

# Implementation of 5G Technology in Rural Education of India

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**Abstract— The potential of the 5G network model to revolutionize Industry and Education is exemplified through 5G technology use cases. Enhanced Mobile Broadband, Massive Machine Type Communication, and Ultra Reliable and Low Latency Communication are the three key components of the 5G concept. The services that 5G provides to users are contained inside these blocks. This study focuses on the concept of a "School on Wheels" as a beneficiary of 5G technologies. Rural Education will benefit from the implementation of 5G-enabled services that are specialized to this industry. We offered frameworks for advancing tools that will accelerate the idea of a Smart Educational System by linking 5G and its disruptive technologies. As a result, this paper provides a thorough examination of 5G technologies, which will facilitate new teaching and learning trends in the educational environment.**

**Keywords—5G Technology, AR-VR, Artificial Intelligence.**

## I. INTRODUCTION

By 2035, the cumulative economic impact of 5G on India might be worth \$1 trillion. This will aid in the integration of artificial intelligence into our daily lives and allow for seamless data transfer to smart devices, creating an environment conducive to the Internet of Things (IoT). Robotics will be able to execute precision manufacturing activities thanks to 5G, especially where humans are unable to do so safely or accurately [1]. 5G has the potential to improve the entire value chain, from agriculture to smart irrigation, soil and crop monitoring, and livestock management. 5G in health care could enable more effective telepathy, remote control of surgical robotics, and wireless data monitoring.

According to a World Bank report, implementing 5G will boost India's economic growth by 13.8 percent. It will make smart manufacturing more automated thanks to the

Internet of Things. Virtual reality and robotics in health education, for example, will be possible thanks to 5G. The Smart City and Digital India initiatives will benefit. Through projects like smart village application cloud solutions to boost productivity in fields like agriculture, MSME, banking, and others, 5G will usher in a digital revolution in rural India. The right to education is a fundamental right in India, according to which every citizen between the ages of 6 and 14 receives free and obligatory education. This clause assures that every Indian citizen receives an education up to the age of 14 without discrimination. However, the truth is rather different. India has a literacy rate of 77.7 percent. However, the literacy rate in India's urban areas is 87.7%, while it is only 73.5 percent in rural areas. There are numerous reasons for the disparity between these two. In India, over 65.53 percent of the population lives in rural areas. There is a significant educational divide between urban and rural areas.

According to the Annual Status of Education Report (ASER) report, a survey was undertaken and practically all rural areas were covered; it was discovered that more than half of children aged 3 to 16 are unable to read and perform mathematical skills in the age group of 5 to 16 years. However, there are several issues with schooling in rural India:

1. Resources are in short supply.
2. Lack of understanding of the importance of education among the people.
3. Less school availability.
4. Digital profit.
5. Financial condition.

Another interesting technology apart from 5G technology is the existing hologram technology which can be used in collaboration with the 5G technology to make it much easier for the learners to develop a good knowledge of the concept [2]. Many EdTech events, especially after the Covid-19 pandemic, have emphasized the critical necessity to integrate holographic technologies in order to suit students' dynamic learning needs. This paper presents a

concept idea to revolutionize Indian rural education which if implemented by right means would prove to be a boon for society.

## II. DATA COLLECTION

Human communication, information acquisition, working, thinking, and other interactions have all transformed in recent years as a result of the internet's widespread availability and the worldwide mobile revolution. '4G,' or fourth generation, is the current level of technology in mobile communication that has been standardized in India. However, people's modern work ethics and expectations demand improved technology that allows them to simultaneously connect to different wireless technologies, networks, terminals, and applications. In addition, we must be able to move between each of them while being compatible with older technological generation devices such as 4G, 3G, or even 2G. 5G, or fifth generation wireless systems, is the designation given to this most recent technology [3].

We conducted a survey with a sample of 80 people across various demographics aged between 18 years to 60 years to try and understand what are their expectations from this new technology that is soon going to be launched in India. We also wanted to know the opinion of the citizens as to which field in India they prefer would require the most technological reforms. Fig 1 shows the following statistics. A whopping 42.1 percent of Indians voted in favour of technological reforms in rural schooling utilising 5G technology. Agriculture, the next field to receive the most votes, came in second with a massive 22.8 percent of the vote from Indian nationals.

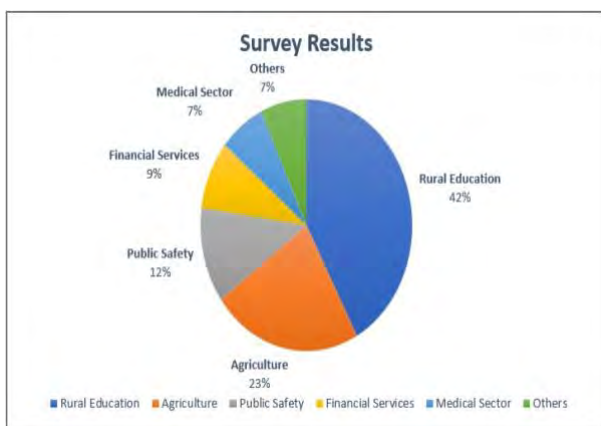


Fig 1. The various industries that Indians prefer 5G to transform technologically (Source: as per our survey conducted online).

These results prompted us to explore and dive deeper into the realm of the ways in which we can bring about technological transformation in the rural education of India. The concept of gaining education now-a-days is highly dependent on the facilities provided by the government for the students residing in the rural sections of India. And mostly because of the lack of resources they face it directly affects the country's literacy rate. To come up with a solution to this the government of India has come

up with a new National Education Policy as an initiative to fill the learning gap between different areas of the country.

Another interesting aspect of the survey revealed that 22.8% of the people who took the survey, believed that Augmented Reality (AR) was going to change their daily lifestyle in the future given the advent of 5G technology.

We found a great scope in integrating the 5G technology with the existing AR technology for the benefit of underprivileged children.

## III. 5G NETWORK AND ITS APPLICATION TO EDUCATION PROPOSED ARCHITECTURE

To begin, we must choose a bus that is appropriate for our mission. The bus that has been chosen should then be changed to fit our project's requirements. The seats on the bus will have to be removed, and benches will have to be installed in their place for kids to sit. The use of an electric vehicle (EV) bus will be favoured in this case, as the prices of alternative fuels, such as diesel and gasoline, are now increasing. So, in terms of the project's economics, an EV bus will be preferred. After the bus has been chosen, all classroom resources, such as laptops, televisions, DVD players, and instructive audio-visual learning materials, as well as some informative books, should be purchased [4].

After doing all the things mentioned above, we will have a basic bus with classroom supplies and other educational learning material with us. To take this a step further, this bus will then be equipped with the latest 5G wireless technology so that the students who use this school on wheels bus facilities, will be able to perform real time lab experiments with the help of this technology. With the use of the 5G antenna which will be structured on the top of the bus, we will be able to locate the current position of the bus while it is out in the rural areas, so that we can monitor the current position of the bus and observe if the drivers of the bus are doing their job effectively [5]. The use of the latest 5G based technologies such as holograms will be incorporated in this bus. Use of holograms will ensure that the lecturer can deliver his lecture from a place of his comfort rather than travelling to these rural areas physically. 3D holograms will then be projected in the bus by using the hologram technology under 5G and this will bring a huge boost in the interest of the students who want to perform real time experiments [6]. The use of Augmented Reality (AR) or Virtual Reality (VR) can also be done in the bus by having the specific equipment for this technology. AR/VR can be used by the students to experience the places that they cannot physically travel [7].

We will next approach experts in their fields all across the world with a proposal to deliver these lectures to students on a specific timetable. If the plan is accepted, the teachers

will be assigned to deliver lectures on time. The lectures will be given by the teachers in a green room with holographic cameras to capture the teacher, and then the same holographic 3D projection will be done in front of the students in the bus. The appointment of drivers/instructors will also be made in order to ensure that the buses arrive on schedule at their destinations. The bus instructor will be present to solve minor queries of the students and help them with using the lab equipment in the bus.

This project will make use of cloud-based data storage to save personal information about students and teachers, as well as some study materials. Cloud-based data storage will also be used to record the teacher's real-time lab sessions so that if a student misses one, he/she can see the tape later [8]. Cloud-based data storage has become much more efficient in terms of speed and reliability thanks to 5G technology.

The bus will also be equipped with a selection of literature that is educational for the students. This will provide youngsters from neighboring areas with access to actual copies of books, giving them a unique experience of learning and incorporates good reading habits in the students. In brief, the students in the surrounding towns can utilize this school on wheels bus outfitted with 5G connectivity as a reading room where they can access a range of books. Fig 2. Shows benefits of 5G in School on wheels concept.

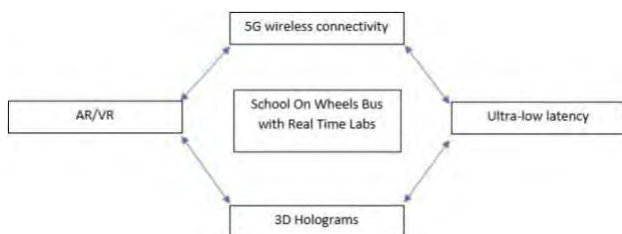


Fig.2 Benefit of 5G in School on wheels

#### IV. 5G INTEGRATED TECHNOLOGIES IN EDUCATION

a) **Augmented and Virtual Reality**  
Virtual reality is a haptic and interesting computer with user environment in which it enables the user to experience real life digital concepts by just the use of a virtual reality gear or equipment. In a constructive view point of the user, augmented reality is the merging of computer generated and real stuff [9]. To achieve a specific goal, augmented and virtual reality technologies might be integrated. The availability of bandwidth, network speed, and latency to execute these technologies is the primary difficulty. 5G services provide this solution. These two technologies, which are enabled by 5G, can essentially help Education

create smart students, smart teachers, and smart administrative teams.

Fig 3. Shows the augmented and virtual reality application to education.

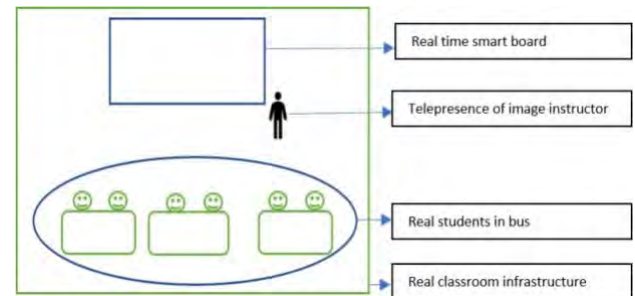


Fig. 3. Augmented and Virtual Reality Applicable to Education.

##### 1) Telepresence Mode (TM):

The ability for people to appear to be physically present at a distant location utilizing both augmented and virtual imagery is known as "telexistence" or "telepresence." Technology that can aid progress education has been created as a result of the development of this concept. A lot of the precise face-to-face communication, such as body language, eye contact, and physical presence, is still lacking in education despite the integration of telepresence with a high-end-to-end audio and video conference call. One of the things that makes traditional classrooms engaging is face-to-face communication. Therefore, it is crucial to include this immersive communication technique within the telepresence notion [10]. With holoportation, an end-to-end system for augmented and virtual reality, users can appear to be physically present at a distant location in the same manner they would in any other form. This system can capture people, objects, and actions in full 360 degrees within a useful environment using a number of specialized depth cameras. This information is then transmitted in real time to faraway participants through a network. The amount of data generated by the transmission of this information makes it challenging to maintain a real-time connection.

This difficulty will be solved by the presence of 5G with eMBB and uRLLC. This technology will be fully utilized thanks to 5G [11]. Students in a physical classroom can see their holoported instructor by wearing an AR or VR Head Mounted Display (HMD) such as the HoloLens or HTC Vive, as illustrated. Because the instructor is a knowledge agent, he or she is able to continue the transfer of knowledge independent of proximity. Distance Learning students can use this technology from the convenience of their own homes.

##### 2) Full and Hybrid Virtual Model:

###### a) Full Virtual Class Model

The Full Virtual Class Model (FVCM) is a concept in which virtual and augmented content is used to give learning content, teaching materials, and evaluations. Students that have access to such virtual content will receive an in-depth education on the topic being presented. This program can be extended to allow students to experience the texture of objects on Mars using Haptic Augmented Technology and Tactile Internet [12]. The Geography Department at UEW can employ such an application to help students have a complete grasp of Mars, which is a futuristic tourism destination. The Full Virtual Class Model could help UEW deliver its distance education programme more effectively. Students can easily attend class no matter where they are because FVCM does not place restrictions on them based on where they are physically. Students enrolled in remote education can use FVCM to simulate a regular classroom setting.

#### b) Hybrid Virtual Class Model

The Hybrid Virtual Class Model (HVCM) is a class in which curriculum and assessments are delivered using a combination of traditional classroom and augmented and virtual content [13]. A conventional class (Traditional Classroom) with a teacher and students utilising HMD is depicted in Fig. 6, section B. Abstract content is being presented through virtual reality to explain the actuality of an idea. The instructor will act as a guide for pupils, pointing them to the visuals and assisting them with questions and answers. The Boulevard app, for example, can be used for museum visits.

#### c) Holograms

According to a recent study, holographic communication is currently one of the most desired 5G-enabled applications by both consumers and businesses.

Holographic communication is the real-time recording, encoding, transmission, and rendering of 3D representations of distant individuals that are rooted in place and shown as stereo pictures or 3D video in extended reality (XR) headsets that create a holographic illusion [14]. After years of experience with video discussions on smartphones and tablets, many users claim that they are eagerly anticipating the chance to meet others virtually via immersive communication services like 3D holographic augmented reality (AR) calls.

Holographic communication, as opposed to flat screen television, can express the intricacies of nonverbal communication and offer a sense of presence and immediacy that improves the quality of human connection.

Holograms can greatly simplify learning and teaching, especially now that we have accepted the concept of hybrid learning. It can aid in the development of conceptual

clarity, the visualisation of abstract concepts, and the effective exchange of information between students and educators. Many EdTech events, especially after the pandemic, have emphasised the critical necessity to integrate holographic technologies in order to suit students' dynamic learning needs.

#### 1) Makes specialized training easier

Holograms can be used by teachers and experts to carry out experiments and illustrate key ideas in front of students. Without having to physically enter a classroom, much less one that is live and in person, medical students, for instance, can be guided through surgical operations [15]. Additionally, students can review extremely challenging concepts and experiments at their convenience from the comfort of their homes with the help of AI holograms. As a result, the process as a whole becomes really interesting.

#### 2) Brings together learners who are in different locations

AI holograms can completely erase geographic borders by simulating in-person communication [16]. For instance, students from different countries and institutions can interact to learn more about one another's distinctive cultures through live projections and perhaps even 3D show-and-tells! Students feel as though they are there and with them, which makes for an interesting and memorable learning experience.

#### 3) Makes history come alive

Students will get a greater knowledge of the events that led up to the French Revolution. Alternatively, you might sit in the classroom and experience the Elizabethan era's Globe Theatre. This is achievable because to holographic technology [17]. Learners can interact with the surroundings while also viewing historical events when spatial sound technology is used.

#### 4) Makes multiple lectures possible

Educators can use holograms to teach many classrooms at the same time. This could be a lifesaver in underdeveloped areas of developing countries where there aren't enough schools. By implementing holographic technology in the near future, school on wheels can increase their global reach and play a significant part in reducing inequities in right to schooling [18].

#### d) Cloud Based Data Storage

With the use of the network, cloud computing may break down complex and large data computations into a myriad of smaller ones that are then processed and analysed by a system made up of servers and returned to the user. It makes it feasible to offer robust network services because it can analyse tens of thousands of data in just a few seconds. Cloud computing has attracted interest from a wide spectrum of scholars due to its large data processing



power, and this field of study is also deepening [19]. It is obvious that cloud computing is developing swiftly, having a big impact on education, and promoting educational growth.

#### e) Industry/Educational Automation

The control and data planes of 5G networks will be separated by a Software-Defined Networking (SDN) architecture [20]. The majority of control plane intelligence will tell the data plane how to operate the infrastructure.

The diagram below shows a possible automated 5G Education configuration that would allow for an intelligent campus. 5G will make communication and automation possible in the classroom when Educational Internet of Things (EIoT) and Industrial Internet of Things (IIoT) are used.

Educational application, which incorporates cloud sensor devices and a computerized system for computation, is used to represent administrative offices. A Smartboard 7000 Series IQ with an image detective sensor, a sensed door with an actuator, a sensed chair, a smart table with an embedded touch screen computer, and a room with educational IoT wireless devices are all included in the educational application.

Fig 4. Shows Prospect Application Scenario of 5G – Enabled Automation in Education.

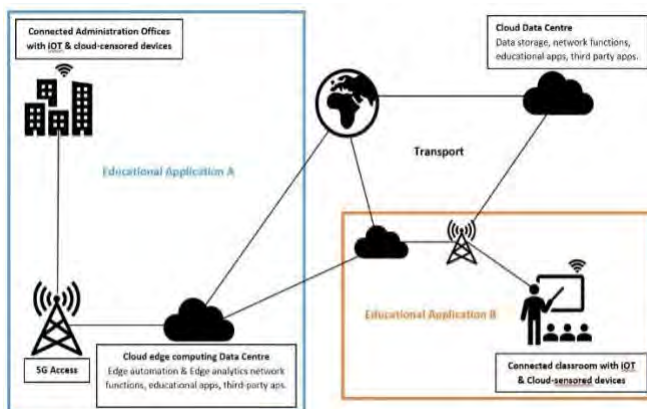


Fig.4 . Prospect Application Scenario of 5G – Enabled Automation in Education.

## V. CONCLUSION

In addition to upending industry, the rollout of 5G networks will also lead to changes in the education system in rural areas. In this study, we evaluated the viability of using the 5G Ecosystem and implementing its key technologies in the sphere of education. We also proposed frameworks. The changes that 5G networks will bring, particularly in terms of enhancing teaching and learning, were highlighted in this study. This research predicts a shift in how kids learn, teachers conduct research, and how materials are delivered with the anticipated adoption of 5G technology in education and the arrival of IIoT devices on school buses.

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