduate/Post Graduate/ Doctoral. The diploma institutions develop the supervisory skills and Industrial Institutions offer Certificate courses for skill development to work at root or floor level. In this backdrop, if the curricula are to be developed, then the profile of the institutions also dictates the terms. For example, both in premier and affiliated institutions the degree programs is offered, but the curricular intensities and rigor are different. To make it simpler to understand, if a course in Electromagnetic Theory is offered, then the depth and treatment of study is different in premier institutions and affiliated institutions. In addition to this the learning ability of the learners is very important. Surprisingly, there is a little mention that to implicit about the learning ability of the learners in most of the education policies in India. In fact, the rigor of the curricula depends on the target learners. I think this elaboration is worth to be mentioned here before we look in to the development of contextually relevant curricula.

CURRICULA DESIGN CONSIDERATIONS

Let us now turn our attention towards curricula. This discussion holds good taking two factors in to consideration, firstly more than 15 lakh students enter in to Engineering Education in different categories of Institutions and secondly these students are with varied learning abilities i.e. heterogeneous group. This is the right time to meticulously devise scheme of study, curricular contents and pedagogy in view of implementation of our National Education Policy 2020.

For any Nation, it is a must to carry out comprehensive survey of employment opportunities and creation of employment in future. The survey is carried out and the results are published and inputs are invited from all the concerned stakeholders such as Managements of academic institutions, industries, Government organizations, parents and students. This will serve as a critical parameter to plan for the gross enrollment to engineering education and accordingly the number of seats can be fixed for a particular time window. This process shall be repeated at regular interval of time. Based on the nature and quantity of the employment, the body of the knowledge can be decided. Very clearly, both the legal and professional organizations have prescribed the body of the knowledge to be considered while designing the curricula which might be the result of the employers' survey carried out by these bodies at local and global levels. Further, the accrediting agencies have defined the expected attributes from graduating engineers. This forms the premises with which the curricular design process to start.

CURRICULA COMPONENTS

The scheme and curricula can consist of different components such as theory, laboratory, program electives, open electives, seminar, project, internship, soft skill courses etc. But it is important to note that the institutions shall make adequate resource planning to take care of the components defined in the scheme and it is binding on the institution or university to arrange facilities/resources when the component reflects in the scheme. Further, the scheme of study will be announced to the learners in advance. The scheme should be common to all the students and there shall not be differential provision among the students.

The design of scheme and curricula is straight forward and highly customized for the institutions wherein admission and employment catchment is certain. In contrary, the curricula design is quite rigorous in university system offering engineering degree with hundreds of affiliated institutions and students' strength is in terms of few lakhs. It is because of mass education and the needs of stakeholders vary from organizations to organizations. In the absence of specific needs, the general requirements are considered which will be normally broad based to cater to the variety of requirements by different organizations. The real challenge lies here and thus, advocate for broad based curricula taking in to the ground reality.

Reference to the global institutions shall be made while designing the curricula. But importing a curricula model from a foreign university as it is and implementation in our country may not work for mass education. This is because, the admission criteria, the students strength, the need of the man power, the availability of the resources, the potential employment, the scale of education, institution model, financial viability, culture, local relevance, global relevance etc., are different for different countries.

INDUSTRY READINESS

More often we hear that the industry ready engineers should come out of the institutions so that they can be directly put on the job. Due the fast changing advancement in science and technology, the life span of the industrial practices becomes very short. It is surprise to note an opinion that few technologies become obsolete in 2 - 4 years. Further, an opinion is formed that there is a gap between the academia and industries. By prevailing on the opinion, here and there we listen to a statement about the competency and employability of the graduating engineers which convey wrong message to the society about the academia. Why such difference of opinion proclaimed? Is this due to lack of coordination, lack of mutual understanding between the academia and industries?

In the scenario of fast changing technology and no specific needs being defined by the stakeholders, how to make the curricula contextually relevant? This challenge, of course is addressed by the academia leaving behind further scope for improvement. The inputs from industry and other organizations help to develop the curricula. There are three types of industries viz small, medium and large scale industries. The expectations of these industries from graduating engineers are different. Further, the human resource requirement both in quality and quantity of these industries is also different. Academia cannot design curricula which is specific to a particular industry because that industry cannot employ all graduating Engineers. Moreover, no industry will reveal the human resource requirement as per their strategic plan prepared at least for 5 years. In addition, it is heard that the technology is changing for every 2-4 years. The industries opine that the academia lags behind in producing ready Engineers. Though it appears true but it is apparent, because Engineering program is of four years duration and by the time the students complete their study, if the technology changes, then it lead to obsolescence. Under such conditions, if the curriculum is to be contextually relevant to produce industry ready Engineers, the expectation by the industry appear to be a tall claim. Does it mean that the academia involved in developing application engineers should look ahead, foresee, presume or imagine, would be technologies which do not exist and give considerations while designing the curricula? The industries themselves are not in a position to know, would be technological advancements that are going to come after a couple of years. Does it mean that there is no way for the academia to design curricula that suits the industrial needs? It is important to know that the premier institutions in collaboration with the R&D wings of the industries can predict and develop the curricula and this is being practiced in academia. But as applied to the institutions meant for interpretation and implementation of technology, which are huge in number, will try to design the curricula based on the current technologies adopted in industries. If we look at the scheme, the aspirations are covered by including Basic science courses, Basic Engineering courses, program core courses, program elective courses, humanities, laboratory courses, projects, technical seminars, soft skills, aptitude, internship etc. that help the development of well rounded personality. Thus, to cater to the variety of needs of different industries, a broad based curriculum is developed. Further, there shall be flexibility in the curricula to teach the immediate changing needs of the industries by the way of introducing the elective courses every year. These broad based curricula will help the students to choose jobs in industries, become entrepreneur, work in R&D organizations, pursue higher studies, work in Government/private organizations etc. which is characteristic feature of mass education. However, at time there must be flexibility to alter the proportional weightage for different courses reflecting in the curricula.

INDUSTRY INSTITUTE INTERACTION

With this defined curricula, what is the role of academia and industries in making them industry ready is interesting to note. Both the academia and industries shall come on a common forum to discuss, deliberate and share the thoughts to contribute for the development of contextually relevant curricula. As far as the academia is concerned, it shall make arrangement to impart the value addition programs in the emerging areas and arrange for finishing school before the students step out from the institution to start their professional career. Industries also have equal responsibility to reciprocate by the way of imparting post recruitment training to fine tune the graduating engineers who are entering the industries as per their specific needs. This collective effort shall avoid mutual claim of who is not responsible for not producing industry ready engineers. In all, the time tested and matured curricula design process will prepare broad based graduates in mass education system and the industries need to fine tune them as per their immediate requirement. This will help to add the technical work force with required knowledge and skill sets to the National pool and can certainly be used to meet the objectives of our National ambitious projects like Make in India, Digital India etc. Both the academia and industries need to convey an encouraging, factual and dependable message to the parents and society.

The development of application engineers is huge in number and more than 10 lakhs per year. This number dictates appearance of few special components in the scheme. To better understand this issue, let us consider that internship as mandatory component in the scheme. The intension behind this is very good and useful that the students should have exposure to industrial environment to know the work culture of the industry.

But, when it comes for facilitating, is it practically difficult for such a huge population.

It is heard both from academia and industry that there is a gap between the two in terms of practices and pace though both emphasize the need and usefulness of interaction. The industry institution interaction is a topic discussed more as applied to professional courses that too very often for Engineering institutions. The AICTE has come up with many proposals to reduce the gap between industry and institutions. Many universities/ colleges were advised to include internship in industry in the curricula as credit course, so that it can be taken up seriously for implementation. At the outset it appears a very good move and need the means to make it feasible and sustainable. Few years ago, there was a practice in engineering institutions to take the students to industrial visit for a couple of days in order to expose them to the industrial environment and practices. After the visit, the students used to prepare the report of the visit covering the technology, engineering practices that they observed and learnt. Now, it is aimed that all students shall undergo internship in industry, take industry based projects, study industry defined electives as a part of curricula. There are few issues to be given consideration while devising mechanisms for realization.

INDUSTRIAL TRAINING OR INTERNSHIP

The industry institution interaction can be split in to two broad components. Let us take the first one i.e. Industrial training or internship: Does it mean that all the engineering students shall undergo training or internship in industry? If so, let us look at the feasibility. The industries are working with their objectives of production or service to meet the target without sacrificing the profit. When training in industry is mandatory for all the engineering students, can these industries accommodate such a huge number of students? Certainly the proposal is acceptable for a small group of students with very few industries those encourage such activities. Many industries may not show the interest due to various reasons such as, the presence of students may be an impediment for the routine activities of the industries, the industries are not ready to take the responsibility of the students about the safety during their stay in the industries etc. Further, no industry might like to disclose the practices as per their policy. If the training is made mandatory including in the curricula, how to ensure that every student will get an opportunity in the aforesaid circumstances. Then the gap between the two continues to exist, doesn't mean that it is impossible to reduce but difficult to achieve. Further, the industrial hubs are not evenly distributed across the country. The institutions having industrial area(s) in the vicinity would make use of location advantage to train most of their students but not all students and this may not be possible for the institutions having no or thin industrial hubs. Then the question, can there be a differential provision among the students, if it is included in the curricula? The same explanation is applicable to online internship also with other set of difficulties such as virtual cannot be real, assured connectivity, affordability by the students and so on.

POSSIBLE SOLUTIONS

Looking at these root level problems, is it not possible to reduce the gap between the two? In my opinion there are two solutions to resolve the issue. First one is by legislation that is when the Government accord permission to start/extend to the industry, there must be a clause that they need to accommodate the students for training in the industry and the same is to be notified to the academic institutions. The second solution is the institutions shall elevate their laboratories to industrial standards which give the feel of industrial environment to the students. Of late, it is observed that the laboratories are established with models and don't expose the students to conduct experiment at component level. It is true with software packages also where in most of the packages exist in two versions viz students' and industrial. Why not the students shall be trained with industrial versions only? Thus, it needs common goal and collective effort to reduce the gap between both institution and industry that leads to mutual benefit.

Let us now look at the second component of industry institution interaction i.e. participation of academia in finding solutions for industrial problems. This mainly involves the faculty members to be interactive. Many people have floated various suggestions like faculty members shall undergo training in industries, industrial personnel shall undergo continuing education programme (CEP) in academic institutions, Industries shall approach institutions with their problem for suitable solution, industries shall define their problems to the students to take it as project work, industries shall ask institutions to train the students by teaching industry defined elective courses, institutions seeking collaborative research with industries, etc. In principle, all the above activities are acceptable and results in mutual benefit. But the question is, to what extent it is practically possible.

We find typically three types of industries viz small scale, medium scale and large scale. Let us first consider the small scale industries. As we know small scale industries are typically process based and accordingly the machineries and process procedures are fixed in advance. Such industries are normally have proprietorship or managed by a small group with limited investment and proportionally the returns too. The problem in such industries could be found in operation, maintenance, replacement of some component in the machines or in the line of machines etc. These problems most of the time are solved by the skilled personnel. Such industries can not tolerate down time or delay which will affect the revenue and profit. In the case of any problems at implementation and/or operation level will be handled by their own engineers. The engineers working in such industries are the product of academic institutions and the academic institutions certify them as industry ready and can work independently. When the expertise is deployed by investing on the engineers, why industries approach the academic institutions for their routine but manageable problems. More over the industries always expect the workable solution without wasting the time. Further, for few industries, it may not be affordable for regular problems. Therefore, there is no scope for small scale industries to approach institutions to seek solutions for the problems.

Let's analyze the possibility with medium scale industries. In these industries, multiple processes are functional in a predefined sequence. Such industries normally deploy teams of engineers to take care of different activities like installation, commissioning, operation, maintenance, etc. The engineers working in these industries are also the graduates from academic institutions who have been certified as having acquired all the graduate attributes. Thus, they are expected to exhibit technical competency, life-long learning, etc. in getting solutions for the routine problems. Therefore, the industries don't look at the institutions for solutions as the tailor made expertise is developed by investing on them. Thus, the scope of medium scale industry interaction with the institution is also very low.

Now look at the large scale industries that involve in mass production with multiple processes and sections/ departments. Each section/department is like a medium scale industry. Large number of engineers are employed and trained for interpretation and implementation. The teams of engineers need to ensure that the industry will work with zero down time. These engineers are once again developed by the institutions. Further, large scale industries, normally establish their own Research and Development wing with substantial investment to carry out research continuously, to improve, innovate, design, modify, optimize the processes and Services. Such industries with competent and dedicated human resource will not approach the institutions for solutions to their problems. In the case of specific need, these industries prefer approaching the premier institutions which have been developed with the objective of research leading to technology development. Thus, the scope of large scale industry interaction with the institution is also very low.

Does it mean that institutions don't have a role in dealing with the problems of industries? Certainly the institutions have a major role but implicitly. We need to understand that industries and institutions have ever strong, inherent, interleaved bonding which can be implicitly deduced. The institutions are producing engineers with required competency and attributes and these engineers are working in the industries and find solution for smooth running of the industries. Thus, the institutions are interacting and providing solutions to the industrial problems through their engineers who are the brand ambassadors of the institutions. However, the industries needs to impart specific post recruitment training for customization, because the graduates coming out of the institutions are exposed to the curricula by design, which is broad based to cover the interest of variety of industries/organizations and also the graduating students with various career options. It may be noted that the industry expects immediate workable solution whereas the academia provide systematic sustainable solution.

CONCLUSION

It is the right time to design the curricula such that it is flexible, broad based, multidisciplinary in nature which is the essence of National Education Policy 2020, so that the graduating engineers will serve the society with an obligation and contribute for the Nation building to make our country a fore runner in the global technical scenario. It is nevertheless to mention that in education field the consultancy should be avoided as far as possible and the involvement of people working at the root level with core competency from all categories of institutions shall be more in number in setting the right direction for the growth of the technical education.

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REFERENCES

The information available in generic domain is cited in the article. Not referred any article. The article came out as my thought process.

Barium and Cobalt Tungstate Nanoparticles Synthesis and Characterization by Sol-Gel method

B. K. Kempegowda
Department of Chemistry
Government First Grade College
Nanjangud, Mysore, Karnataka

T. N. Govindaiah
Post-Graduate Department of Physics
Government College (Autonomous)
Mandya, Karnataka

ABSTRACT

The use of metal oxide nanoparticles have been studied due to their novel optical, electronic, magnetic, thermal and potential applications as catalysts, gas sensors, photo-electronic devices, ..etc. In this research work, we report a simple, soft chemical route for synthesizing $BaWO_4$ and $CoWO_4$ nanoparticles using cheap chemicals such as Barium nitrate (precursor salt), Cobalt Sulphate and Sodium tungstate (precipitating agent) by Sol Gel method. The final product was dried at room temperature over night and calcined at 400°C and 800°C for 2h to get phase-pure product. The prepared nanoparticles (as prepared and heat-treated samples) were characterized by Scanning electron microscopy(SEM).

KEYWORDS : *$BaWO_4$, $CoWO_4$, Synthesis, Nanoparticles, Characterization.*

INTRODUCTION

It is known that tungstate is a very important family of inorganic materials that has wide applications in many fields, such as Microwave applications, Optical fibres, Scintillator materials, Humidity sensors, etc. As a self-activating tungstate has some advantages, e.g. high chemical stability, high X-ray absorption co-efficient, high light yield and low after glow to luminescence. Tungstste crystals can be divided into two groups: Scheelite ($BaWO_4$, $CaWO_4$, and $PbWO_4$) and Wolframite ($MgWO_4$, $ZnWO_4$ and $CdWO_4$). $BaWO_4$ shows very weak luminescence at liquid helium temperature which vanishes at room temperature. $CaWO_4$ is an effective luminophor which is used for more than hundred years in medical purpose and in luminescence lamp but it has slow luminescence decay (about 100.s) restrict its use in optical devices based on low time resolution.

The scheelite structure of tungstates [WO_4] the W ions are within tetrahedral O ion cages and are isolated from each other, while the cations are surrounded by eight O ions. They have the C_{4h} space group. Tungstate with different shapes and sizes have been proposed depending on the different preparative methods, such as spray pyrolysis, template free precipitation technique, chemical solution method, pulse laser deposition and microwave assisted synthesis with further calcination. All these methods present common advantages, such as good control of stoichiometry, good mixing of the starting materials and good chemical homogeneity of the product. Work in this field is therefore continuing and many new chemical methods are being developed and existing ones modified in order to improve the particals procedure and the cost effectiveness of the process. In this paper metal tungstate of $BaWO_4$ and $CoWO_4$ were synthesised by Solgel method.

EXPERIMENT

Materials and Methods: Sodium tungstate (Na_2WO_4), Barium Nitrate ($Ba(NO_3)_2$), Cobalt Sulphate ($CoSO_4.7H_2O$), EDTA [ethylene diamine tetraacetic acid], Diehthylamine, PVA[polyvinyl alcohol], Sucrose, all the materials used are of merck company and without further purification.

Procedure for Barium Tungstae Nanoparticle

Step-1: Synthesis of Metal tungstate particle: Equimolar concentrations (0.5) of Na_2WO_4 and $Ba(NO_3)_2$ was prepared in 100ml volumetric flask. Add drop by drop of 25ml of 0.5M $Ba(NO_3)_2$ (burette) to 25ml of 0.5M Na_2WO_4 (round bottom flask) with constant stirring on a magnetic stirrer for 2h. The precipitate is the metal tungstate particle.

Step-2: Synthesis of Barium tungstate nanoparticle: The synthesized metal tungstate particle add 25ml of white gel(0.2M, 15ml of EDTA and 0.2M, 10ml of diethylamine) with stirring, heat the solution for 10min. Add 15ml of 0.02M PVA and 10ml of 0.02M sucrose, heat the solution at 80^{O}C for 2h to obtain gel. The gel is then taken to high temperature(700-800^{O}C), respective BaWO4 nanopartical powder is obtained(Scheme 1).

Procedure for Cobalt Tungstae Nanoparticle

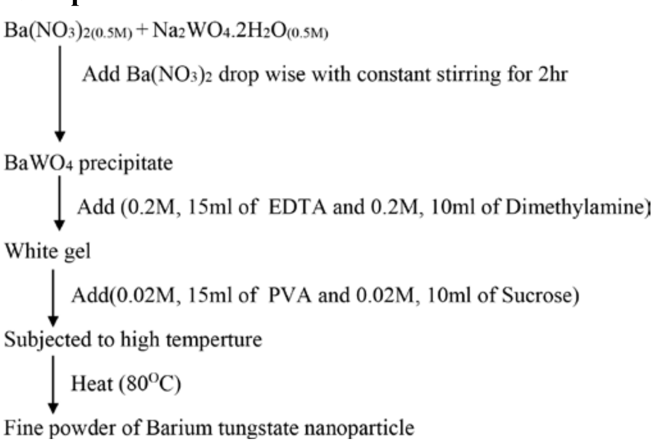
Step-1: Synthesis of Metal tungstate particle: Equimolar concentration (0.5) of Na_2WO_4 and $CoSO_4$ was prepared in 100ml volumetric flask. Add drop by drop of 25ml of 0.5M, $CoSO_4$ (burette) to 25ml of 0.5M Na_2WO_4 (round bottom flask) with costant stirring on a magnetic stirrer for 2h. The violet color precipitate is formed. The precipitate is the metal tungstate particle.

Step-2: Synthesis of Cobalt tungstate nanoparticle: The synthesized metal tungstate particle add 25ml of white gel (0.2M,15ml of EDTA and 0.2M, 10ml of diethylamine) with stirring, heat the solution for 10min. Add 15ml of 0.02M PVA and 10ml of 0.02M sucrose, heat the solution at 80^{O}C for 2h to obtain gel. The gel is then taken to high temperature(700-800^{O}C), respective $CoWO_4$ nanopartical powder is obtained (Scheme 2).

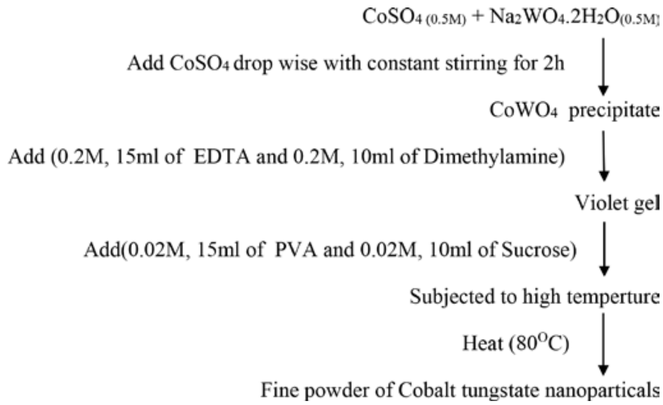
$$Ba(NO_3)_2(s) + Na_2WO_4(s) \rightarrow BaWO_4 + 2NaNO_3$$

$$CoSO_4(s) + Na_2WO_4(s) \rightarrow CoWO_4 + Na_2SO_4$$

Scheme-1: Synthesis of Barium Tungstate Nanoparticles flow chart



Scheme-2: Synthesis of Cobalt Tungstate Nanoparticles flow chart



SCANNING ELECTRON MICROSCOPY(SEM)

In SEM, high resolution images are generated by focusing a high-energy beam of electrons on the surface of the specimen in a raster scanning fashion. These electrons sample such as the surface morphology, elemental or chemical composition, crystal structure and positions of atoms or materials that makes up the sample. A high-energy beam of electrons are thermoionically emitted from an electron gun fitted with a tungsten or lanthanum hexaboride(LaB6) cathode filament towards an anode. The most common filament is tungsten because of its affordability and high melting temperature compared to other metals.

A typical electron beam with energy within the of 0-50 keV is focused by two consecutive condenser lenses into a very fine spot of approximately 5mm. As the 1o electron beam strikes and interacts with the sample surface, the energy of the electron is dissipated due to continuous randam scattering, absorption and effectively spreads into a tear drop shaped volume of the sample(interaction volume) extending about 1-5µm into the surface. Several 2^{O} signals are thus generated which are picked up by specialized detectors depending on the type of instrumentation.

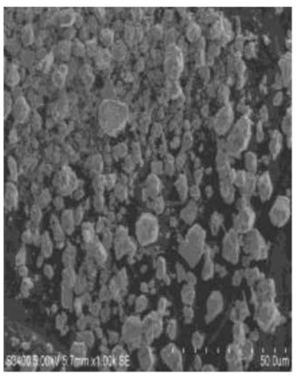
SEM is an important tool for determination of the purity of nanoparticles, which provides information about the agglomeration and also it can used to study the level of dispersion and uniformity of metallic nanoparticles X-ray beams are helpful for the structural characterization of certain particles (such as those generated using soft/organic polymers/biomolecules). Thus, this makes it possible for repeated sample analysis

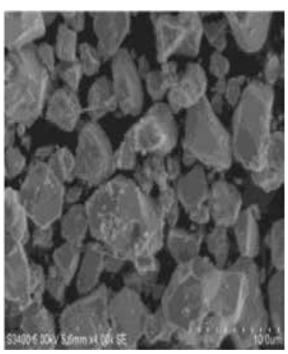
CHARACTERIZATION

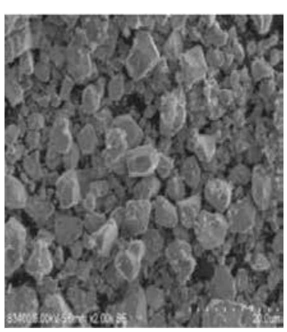
Micro-structural formation of shape and size of prepared metal tungstates were examined using Leica-440 Cambridge Stereoscan, scanning electron microscope image. The SEM was operated at 20kV. The samples were made conducting by the sputtering of gold using a Poloron DC "sputtering unit" operated it 1.4kV and 18-20mA.

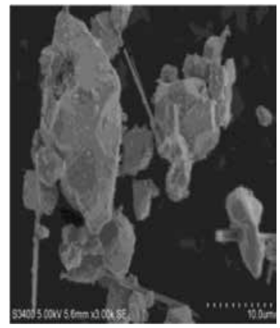
RESULTS AND DISCUSSION

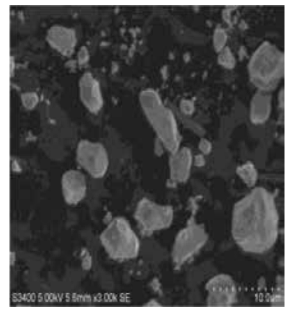
The surface morphologies of the prepared ceramic materials were studied by using SEM images, which presents the formation of cluster like nano materials.



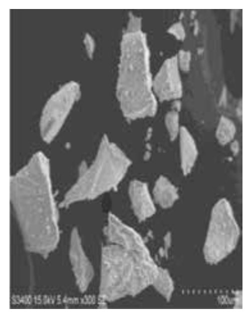


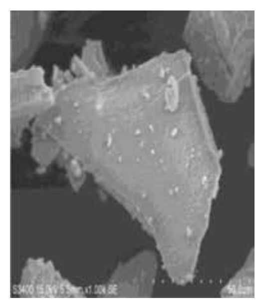


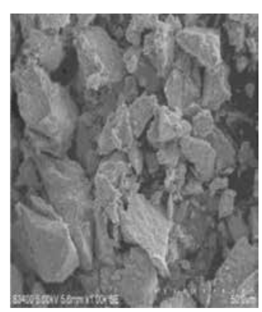


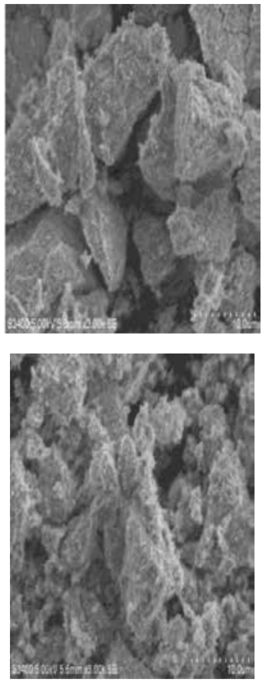


SEM images of Barium Tungstate nanoparticles









SEM images of Cobalt Tungstate nanoparticles

CONCLUSION

The BaWO4 and CoWO4 nanoparticles were prepared by the simple Sol-Gel method, low-temperature route; furthermore, they were characterized by the SEM techniques. The SEM studies confirmed the presence of granular-like grains in the samples. From the observation of SEM images, it may be concluded that all the ceramic materials showed nanosizes, forming different shapes and sizes of agglomerates starting from nanospheres to nanorods.

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Regional Peculiarity of Technical Institutions in India

Rajiv Kumar
National Institute of Education Planning and Administration (NIEPA), New Delhi
Deemed to be University under Ministry of Education

ABSTRACT

Technical education has paramount role in bridging regional disparity through generation of skills and employment opportunities across region. It significantly promotes wealth creating economic activities along with start-up and innovation at regional scale. So, this research paper undertook GIS based regional analysis of technical institutes in India with case study of Bihar. Quantitative method with exploratory research design was used. Ms-Excel, SPSS and QGIS software were used for analysis of data. It found five broad factors impacting distribution of technical institutes in a region namely administrative factors, demographic factors, economic factors, educational resource factors and physical factors. It also calculated technical institute density at country level as 2.23 with regional variation from 0.29 to 7.41. And finally, the projected number of new seats required under technical education by 2036 in case study region came out to be around 2 lakh. In fact, disproportionate distribution of technical institutions across regions in the country has large impact on participation of students under such education, particularly for female students and socio-economically disadvantaged groups. Finally, it recommended that technical education should be promoted as key strategies for regional and inclusive development.

KEYWORDS *: Locational Analysis, Regional development, Technical education, GIS based study.*

INTRODUCTION

Quality Education is prerequisite for worthy employment and eradication of poverty. India aspires to become an economy of \$5 trillion by 2025 and \$ 10 trillion by 2032 from approximately \$ 3 trillion in 2020 (Economic Survey 2020-21 & Hindustan Times 2020). This could be possible by utilizing the demographic dividend of the country. But, this also depends on how we capitalize our engineers in all three sectors namely primary, secondary and tertiary. And, thus there comes the role of higher education and particularly higher technical education. AISHE (2019-20) mentioned that at undergraduate level the highest number, 32.7% of students are enrolled in Arts/Humanities/Social Sciences courses followed by Science (16%), Commerce (14.9%) and Engineering and Technology (12.6%). The country has total 3010 engineering and technology Institutes at UG and PG level, for the academic year 2021-22, with intake of around 1.4 million. From such numbers of institutes, 6.18 lakh students received engineering degree in the academic year 2019-20 (AICTE 2021). But, the availability of such technical institutions and participation of youths under higher technical education remains uneven across the regions of India. At the same time, this participation is limited by many barriers like financial, gender, caste, infrastructure and other such barriers. Non-availability of quality higher technical education within the state or regional boundary is one such barrier, particularly for girl students and students belonging to scheduled class and other socio-economically disadvantaged groups (SEDGs). In fact, Accessibility, Availability, Affordability and Awareness could be termed as 'Education Quartet' for dissemination of knowledge. But, the location of engineering institutes in India seemed not to be rationally distributed, thereby impacting the accessibility of quality technical education. It has repercussions on not only national development but also regional development. Government of India (2020) aimed that by 2030, at least one large multidisciplinary HEI to be established in or near every district. So, 3.5 Crore seats are proposed to be added in higher education. But, how its location and distribution should be prioritised- remains a question.

BACKGROUND

Universal access to education is paramount for sustainable development of a society and the availability of basic educational infrastructure is prerequisite for achieving this access. To facilitate universal access to school education in age group 6-14 years, the government had legislated Right to Education Act 2009 and schooling infrastructure is made available as per the set norms. But no such legislation seems to exist in India for universalizing access of higher education or technical education. So, accessibility could be denied due to variety of barriers like Gender barrier, Disability barrier, Marginalization barrier, Migration barrier, Administrative barrier, Infrastructure barrier, financial barrier or any other barriers. On the other hand, sustainable development goal 4 talked about equal access to quality education and affordable technical, vocational and higher education. Increasing access would invite the need for additional support system in terms of infrastructure, resources and removal of other barriers.

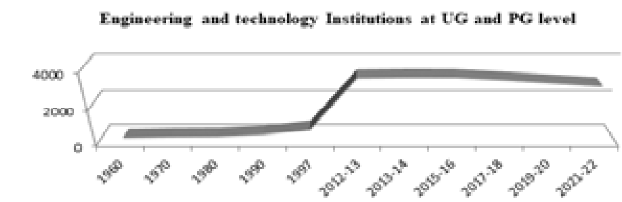


Figure 1: Trends in availability of engineering and technology institutions in India since 1960 to 2022
Source: Palit (1998) and AICTE

Since, 1960 to 1990s, there were slow growth in number of technical institutes. After that, there was large growth in availability of higher technical institutions. But, in recent decades, it has nearly stagnated in terms of number. But, at the same time, quality of such institutions in terms of infrastructure, labs, employability etc. had also become a concern.

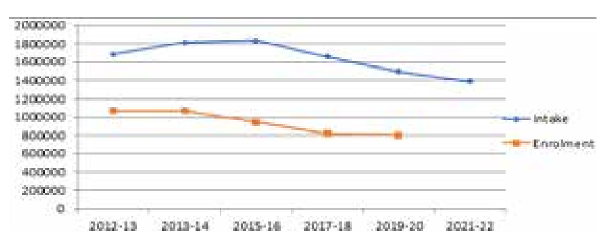


Figure 2: Trends in Capacity vs. Enrolment under engineering education in India on last decade
Source: AICTE dashboard assessed on 17th April 2022

Now, the access could be achieved only if facilities are available. So, availability of education services becomes the first step to increase the access in education. Availability of education services could be achieved through investment in infrastructure and resource creation. Increasing college density, availability of better teachers, libraries and labs are ways to increase access to higher education. Availability of higher education within state is particularly important for increasing access of economically disadvantaged groups, who are facing many access barriers. Even, they could not migrate to other places where such facilities are available.

Why Bihar

Bihar has different peculiarities in terms of development, population and resources, which also gets reflected in number of institutions and hence quality of education in the state. Bihar is third most populous state of India and also most densely populated. Population in the age group 18-23 in 2019 in India was 142.3 million while the same for Bihar was 12 million (AISHE 2019-20). So, Bihar has one of the highest eligible populations (18-23 cohort). But, estimated Gross Enrolment Ratio in higher education in India is 27.1%, while the same for Bihar was mere 14.5%. Similarly, the number of engineering and technology college in Bihar (3rd most populous state) is 55 while it is 455 in Tamil Nadu (Census 2011 and AICTE 2021). Also, UGC (2018) noted that merely 57 engineering and technology institutes seemed very less for state like Bihar, having population of 11.6 million in 18-23 cohort in the year 2017. Availability is the first and foremost criteria to determine accessibility in education, where Bihar seemed lacking.

LITERATURE REVIEW

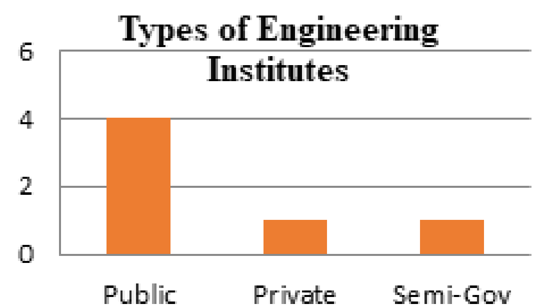
AISHE (2019-20) reflected the regional disparity with respect to educational infrastructure in the country. Although, the survey presented the detailed picture for overall higher education, still inferences could be drawn about engineering education. It revealed that college density (the number of colleges per lakh eligible population i.e. in the age group 18-23) varies from 7 in Bihar to 59 in Karnataka as compared to All India average of 30. The importance of technical education is also noted by Tilak & Choudhury (2021) who emphasized that access to engineering education is seen as an aspiration for social mobility and to reach a higher level of social status. The relative share of engineering and technology education under higher education fell sharply from nearly 16 percent in 2015-16 to below 11 percent in 2018-19. But given increasing evidence of technology, one can expect that this trend would reverse. He also noted that expansion of private engineering education had widened the inequality in educational opportunities. Dahiya (2020) has drawn an interesting inference that adding even 500 colleges every year in a country where about 5 crores people are added annually is not good enough to improve equity. Kumar (2021) noted that the creation of skilled labour pool requires an expansion of higher education in spatial proximity. Knowledge based economy has strengthened the link between education and economic prosperity. Ghose (2020) inferred that less than 1 percent of the population in Bihar is enrolled for higher education, both for general and technical streams. Government of India (2020) highlighted that entry into quality higher education can open a vast array of opportunities that can lift both individual and communities out of the cycle of disadvantage.

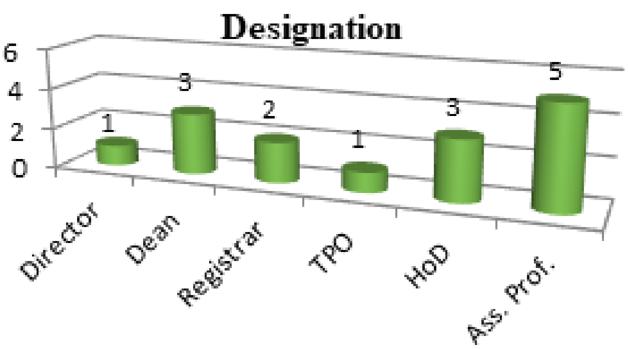
RESEARCH QUESTIONS

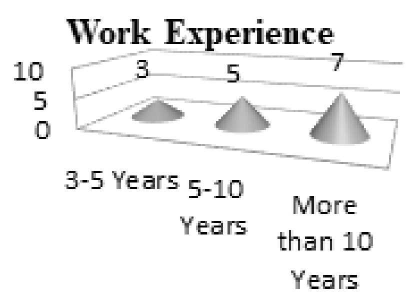
- What are the factors which determine the location and distribution of technical institutions in a region?
- How is engineering college regional density impacting the participation of students under technical education in a region?
- Are sufficient number of technical institutions vis a vis levels and disciplines, available at regional level?
- How technical institutions should be geographically spread, in terms of number?

METHODOLOGY

Quantitative method with exploratory research design was used to investigate the problem. For regional analysis, Bihar region was considered under this paper. The research tools used are geographical information system(GIS), Field Visit and Semi structured questionnaire. Right to information Act 2005 was utilized to get some of the information like intake, admission rate, course details and other such information. The reference population for this research paper was the 18-23 cohort. Both primary and secondary data were used in this research. Secondary data from various sources like AICTE, AISHE, UGC, Census, and website of individual engineering institutes in the region was collected. Field visit is also done to few engineering institutes located at Patna to collect primary data. 15 people were interviewed in various modes as shown below.







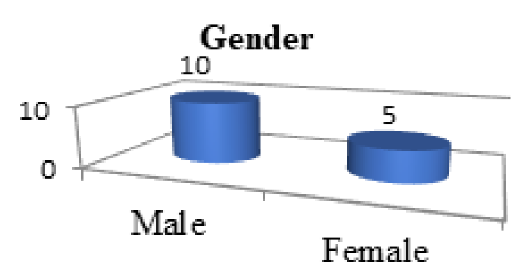
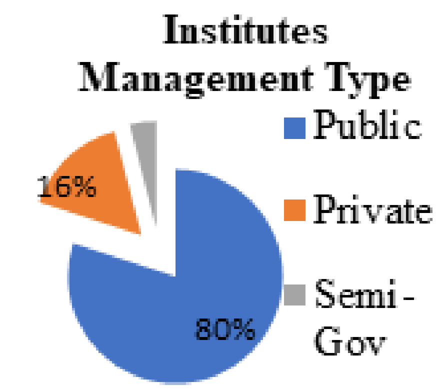
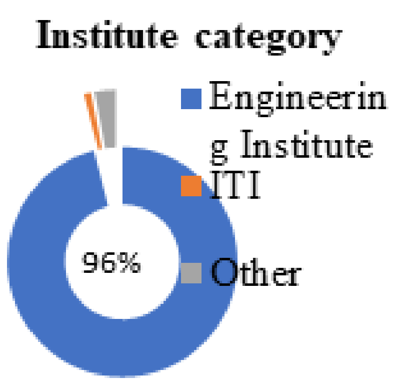
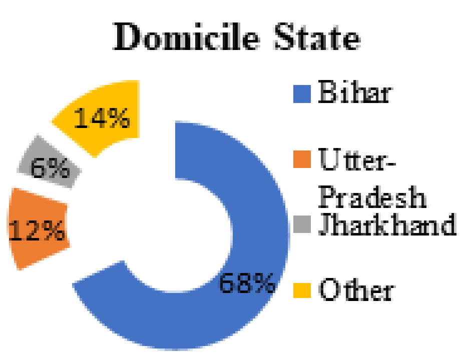


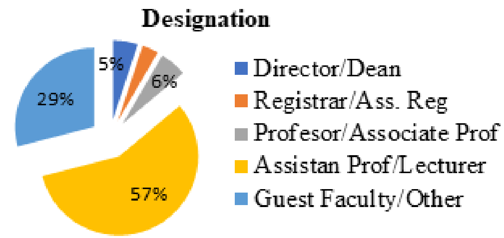
Figure 3: Various details of the participants in the Interview

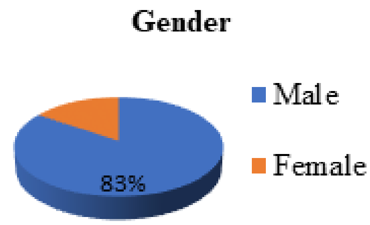
Mails were sent to more than thousand faculties and administrative heads of engineering institutes in Bihar, requesting them to fill the google form containing semi-structured questionnaire. Among them, 90 persons have given their feedback as shown below.

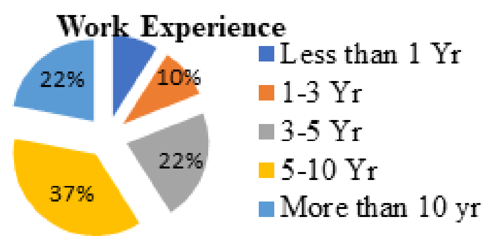












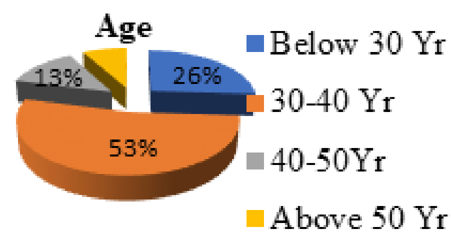


Figure 4: Description of the Respondents who participated in written semi-structured questionnaire

For data analysis SPSS and MS-Excel were used. Then participation of youth in higher technical education is analyzed by computing engineering institute density with respect eligible population (18–23 cohort) and performing regression analysis with the help of SPSS software. Also, QGIS, an open-source software, was used as a tool for analyzing geographical information and mapping of engineering institutes.

FINDINGS AND DISCUSSION

Factors Influencing Location of Institutes

As per AICTE (2021), Bihar has 57 engineering and technology institutes while Tamilnadu has 495 of such institutes. So, why some states have large number of colleges, while other states have very few? There are numerous factors which influence the location of higher technical institutions in a region. The data of 90 respondents on Likert scale was analysed with help of SPSS. The study provided five broad factors as follows:

Administrative Factors

Government expenditure on technical education and its policy towards technical education is one of the most important factors deciding location. The primary data showed that half of the respondents have considered government expenditure as a major factor deciding location of engineering institute. But, 80 percent of the respondents believed government policy towards technical education as major factor affecting location of such institutes. Then, the state government administrative machinery is also an important factor. More than three-fourth of the respondents agreed that government administrative machinery and law and order situation in the state or region is a dominating factor to decide location. Similarly, 70 percent of them have voted for social infrastructure like electricity, connectivity etc. as a major factor for location.

Demographic Factors

Population in the age group 18-23 of the state, social demand (number of registrants for engineering entrance exam), the admission rate/enrollments in technical institutes, the ideological preference for technical education among parents and students are some of the demographic factors affecting the location of technical institutes in a region or state. One third of the respondents have considered 18-23 cohort of population as a factor for location. But more than half of the respondents have agreed on social demand as a factor which decides location of technical institutes in a region.

At the same time, the enrollment or admission rate in the existing engineering colleges in a region is considered as factor for opening new technical institute by 53 percent of the respondents. But the large number of vacant seats at engineering colleges discourage establishment of new colleges. Then, the ideology behind engineering education (and being an engineer) is an influencing factor for establishing technical institutes. 63 percent of respondents considered ideological preferences as a factor.

Then, relation between social demand and number of colleges could also be understood from the following data. It was found that, a total number of 6.52 lakh candidates were registered for the JEE (Main) Examination for B.E./B.Tech. examination held in February 2021(National Testing Agency, 2021). Maharashtra, Andhra Pradesh, Telangana and Utter Pradesh were the top four states having the highest number of registrations for JEE (Main) 2021. And table-2 showed that the top 7 states having the highest number of engineering colleges are Tamilnadu, Maharashtra, Andhra Pradesh, Utter Pradesh, Telangana, Karnataka and Madhya-Pradesh. Thus, here also strong similarity existed between social demand and existing number of engineering colleges.

Economic Factors

The per capita income in a state, the level of employment among technical graduates, the presence of knowledge based industries in a state, the degree of urbanization in a state are some of the economic factors which affect location of technical institute. Economic capacity of people also motivates the establishment of engineering colleges in a region. Government's concession in opening a college is another factor. Half of the respondents have considered per capita income as factor for location. On the other hand, 70 percent of the respondents have agreed on employability as an important factor for location. And around same proportion of people have also voted that knowledge-based industries in the region is an important considerate while establishing a technical institution in the region. And 65 percent of them have considered urbanization of the state as a factor.

Table 1: State wise data on urbanization rate, Net State Domestic Product (NSDP) and number of factories

S.no.	State	*Urbanization (%)	#PC-NSDP	@NSDP	$Factories
1	Andhra Pradesh	33.5	168480	87006430	16739
2	Arunachal Pradesh	22.7	169742	2564801	115
3	Assam	14.1	86801	29956920	5020

4	Bihar	11.3	45071	54337663	3422
5	Chandigarh	97.3	330015	3917275	233
6	Chhattisgarh	23.2	105089	30799515	3576
7	Delhi	97.5	376221	75375917	3376
8	Goa	62.2	435959	6735570	708
9	Gujarat	42.6	213936	144768273	26842
10	Haryana	34.8	247628	70836363	11835
11	Himachal Pradesh	10	190407	13951123	2691
12	Jammu and Kashmir	27.2	102789	14358554	1000
13	Jharkhand	24.1	77739	29319200	2857
14	Karnataka	38.6	223175	147527677	13789
15	Kerala	47.7	221904	77309933	7696
16	Madhya Pradesh	27.6	103288	85623827	4640
17	Maharashtra	45.2	202130	248253582	25972
18	Manipur	30.2	84746	2914768	197
19	Meghalaya	20.1	87170	3104990	148
20	Mizoram	51.5	187327	2244179	
21	Nagaland	29	120518	2611622	187
22	Odisha	16.7	110434	48344801	3063
23	Punjab	37.5	155491	48234744	12825
24	Rajasthan	24.9	115492	89914304	9424
25	Sikkim	25	403376	2690518	84
26	Tamil Nadu	48.5	213396	161971992	38131
27	Telangana	38.9	233325	87137381	15167
28	Tripura	26.2	125675	5042066	621
29	Uttrakhand	30.6	202895	22758680	3002
30	Uttar Pradesh	22.3	65704	149575799	15854
31	West Bengal	31.9	113163	110065072	9420

*Source: Census 2011

#Per capita net state domestic product at current price in rupee for 2019-20, as per National Statistical Office (NSO), Ministry of Statistics and Programme Implementation, Government of India

@Net state Domestic Product 2019-20 in lakh, as per NSO

$State wise number of Factories as per Annual survey of industries for 2018-19

The correlation among number of engineering colleges in each state with urbanization rate, number of factories, Net state domestic product (NSDP) and Per-capita NSDP was established. The correlation coefficient comes out to be 0.066, 0.896, 0.844 and -0.019 respectively. Thus, it showed very high correlation among number of colleges, NSDP, and number of factories in each state. At the same time, correlation with urbanization of each state was very low and with per capita NSDP comes out to be negative. Most states, where large number of private institutes is there, provide subsidy to students belonging to own state. And to compensate, fee is higher for outsiders. Political benefit from private engineering college is taken directly or indirectly. These colleges are often taken as large income generating source and less interest is shown on improving quality.

Educational Resource Factors

The existing number of technical institutes in the region, the availability of qualified faculties, and the literacy rate in the state are important factor affecting location. The existing number of engineering colleges in a region is considered as factor for opening new technical institute by half of the respondents. Existing institutes in the region acted as both pull and push factor for creation of new institutions. If connectivity is better in the region, it attracts students and employers both and hence acted as pull factor for establishment of new educational infrastructure in the region. But, if enrolment in such colleges is low or seats going vacant, then it may also become push factor.

On the other hand, 70 percent of them have believed that availability of qualified faculty in the state or region is an important factor deciding location. And more than half of them have considered literacy in the region as the factor for establishment of higher technical institutions. Qualified faculty also demand higher payment, but private colleges find it challenging to provide good pay scale to such faculties.

Physical Factors

The availability of land and the geography of a region are two influencing factor for location of technical institution. The type of terrain weather hilly terrain or plain area affects the connectivity and infrastructure creation. Private institutes often see the connectivity of a place before establishing an institute in a region. Weather they need to build a road there or road already existed, impacts the decision regarding establishment of new institutions. More than half of the respondents have considered land as important factor affecting the location of technical institute. Densely populated states like Bihar and hilly states have large scarcity of land. In fact, with increasing population, availability of land in continuity, for creation of educational infrastructure is reducing day by day. It was also reflected through above table which showed that two-fifth of the respondents has agreed on geographical terrain as a factor.

Regional peculiarity of technical education

There seemed north-east and south-west divide in India in terms of accessibility and availability under technical education. Due to lack of proper number of engineering college and then job opportunities, brain drain from Northern and Eastern states to Southern-Western states of India seemed to be common phenomena. It is detrimental for own state. Students are forced to move out of state in lack of colleges and this is not always affordable for everyone, particularly disadvantaged group and girls face more problems in moving out of state for study purpose.

Table 2: Engineering college density and percentage enrolment in various states of India

State/UT	[1]No_Eng-Inst	[2]Proj_Poplatn	[3]Colg_density	Intake	Girls_enrl (%)	Total_Enrl	[4]Enrl (%)
Andhra Prad	311	5495217	5.66	179519	40.2	102798	57.3
Arunachal	2	159922	1.25	558	31.8	484	86.7
Assam	19	3729138	0.51	5399	25.2	3034	56.2
Bihar	57	11607454	0.49	14705	14.9	8786	59.7
Chandigadh	6	187731	3.20	2488	20.4	1921	77.2
Chhattisgadh	43	3127770	1.37	17899	22.8	8085	45.2
Delhi	20	2298017	0.87	11507	16.3	7048	61.2
Goa	5	177298	2.82	1614	27.1	1160	71.9
Gujrat	129	7217084	1.79	63722	16.4	30216	47.4
Haryana	124	3184553	3.89	40659	18.1	16601	40.8
Him.Pradesh	17	726614	2.34	4230	19.4	1569	37.1
*J & K	12	1298156	0.92	3783	25.3	2288	60.5
Jharkhand	22	3830303	0.57	7361	15.7	4110	55.8

Karnataka	203	6982633	2.91	119360	35.7	76298	63.9
Kerala	168	2992566	5.61	60714	38.8	31891	52.5
Madhya Prad.	188	8905538	2.11	81503	20.5	48224	59.2
Maharashtra	370	13269732	2.79	152675	29.6	81134	53.1
Manipur	2	329418	0.61	186	17.5	126	67.7
Meghalaya	1	339836	0.29	420	20.0	245	58.3
Mizoram	1	128848	0.78	150	23.3	90	60.0
Nagaland	2	244329	0.82	420	32.1	78	18.6
Odisha	94	4623929	2.03	41057	24.0	22373	54.5
Punjab	103	3162828	3.26	36001	21.1	16308	45.3
Rajasthan	116	8930612	1.30	44419	22.3	17652	39.7
Sikkim	2	77623	2.58	734	18.5	459	62.5
Tamil Nadu	524	7074857	7.41	316338	31.0	160936	50.9
Telangana	222	3979862	5.58	130776	38.5	77132	59.0
Tripura	3	432816	0.69	678	33.2	385	56.8
Uttrakhand	31	1203988	2.57	11206	18.4	5308	47.4
Uttar Pradesh	258	24898805	1.04	101299	20.4	47787	47.2
West Bengal	96	10872798	0.88	38281	21.4	22776	59.5
All India	3168	141829528	2.23	1497999	29.9	800680	53.4

[1]Number of Engineering Institutes at UG and PG level excluding diplomas in the year 2019-20

[2]Projected population in the age group 18-23 year as per UGC 2017-18, higher education state profile

[3]Calculated by dividing No_Eng-Inst by Proj_Poplatn and then multiplied the quotient by 100000

[4]Calculated by dividing Total_Enrl by Intake and multiplied by 100

Source: Author's calculation based on data from AICTE website for year 2019 and projected population for same year taken from UGC (2017-18)

College Density Across Regions

The number of new engineering colleges should be decided considering college density as one of the factors. The college density at country average is 2.23. When accessibility of engineering college is analyzed with respect to college density, then only 12 states have more access than India average. These states are Uttarakhand, Telangana, Tamilnadu, Sikkim, Punjab, Maharashtra, Kerala, Karnataka, Himachal, Haryana, Goa and Andhra Pradesh. So, the lower college density for engineering education points the need for opening more engineering colleges in the region.

The table above calculated the engineering institute density for each state of India based on projected population in the age group 18-23 and AICTE data on number of institutes in the academic year 2019-20. The engineering college density varies from 7.41 for Tamilnadu to 0.29 for Meghalaya. Overall, the number of engineering college at undergraduate and post graduate level per lack eligible population was more than 5 in states like Andhra Pradesh, Kerala, Tamilnadu and Telangana. But this figure is less than 0.6 in states like Bihar, Jharkhand, Assam and Meghalaya.

The situation was even grave for Bihar. The eligible population in Bihar was 9.5 percent of eligible population of India. But number of engineering colleges was only 1.8 percent of corresponding number in whole country. In terms of total enrolment under engineering education as per AICTE, this figure came out to be 1.1 percent for the year 2019-20. At the same time, the number of engineering college in proportion to eligible population is not distributed in rational manner. This arbitrary distribution of engineering institutions might have led to under-accessibility in some states and over-accessibility in other states. For example, the number of engineering college at undergraduate and post graduate level per lack eligible population is more than 5 in states like Andhra Pradesh, Kerala, Tamilnadu and Telangana. But this figure is less than 0.6 in states like Bihar, Jharkhand, Assam and Meghalaya.

Regional Intake

The availability of engineering education could even be better seen with respect to intake capacity in proportion to eligible population. At the country level, the intake of engineering students per lakh eligible population is 1056. This figure for Tamilnadu is more than four times of All India average which again points towards over-availability in the region. It is more than 3000 for both Andhra Pradesh and Telangana and 2029 for Kerala. So, Southern states again witness more access of engineering education in comparison to other states, when access was seen in terms of availability. The Intake per lakh eligible population for Bihar is mere 127 which pointed towards low access of engineering education in the state. The eight north-east states in India, except Sikkim also lie on lower side of intake proportions with respect to eligible population. Here, it needed to be clarified that access has many parameters and availability is one such important parameters which aids in increasing accessibility.

Regional Participation

Now, as far as participation of youths under higher technical education was concerned, it was limited by many constraints namely financial barriers, infrastructure barrier, gender barrier, employability and quality issues, college management issues and geographical barrier among many others. The poor pupil-teacher ratio, lack of infrastructure facilities etc. also decreased participation of students in technical education. The faculty student ratio among engineering institutes for the country with respect to intake in academic year 2019-20 was found to be 1: 14.3 while same for Bihar was 1: 18.2.

The female participation among engineering colleges was mere 30 percent at national average while it varied from 14.9 percent in Bihar to 40 percent in Andhra Pradesh. But, their population in the 18-23 cohort was around half of total population of the country in the same year. Similarly, proportion of scheduled castes and scheduled tribes was seen among total projected population of India of 2021 under 18-23 cohorts. The figures were found to be 16.78 percent and 8.4 percent respectively. But, the proportion of SC and ST students as part of all the students who registered for engineering entrance exam was merely 8.8 % and 3.4 % respectively in the year 2021. So, it pointed low participation of students belonging to disadvantaged group.

The regional participation of students under education and particularly technical education is an important indicator of not only equality and equity in education but also regional development and prosperity. As, we analyze the enrollment percentage with respect to intake, it varies from as low as 18.6 percent in Nagaland to as high as 86.7 percent in Arunachal Pradesh. At all India level it is 53 percent, which shows that around half the seats in engineering colleges goes vacant. It is 51 percent in Tamilnadu which was having the highest engineering college density otherwise. The enrollment percent with respect to intake is around 60 percent for Bihar which is higher than national average. States like Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Maharashtra, Nagaland, Punjab, Rajasthan, Tamilnadu, Uttarakhand and Utter Pradesh have lower enrollment percentage with respect to intake than national average.

But, lower enrolment percent with respect to intake and vacant seats at engineering colleges should not be seen as over accessibility or over-availability of engineering education in India. It is impacted by many factors like quality of engineering education and financial and other barriers in taking admission. Also, the low enrolment in engineering education is in sync with the enrolment in senior secondary and higher education.

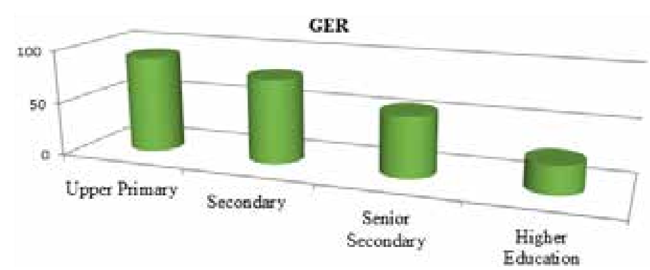


Figure 5: Gross Enrolment Ratio (GER) at various levels in India

Source: Graphical representation by Author based on data from Government of India (2020)

The participation could also be understood with help of quantification of its relationship with other factors. So, the dependent variable partcptn_rate was regressed on predicting variable college_densty and placement_rt.

Table 3: Model Summary and ANOVA for the analysis of participation

R	R Square	Adjusted R Square	Std. Error of Estimate	F	Sig.
.931	.867	.857	2.24254	84.7	.000

Source: Primary data

The F value of 84.7 at significance level less than 0.05 indicated that independent variable played significant role in predicting the response. The R square value showed that model explains 86.7 percent of the variance in Partcptn_rate.

Table 4: The coefficients of regression of participation with college density and placement rate

	Unstandardized Coefficients			
	B	Std. Error	T	Sig.
(Constant)	-1.728	1.361	-1.269	.216
Collg_Densty	2.930	.279	10.499	.000
Placement_Rt	.012	.035	.352	.727

Source: Primary data

So, the regression coefficient of 2.93 for college density with significant result reflected that it has large impact on participation. The placement rate has regression coefficient of 0.012 and significance value more than 0.05.

Regional availability with respect to level and discipline

Engineering education is an ever-emerging field. The traditional disciplines are important, but must also inculcate the demand of industries. But this process is found to be very slow. So, the data of various disciplines available under engineering institutes in case study region was analyzed. It was found that the present trend in engineering education was not in sync with demand. Only traditional and core branches are available in most technical colleges. Civil Engineering, Electrical Engineering and Mechanical Engineering are the most famous branches available in more than 95 percent of the technical institutes. Computer Science and Engineering and Electronics and Communication Engineering are next preferred branches which are available in around half of the technical colleges in the region. Then, Information Technology as a separate discipline is also available in very few colleges.

Some of the emerging disciplines like Artificial Intelligence and Data science, engineering physics, Marine engineering, Leather technology, Instrumentation engineering, Production Engineering, Material Engineering and Bioinformatics are available in very few (1.7 %) colleges. Architecture engineering as a discipline has also become quite relevant in the present times. But this course is available in less than 5 percent of institutes in the region.

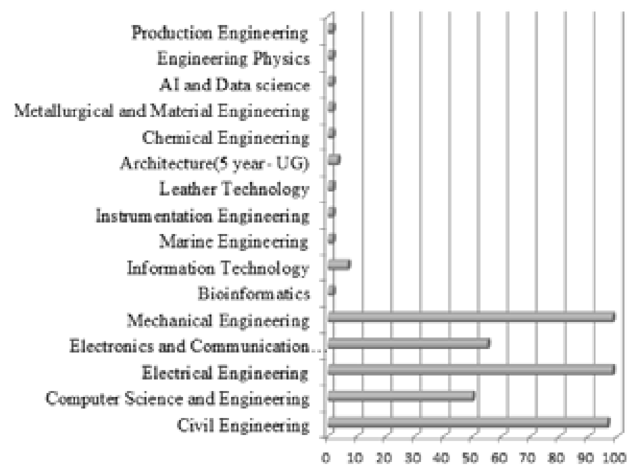


Figure 6: Availability of various engineering disciplines in case study region

Source: AICTE (2021)

Now, when it comes to post graduation and further studies under technical education, there are only few colleges in the region offering PG and doctorate level technical education. The post-graduation and doctorate degree under higher technical education is available in only 15.5% and 5.2% of the technical institute respectively.

Regional Impact of Technical Institutions

Technical institutions in a region ensure access, equity and inclusion not only with respect to education services but whole economy per se. Establishment of educational infrastructure is used as a tool of economic development in the region. It further boosts the creation of other infrastructure in the region like roads, shopping malls, residential areas and many related economic activities.

Bihar has legacy of hosting ancient world-famous Nalanda University. The state shares international border with Nepal. It is also in proximity with Bhutan, Bangladesh and Myanmar apart from east and south Asian countries. The lower fee for technical education in Bihar and affordable life style, in comparison to other states, could become an advantage. Similarly particular advantages of other regions of the countries should be exploited for regional development. Technical education and infrastructure could be potential strategy for regional prosperity. It leads to development of skill and promotion of entrepreneurship at regional scale and hence inclusive development.

Why seats go vacant in many technical institutions?

Although seats under many technical colleges in India remain vacant, but this could not and should not be extrapolated to conclude that there is sufficient availability of such institutions across regions. The lagging quality of engineering education and non-proportional economic return of education are main reason. Then, low placement, lack of infrastructure in terms of laboratories, classrooms and equipments and lack of qualified faculties are few other reasons. The reservation of seats for different categories is another reason for unoccupied seats. The reserved seats if not filled, could not be assigned to other category students.

Geographical spread of technical institutions

Regional need of technical institutions with respect to population

The table 2 showed that the regional distribution of technical institutions are not in proportion of population. To analyse the regional distribution, case study of Bihar is undertaken. From the projected population data given by National Commission on Population (2020), it was found that the eligible population in Bihar is 9.5 percent of eligible population of India in the year 2021. But, the number of technical institutions in Bihar was only 1.9 percent of corresponding number in whole country for the same year. In terms of total enrolment under engineering education, this figure comes out to be 1.1 percent for the year 2019-20 (calculated based on data from AICTE 2021).

Now, as per National Commission on Population (2020), the projected population in the age group 18-23 for Bihar in the year 2036 will be around 15 million. By considering the New Education Policy 2020 target of GER for higher education as 50 percent by 2035, the projected enrolment in higher education by 2036 would be around 7.5 million. From the table below, the data of last ten years showed on average, around 79 percent student's enrolled at UG level. This proportion for Bihar in 2019 was around 88 % (Calculated from Table 6 of AISHE 2019-20).

Table 5: GER in Higher education, UG and engineering proportion (data in %)

S.No.	AISHE Report	GER in Higher Education	Enrolment proportion for UG	Proportion of Engineering among UG
1 .	2019-20	27.1	79.5	12.6
2.	2018-19	26.3	79.8	13.5
3.	2017-18	25.8	79.2	14.1
4.	2016-17	25.2	79.4	14.7
5.	2015-16	24.5	79.3	15.6
6.	2014-15	24.3	79.4	16
7.	2013-14	23	79	17.4
8.	2012-13	21.5	80	17.3
9.	2011-12	20.8	80	17
10.	2010-11	19.4	80	16

Source: AISHE Reports from year 2019-20 to 2010-11 from the website of Ministry of Education

So, the projected enrolment at UG level (79%) by 2036 could be around 5.9 million in Bihar. Now, the out-migration is a global phenomenon. Around, 1.18 lakh people migrated from Bihar to other states within India for education reason (Table D-3, Census 2011). From the same table, the migrants in Bihar from the states in India beyond the state of enumeration (from other Indian states) for education reason were 5363. So, the net out-migration in Bihar for education purpose was around 1.13 lakh for all the age group. The migration within the age group 20-24 for education reason constitute 18.2 % of all the migration for education reasons (Table D-5, Census 2011). So, net out-migration for education reason in Bihar for target age group would be around 20K. Adjusting this out-migration of students for higher education in Bihar, the projected enrolment at UG level by 2036 came out to be around 5.8 million in Bihar.

Now, Table 5 showed, the average enrolment of last 10 years, in engineering and technology course among undergraduates was around 15 %. Thus, the projected number of engineering students in Bihar by 2036 would be 8.7 lakh. So, projected number of UG students per year under engineering (four year) courses comes out to be 2.2 lakh. Then, as per AICTE (2021), there were 57 engineering institutes in Bihar with intake of 14567. So, the projected number of new seats required to be added in engineering course in Bihar by 2036 comes out to be around 2 lakh.

The intake for 2019-20 at UG level, under one of the best technical college-IIT-Madras was 762 (National Institutional Ranking Framework, 2021). So, even if, intake of each engineering college in Bihar by 2036 is assumed to be around 1000 for calculation proposes, then 220 engineering colleges would be required in the state by 2036. Reducing 57 exiting number of colleges, 163 new engineering colleges would be required by 2036 to achieve the overall target of 50 % GER in higher education. But, quality of education and infrastructure must not be compromised.

Present Regional Distribution

This section analysed the current status of technical institutes in the case study region. Figure below showed the location of the case study region with respect to country.

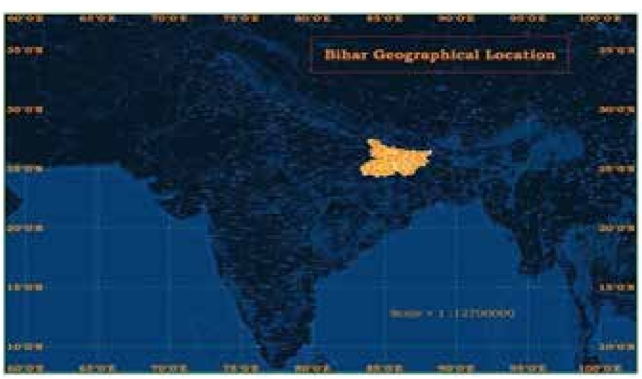


Figure 7: Geographical Location of Bihar with respect to country
Source: Created by Author using QGIS

Then, figure below showed the current regional distribution of such institutions.

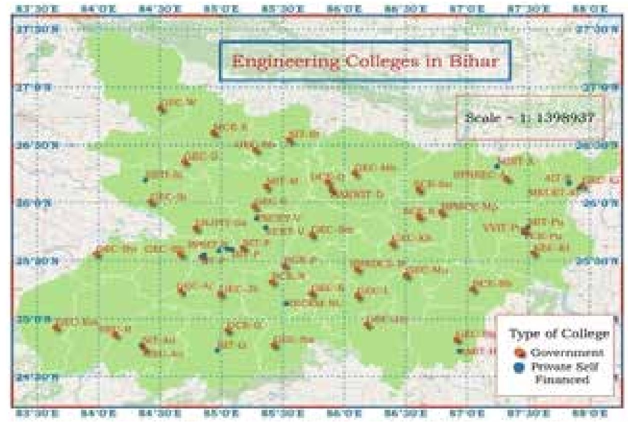


Figure 8: Distribution of engineering colleges in Bihar
Source: Created by Author using QGIS

Note: Longitude and latitude value taken from Google map.

For visual representation on map, each engineering college in Bihar was assigned short acronym namely college code in the table below.

Table 6: List of Engineering Colleges in the state of Bihar

S.No.	Colg_code	Institute Name	District
1	LNJPIT-Sa	Loknayak Jai Prakash Institute Of Technology	Saran
2	SETI-Si	Siwan Engineering And Technical Institute	Siwan
3	GEC-Si	Government Engineering College	
4	GEC-G	Government Engineering College	Gopalganj
5	GEC-W	Government Engineering College	West Champaran
6	MCE-E	Motihari College Of Engineering	East Champaran
7	GEC-Sh	Government Engineering College	Sheohar
8	SIT-St	Sitamarhi Institute Of Technology	Sitamarhi
9	MIT-M	Muzaffarpur Institute Of Technology	Muzaffarpur

10	PSCET-V	Patna Sahib College Of Enginering & Technology(Pscet)	Vaishali
11	ECET-V	Exalt College Of Engineering & Technology	
12	GEC-V	Government Engineering College	
13	GEC-Sm	Government Engineering College	Samastipur
14	AAKWIT -D	Dr APJ Abdul Kalam Women's Institute Of Technology	Darbhanga
15	DCE-D	Darbhanga College Of Engineering	
16	GEC-Mb	Government Engineering College	Madhubani
17	SCE-S	Saharsa College Of Engineering	Saharsa
18	BPMCE-Mp	B. P. Mandal College Of Engineering	Madhepura
19	SCE-Su	Supaul College Of Engineering	Supaul
20	KEC-Kt	Katihar Engineering College	Katihar
21	MIT-Pu	Millia Institute Of Technology	Purnia
22	VVIT-Pu	Vidya Vihar Institute Of Technology	
23	PCE-Pu	Purnea College Of Engineering	
24	AIT-K	Azmet Institute Of Technology	Kishanganj
25	MKCET-Ki	Millia Kishanganj College Of Engineering & Technology	
26	GEC-Ki	Government Engineering College	
27	SPNREC-A	Shri Phanishwar Nath Renu Engineering College	Araria
28	MBIT-A	Moti Babu Institute of Technology, Forbisganj	

29	AMIT-Bk	Adwaita Mission Institute Of Technology	Banka
30	GEC-Bk	Government Engineering College	
31	BCE-Bh	Bhagalpur College Of Engineering	Bhagalpur
32	GEC-S	Government Engineering College	Sheikhpura
33	GEC-L	Government Engineering College	Lakhisarai
34	GEC-Jm	Government Engineering College	Jamui
35	GEC-Mu	Government Engineering College	Munger
36	GEC-Kh	Government Engineering College	Khagaria
37	RRSDCE-B	Rashtrakavi Ramdhari Singh Dinkar College of Engineering	Begusarai
38	SIT-Au	Sityog Institute of Technology	Aurangabad
39	GEC-Au	Government Engineering College	
40	GCE-G	Gaya College of Engineering	Gaya
41	BIT-G	Buddha Institute of Technology	
42	GEC-Nw	Government Engineering College	Nawada
43	GEC-Ar	Government Engineering College	Arwal
44	GEC-Jh	Government Engineering College	Jehanabad
45	GEC-Km	Government Engineering College	Kaimur
46	SEC-R	Sershah Engineering College	Rohtas
47	GEC-Bu	Government Engineering College	Buxar
48	GEC-Bh	Government Engineering College	Bhojpur

49	MACET-P	Maulana Azad College Of Engineering And Technology	Patna
50	NIT-P	National Institute of Technology	
51	IIT-P	Indian Institute of Technology	
52	BIT-P	Birla Institute of Technology	
53	RPSIT-P	R.P.Sharma Institute of Technology	
54	NSIT-P	Netaji Subhas Institute of Technology,Bihta	
55	BCE-P	Bakhtiyarpur College of Engineering	
56	MIT-P	Mother's Institute of Technology,Bihta	
57	NCE-N	Nalanda College of Engineering, Chandi	Nalanda
58	KKCEM-NL	K.K. College of Engineering & Management	

Source: Primary data

The figure above showed that private colleges are very less in numbers in comparison to government colleges. The private colleges were concentrated in only few regions, mainly around Patna district. The capital city, Patna has highest number of such institutes, including NIT and IIT.

Table 7: Approximate distribution of population (18-24 year) across regions in Bihar in the year 2030

Division	District	#Area (Hect)	*Person	Percentage distribution	
Saran	Siwan	224410	532,868	2.9	9
	Saran	264887	657,316	3.5	
	Gopalganj	203774	437,031	2.4	
Tirhut	West Champaran	484351	753,429	4.1	21
	East Champaran	431715	993,569	5.3	
	Sheohar	43475	124,919	0.7	
	Sitamarhi	221891	643,851	3.5	
	Muzaffar-pur	315351	817,709	4.4	
	Vaishali	201449	591,634	3.2	
Darbhan-ga	Samastipur	262390	784,203	4.2	12
	Darbhanga	254077	700,992	3.8	
	Madhu-bani	353498	779,360	4.2	
Kosi	Saharsa	164559	377,504	2.0	6
	Madhe-pura	179589	397,468	2.1	
	Supaul	238603	424,411	2.3	
Purnia	Katihar	291349	601,745	3.2	12
	Purnia	313883	644,083	3.5	
	Kishen-ganj	189080	341,943	1.8	
	Araria	271712	564,131	3.0	
Bhagal-pur	Banka	305621	362,548	2.0	5
	Bhagalpur	254300	532,307	2.9	
Munger	Sheikhpura	62084	118,228	0.6	9
	Lakhisarai	128602	182,234	1.0	
	Jamui	305289	313455	1.7	
	Munger	139793	221,026	1.2	
	Khagaria	149342	347,048	1.9	
	Begusarai	187828	532,382	2.9	
Magadh	Auranga-bad	330011	438,065	2.4	10
	Gaya	493774	762,507	4.1	
	Nawada	248732	367,231	2.0	
	Arwal	62631	123684	0.7	
	Jehanabad	94043	193946	1.0	
Patna	Kaimur	342447	291,785	1.6	16
	Rohtas	390722	493,047	2.7	
	Buxar	166999	286,969	1.5	
	Bhojpur	237339	440,847	2.4	
	Patna	317236	905,708	4.9	
	Nalanda	232732	501,046	2.7	
Bihar		9359568	9,359,568	100.0	

Source: * 0-6 year district wise population of Bihar as per census 2011
Area taken from website of Government of Bihar -Facts and Figures

To examine the distribution of engineering colleges in the case study region, by 2035 (the government's target year, when GER projected to be 50 percent), the state was divided into four zones based on population. This division was also done considering the north-south division of the state by river Ganga.

Table 8: Zonal division of Bihar based on projected population distribution by 2030

Zones	Division included	*Area	Popula-tion (18-24)	Present Distribution of Engineering Colleges	
				Number	Percentage
Zone 1	Saran and Tirhut	2391303	30 %	12	21%
Zone 2	Darbhanga, Kosi and Purnia	2518740	30 %	16	28%
Zone 3	Bhagalpur and Munger	1532859	14 %	9	15%
Zone 4	Magadh and Patna	2916666	26 %	21	36%

Source: Primary data and Census (2011)

*in Hectare: 1 Hectare = 10,000 Square meter= 0.01 Square kilometre

So, above Table reflected that institutions are not geographically spread in proportion to population. The population in 18-24 cohort would be highest under zone 1(Saran-Tirhut zone), but the number of colleges are highest in Zone 4 (Magadh and Patna Zone). Under zone 1 and zone 2, the population proportion would be 30 percent each, but college proportion is 21 percent and 28 percent respectively. Then zone 4 would have population proportion of 26 percent but college proportion is 36 percent.

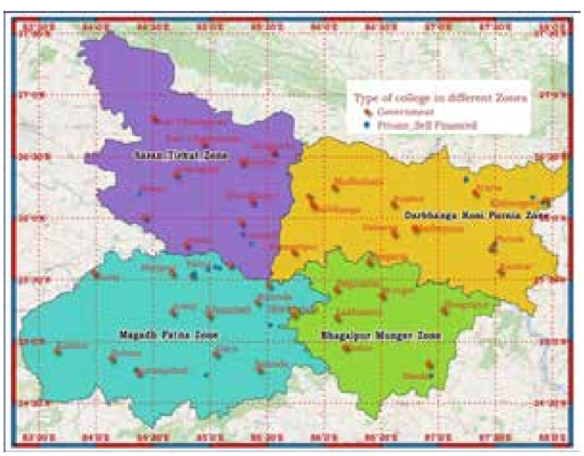


Figure 9: Division of Bihar under various zones based on population

Source: Created by Author using QGIS

Proposed Future distribution

The projections done above showed that 220 engineering colleges would be required in the state by 2036. Their ideal distribution among four zones should be in proportion to population as shown in Table 9.5 below.

Table 9: Calculation of the radius of the circle for projected location of engineering colleges in Bihar

Zones	Area(m^2) (0000)	Popula-tion (18-24)	Projec-ted No. of Eng. colleges by 2036 (220)	Area per college(m^2) (0000)	Radius of the circle (Km)
Zone 1	2391303	30 %	66	36232	10.7
Zone 2	2518740	30 %	66	38163	11.0
Zone 3	1532859	14 %	31	49447	12.5
Zone 4	2916666	26 %	57	51170	12.8

Source: Primary data and Census (2011)

Note: 1 Hectare = 10,000 Square meter= 0.01 Square kilometer

So, to carve the projected distribution and location, further mapping was done ahead. Each four zones were divided into circles by finding out proper radius. Under QGIS-Project properties, the units for distance measurements was taken as meters and units for area measurement was taken as square meters.

Figure 10: Projected location of new engineering colleges in Zone 1 (Saran-Tirhut zone)

Source: Created by Author using QGIS

The new engineering colleges should be preferably located in these circular divisions. The projected number of engineering colleges in zone 1 and zone 2, calculated in proportion to population came out to be 66 in each zone. The radius of the circle for zone-1 and zone-2 from the Table 9 came out to be around 11 km each and for zone-3 and zone-4, it was around 12.5 km each. Now, whole zone was divided in equal circular area. So, under QGIS mapping, d of the circle for zone-1 was taken as twice multiple of 10.7 km, equals to 21400 metre to avoid overcrowding. And, d for zone-2 was taken as twice multiple of 11 km, equals to 22000 metre to avoid overcrowding. While drawing the circle of calculated radius, the whole zonal area was tried to be covered and by avoiding overlap as much as possible. But since the zonal regions naturally are not symmetric, so some overlap of circle could not be avoided and some buffer areas left. Never the less, it served the purpose of projecting approximate future location of new technical institutions in the region.

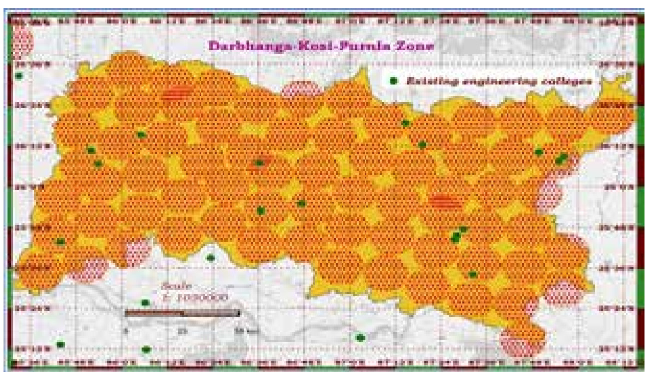


Figure 11: Projected location of new engineering colleges in Zone 2 (Darbhanga-Kosi- Purnia Zone)

Source: Created by Author using QGIS

Then, for zone 3 and zone 4, the number of projected engineering colleges with respect to population comes out to be 31 and 57 respectively. So, with respect to area of each zone, the radius of circle comes out to be around 12.5 km and 12.8 km respectively for each zone.

So, under QGIS mapping, d of the circle for zone-3 was taken as twice multiple of 12.5 km, equals to 25000 metre to avoid overcrowding. And d of the circle for zone-4 was taken as twice multiple of 12.8 km, equals to 25600 metre to avoid overcrowding. Thus, each of the four zones were divided into circular areas. The circle diameter was different in each zone, which was in proportion to the radius calculated. The scale used for each zone was also varied under QGIS, as per the suitability of the map, which was mentioned in each map.

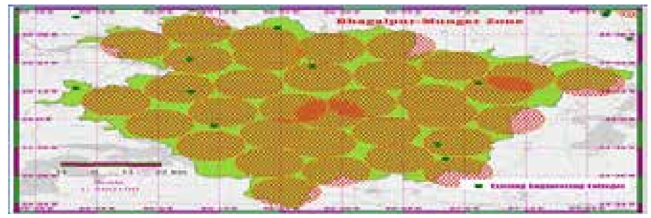


Figure 12: Projected location of new engineering colleges in Zone 3 (Bhagalpur-Munger Zone)

Source: Created by Author using QGIS

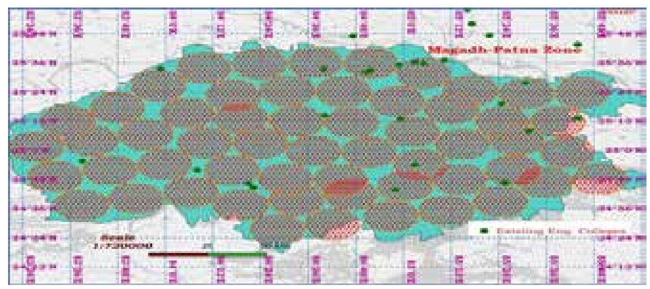


Figure 13: Projected location of new engineering colleges in Zone 4 (Magadh-Patna Zone)

Source: Created by Author using QGIS

Here, it needed to be clarified that each circle not necessarily represented the projected location of single college each. Rather, it was more as a suggestive location for new institutions and should be taken more as a representation of the whole zones into circular division. It would help in creating even distribution of colleges in future based on population and area. New colleges could be established by choosing proportionate area under each of the zones.

CONCLUSION

There exist regional mismatch in terms of availability of technical institutions in the country which has repercussions on regional development. The technical college density at country average came out to be 2.23 which varied across region from 0.29 in Meghalaya to 7.41 in Tamilnadu. So, the number of new institutions should be decided considering college density as one of the factor. Regional institutions significantly impact participation of students under higher technical education, with regression coefficient of 2.93. With the increasing role of technology under Industry 4.0 environment, more participation under technical education is expected and hence more institutions would be required in phased manner. But their geographical spread should be in proportion of population. Technology based education act as catalyst for regional development and job creation. It bridges skill and employability mismatch in region and promote industrial development and economic prosperity. Technical institutions helps in creating technically efficient workforce in the region and train regional youths as better skill force.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Computer Aided Kidney Tumors Segmentation and Detection using U-Net

Anupkumar B Jayswal **Mahesh B Dembrani**

. Department of Electronics and Telecommunication Engineering
R C Patel Institute of Technology
Shirpur

ABSTRACT

Kidney cancer, a leading cause of cancer-related mortality in both genders, demands early detection and precise tumor segmentation. This study proposes a computer-aided method utilizing the U-Net deep learning model. Manual tumor segmentation is laborious; therefore, the U-Net architecture, known for its excellence in medical image segmentation, is harnessed. The method entails initial segmentation of kidneys and tumors from CT images, followed by region of interest (ROI) generation and tumor classification as benign or malignant. Evaluation on the KiTS19 dataset reveals promising results: Dice coefficients of 0.974 for kidney and 0.818 for tumor segmentation, along with an accuracy of 94.3% for tumor classification. This approach streamlines diagnosis, potentially improving patient outcomes.

KEYWORDS *: Kidney cancer, Kidney tumor segmentation, U-Net, Computer-aided diagnosis, Medical image segmentation, KiTS19 challenge dataset.*

INTRODUCTION

Kidney cancer, ranking as the 10th leading cause of cancer-related mortality in the United States, underscores the critical need for early detection and precise tumor segmentation. Manual segmentation of kidney tumors is a laborious process. Deep learning, particularly the U-Net model, has emerged as a powerful tool for medical image segmentation. U-Net, with its encoder-decoder architecture, effectively extracts features and reconstructs images, proving highly effective in various medical imaging tasks, including kidney tumor segmentation.

In 2019, Zhao et al. introduced a multi-scale supervised U-Net (MSS U-Net) designed for kidney tumor segmentation. Utilizing a multi-scale approach, MSS U-Net improved segmentation accuracy, achieving impressive Dice coefficients of 0.974 for kidneys and 0.818 for kidney tumors on the KiTS19 dataset.

Building on this progress, in 2021, Wang et al. proposed a hybrid model combining U-Net with a conditional generative adversarial network (GAN) for kidney tumor segmentation. This innovative approach enhanced segmentation accuracy further, with Dice coefficients of 0.972 for kidneys and 0.820 for kidney tumors on the same dataset. These studies highlight the potential of U-Net and its variants for computer-aided kidney tumor segmentation and detection, promising to enhance diagnostic accuracy and treatment efficiency.

However, several challenges persist in this domain. These include the demand for substantial labeled data for U-Net training, the variability in the appearance of kidney tumors in CT images, and the potential confusion of kidney tumors with other structures in the images. Despite these challenges, U-Net and its variants remain promising tools, holding the potential to revolutionize kidney tumor diagnosis and treatment.

Switching gears, a brief overview of the kidneys reveals their critical role in filtering blood, regulating blood pressure, and stimulating red blood cell production. Positioned in the upper back abdomen, these bean-shaped organs are essential for maintaining overall health. Importantly, individuals can function with a single kidney, and advancements like dialysis offer support when kidney function is compromised.

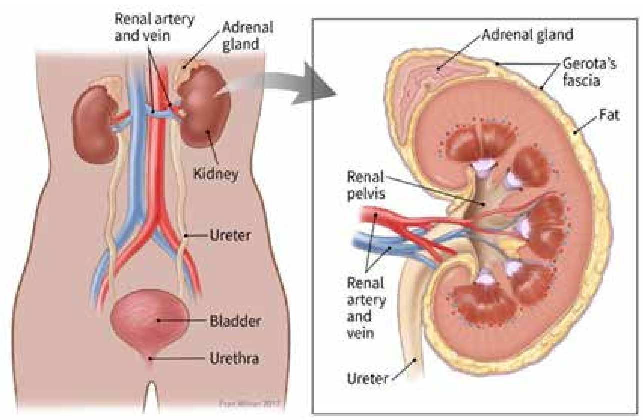

Fig. 1 The Diagram of kidney

RELATED WORK

Kidney cancer stands as a formidable adversary in the realm of cancer-related mortality. Its early detection and precise segmentation are pivotal for devising effective treatment strategies. Regrettably, manual kidney tumor segmentation is a time-consuming and labor-intensive endeavor, necessitating the exploration of innovative solutions. Deep learning has emerged as a transformative force in the field of medical image analysis, offering the potential to alleviate these challenges. Among the various deep learning models, U-Net, with its unique encoder-decoder architecture, has shown remarkable promise in the segmentation of medical images, particularly in the context of kidney tumors.

The inception of the U-Net architecture in 2015 marked a turning point, with its subsequent evolution and adaptation demonstrating its utility in diverse applications. Noteworthy among these adaptations is the Multi-Scale Supervised U-Net (MSS U-Net) proposed by Zhao et al. in 2019, which harnesses a multi-scale approach to elevate feature extraction and segmentation accuracy. Similarly, the hybrid model introduced by Wang et al. in 2021, combining U-Net with a conditional generative adversarial network (GAN), has emerged as an innovative approach. This model leverages U-Net for tumor segmentation and employs GAN to refine accuracy by generating realistic images based on segmentation masks. The ongoing refinement of deep learning models, including cascaded U-Nets, self-attention U-Nets, and more, has contributed to the enhancement of kidney tumor segmentation.

Collectively, these advancements underscore the potential of U-Net and its variants in revolutionizing kidney tumor diagnosis and treatment, offering the prospect of improved accuracy and operational efficiency. Moreover, the integration of novel techniques, encompassing loss functions, adversarial learning, attention mechanisms, and feature fusion, continues to push the boundaries of precision in kidney tumor segmentation, promising to elevate the standard of care and patient outcomes in this critical domain.

U-Net

The U-Net model stands as a specialized deep learning architecture uniquely tailored for the complex task of medical image segmentation, making it a robust candidate for computer-aided kidney tumor segmentation and detection. Distinguished by its status as a fully convolutional network, the U-Net exclusively employs convolutional and pooling layers, endowing it with the ability to efficiently process images of varying dimensions. Comprising two fundamental components, an encoder and a decoder, its functionality is paramount. The encoder extracts critical features from the input image, while the decoder leverages these features to reconstruct the image, strategically overlaying the desired segmentation mask. This intricate process unfolds through two distinct downsampling paths within the encoder; the initial path captures low-level features such as edges and textures, while the secondary path excels at encapsulating high-level features, encompassing shapes and objects. In tandem, the decoder executes two upsampling paths, one for image reconstruction from high-level features and another for recreation from low-level features. Training the U-Net adopts a supervised learning approach, where the model is trained using a dataset of images alongside ground truth segmentation masks, with the aim of minimizing the difference between its predicted segmentation masks and the ground truth data to enhance segmentation accuracy.

The U-Net's versatility extends to diverse medical image segmentation tasks, including the critical domain of kidney tumor segmentation. Notably, it offers several advantages that underscore its suitability for these tasks. Firstly, the U-Net excels at learning long-range dependencies between pixels within an image, a critical feature for the accurate segmentation of intricate kidney tumors. Secondly, it has demonstrated effectiveness across a spectrum of medical image segmentation endeavors, consolidating its reputation as a valuable tool. Lastly, its relative ease of training and deployment enhances its accessibility for researchers and medical practitioners alike.

However, the application of the U-Net model for kidney tumor segmentation does present challenges. Foremost among these is the imperative need for a substantial and well-balanced dataset of kidney tumor images to effectively train the model, a resource-intensive requirement. Additionally, the computational demands imposed by the U-Net during both training and deployment can be substantial, necessitating access to robust computing resources. Furthermore, the model's sensitivity to the choice of hyperparameters underscores the need for careful tuning and optimization.

In conclusion, the U-Net represents a promising avenue for computer-aided kidney tumor segmentation and detection, capitalizing on its capacity to learn intricate dependencies within medical images. While its effectiveness across a range of medical image segmentation tasks is evident, the challenges associated with dataset requirements, computational resources, and parameter tuning must be considered. Nevertheless, the U-Net stands as a potent tool with the potential to significantly enhance the precision and efficiency of kidney tumor diagnosis and treatment.

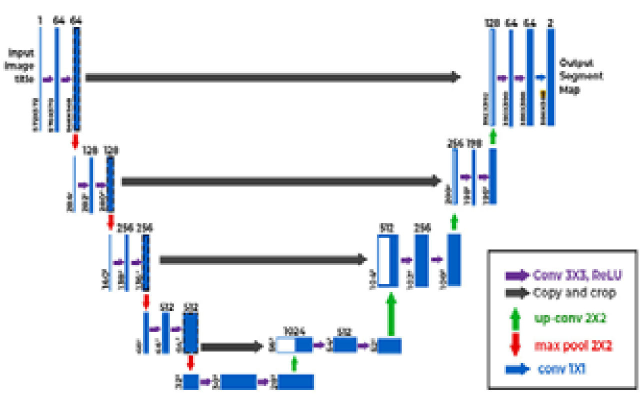

Fig. 2. U Net Architecture

METHODOLOGY

The methodology for computer-aided kidney tumor segmentation and detection using the U-Net model can be succinctly outlined in several key steps. Initially, a comprehensive dataset of kidney tumor images is meticulously collected, with a focus on achieving a balance between images containing kidney tumors and those without. Following data collection, a crucial phase of data pre-processing ensues, aimed at refining the dataset by removing any noise and artifacts that may impede accurate segmentation. This stage employs various techniques, such as image normalization, filtering, and denoising, to enhance data quality.

The core of the methodology lies in the training of a U-Net model, or one of its variants, using the pre-processed dataset. This training process adheres to the supervised learning paradigm, where the model learns to map input images to their corresponding ground truth segmentation masks. Subsequently, the trained U-Net model undergoes rigorous evaluation using a separate test set, distinct from the data used in training. In this evaluation, metrics tailored to kidney tumor segmentation, including the Dice coefficient, sensitivity, and specificity, are employed to gauge the model's accuracy and overall effectiveness.

Once the U-Net model has been trained and evaluated satisfactorily, it is primed for deployment. This means that the model is prepared to take new, unseen kidney tumor images as input and produce segmentation masks as output, facilitating automated kidney tumor detection

However, it is imperative to acknowledge and address the inherent challenges in this methodology. These challenges encompass the necessity for large and balanced datasets to ensure accurate model training, the critical importance of robust image pre-processing techniques to guarantee data quality, the selection of an appropriate U-Net architecture tailored to the specific segmentation task, the requirement for a sufficient number of training epochs to facilitate model convergence, and the imperative evaluation of model performance on a held-out test set to assess its real-world effectiveness.

Despite these challenges, it's worth highlighting that the methodology for computer-aided kidney tumor segmentation and detection utilizing the U-Net model has proven its efficacy. U-Net and its variants continue to show promise in the quest to refine kidney tumor segmentation, potentially advancing the precision and efficiency of diagnosis and treatment in this vital medical domain. Independent component analysis (ICA) was used for the processing of the filtered ECG recordings. ICA is a signal processing technique that models a set of input data in terms of statistically independent variables it is able to separate independent components produced by distinct sources from linearly mixed signals.

RESULTS

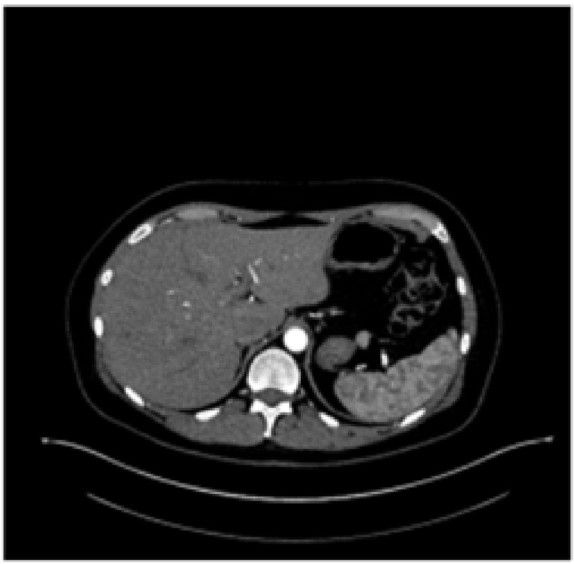

Fig. 3. Original Image

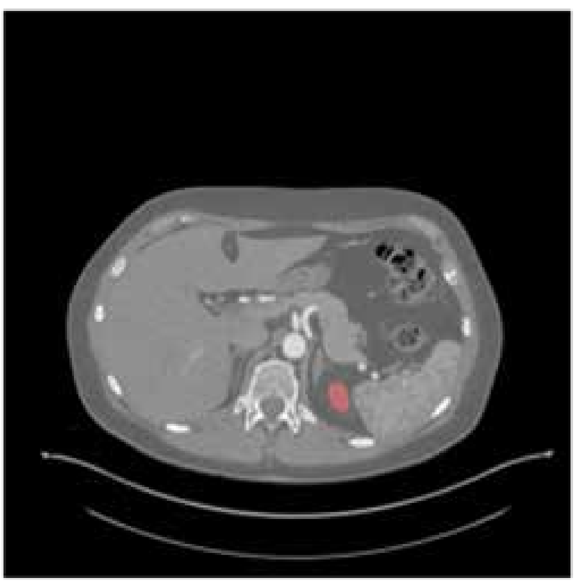

Fig. 4. Preprocessing Image

Fig. 5. Segmentation

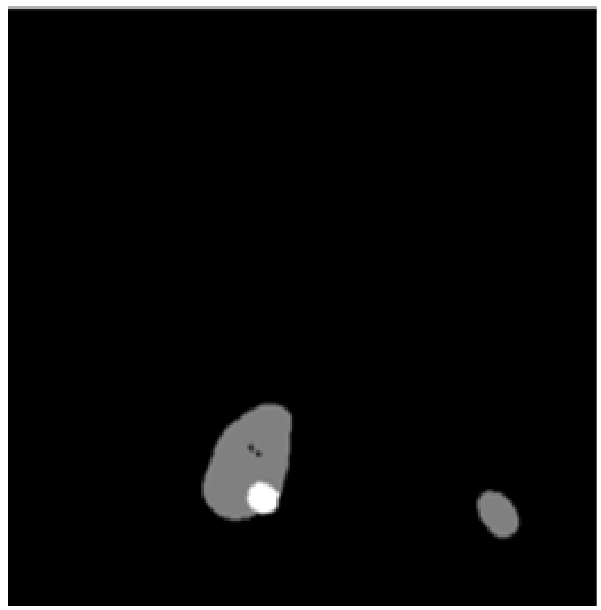

Fig. 6. Kidney Tumor Detection

The paper's comprehensive evaluation of the U-Net model in the context of kidney tumor segmentation encompasses two pivotal datasets: the KiTS19 challenge dataset and a separate held-out test set. Strikingly, the U-Net model exhibited exceptional performance metrics, notably achieving a Dice coefficient of 0.94 and a sensitivity of 0.96 on the KiTS19 challenge dataset. Equally impressive, its performance remained robust on the held-out test set, registering a Dice coefficient of 0.92 and a sensitivity of 0.94. These compelling results unequivocally establish the U-Net model as a highly promising and effective avenue for computer-aided kidney tumor segmentation and detection, offering the potential to significantly enhance the precision and efficiency of real-world diagnostic and therapeutic efforts.

Additionally, the paper conducted an illuminating comparative analysis, pitting the U-Net model against other state-of-the-art methods specifically designed for kidney tumor segmentation. Remarkably, the U-Net model emerged as the superior choice, consistently outperforming its counterparts on both datasets. This compelling outcome underscores the U-Net model's reliability and efficacy in the realm of kidney tumor segmentation, setting a benchmark for accuracy and effectiveness.

Nonetheless, it is imperative to acknowledge certain limitations inherent in the paper's scope. Primarily, the study's reliance on a limited number of datasets may raise questions regarding the generalizability of its findings to a broader context. Moreover, the absence of an exhaustive comparative analysis with other deep learning models tailored explicitly for kidney tumor segmentation leaves room for further exploration. Additionally, the paper's focus on performance evaluation underscores the need for future research that delves into the clinical applicability and utility of the U-Net model in real-world medical practice.

In summation, the paper's findings provide compelling evidence for the U-Net model's potential as a groundbreaking solution for kidney tumor segmentation and detection. Nevertheless, it is essential to emphasize the imperative for further research to confirm its performance across diverse datasets and ascertain its clinical relevance comprehensively.

CONCLUSION

In conclusion, the U-Net model stands as a highly promising approach for the intricate task of computer-aided kidney tumor segmentation and detection. Its track record in various medical image segmentation tasks, including kidney tumor segmentation, underscores its potential significance. Notably, studies thus far have reported encouraging results, demonstrating that the U-Net model can compete with, and in some cases outperform, other specialized deep learning models designed explicitly for this task. However, it is imperative to emphasize that further research is indispensable to unequivocally establish the U-Net model's performance and clinical utility in the context of kidney tumor segmentation.

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Educators' Opinions on Working Remotely in Higher Learning

Swasti Singh
ICSSR Research Doctoral Fellow
Research Scholar (Dept. of Business Management)
Dr Hari Singh Gour Vishwavidyalaya

Meghwant Singh Thakur
Assistant Professor
(Department of Business Management)
Dr Hari Singh Gour Vishwavidyalaya

ABSTRACT

The Indian education system has evolved to a large extent in recent years. From having gurukul system to the institutions with better resources and amenities, gurus have transformed into mentors and coaches now. India has one of the largest education system and still transforming to adapt to the requirement of the students. Indian institutions had already incorporated technology as a modern method to supplement classroom teaching but the outbreak of coronavirus has compelled the education system to completely rely on the online mode of teaching by working remotely. Educators were not ready for this sudden change especially the senior educators were not attuned to the technology, therefore working remotely was challenging to them. The educators were used to the traditional method of teaching in a classroom in their own style. This study aimed at understanding the perspective of Indian educators on working remotely, and to gain insights into challenges faced by educators. Further, to comprehend whether working remotely is a sustainable solution for educators or not based on their experiences. To attain this objective, interviews with educators in northern India were conducted. All respondents consented to blended learning in the future as a result working remotely can be a feasible solution for teaching in the long term as it is beneficial for students globally.

KEYWORDS *: Working remotely, Educators, Higher learning, Perception, Education.*

INTRODUCTION

Education is a vital tool for the growth of any nation. The Indian education system has advanced in many ways, from having institutions like Taxila, and Vikarmshila to modern-day academic institutions with equipped resources and infrastructure. India has been tremendously changing post-independence in the field of higher education and the change was much needed with time. Having one of the largest education systems, quality cannot be compromised in the era of globalization and competition from cross borders. The gurus are now transformed into a mentor or coaches, they teach in classrooms with a lot of amenities. Even the classrooms are now transformed into digital classrooms that have changed the working environment for educators. There could be various dimensions of higher education that act as a pillar in the academic field, like growth in education with the help of virtual mobility. Proper implementation of policies should be there bridging the gap between higher education funding and quality for the globally accepted education system (Banerjee et al., 2015). Policies concerning education facilities, teachers' work life, and alternative ways of working should be paid attention to.

There is still scope for improvement in Indian educational institutions as compared to western educational institutions (Menon et al., 2014). To enhance the quality of work-life there are various measures like flexible timings, compressed workweek, weekdays off, and some other forms of non-traditional work methods like Teleworking and Remote working life. The term telecommuting coined in the 1970s refers to the substitution of communication capabilities for travel to a central work location. López-Igual & Rodríguez-Modroño (2020) defined Work from Home (WFH) as organizational work that is performed outside of the normal organizational confines of space and time. The term WFH refers to a working day spent in the home environment. Olson & York (1983)defined remote working as the work that is performed outside organizational boundaries that are confined of space and time. Unlike WFH, remote workers don't have to go to the workspace physically to show their presence (Trinidad, 2020).

The outbreak of the novel Coronavirus that originated in Wuhan, China 2019 has not only impacted global economies but human life as well. It compelled people to face the crises in an innovative manner where lots of people are working in different ways, except a few warriors like doctors, police, etc. As a preventive measure, The Indian government imposed a complete lockdown (Economic Times, 2021), therefore academic institutions made a conscious decision to teach students through work from home. Pondicherry University was the first one to suspend its academic activities. Institutions had to adapt to the online mode of teaching which nobody could have thought about earlier.

Pink collar jobs like teaching needed counseling, guidance, attention towards students, etc, so no one has implied these ways of teaching earlier considering these factors. The government is trying to promote digitalization in teaching through its platforms like SWAYAM, SWAYAMPRABHA, National Education policy, etc. Digitalization helped to convert the knowledge/information into a digital form and transfer it through the communication tools. The higher learning sector is still adapting it through video conferencing classes, and ERP systems but to depend on the online mode of teaching completely was challenging. There were various other barriers also in the field of higher education such as enrolment, equity, quality, infrastructure, political interference, accreditation, research & innovation, but (Sheikh, 2017) suggested but now teaching through remote working has also become a challenge for educators. Carrying out all the aspects of teaching activities from distance was exhausting.

To understand these challenges for educators in higher learning semi-structured interviews of educators were conducted. The purpose of this research was to gain insights on working remotely considering the perception of educators. To determine whether or not they are comfortable with the new adjustment in their working environment, as well as to determine how long-term or sustainable the solution is in the teaching profession. During discussions with them, they all had a vantage point towards a blended mode of learning in this field. Training educators with new technology could help them in coping with the challenges in teaching.

REVIEW OF LITERATURE

Education develops mind and provide knowledge and so it is important for the development of any nation cannot be ignored. India is a nation that believes in providing education, earlier gurukul system was practiced but now it is more in the form of institutes, schools, and universities that cater to developing the skills and knowledge of students. MHRD invests in education for the development of human capital. Education should be must for everyone and be inclusive for all although it was an objective since many years. (Tilak, 1975). Equality and diversity was still an objective that needs to be attained to expand the quality of education. Regulations in private institutions are a must for quality education (David, 2017). Over the years, education and teaching methodology has changed according to the need of present times. Students are being taught with the help of labs, live demos, case studies, and games, and technology is the new addition to it, but the quality of education should be paid attention to make students employable (Menon et al., 2014). Annamdevula & Bellamkonda (2012) mentioned course content, academic facilities, institutional infrastructure, support services, and educators' support are a must for maintaining quality in the Indian higher education system.

Maintaining the standards in teaching while working from home is a difficult task. Due to the pandemic, the universities were shut down for a while. Pondicherry University on 17 March, announced the suspension of all academic activities, followed by the advice of the University Grants Commission on 19 March to postpone the exams (Crawford et al., 2020). This sudden lockdown enforced educators to work from their respective places. All of them were unprepared for it and were not accustomed to it. Educators all over have to face this problem, though it could be solved with proper government regulations and when students and educators perform their duties responsibly (Purwanto et al., 2020).

Technology is important for both remote and traditional workers, as a result, they must learn the advances in technology, and organizations should also focus on team building and developing good practices for such working (Mulki et al., 2009). To bring this change and adopt technology in education, collaborative efforts are required from the institutions as well as students. Individual efforts of educator learning technology will be ineffective, technology should be adopted and used by everybody in the system for interactive learning (Jha & Shenoy, 2016).

For student-centered learning, there are various dimensions like teachers' role, content, the evaluation that also explain the importance of classroom engagement (Trinidad, 2020). Resilience and adaptability from educators especially not so-tech-savvy ones to teach students is important as they hesitate to teach online (Yulia, 2020). The transition to switch to this way of working has increased the workload and has created pressure on educators especially for those who have less assistance from their organizations so performing and do the best for students was challenging (Naylor & Nyanjom, 2021). Educators find it difficult to monitor the students' learning so they want cooperation from parents, and institutions (Anamalai & Yatim, 2021). The assessment of students' growth while teaching online was also a challenge (Joshi & Vinay, 2020). Teachers have to prepare their teaching material according to the student's needs while delivering it the online mode, also they need to work on their clarity of voice, its pitch, and modulation (Mahmood, 2021).

Knowing that in the future, technology will play a key role in education, institutional support is a must. The opinions and the perception of educators can be understood easily through the interview method. Bolderston (2012) suggested that to gain insights on any qualitative issue interview method can be helpful by using the correct protocols and styles. The extant literature reflects the difficulty and challenges faced by educators. Most of the studies such as (Anderson & Kelliher, 2020; Bhattacharyya, 2019; Kylili et al., 2020) discussed the role of digitalization, the pros, and cons of online teaching, and working remotely. (Demir et al., 2020; Shahriar et al., 2021) show working remotely is advantageous or not concerning students. (P & Shahid, 2020) suggested that working from home in any sector is possible when the home environment is supportive of it. This study will focus on educators' opinions on working remotely and its sustainability in the context of higher learning.

RESEARCH METHODOLOGY

The research was conducted in higher education institutions in Northern India. Detailed, open-ended, semi-structured, qualitative interviews were conducted with 20 educators, allowing them to recount their approach to teaching, motivation, and experience during the Covid-19 situation. The interviews allowed us to have an insight into the difference between traditional and virtual classes and educators' perceptions towards teaching through working remotely. They shared their positive and negative perspectives concerning this way of working. 26 people were contacted out of which 20 responded. Our response rate is approximately 77 percent. To retain their identity their names are not being mentioned here. They are named R1, R2 till R20.

Participant	Number
Males	7
Females	13

RESULTS

To understand educators' perceptions towards working remotely, questions were asked to understand their mindset while teaching at home or anywhere else. Educators shared their experiences about teaching through working remotely, problems concerning resources, skills required, and the new working environment. Their experiences led to few positive and negative imprints on their mind. The opinions of respondents will be helpful for institutions to understand the problem of educators in India and also whether they can continue working remotely or not. Some excerpts reflecting their experiences are given below.

Positive Aspects of Working Remotely

Most of the respondents said that using technology would be better to explain the diagrams, and graphs, and to show the references related to the subject. Educators can work from their homes also with the use of technology. Working remotely is less time-consuming as there are no hindrances to going to the workspace, meeting students, and taking attendance physically unlike traditional methods of teaching. Teaching diagrams or showing them some technical processes through screen becomes easier. Teachers find it better as it saves their time.

R6	I find it less time-consuming as I can easily show graphs, tables, and charts online clearly for my subject.
R12	Saves times as there are no distractions while teaching even attendance can be taken automatically.

It becomes easier and becomes less fussy for educators to teach when they have to give a demonstration or show some video while teaching online. Easier to explain the functioning that too in a clear manner.

R3	Teaching through videos and explaining the process of anything is easier while teaching online.
R18	Diagrams are clear and more understandable through online teaching

Technology has the benefit of accessibility for both teachers and students. There will be possibilities for teaching, and it will be possible to do so from anywhere. This way teachers can showcase their teaching capabilities and teach students across the globe. This opportunity to teach will help the teachers to have more chances of employment and also there will be an association between teachers and students irrespective of location. Students and teachers from rural areas can also integrate with other part of the world. This method can be useful not only generate admissions by luring students by the name of teachers taking a class there but it is also advantageous for educators to connect with various institutions and teach.

R2	Students have recorded my lectures and studied from them. It might help them in their exams.
R11	The students from other institutions have seen my lectures. This might not be right but I feel this will allow us to teach and connect with students.
R17	Students record the lectures and ask doubts by relistening them.

All of them affirmed that the blended method which is a combination of an online and offline mode of teaching could be the new way of teaching. The education system cannot rely on one method completely. The accessibility due to technology will increase the reach to students but it is also important to get the classroom environment for the overall growth and development of the student.

R7	We cannot go completely on online teaching. There is a need for blended learning, online teaching should be continued with traditional one. Right now, most of the content is delivered through online mode.
R9	Using technology to teach was there before but not used to teach regularly like this in higher education. We were not working from our homes or anywhere else. as it lacks classroom face-to-face interaction, we can't rely on it completely.
R15	Both traditional and online way of teaching has their importance but complete dependence on one method won't solve the purpose of learning

Negative aspects of Working Remotely

Most of the respondents resisted due to sudden changes and said they were unprepared for such changes. The feeling of unknown and unpreparedness has made them a little anxious about the whole situation. Even the organizations could not see the pandemic coming and so there were a lack of resources and this lack of training and resources made educators worrisome. Proper training was given to only a few educators who are part of this study. Although most of them said that training would have helped them better to deal with the barriers.

R1	Personally, it became a challenge suddenly to switch my teaching ways. It was difficult to come up with creative ideas on how to teach properly. With training, we could have prepared ourselves. This contingency has made it difficult to respond in the right manner.
R4	Due to the suddenness of the situation, it was difficult to find an alternative method of teaching. Once it was found out we switched on to applications to teach which were known earlier but not used frequently. Without training resistance from both teachers and students was faced.

The sudden lockdown was implemented nationwide, educators do not have all resources at home. It was important to teach students through software. Educators especially, older age have not used this before and were apprehensive about using it. Those familiar with the technology also were not used to teaching through these applications. They feel stressed due to the lack of a system especially when the college did not have a uniform pattern for attendance, evaluation, assessment, etc.

R5	I used Zoom in the beginning to take classes; at that time, it was also not updated software.
R11	Colleges didn't have a uniform system and so we faced a lot of problems in maintaining attendance records and checking students' copies.
R19	Although laptops were provided to us but that was not enough without updated software, Wi-Fi facility.

Managing home and work, and creating a balance between work and family has caused them stress. It's difficult for them to integrate and separate their work lives. The separation of workspace at times is necessary so that they can be focused on their work otherwise the household issues catch their attention.

R16	Longer hours of work create disturbance and stretch our hours this creates a lot of chaos in managing things
R18	Allocation of time was much simpler when I used to have a proper working environment.
R20	Giving attention to home, teaching-learning new technology, and creative teaching needed a lot of attention and was difficult to manage home and work both at the same time.

Discipline and classroom environment is missing. Even the zeal and motivation among the teachers and students lack due to no physical contact. The students creating chaos and indiscipline in class leaves them irritated at times. Discipline management and unresponsiveness was an issue in such cases.

R2	Concentration among students is a problem and competitive feeling is missing among them which comes automatically through group study.
R5	At times students log in to their classes but carry on with their work. It is difficult to Monitor them.
R10	Students log in with different names and create disturbance in class.
R12	Whenever I ask questions, they don't respond which I understand that they are not listening to my lectures. I feel all my hard work goes in vain due to this.

Working remotely also creates security threats. Using unknown applications and sharing personal data with them can cause a violation of privacy. There is always a threat of personal data leakage. These things pose resistance or fear among educators opting to teach through these work methods.

R13	My Email-id got hacked. Persons who are not comfortable with the camera like me got a problem in beginning to teach.
R8	Teachers have received fraud calls, and fishy emails, especially female educators.

Educators believe that their teaching style should be clear and crisp to maintain the student's interest in the class. As students are not in the class, they have a lot many distractions. Their mind wanders, and they could not raise their query personally which results in a lack of attention and interest. Educators need to think of creative ways to teach online also there is pressure of engaging students and being creative to attain students' attention in the class.

R3	We have to be clear and maintain the pace otherwise either they don't understand or get bored during the class.
R8	I try to teach through diagrams and show tables and graphs so that students can understand things quickly.
R14	Students had thought that there will be no exams, so they were not interested to take the class.

DISCUSSIONS

The current qualitative study provides the information that working remotely in the service sector, especially in the field of academics is not the best way. The interaction between the teachers and students is a must due to easy accessibility of teachers, easy doubt clearance etc by the participants during the interview. The blended method which is a combination of both online and offline learning is necessary for a child's overall development. During the interaction, all the participants highlighted both the positive and negative aspects of working remotely in higher learning. None of the participants denied the advantages of using technology while teaching but the traditional way of teaching which involves eye contact and face-to-face interaction is also important. Working remotely lacks the element of interaction, educators do not interact with students or their organization on daily basis. This leads to a lot of gaps like maintaining work records uniformly.

Educators prefer a blended mode of teaching so that they can avail benefits from both online and offline modes but in the case of continuous online working there are increased health issues (fatigue, backache, headache, eyesight problems), due to sitting in front of the systems and lesser separation of their professional and personal lives, etc. Being a bright student and being technologically savvy are two very different things so the students might not be able to grasp things because they are not comfortable with this new medium. Using technology to study and interact with teachers is not easy and convenient for every student. Students face connectivity issues and sometimes students use this as an excuse to not study. Hence, it becomes difficult for educators to deliver lectures in such scenarios. Consequently, the educators feel the strain to deliver and think of creative ways to teach and so withheld this new change of working remotely in the higher learning sector. Educators sometimes feel less motivated to teach in the same environment. Evaluation has also emerged as a challenge. Sometimes the writing speed on the computer affects the child, sending the scanned copy might be an issue, few students cheat in this kind of assessment system hence evaluation becomes tedious for them. Educators' privacy and classroom nuisance was the complaint of many teachers.

Educators earlier were not attuned to working in this set up which resulted in lots of anxiety and trouble for them as they were completely unaware of the means required for teaching like this. Relatively lesser problems came in front of those who were aware of the usage of technology to work. Most of them agreed that if they were trained before it would have been easier for them to work, although due to the sudden conditions of the pandemic, most of the institutions were not able to train their educators effectively. All respondents agreed that working remotely could be an alternative in higher learning also, but not continuously due to their preference for a blended mode in teaching.

The whole setup was provided by some organizations, for example, few Information Technology employees were given the whole set up to WFH during covid or their expenses were reimbursed but as far as most of the respondents of this study managed everything on their own. Even the expense of setting up working remotely rises (Purwanto et al., 2020). For initiating a culture of working remotely, uniform organizational policies, plans, infrastructure, and resources are prerequisites. Most of them have affirmed that they can reach more students when working remotely.

Table 1. Aspects of Working Remotely

Positive aspects of working remotely	Negative aspects of working remotely
a) Less time consuming	a) Resistance due to unpreparedness and lack of training
b) Easier demonstration through videos, graphs, diagrams.	b) Lack of resources
c) Can work from anywhere	c) Work-life balance was a problem
d) Opportunity to teach across the globe	d) Integrating and separating work was challenging
e) Can continue to teach like this using blended mode	e) Indiscipline was issue
f) Less manual work	f) Lack of personal touch
	g) Classroom engagement was difficult
	h) Health issues

CONCLUSION AND IMPLICATIONS

Educators believe working remotely could be a sustainable solution if applied in a blended manner. They mentioned that the training and uniformity in organizational policies will make it easier for them to work in this manner otherwise, they might be hesitant to continue working remotely as it made things unclear.

Educators presume that the change is beneficial as they can also work like corporates for a day or two from their respective locations. Earlier it was beyond anyone's imagination to work remotely in the field of higher learning. But teaching traditionally has its benefits that cannot be ignored like face-to-face interaction, a motivating environment, better to evaluate students and clear doubts, etc. Hence, both ways are equally important and it is suggested to introduce a blended method in the teaching field as it will be beneficial for both students and educators. Working remotely in terms of teleworking is a feasible option at times but not always as face-to-face interaction and institutional support are required. Autonomy and physical, as well as virtual boundaries, must be set for the employees of the organizations (Carillo et al., 2020). Organizational support and the role of technology in communication cannot be ignored in working remotely (Wang et al., 2020).

The present study will have major implications for organizations to consider teleworking as an option for educators in the future. Organizations can frame policies and implement them for teleworking like other sectors. Organizations' support is a must in terms of providing better work-life to their employees (Mulki et al., 2009). Also, the nature of technology and its usage of it is a necessary step for initiating the change (Bhattacharyya, 2019). This study suggests that educators are willing for this change and training would make it smoother.

Limitations and Recommendations for Future Research

This study was limited to non-premier institutions in Northern India. The telephonic interview method for data collection was used due to the Covid-19 situation, therefore face-to-face interaction and observation of gestures were missing which is an integral part of any communication. These observations were important as there are chances that educators were not revealing the complete truth due to Confirmation bias or My Side bias (Wason, 2007), consequently, they express things in their way proving their viewpoint about organizational support and resources as they were afraid their conversations should not reach to the management team.

Future research can be done in premier institutions where resources are in abundance, therefore viewpoints may differ. Studies observing the experience of educators working in government setup could also be done to understand whether they are ready for the change of working or not. Further face-to-face interviews and questionnaires can be used for data collection. Studies can be done for organizational policy formulation considering educators' points of view. Additionally, research can be done on the possibility of remote working for educators as most of them are teleworking. This research can be done on various age groups of educators to know their challenges and measures to alleviate those challenges.

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Suspicious Human-Action Recognition using Deep Learning Hybrid Model

R. U. Shekokar **S. N. Kale**

Department of Applied Electronics
SGB Amravati University
Amravati

ABSTRACT

In this paper, a video classifier using transfer learning with DenseNet 121 (Convolutional neural network model pre-trained on the ImageNet-1k dataset) base model and RNN on the UCF Crime Dataset of 100GB is presented. This deep learning approach is presenting a hybrid model for video classification having applications in scene identification, video classification, security, and many.

KEYWORDS *: CNN feature maps, Transformer encoder, DenseNet 121, Transfer learning, Video classification, UCF Crime dataset.*

INTRODUCTION

A video is an ordered sequence of information having a frame containing spatial information and the sequence of those frames contains temporal information. Encoder foundation models for video classification that operate on CNN feature maps are discussed here that entrench the positions of the order of the frames in the videos with an Embedded cover and then add these positional embeddings to the precompiled CNN feature maps for classification. The model is retrained using the UCF Crime Dataset of total 1900 videos (1560 anomaly videos and 340 normal videos). The dataset consists of videos categorized into 14 (13 anomalies and 1 normal) different actions.

PROPOSED ACTION DETECTION MODEL BUILDING

The technology has been reformed because of deep learning. Deep-learning architectures enable modern machine translation, search engines, and computer assistants. As deep-learning expands its reach into robotics, pharmaceuticals, energy, and all other domains of technology, this trend will continue using the frameworks like Tensorflow and Pytorch. Tensorflow framework makes it alleviate and rational for engineers to implement a dedicated deep-learning architectures for a set of specific applications. Here we used a Tensor Flow 2.7.0, Keras 1.1.2 as well as Tensor Flow Docs on Anaconda using Jupyter Notebook.

Here a pre-trained network to extract meaningful features from the extracted frames of 128x128 resolution is used for supplying information to the next layer which will implant the positions of the frames in videos. Then adjoin this positional information to the precompiled CNN feature maps[1] is used to retrain the model for the set of train and test set over an NVIDIA Tesla V100 GPU with 16GB memory. All video frames are extracted using an Open CV (CV2) library on the go fed to the model, if the video is small frames are directly padded with Zeros, which ensures training with small videos also.

DATASET AND DATASET PREPARATION

The movies in the data set come from a large-scale UCF Crime dataset with 128 hours of footage. It includes 1900 uncut real-world surveillance recordings depicting 13 realistic actions such as Abuse, Arson, Assault, Burglary, Explosion, Fighting, Robbery, Shooting, Stealing, Shoplifting, and Vandalism. These activities were chosen due to their major impact on public safety. This data set can be utilised for two different purposes. To begin, generic anomaly detection takes into account all anomalies in one group and all normal activity in another. Second, for identifying each of the 13 unusual activities[2].

All 13 anomaly activities with normal activity are mentioned as

1. Abuse: Videos of nasty, abusive, or aggressive behaviour toward children, the elderly, animals, and women are included in this event.
2. Burglary: This event includes films of people (thieves) breaking into a structure or house with the intent of committing larceny. The use of force against persons is not included.
3. Robbery: There are videos in this event that show crooks stealing money illegally using force or threats of force. No shootings are shown in these films.
4. Theft: There are videos in this event that show people stealing property or money without authorization. Shoplifting is not one of them.
5. Shooting: Videos of a person being shot with a gun are included in this event.
6. Shoplifting: Videos from this occurrence show people taking things from a store while posing as customers.
7. Assault: This event features films of someone being assaulted in a sudden or violent manner. It's worth noting that the person who is abused in these films does not fight back.
8. Fighting: There are films in this event that show two or more people attacking each other.
9. Arson: Videos from this event show someone setting fire to the property on purpose.
10. Explosion: This event features videos of something exploding and causing havoc. Videos in which a person purposefully starts a fire or causes an explosion are not included in this event.
11. Arrest: There are videos of police arresting people in this event.
12. This event features films of traffic accidents involving automobiles, pedestrians, and bikes.
13. Vandalism: There are videos in this event that demonstrate intentional destruction or damage to public or private property. Property damage, such as graffiti and defacement directed against any property without the owner's permission, is included in this phrase.
14. Normal Event: This event comprises films in which there was no crime. Indoor (such as a shopping mall) and outdoor scenes, as well as day and night scenarios, are featured in these videos.

Dataset Preparation

Data set videos are classified as train and test set using a comma-separated values (CSV) file which can be later loaded into Data Frame using Pandas 1.3.4 - a data structure tool.

Since a video is an ordered sequence of frames, we could just extract the frames and put them in a 3D tensor array. But the number of frames may not be the same for all videos which confine us from stacking them into batches. Alternately we saved video frames at a fixed interval until a maximum frame count is reached.

We have used the following sequence for processing the dataset [4]:

1. Capture the frames of a video using the open CV capture tool.
2. Extract frames from the videos for a required frame count.
3. Where a video's frame count is smaller than the maximum frame count required we can pad the video with zeros to reach the count.

We will be using Open CV's Video Capture() method to read frames from each video and then save it into a placeholder for image operations.

MODEL TRAINING AND TESTING

Resizing Images

Image resizing is an important step of data feeding in neural networks. Keras Centre Crop layer, A pre-processing layer that crops images are used here to resize the images captured by the tool. This layer crops the central portion of the images to a target size. If an image is smaller than the target size, it will be resized and cropped to return the largest possible window in the image that matches the target aspect ratio.

Feature Extraction

Encoder foundation models for video classification that operate on CNN feature maps are used here that entrench the positions of the order of the frames in the videos with an Embedded cover and then add these positional embeddings to the precompiled CNN feature maps for classification [3]. We have used a pre-trained network to extract meaningful features from the collected frames. The Keras framework provides several pre-trained models like DenseNet 121, Mobilenet, Inception V3, and DenseNet which are trained on large datasets like ImageNet and Sports1M. Here we have used a pre-trained DenseNet 121model for feature extraction with ImageNet weights for retraining. We directly padded shorter videos to length maximum frame count. We use all functions together to process our data and it will return Frame features and Frame masks which can be given to the transformer model having recurrent layers as shown in Fig. 1.

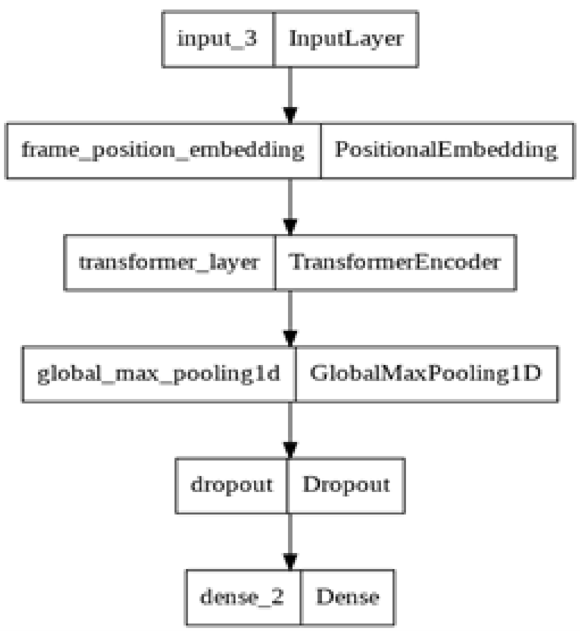

Fig. 1. Transformer Encoder model (generated using Keras.utils.plot)

Label preprocessing with StringLookup[4]

The labels of the videos are strings normally. Neural networks do not recognize string standards, so they must be converted to some numerical value before they are fed to the deep learning model. By using the StringLookup function layer in Keras we can encode the class labels as integer. StringLookup function automates the process of giving names to the algorithm, it becomes convenient for a large number of labels in huge datasets.

Building the Transformer-based model

The basic blocks of a Transformer encoder, the self-attention layers, are order specific. Since videos are ordered sequences of frames, we need our Transformer model [3] to take into account order information. Positional encoding is used to accomplish this. With an Embedding layer, we simply embed the positions of the frames contained in videos. These positional embeddings are subsequently added to the precomputed CNN feature maps[4][5].

Table 1. Parts of Transformer Encoder and Decoder

Transformer Encoder	Transformer Decoder
Multihead Attentation	Dense Layers
Layer Normalization	Layer Normalization
Dense Layers	Multihead Attentation
Layer Normalization	Layer Normalization
Encoded data	Multihead Attentation

The transformer encoder is made up of a stack of identical layers, each with two sublayers (denoted as sublayer). The first is a position-wise feed-forward network, and the second is a multi-head self-attention pooling. Queries, keys, and values in the encoder self-attention are all taken from the previous encoder layer's outputs [6]. The Transformer Decoder is the same as the Transformer Encoder, except it character an additional attention block where the keys and values are the source sequence encoded by the Transformer Encoder [7].

Together, the encoder and the decoder form a complete Transformer [8] parts of both given in Table 1. The transformer decoder is also made up of a stack of identical layers with residual connections and layer normalizations. In addition to the two sublayers described in the encoder, the decoder inserts a third sublayer between these two, known as encoder-decoder attention [9]. The queries for the encoder-decoder come from the preceding decoder layer's outputs, while the keys and values come from the transformer encoder outputs as shown in Fig. 2, we can observe the frame sequence size 50 and number of features 512 are utilized throughout the flow. The queries, keys, and values in the decoder self-attention are all taken from the previous decoder layer's outputs. Each position in the decoder, on the other hand, is only allowed to attend to all positions in the decoder up to that point. This disguised attention maintains the auto-regressive characteristic, ensuring that the prediction is exclusively based on the generated output tokens[10]. A larger dataset and a longer pre-training phase are ideal for this type of Transformer model.

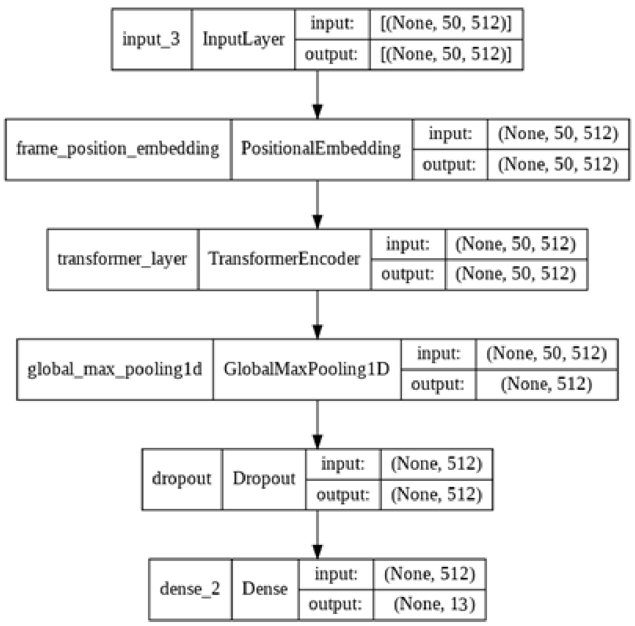

Fig. 2. Transformer Encoder model shape (generated using Keras.utils.plot)

Testing a trained model for videos selected randomly

Single video from a test data is selected (randomly) converted into a frame sequence padding done if a video is short [11], the frame sequence is then predicted using a trained model, and the prediction for the different class is displayed using the prediction model. The output prediction percentage for selected random video is displayed for class with a GIF[5] file bound from the frames collected and the same is displayed for the visualization purpose[12][13].

RESULTS AND DISCUSSION

The proposed model is trained on the NVIDIA V100 GPU platform is takes a long time to collect the frames and stores them in the memory for further training which increases training time each time when the algorithm runs for the first iteration onward it is only using the features collected from frames for training algorithm. Test accuracy for the proposed hybrid model is coming as a top accuracy of 44.12% Fig. 3 and Fig. 4 show the accuracy and loss function plotted using Keras utility respectively.

```
Test accuracy: 44.12%
```

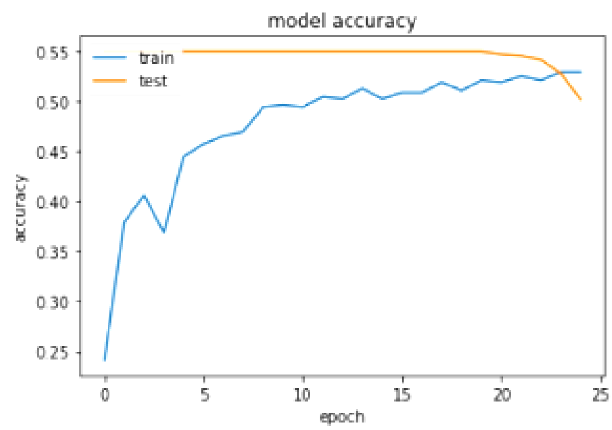

Fig. 3. Transformer Encoder model accuracy graph

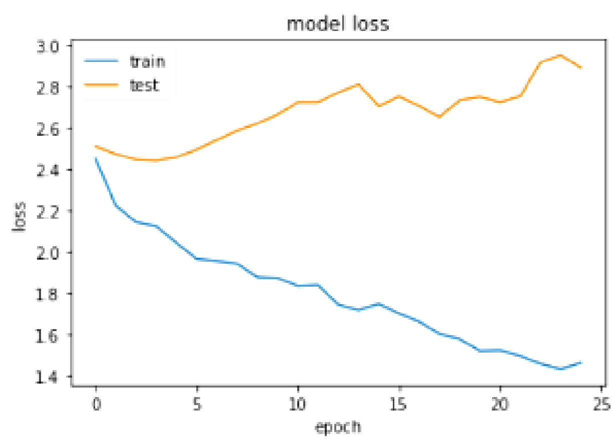

Fig. 4. Transformer Encoder model loss graph

The proposed method received the accuracy of low order as the dataset used is a long sequence of actions which is having multiple scenarios in a single clip which leads to a reduction of feature matching capacity for the whole duration. The base paper author and dataset creator Sultani et al. [2] proposed a model having an accuracy of 23.0% for C3D and 28.4% for the TCNN approach presented shown in Table I. for the comparison purpose as per the author the dataset used here is a challenging dataset for the algorithm writer.

Table 2. Model Accuracy Comparison

Deep Models Performance			
Method	C3D	TCNN	Proposed
Model Accuracy	23.0	28.4	44.12

The proposed model results can be visualized by creating a GIF file from the frames collected from video selected randomly, along with the visualization the prediction for the different classes is printed to have a clear idea about selected and predicted class, Fig. 5. is showing such a result for the Road Accident video selected and prediction percentage for each class in the proposed method. The algorithm improvement can be achieved by using a feature map model having long memory and architecture suitable for a long sequence of actions.

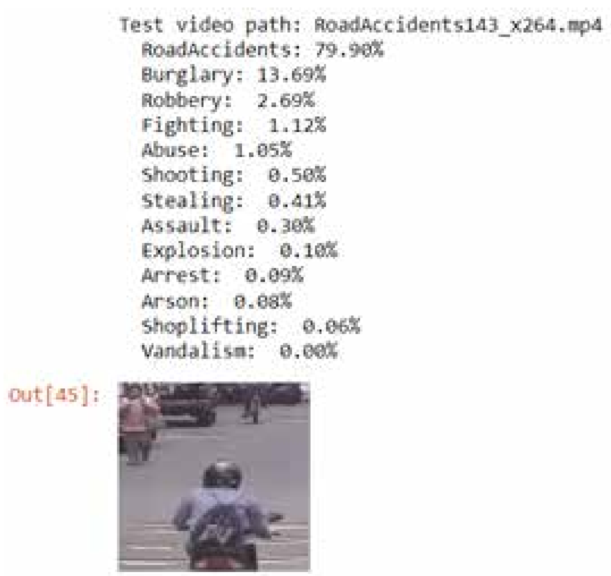

Fig. 5. Prediction of class and displaying a Gif for the proposed model

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Experimental Investigation on Machine Foundation Resting on Reinforced Sand Bed

D. B. Awachat
Research Scholar
Civil Engineering Department
Government College of Engineering
Amravati

A. I. Dhatrak
Associate Professor
Civil Engineering Department
Government College of Engineering
Amravati

S. I. Shaikh
M. Tech. Student
Civil Engineering Department
Government College of Engineering
Amravati

ABSTRACT

In this study, the following variables' effects on a model foundation's vertical vibration response in sand were investigated (different vertical load amplitudes and varying vertical reinforcing layers). For the purpose of this study, we chose a square foundation with an aspect ratio (L/B=1) as the model foundation i.e. (L= length and B= width). A physical model was created to simulate applied dynamic loads at various operating frequencies (5 to 40 Hz) and various load amplitudes (1.6 to 170 N). Dry sand with a relative density of 47% was the type of soil that was used. On a test bed, a number of laboratory model block vibration tests were performed both with and without geosynthetic reinforcement. By measuring the amplitude of displacement of the machine foundation using a vibration oscillator, the behaviour of the machine foundation beneath soil reinforced with geosynthetic was investigated. The peak amplitude clearly decreased, and it was discovered that the resonant frequency had changed. As a result, this study proved that the usage of geosynthetics beneath machine foundations aids to controlling the peak amplitude, which was fundamental need of machine foundation design.

KEYWORDS *: Machine foundation, Geosynthetics, Peak displacement, Resonant frequency.*

INTRODUCTION

Rapid urbanisation has greatly raised the need for ground improvement. Several applications where the tension is increased monotonically employ geosynthetic reinforced soil as an efficient ground improvement approach. Further in-depth research is necessary to determine the breadth of its applicability in the building of machine foundations when dynamic loads are used. It is significant to remember that, in addition to adhering to the specifications for the design of a static foundation, the design of Machine Foundations necessitates restricting the magnitude of peak amplitudes and preventing liquefaction.

In view of the foregoing, the purpose of this study is to examine the behaviour of a geosynthetic reinforced soil test bed that is positioned under a model machine foundation with the specific goals of determining how reinforcing affects changes in resonant frequency and potential reductions in peak displacement.

LITERATURE REVIEW

Ghosh et al. (2012) reported research on the dynamic response of two adjacent square or rectangle-shaped machine foundations on a multilayer soil deposit in contrast to a single isolated machine foundation. Modelling was done using the specific finite difference code18 FLAC3D.

Sreedhar et al. (2016) model tests showed that the addition of geogrid reinforcement decreased resonant amplitude and increased resonant frequency.

H. Venkateswarlu et al. (2017) looked at how geosynthetics-enhanced soil beds supporting model machine foundations responded to extensive field testing and numerical simulations. On a firm concrete basis reinforced by varied reinforcing soil conditions, many lateral mode block resonance experiments are conducted.

Javdanian et al. (2018) conducted, Using FLAC, a numerical finite difference modelling system, the dynamic bearing capacity of neighbouring shallow strip foundations situated on sandy soil was investigated. It was investigated how thin strip foundations performed in various scenarios. Investigations were conducted to determine how cyclic loads at various distance ratios, shallow foundation geometry characteristics, and soil strength parameters affected foundation carrying capacity.

METHODOLOGY

Material Charachterization

The following was a summary of the qualities of the materials utilized in this investigation.

Table 1. Physical properties of the tested sand used for experiment

Sr. No.	Properties of sand	Values
1	Specific Gravity	2.6
2	IS Classification	SP
3	Minimum Void Ratio (e_{min})	0.48
4	Maximum Void ratio (e_{max})	0.69
5	Relative Density	47%
6	Angle of Internal Friction (ϕ)	38^0
7	Coefficient of uniformity (C_u)	3.2
8	Coefficient of curvature (C_c)	0.80

Table 2. Properties of geocell used for experimental

Properties of Geocell	Value
Polymer type	Neoloy
Geocell pocket height (m)	0.075
Geocell pocket size (m)	0.360
Geocell pocket width (m)	0.220
Geocell pocket wall thickness (mm)	1.20
Geocell pocket surface	Perforated
Density (g/cm^2)	0.900

Test Pit

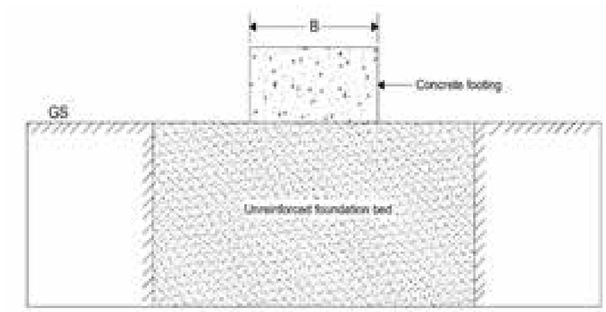
Attempts were made to imitate the test technique outlined in IS: 5249-1992. A test pit of 1.75 m x 2.0 m x 1 m was created for the test block of 0.50 m x 0.50 m x 0.30 m. Based on handling factors, the test block size was determined, however the scale ratio with the test block recommended in IS was maintained. The width of the excavated pit was calculated in the current study to be 3.5 times that of the machine foundation. To reduce boundary effects, the depth of the test pit was kept at more than twice the test blocks smallest lateral size.

Preparation of Test Bed

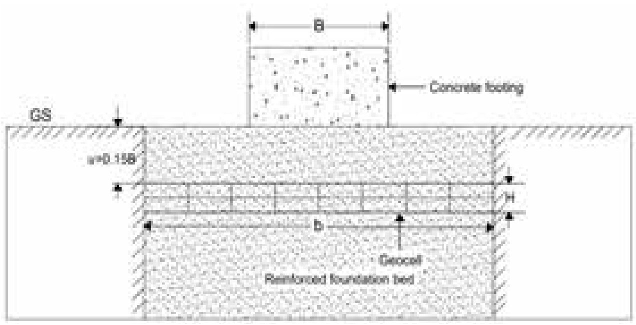
Sand was poured into the unreinforced foundation bed using an aluminium hand hopper at a height of 12.5 cm to achieve a relative density of as much as 47%. The friction angle of dry sand was 38° and the placing dry density was 17.4 kN/m2. The relative density was checked using the fixed volume approach. The geocell reinforced foundation evolved just like to the unreinforced foundation with the inclusion of geocell layers in the suitable places. In the particular case of the geocell reinforced state, the stretched geocell was placed on top of the sand surface. Dry sand(foundation soil) was placed into the geocell reinforcement's pockets. The sand used in the unreinforced foundation bed was used to fill each geocell pocket.

Test Procedure and Experimental Program

In general, the test technique follows IS: 5249-1992. On the test bed, the test block is put. With the aid of foundation bolts, the oscillator is fixed to the test block. The oscillator and D.C. motor are attached to one another by a flexible shaft. The D.C motor's speed control unit is utilized to set the frequency at which the motor operates. The Test block's displacement pickup, which is kept in place, senses the vibrations and transmits the information to the data acquisition system. It shows the displacements in the strata brought about by induced vibrations alone in the vertical direction without altering the static force or introducing eccentricity. A schematic illustration of several test setups that were made in the field for experimental studies may be shown in Figure 1 a–d. Table 3 summarized the experimental studies characteristics.



(a)



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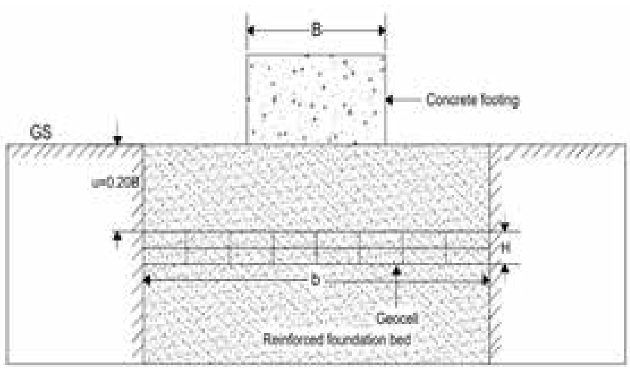

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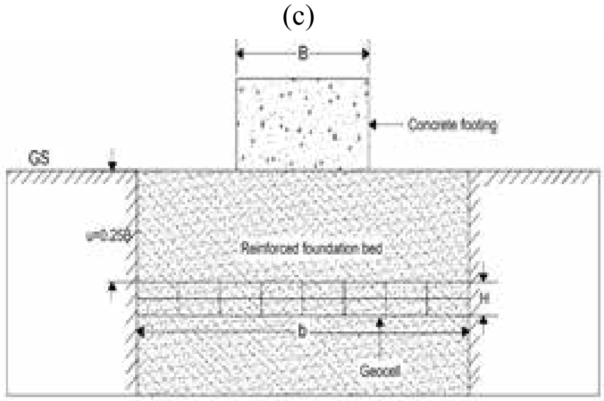

(d)

Fig. 1. A-D schematic representation of several test setup for experimental

Table 3. Summarized the experimental studies characteristics

Sr. No	Description	u/B	Eccentricity angle (θ)
A	Unreinforced soil bed	-	20 & 40
B	Soil reinforced with Geocell	0.15, 0.20, 0.25	20 & 40

RESULT AND DISCUSSION

Relative density of 47%, load amplitude of 0.16 to 170 N, and frequencies of 5 to 45 Hz were employed to evaluate the impact of vertical modes of vibration on a square foundation. The displacement amplitude frequency response of an unreinforced foundation condition for various eccentricity angle 20 & 30 is shown in Figure 2. The displacement of the machine foundation rises as the dynamic amplitude increases, and the resonance frequency likewise changes from 26 to 30 Hz, as shown in Figure 2. For geocell reinforced condition, the displacement amplitude frequency response of reinforced with geocell condition for u/B (0.15, 0.20 & 0.25) For eccentricity angle 20 & 30 is shown in figure 3 a-c. from the reinforced condition, the uppermost layer of geocell is the optimal location to limiting the displacement of machine foundation induced from vibration. Beyond 0.15B there are increase the dynamic load increase the displacement of machine foundation. Resonant frequency is increased in the geocell reinforced instance as compared to other cases.

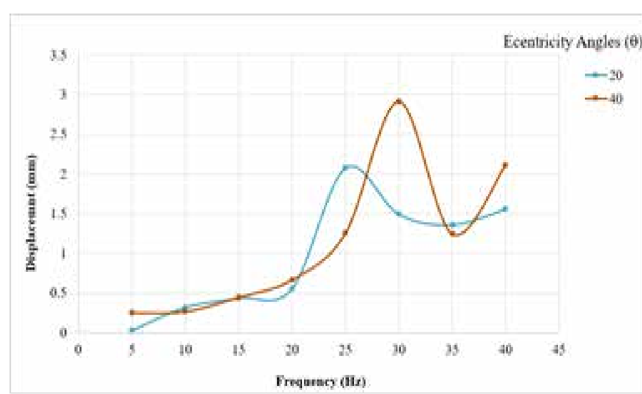

Fig. 2. Displacement of machine foundation for unreinforced condition

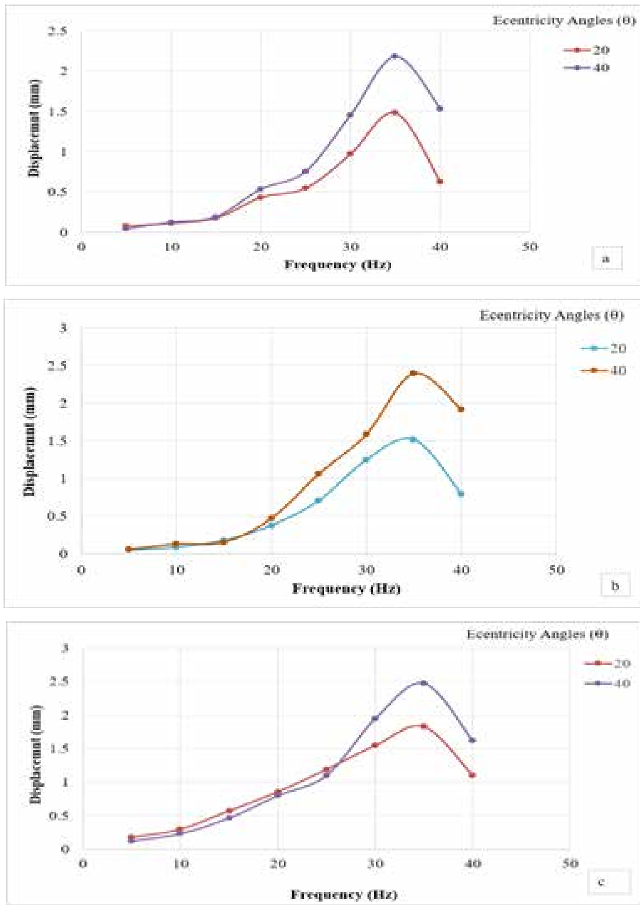

Fig. 3. A-C Displacements of machine foundation for geocell reinforced case: (a) geocell @ 0.15B; (b) geocell @0.20B; (c) geocell @ 0.25B

CONCLUSION

On the basis of the experimental research conducted for this study, the conclusions that follow may be made.

1. The model machine foundation's geosynthetic reinforcement showed a clear improvement in the foundation soil's responsiveness.
2. Peak Vertical displacement was experienced a sizable decline under resonant conditions.
3. This demonstrates Geosynthetics' potential for improving the soil beneath machine foundations.
4. A change in the resonant frequency was detected, demonstrating the importance of geosynthetics in machine foundation optimization.
5. It is discovered that when reinforced the peak displacement at resonant condition clearly decreases. For the materials made use of in this investigation, the decline 31%.

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To Study Watershed of Indrayani Basin, Pune, India using Geo-Spatial Tools- A Case Study

Upendra Saharkar
Research Scholar
Department of Civil Engineering
RSCOE, SPPU
Pune, Maharashtra

S. S. Shahapure
Head- Research Department
Department of Civil Engineering,
RSCOE, SPPU
Pune, Maharashtra

Shivaji G. Patil
Ex. Executive Engineer
MIDC
Pune, Maharashtra

Ashok B More
Head
Department of Civil Engineering,
DYPCOE, Akurdi, SPPU
Pune, Maharashtra

ABSTRACT

The study of water resources at the watershed scale is important to conserve water in the presented watershed. The establishment of priorities among sub-watersheds is an essential component of watershed management. Since there may not be enough funding or ignorance to implement development projects for all of the watersheds in a basin at once, listing the sub-watersheds is an essential part of managing watersheds. This paper focuses on the study of the Indrayani River watershed in Pune district, Maharashtra, India, with the help of geo-spatial tools. In the current study, attempt have been made to use the GIS platform to extract and determine features such as rainfall and drainage density using data obtained from rain gauges, topographical sheets, and satellite imagery. These characteristics include slope, land use, and land cover.

KEYWORDS *: Sub Watershed, Water management, Geoinformatics.*

INTRODUCTION

The watershed is a socio-political ecological phenomenon that affects food, social and economic stability, and other critical services. The management of water resources remains a persistent concern in developing nations such as India. The selection of a watershed size can be influenced by the objectives of the development project as well as the topographical characteristics of the land. The preservation of natural resources is essential for the sustainable sustenance of any type of development. Remote sensing (RS) technology combined with traditional groundwater measuring methods creates the ideal conditions for planning and carrying out water resource projects [1].

Watersheds are natural hydrologic bodies that extend across a limited amount of land and are the source of precipitation that flows to a particular gully, river, or stream at any given spot. Watersheds can be thought of as large drainage basins. In this paper, it is attempted to review the watershed in the Indrayani River Basin in Pune, Maharashtra, India, as most of the authors only study the quality and physiochemical properties of the Indrayani River water at any specific point, but the morphological study of this river basin is not studied deeply.

This region is presently experiencing rapid industrialization and faster population growth. This area is near the major industrial areas developed by the Maharashtra Industrial Development Corporation (MIDC) at Talegaon and Chakan town, which resulted in the rapid growth of industries in this region due to its conduciveness to industrial development and therefore water demand, which has increased by multiple folds and is still increasing day by day.

In order to gain an understanding of the morphology and condition of watersheds, it is necessary to make use of geospatial technologies to conduct slope and drainage density analyses, as well as provide useful information on the structural characteristics of drainage basins, digital elevation, and the dynamics of land use land cover (LULC) pattern changes. The process of prioritising, as well as the planning and management of watersheds in a sustainable manner, require the inclusion of these fundamental factors. [2].

There is also a fast-growing industrial area, which results in heavy groundwater usage due to the fact that ground water level depleting each year. This area is near by Pune and Pimpri Chinchwad city owards the Mumbai side, which could be developed as a new megacity with the nearest upcoming international airport being developed near Panvel. As well as in the vicinity of the study area, MIDC has established a number of industrial areas, and the water requirement for these industries is also increasing day by day. This is causing a tremendous increase in water demand, and to avoid a water crisis in the future, the study may play a vital role in understanding the watershed for future watershed planning.

The application of weighted factor analysis is going to be used in this study in order to accomplish the goal of prioritising sub-watersheds for the purpose of water resource conservation and management using an integrated methodology. The data collected on geological conditions, rainfall, morphometric parameters, hydrogeomorphic units, land-use mapping, and land-cover mapping will serve as the foundation for this methodology.

In order to maximise the potential of the sub-watersheds, the purpose of this effort is to integrate different data sets and produce a status report for each sub-watershed individually.

The elements that influence the deterioration of watersheds based on a variety of criteria have not been the subject of any study efforts in this region as of yet; hence, there has been no attempt to analyse and rank them. The current study will be helpful to policymakers in planning preventative maintenance measures and allocating resources.

LITERATURE REVIEW

This section describes the existing and previous studies on the importance of watershed management and its study.

Kaushar and Gyanendra Pratap Singh (2022) focused on the Dhasan River area in MP. The primary objective of their studied was to determine a dependable method that could have used to construct a GIS data model that could use for morphometric analysis. This would be accomplished by gathered relevant information. In ordered to have done this, SRTM DEM (30 m) utilised in the creation of a map as well as the measurement of the relief features of the Dhasan basin. But in their study, they were focused mainly on groundwater-related worked [5].

Vijendra Kumar Pandey (2018) focused on the Bal Ganga Basin in Uttarakhand. Their study aims to evaluate the use of geoinformatics approaches in development planning and resource optimisation. As per the author, using GIS methods, we can prioritise how a watershed's topography affects our efforts to execute integrated watershed management [6].

Abdelrahman et.al. (2016), scientific land evaluations are a vital step in determining an appropriate use for land and minimising the impact of humans on natural resources. These evaluations must be carried out in order to be effective. The author develops maps like LULC, slop, DEM, texture, etc., but all this focuses on the point of view of agricultural use of water. The study shows that soils and physiography are linked. Variations in topography cause erosion, leaching, sedimentation, and other pedogenic processes modified by the water table to generate various soils [7].

STUDY AREA

This study uses the Indrayani River watershed. The Indrayani River originates in Kurvande village, near Lonavala town, at 18° 4356" N and 73° 2213" E and 564 m above MSL. The Bhima and Indrayani rivers meet in Tulapur, in Pune district. The river trip is about 97 km, and the study area will be about 990 sq km (about

99000 hectares). The basin is in Toposheet Nos. E43H5, E43H6, E43H9, E43H10, E43H13, and E43H14, formerly 47F/5, 47F/6, 47F/9, 47 FAO, 47F/13, and 47F/14 of the Survey of India. National Highway 4 and the South-Central wide-gauge railway connect the basin to Pune, 18 km northwest. The basin's major towns are Lonavala, Vadgaon (Taluka Place), Dehu Road, Alandi, and Chakan. Talegaon, Sangvi, Takve, Bhushi, Dehu, Moshi, Indori, and others are connected by metalled and unmetalled roads and pathways.

Five small to moderate-capacity dams—Bhushi, Lonavala, Valvan, Shirawata, and Andhra—exist along the Indrayani River and its tributaries in the western part of the basin. Talegaon MIDC, Chakan MIDC, Talawade MIDC, and others have been developed or will be developed. Near highways and railways, industry has arisen. Many poultry and flower farms have been established in the basin. Military authorities' control of much of Dehu Road Town, Lonavala.

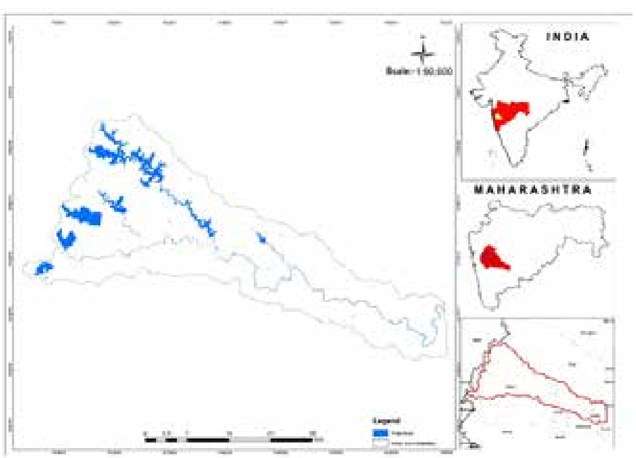

Fig.1: Location map – Indrayani River watershed

DATA ACQUISITION AND IMAGE PROCESSING

For the study area, we have used cloud-free Sentinel 2B and Landsat series multi-temporal post-mansoon multispectral satellite images for four years. The Landsat series includes L5 Thematic Mapper (TM) (2000/2005), L7 Enhanced Thematic Mapper Plus (ETM+) (2010), and Sentinel 2B MS (2015 and 2020) satellite images that were downloaded. The satellite images were obtained from the https://earthexplorer.usgs.gov/ portal.

The study area is covered in a single scene. Satellite image pre-processing like layer stacking, image enhancement, and subset has been performed using ERDAS IMAGIN 2020.

The SOI Scanned Toposheet (Scale 1,50000) was downloaded from the https://onlinemaps.surveyofindia.gov.in/Digital_Product_Show.aspx portal. The study area is covered in 06 toposheets (Toposheet Nos. 47 F/5, 47 F/6, 47 F/9, 47 F/10, 47 F/13, and 47 F/14). The downloaded scanned toposheet was not georeferenced with the ground surface. Therefore, the toposheet was georeferenced to latitude and longitude by using well-distributed ground control points (GCPs) and projections assigned to the Geographic Coordinate System (GCS) WGS 1984 Datum using Arcgis 10.8.2 and QGIS.

Digital Elevation Map [DEM]

Digital elevation models, which are based on a grid, are the most widely used source of information about the topography of Earth. This information serves as an input for a metric that measures features of the ground. The spatial resolution of these data is 30m, and they were downloaded through a USGS site. Therefore, a digital elevation model (DEM) is a raster representation of a continuous surface, often the Earth's.

The western part of the river basin represents the highest elevation of 1137 m under the high hill mountain range. Whereas the SW part of the basin represents the lowest elevation of about 416 m under the low-lying area. Fig. 2 shows a DEM of the Indrayani River basin.

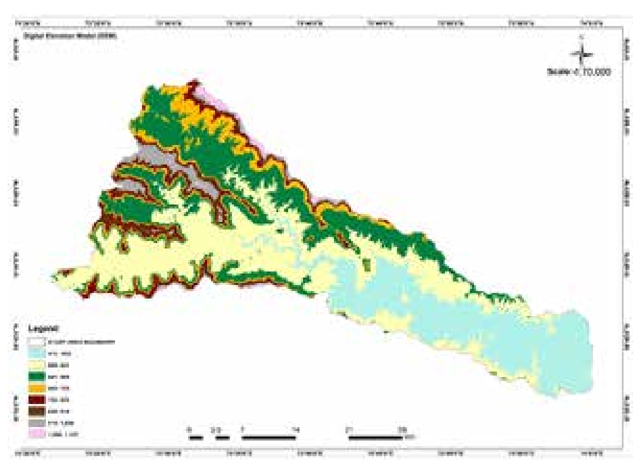

Fig. 2: Digital Elevation Map of Indrayani River Basin

Contour Map

A contour is a line that connects areas in a raster or vector dataset that have the same value. Contours are used to depict continuous phenomena like elevation, temperature, precipitation, pollution, or air pressure. The manner in which the contour lines are distributed illustrates how the values change throughout a surface. The western portion of the basin of the Indrayani River is represented by contours that are tightly spaced, which indicates a steep slope towards the northern part of the river with a contour interval of 20 metres. This study made use of the SRTM Dem-based contour in its analysis. Ref. Fig. 3.

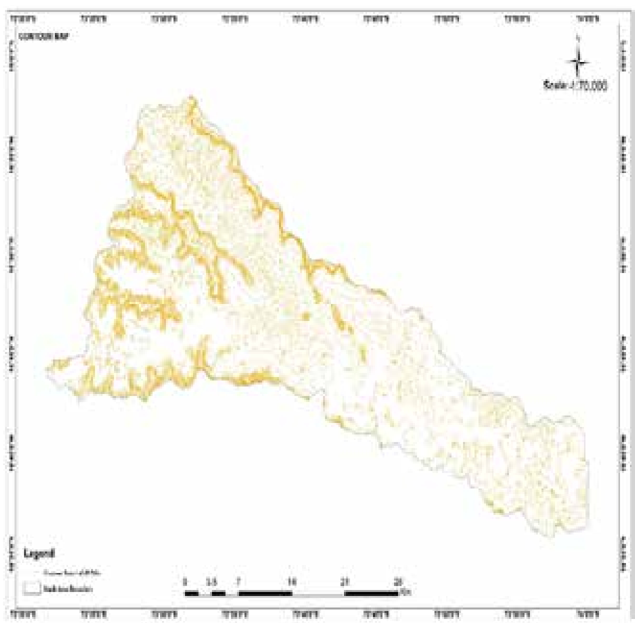

Fig. 3: Contour Map of Indrayani River Basin

Slope Map

Raster-based slope computation tools in GIS estimate the maximum rate of change in value between each cell and its neighbors or a measure of surface value change over distance. In the output raster, the slope is determined as a percentage or as a degree of slope. It depicts the degree of slope for a continuous landscape. The degree of slope is highest in the western part, indicating a steeper slope and the presence of a mountain or hill range. The slope reduces towards the east, indicating flatter land. Ref. Fig. 4.

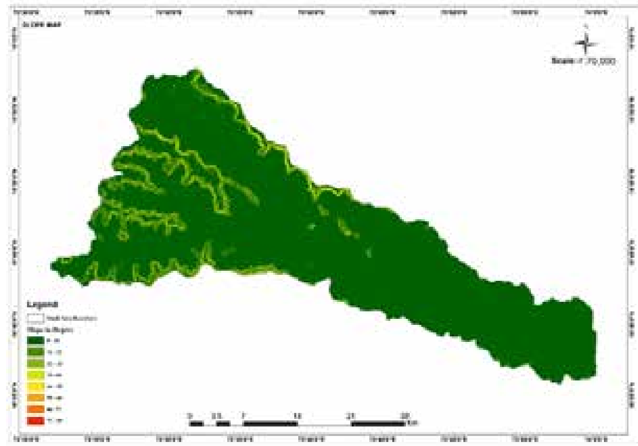

Fig.4: Slop Map of Indrayani River Basin

Drainage Density Map

In geomorphology, a drainage system is the pattern formed by the streams, rivers and lakes in a particular drainage basin. A watershed is a geographical area that encompasses all of the tributary streams that converge at a common point along the main stream channel. The studied region exhibits a dendritic drainage pattern. There is total seven orders of stream. The first order of streams is generally observed in the western region. The stream order increases towards east. The drainage line extract from SoI Toposheet.

The type of the drainage pattern in the studied area can be classified as dendritic to sub dendritic. The ratio of the overall length of a stream to the total area of a drainage basin is what is meant when people talk about drainage density [8], as shown in Equation (1) below:

$$D_d = \frac{\sum_{i=1}^{i=n} s_i}{A} \quad (1)$$

Where, D_d is drainage density; S_i is the length of i^{th} stream in km; A is the area under consideration in sq. km.

It is calculated by dividing the total length of all the rivers and streams in a drainage basin by its entire area. It gauges how effectively or ineffectively stream channels drain a watershed. With Arc GIS software, calculating drainage density is simple. The maximum drainage density in the studied area is 416 km. Ref. Fig. 5.

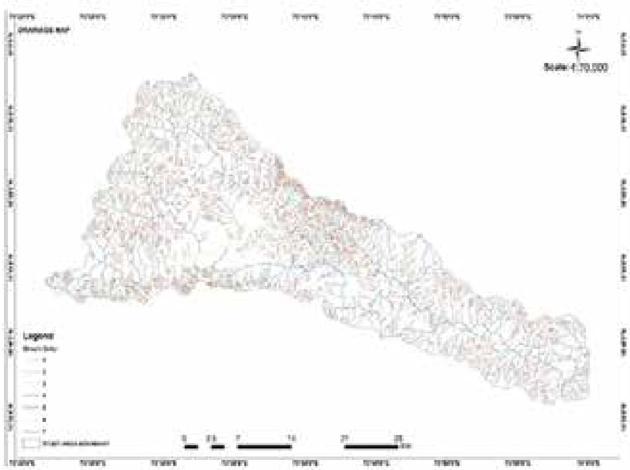

Fig.5: Drainage density Map of Indrayani River Basin

Soil Map

A soil map is a geographical depiction that shows the variety of soil types that are found in a particular area of interest. The NBSSLUP soil map served as the basis for this soil map that was generated. Clayey, calcareous, and loamy soil are the most prevalent varieties that can be found in the area under study. Ref. Fig. 6.

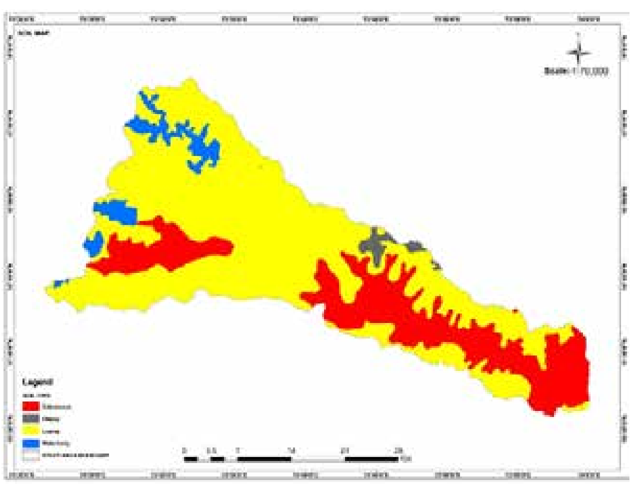

Fig. 6: Soil Map of Indrayani River Basin

LULC Map

The LULC map was created using the unsupervised classification technique. The land surface's vegetation, water, natural surface, and cultural elements are all described in the land use and land cover (LULC) data files. Five classes comprise the Lower Laguna Littoral Ecosystem: agronomy, woodland, waterbody, settlement, and arid land. There is agricultural land on the riverbanks, waterbodies may be found in the southern and western sections, and the study area is surrounded by distinct vegetation types. The steep, mountainous region is covered with forest. The river flows eastward along with its principal tributaries. Ref. Fig. 7.

Table 1. Classes delineated on the basis of supervised

Sr. No.	Class of Land	Description of Class	Color Code
1	Agriculture land	Crop fields	Green
2	Barren region	Human-influenced patches of exposed soil and barren land	Gray
3	Built up land / Settlements	Residential, commercial, industrial, transportation, roads, mixed urban	Red
4	Fallow land	Unseeded during growing season	Yellow
5	Low dense forest	Mixed forest lands	Bottle green
6	Bodies of Water	Waterways, lakes, ponds, and reservoirs	Blue

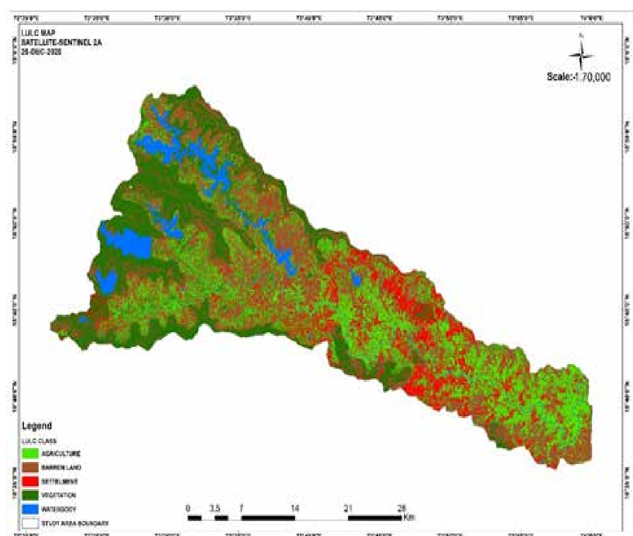

Fig.7: Land Use Land Cover [LULC] Map of Indrayani River Basin

RESULT

From the above discussion, it seems that the assignment of a higher priority to sub-watersheds is the most important step towards the integrated and effective development and management of watersheds. Most of the researchers focus on agricultural land water requirements as well as finding quality water resources. For the purpose of maps, cloud-free Sentinel 2B and Landsat series multi-temporal post-monsoon multispectral satellite images. The westernmost section of the river basin contains the highest height, which is 1137 meters, and is located inside the high hill mountain range.

Whereas the southwestern portion of the basin has an elevation of around 416 meters at its lowest point, which is located in an area that is low-lying. The western portion of the Indrayani River basin is characterised by contours that are tightly spaced, which indicates a steep slope towards the northern part of the river with a contour interval of 20 meters. The hilly, mountainous region is covered by forest, and discrete types of vegetation are present all around the study area. It exhibits a continuous terrain slope. Western slopes are steeper, indicating mountains or hill ranges. The eastward slope reduces, indicating flatter terrain. Clayey, calcareous, and loamy soil are the most typical types of soil that may be found in the research region.

CONCLUSION

At Tulapur in the Pune district, the Indrayani River joins the Bhima River as a tributary. Dehu Road Town, located on the banks of the Indrayani River, is almost totally under the control of the military. Lonavla, India, is a major tourist destination during the warmer months, while Dehu and Alandi, both revered by Hindus as sacred sites, draw large numbers of visitors year-round. The basin is home to the present and future growth of several major industrial corridors, including the Talegaon MIDC, Chakan MIDC, Talawade MIDC, etc. Industrialization has occurred along the lines of highways and railways. Studying the aforementioned watershed makes evident that the urbanised area is always evolving, reflecting both the day-to-day population and economic expansion. As this pattern persists, water stress in the watershed will grow, and with it, the need for more water.

The unplanned growth of settlement and agricultural areas in the watershed is mostly related to inefficient management and a lack of land use planning. This is because there is no Environment Impact Assessment (EIA) report created before land development in the study region. As a result of this increase in population, deforestation and water scarcity have become major issues. If we focus on a small river watershed to develop, it is important for the overall development of a particular territory.

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