The Role of IoT in Senior Secondary Education Its Challenges and Opportunities

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Abstract:

Indian education system is reforming from traditional to modern and after the pandemic of Covid-19 education system shifted on digital platform. In current scenario IoT plays vital role in transforming secondary education system in India. Smart classroom, Biometric system of attendance, personalized learning and feedback, virtual laboratory, Smart ID cards, Virtual classroom and safety with security enhanced engagement of learner into practical learning. IOT devices provide insights into academic performance, enabling timely interventions. It optimized use of resources and also reduced wastage with skill development of students for their careers in emerging technology and education.

Google for Education Kit includes connected devices for classroom, Raspberry Pi kits are uses for IoT based STEM learning projects. Smart Boards, Smart classrooms are interactive and connected to cloud resources. Integration of IoT, senior secondary education system can bridge the gap between traditional teaching methods and modern technological advancement, it prepare future students with technological advancement. Every opportunity comes with challenges and challenges overcome by determined actions. Cost of implementation, data privacy, training requirements and connectivity acted as challenges in use of IoT in senior secondary education system due to lack of proper financial and administrative management but IoT transformed education system in India and education entered in new era of excellence and development.

Key words: IoT, Smart classroom, individualized learning, Resource management, Virtual labs,

1. Introduction

Internet of Things (IoT) is the network of interconnected physical devices fully loaded with sensors, software and other technologies that enables them to collect and exchange data over the internet. IoT devices include a network of physical objects connected to internet and can communicate with each other with cloud. Simply IoT is device with sensors, processing ability, software and other technology it connect, communicate with data exchange with help of internet. It uses in Home such as vacuum cleaner, voice assistant and security system, in retail environment it is present in form of self checkout, in store offers, in farming it uses in monitoring environmental conditions.

1.1. Background: The Emergence of Iot In Education

In education IoT introduced as educational technology during the period of 1980-1990s but it became popular in last one decade. In start it was the use of PC in classrooms for digital learning, it was first step toward networked education. In year 2000 interactive Smart boards

assisted teachers to engage students in digital content in interactive way. Internet connectivity Wi-Fi enabling mobile phones, laptop and tablets to access internet for learning.

Emergence of IoT in Education- In the decade of 2010-2020 smart phones, tablets introduced web based or app based learning it allowed IoT entrance in classrooms. Google Classroom enabled collaborative learning and data sharing for purpose of teaching and learning. IoT powered devices such as smart boards, sensors WiFi enhanced data collection and data sharing. It also provided remote monitoring facilities. In the pandemic period of Covid-19 classrooms shifted at online mode with the use of sophisticated technology and internet. IoT enabled tools such as Smart/ Android phones, camera, virtual reality (VR) headsets AI powered platforms became integral part of modern classrooms. AI integration in teaching and learning, smart campuses optimizes resource management and enhance security.

2. Objectives of The Study

The present study has following objectives

1. To investigate how IoT can provide interactive and engaging learning experience for senior secondary students.
2. To examine how IoT promoting STEM education and encourage interest of senior secondary students in science, technology, engineering, and mathematics.
3. To know how IoT can support adaptive learning tailored to individual students of senior secondary students.
4. To know how IoT can increase access to educational material and tools through smart devices in learning of senior secondary students.
5. To know how IoT develops teacher competence effectively in their classrooms at senior secondary education.
6. To know how IoT can improve Administrative efficiency in streamline management task such as attendance tracking and energy management.

3. Iot Applications In The Senior Secondary Education

In education IoT has following key applications:

1) **Smart Classrooms** Smart classrooms are equipped with interactive whiteboards and IoT enabled devices connect to learner's device and allowing them for useful effective interactive lesions based on quality content teaching. It also useful in tracking of attendance and engagement of students in academic and co-curricular activities at different levels. Teacher can monitor student's performance and their adaptation of lesions dynamically.

2) **Personalized learning** smart devices collected data and it offers tailored learning experience for students and teachers. It also provides resource based individual progress of learner.

3) **Enhanced security of premises** CCTV, Scanners, Biometrics and internet/WiFi devices provides better security of campus of institution, it also monitor and controls movements of students teachers and visitors with possible opportunity to avoid

unfavorable activities in the campus of institution. IoT gives alerts against unauthorized access or any kind of emergency in order to secure campus.

4) **Resource Management** IOT is very helpful in the management of resources of institution such as Energy Efficiency including smart lighting and HVAC that reduces consumption of energy in institution. It also managed supplies of lab equipments, library books and other learning material in the institution.

5) **Virtual Learning** in this modern era of education IoT supports e-learning with virtual setups of modern technical devices such as projectors, cameras speakers, VR Sets and other required tools of virtual learning. It also ensures tracking of progress of learner and his engagement in online content delivery and teaching.

6) **Assistive Technology** IoT is disabled friendly it assist students with different abilities through tools such as smart text-to –speech, smart hearing aids, hearing devices and smart readers.

7) **Virtual Labs** IOT is equipped with the facility of virtual labs here IoT allows students to perform experiments virtually similar to gaming platform, students perform experiments with curiosity and interest it looks very realistic in real-world simulation. Students conducted experiments of science, mathematics, geography etc. with permanent learning of concept. Things are available in 3D model in virtual labs that attract student's creativity and built his memory permanent with better understanding of concepts and parts of experiments.

8) **Digital Library** this is the era of technology in education and manual things and resources shifted to digital here e-library or digital library is another useful resource of learning for students in schools and it possible due to presence of IoT in education sector since last two decades. Access of digital library is easy for students with login and password facility. Students can access here variety of subjects, contents, materials, encyclopedia and other useful data required as per their need and demand.

9) **Campus Management** IOT made every aspect of schooling better and secure with effective management of things that's going on in the premises of the school. FRIDS tags and Biometrics changed the scenario of management of students tracking and truancy habit now they once entered in the campus keeps under the surveillance system till the closing of the school. They can easily track during the schools hours. IoT managed every needful task in the campus of school and help in better management of things in daily schooling.

10) **Minimize Dropouts Risk** IoT helps to solve the problem of dropouts in senior secondary schools here it provides predictive analytics that is helpful to identify issues related with the dropouts such as problem and issues of students. Schools can take safety measures and solved the problem of students and minimize the chances of dropout from schools.

11) **Assessment of Teacher's Effectiveness** Iot and its devices are now very useful in assessment of teacher's effectiveness, Smart sensors and devices such as microphones

and smart cameras or voice enabled cameras can monitor classroom interaction of teacher with recording real time data of teacher student engagement, teaching style, teaching methodology, discipline and personality impact of teacher in the classroom situation.

12) **Feedback and improvement** IoT devices provides real time feedback through quiz, polls and questions during lectures it allows teacher to modify his methodology and style in classroom. Other important task related with school can be easily improved with the feedback system based on IoT devices. From beautification of campus to internal examination every aspect can be changed with it.

4.   Opportunities of Iot In Senior Secondary Education

In this technological era of schooling opportunities of IoT are following:

1) **Enhanced Learning experiences-** Implementation of smart devices provided numerous opportunities to enhance education system of schools. Smart boards, projectors and other connected devices powered by IoT devices facilitated interactive teaching learning and better understanding of concept. It also promotes personalized learning on pace of learner in healthy learning environment.

2) **High student engagement-** IoT turned learning into gaming so now learning is Gamified and students showed interest with high devotion and engagement because learning became interesting as games are interesting and participation of students is high in this type of learning empowered by IoT.

3) **Self directed learning and Instant feedback-** In learning new concepts students receive instant feedback through smart connected devices it fosters their self directed learning and improvement.

4) **Effective School Management-** IoT empowered schools with RFID cards and Biometrics and solved the issues of taking daily attendance by teachers here automatically attendance record by cards and scanning of faces of students. It also manages water, electricity and others bills of school by reducing its costs. IoT RFID enabled system of schools library checkout issuing, return and book entry in account of students.

5) **Smart Surveillance-** IoT based cameras with voice recording and facial recognition facility gave smart surveillance system to the schools, its ensured better monitoring and safer premises of school.

6) **Emergency Alerts**- sophisticated fire alarm system that is based on IoT provides instant emergency alert and communication regarding fire, earthquake and during other emergencies. It makes campus safe than traditional campus of schooling.

7) **Support for Divyang Children-** students with any disability can learnwith the assistance of IoT with least knowledge of handling the devices and equipments. Equipments are available for these kinds of students in order to help them in learning and participating in school activities, smart speech aids, smart hearing tools and smart

walking aids are useful for these students. AI smart glasses are wearable glasses with artificial intelligence, computer vision with a natural language processor that help students to find objects, scan text and navigate his surroundings.

8) **Career Readiness-** introduction of IoT in schools is preparing students for career oriented technology and education they easily relates their potential, aptitude and interest to decide the field of career. It exposing the areas or field of future development and students caliber based on science, technology, arts, gaming, music, drama etc. here students can easily select area of career. Experiments based on robotics, coding platforms strengthen student foundation in science technology engineering and mathematics (STEM) subjects.

5.   Challenges In Implementation of Iot In Senior Secondary Education

There is challenge rise with dawn of any new technology or introduction of technology following are possible challenges in implementation of IOT in senior secondary schools:

1. **High Cost and Accessibility** it is matter of finance that raise challenge in implementation of IoT in Schools because the devices such as smart cameras, virtual labs, hearing devices, WiFi are very costly and needs infrastructure that is again costly for management and administration that looks school education. Technology and infrastructure requires lot of fund for purchasing and establishment of IoT in schools.

2. **Privacy and data Security** There is a problem mostly common to see that is leaking of data and privacy. This is risk factor for data breaches and misuse students, teachers and schools data by any data hacker or agency. It also requires high cyber security measures in the schools.

3. **Need of Technical Experts** data of school is very sensitive thing and for data collection data analysis and data security a technical expert is must required in the schools other than regular teachers. In this case school need to appoint a new technical expert is suppose to be a extra burden of finance in schools and management and administration unable to keep a expert all the time in the school.

4. **Technical Complexity** IoT is data and devices communication system it is integrated with legacy system and it can be challenging. It required regular maintenance and upgrades time to time when necessary in the school.

Conclusion:

In modern education system it is era of 5G technology in education and education is transforming quickly here schools are the laboratory where these technologies are to be tested in future. 5G connectivity, AI integration and edge computing giving advancement to school education, from traditional offline classroom education shifted to online education and physical classroom to e-classroom/ online classroom. Effective implementation of IoT provided opportunities for both students and educators with corporation of technology and schools now learning is more creative and environment is more secure for learner. It improves resource

management and overall learning experience of learner IoT prepares students for a technology-driven future of education. By keeping a balance between innovation and practicality of things, IoT can revolutionize senior secondary education and equipping students with future tools and knowledge to flourish in connected world.

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