

Empowering Education: A Comprehensive Review of IoT-Integrated Smart Education System

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ABSTRACT- The Smart Education System leverages advanced IT technology, particularly Internet of Things (IoT) and cloud computing, to enhance various components of the educational system. The integration of intelligent technologies in the education sector is becoming increasingly vital, and IoT plays a crucial role in Information and Communication Technology (ICT) and social development. The continuous growth of connected devices in education allows for a wealth of data, enabling campus leaders to engage in iterative processes with students, teachers, administrators, and service providers, transitioning from a transactional relationship to a more dynamic and responsive educational environment. The emphasis on creating a person-centered environment within smart campuses aligns with the broader strategy of smart environments. This strategy aims to enhance productivity, promote sustainability, and improve the everyday conditions of educational institutions' constituents. The research, based on an analysis of literature from various papers published in journals and online sources, aims to elucidate the role of IoT in the development of the Smart Education System. However, it acknowledges a limitation in that it focuses solely on the application components of the subject matter, omitting physical components. Conventional educational delivery and management methods may fall short in meeting the demands of this industrial era. Therefore, disruptive technologies like IoT hold significant potential for transforming the current educational setup. The research work provides an overview of IoT applications in educational settings, examining the perspectives of school management, teachers, and learners. The paper delves into recent research to showcase how IoT benefits school managers, teachers, and learners. It explores the three perspectives mentioned earlier, shedding light on the practical applications of IoT in the educational landscape. Additionally, the research identifies bottlenecks in IoT applications, elucidating security, privacy, scalability, reliability, and dehumanization as key constraints in implementing IoT technologies within educational settings. The comprehensive overview aims to contribute to the understanding of the role and challenges of IoT in the evolving field of smart education.

Keywords: Intelligent Education, IoT, Smart Education, Cloud Computing, Smart Campus, Sensor, Actuator, teaching-learning.

I INTRODUCTION

The Internet of Things (IoT) has the ability to be very helpful to colleges and universities. Educational organisations have a lot of chances to make money with the Internet of Things. They can get smart cards with IOTs on them. These smart cards let students into many places on campus, such as the grounds, labs, classes, and libraries. As soon as a student gets to school, they will be reminded of their daytime schedules, the availability of reserved books in the library, and other important details. After a teacher arrives on campus, students in a choice-

based course can get that teacher's personalized schedule and classroom location [1]. A lot of the time, students are free to choose their own topics or papers. It's possible that a biometric attendance system would use this to keep track of which students are present. Someday, it might be connected to things like grants, cell phones for parents, and other similar things. With exercise apps, it's possible to keep an eye on the health of both students and people who live in dorms. Automatic temperature tracking is possible in both labs and the tools that are used in them. Touch screens, interactive projectors, and automatic text capture [2] are some of the things you could use. When touch boards are connected to the internet, users can easily download the content they need to the board. Because of this, strong and flexible learning spaces can be made for both the teachers and the students. According to [3], the student's study database can be saved and looked over so that the student can get personalized comments on their work. If a review shows that a student is having trouble in school or with friends, you can send them personalized advice. In this way, the management will be able to handle problems quickly and well. Along with a student's time on school, a profile of that student can be made to help them do their job better. Apps that are smart will let workers and sellers know when equipment needs to be serviced before it breaks down. Smart locks, doors, and cameras can be used in many places to keep an eye on and manage traffic flow. Individualized education, as explained by [4] lets students learn at their own pace and level of intelligence. Customers might be able to get pre-paid dining services with smart cards. On top of that, the Internet of Things lets campus managers connect all the devices to a single, reliable, centralised network from anywhere. This gives the school's leaders power over the lights, parking, and cameras on campus, as well as useful data and analytics for making the best use of resources [5]. the system still has issues that need to be fixed. These are some of the most well-known: In the future, more computers, cars, homes, and other gadgets will be online. This means that big data may become a bigger threat to society. The task of creating a number of networking standards for both wired and wireless devices is still very large. There will be a way for different gadgets to talk to each other. The fact that all data is kept in files and that it is easy to get to important and sensitive data could make it harder to keep information safe and private. Everybody should be able to get high-speed broadband internet. Also, energy is very important because a lot of Internet of Things systems need years to work [6].

IoT Applications in the Education Industry: The Internet of Things could help make educational chances more accessible, useful, and high-status in more places. There are almost infinite ways that solutions that are allowed by the Internet of Things could be used in institutions. These give a strong base from which to build a full understanding of how it can be used in educational settings. Also, schools don't have to hire more teachers to improve their lessons; they can use technology instead. Some students and teachers want help with technology so they can show how good they are at teaching. IoT Solutions for Education is aware of this fact and gives solutions that help improve education around the world. Today, students with disabilities can do the same things as students without disabilities. In the past, this wasn't the case. The idea of making numbers, thoughts, and theories easier to understand has just come up [7]. Now more than ever, learning in the classroom is fun, interesting, and involves everyone. In fact, devices connected to the Internet of Things have been able to rebalance a large part of modern education in order to fully advance global society. It's never been easy to use and fun to interact with in school situations. In the classroom, the Internet of Things (IoT) is the future for almost all of the kids. With the Internet of Things, teachers can easily get to a wide range of cutting-edge teaching materials. Because of the Internet of Things, teachers can adapt their lessons to meet the needs of each student and give them one-on-one, following a set lesson plan. As an example, it uses data to figure out which addition will help each student the most and then creates content automatically based on the on-demand lessons

that student has already watched [8]. Utilizing technology in all areas of education helps teachers become better professionals. This is because scholars are better able to understand what they're doing and learn the skills they need to come up with better methods instead of just using old or useless ones. IoT can also be used to improve the information base that is used to put standards and practices into place in schools. It's hard to do accurate research in the field of education because there isn't almost enough data. It is a very large, high-quality set of data from the real world that focuses on educational planning [9]. The unique power of IoT to gather a huge amount of strange data from many places around the world is where it comes from. Students can also learn how to adapt through the Internet of Things, which gives them access to tools that meet their specific needs. Every student can see how they're doing and help make the programme better. Many of them are done without doing anything. Anytime the kids want, they can use the system; the design is based on the performance data. This makes education very efficient, which in turn lowers the costs of planning and tailoring education. [10]

Smart Classroom: That is possible in schools that have Internet of Things (IoT) features because they can track and grade how well and how efficiently students do their work. With the help of Internet of Things (IoT) gadgets, students' attendance will be tracked automatically. These days, teachers and other educators who use remote administration have to give tests and tasks. As another way to keep an eye on the kids' safety, IoT wrist bands can be used. Any possible learning setting in the classroom can have its ventilation, air quality, temperature, and humidity controlled and made the best they can be. This will keep the facilities in good shape and make the space a safe and comfortable place to learn. [11].

Smartboards: As things have changed, interactive whiteboards are now better for students than blackboards. A smart board is an electronic whiteboard that can show a picture of the subject being talked about. Make sure that both teachers and kids can use it. You only need to walk into the room or switch seats during the lesson. From now on, things look like they will get more fun and interesting. People often wonder if a smart board can absolutely replace a blackboard. Simply put, "yes." There aren't enough words and pictures on the blackboard or in textbooks to quickly explain what the writing means. People's views start to differ, and the classes fall into chaos when this happens. Through its use in education, the Internet of Things has made learning and sharing knowledge easier, more interesting, and more social. With a smart board, teachers can slowly let out a sigh of relief. Numbers and moths are especially good subjects for using infographics, educational videos, and complicated moths. [13].

Attention to Attendance: Organizationally, the rules are set up based on the educational organisations. Less than a certain percentage of students, according to some, should take the test. Utilizing the Internet of Things, management can get accurate details about employee attendance. Nobody has changed the facts in any way. "Knowing the real-time location of the students living in the hostel can help establish their level of safety and quality of life," say Wan and [14]. For managers, keeping track of who is present can be hard. Utilizing an internet of things (IoT)-based attendance system makes it easy for students to figure out their attendance, regularity, and personality reports. Saving lab workers time can have a big effect on how happy they are with their job. And because of IoT, we need a digital attendance register to get kids to show up to class more often. If parents don't pick up their child from school for any reason, they will get a short audio message. Checking the level of protection in this way works very well.[15].

Significant Safety: The lab has a short circuit, and the IoT monitor finds it right away and sends an alert right away so that the problem can be fixed. For emergency lights, sound upgrades, Wi-Fi watches, or deaf alerts, this could be a fun way to keep them safe. No matter what the case is, the problem is fixed right away. If someone gets stuck in the lift, a "auto" real-

time message will also be sent. We will now talk about some of the many ways that globalization has changed things around the world. Because of the harsh weather, the chance of an earthquake is changing quickly, and they are happening more often. This is why schools and other places that teach spend money on IoT monitors and metres when they are worried about natural disasters. [16].

Adjusting Disability: It was really hard for kids with disabilities to learn new things and think about what they already knew a few years ago. They can learn new things and study just like any other skilled student because of the creative way the technology is set up. Some people have trouble hearing, which is called hearing loss. A system that combines a glove and a tablet into one gadget can translate conversations into sign language. There is a big motivation to turn spoken words into written ones. With IoT gadgets, kids with disabilities can get useful educational help, which makes their world a better place. It guides their smarts and keeps their energy on small goals. [17].

Mobile Apps and Tablets: Students of the millennial generation need to limit their use of electronic devices. Unhappily, the lives of today's pupils appear to centre around their smart phones, tablets, and various other screen-based electronic devices. Experts in the Internet of Things have switched their focus on this particular aspect to educational topics in gaming and social networking gadgets. Engaging people from different parts of the world who share your objectives and passions is now much simpler. [18] According to [19] The Internet of Things sensor used in education gathers data and then makes automatic recommendations to pupils on the other side of the screen on academic subjects that may be of interest to them. The usage of mobile devices such as smart phones and tablets is almost immediately beneficial to students' grades.

The Roles of IoT in Education

The Internet of Things (IoT) is a very smart part of today's schools, especially universities and classes, because it helps schools get better while also raising costs for services and systems. A mysterious university has the advantage of being able to easily give each person more detailed information. For example, [20] Smart phones and tablets are used all over campus to connect to the Wi-Fi network and send and receive information and orders. Additionally, the computing IoT devices for facilities and learning facilities help make better lesson plans, keep track of key resources, improve admissions records, create safe schools, and more. The Internet of Things will soon be used in more and more schools. Furthermore, [21] say that many schools use this to teach their students in order to help them understand things better. Other schools may use it to store information, save resources, or meet other similar needs. [22]. If the Internet of Things is going to be used in schools, we will have to change how we think about school.



fig.1 IoT in Education

II MATERIALS AND METHODS

The outlined materials and methods provide a systematic approach for identifying and analyzing Smart Education System techniques during the selected time frame. This process ensures a focused and comprehensive review of relevant studies, offering insights into the evolving landscape of educational technology and smart learning environments. Total 80 article taken for the review

1. Data Collection:

Data Sources:

- **Academic Journals:** Relevant articles from peer-reviewed journals were accessed through databases such as IEEE Xplore, PubMed, and SpringerLink.
- **Conference Proceedings:** Proceedings from conferences focusing on IoT, education technology, and related topics were explored.
- **Online Repositories:** Reputable online sources, including educational research databases, were utilized to gather relevant materials.

2. Search Process:

Keywords:

- Primary keywords: "IoT in education," "Smart Education System," "educational technology."
- Secondary keywords: "Internet of Things in schools," "smart campuses," "IoT applications in learning."

Boolean Operators:

- Boolean operators (AND, OR) were employed to combine and refine search terms.
- Filters such as publication date and document type were applied to narrow down results.

3. Data Selection:

Inclusion Criteria:

- Relevance to the research topic.
- Recent publication dates to ensure up-to-date information.
- Publications from reputable journals and conferences.

Exclusion Criteria:

- Irrelevant to IoT applications in education.
- Outdated or obsolete information.

4. Data Extraction:

- Key Information Extracted:
- Study objectives and research questions.
- Methodologies employed in the research.
- Findings and insights related to IoT applications in education.
- Perspectives of school management, teachers, and learners.

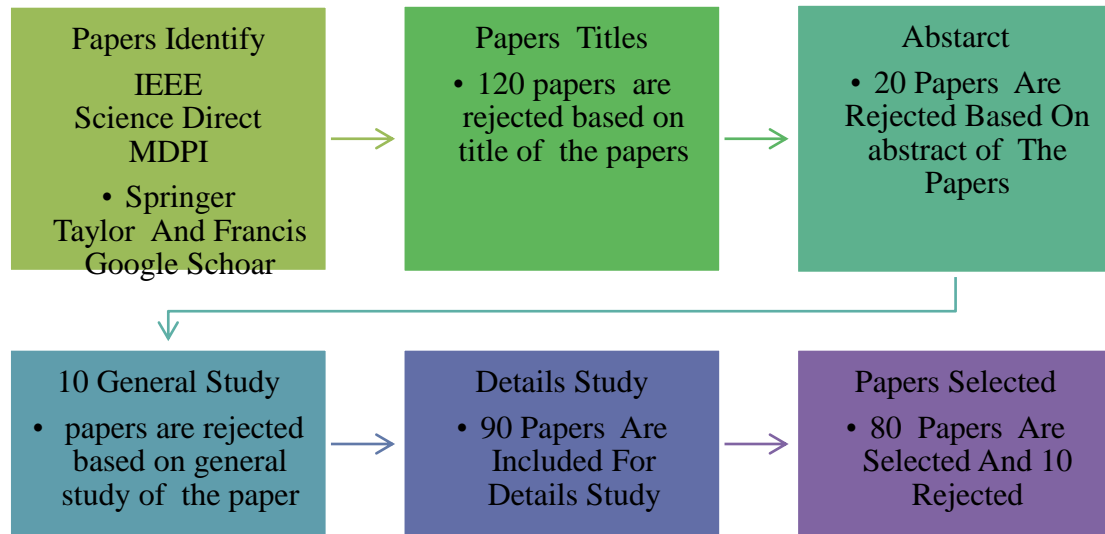


Figure 2. review process

III LITERATURE REVIEW

Educational institutions have quickly accepted technology because it may be one of the most important factors for improving student outcomes. Consumers are interested in education, like flipped classes, smart boards that can use Virtual Reality and Augmented Reality, or having access to safe learning settings [23]. The interest goes beyond just hiring a teacher, giving a library, or learning the subject. Because more and more schools are using this technology, the Internet of Things (IoT) is set to become a major game-changer in the education field. For added convenience, many schools use connected smart devices to support the current smartboard and e-learning infrastructure. I've listed some of the reasons below:

- One reason why cloud services are so popular is that they are easy to use and not too expensive. More and more tools are being made that can connect to the internet of things.
- As long as you pay for what you use, unlimited storage makes it easier and cheaper to store, examine, and access data.
- An app has been made that is very specifically designed to meet the needs of the educational system.
- Anyone's life could be easier with the Internet of Things (IoT), from kids and teachers to parents and the people in charge. [24].

Applications of IoT are designed for the almost all facets of the field of the education, such as

- A solution for educators that facilitates stakeholder interaction
- Application management solution for feasibility and cost optimization
- Classroom management solutions for improving education

Harpreet Singh & Shah J. Miah (2020) [26] have Proposed a Conceptual framework Students' Career Assistance System (SCAS) IoT-based mobile application. It is providing the next way to education, and it is a great initiative for the academic industry as well. This framework includes the basic components of education and the Internet of Things. The combination of both components is producing an enhanced education delivery by using the security techniques like AES, DES, Steganographer, etc. Security may be improved, and with the help of Hadoop and other big data tools, data can be managed in a more efficient way.

Amr Adel (2020) [27] has proposed an IoT-based model for smart universities, which is helpful for the student. The Author tried to share the data using the API. The architecture of the

proposed model includes the timer, state machine, Service Registry, and action bus. The implementation of the proposed model results in the smart classroom enhances the skill of critical thinking. The Security may be improved with the help of appropriate tools and techniques. There are several sensors that are why it needs to reduce the congestion of sensors and applications. By dividing the modules, privacy can be enhanced.

Saeed et al. (2021) [28] have presented a technical review and criticized the existing models. The Authors described only design a theoretical framework for the Digital Campus, Smart Classrooms, and Smart Laboratories. In the future, a detailed framework for the next generation of smart campuses and universities will be designed.

K. Palanivel (2019) [29] has presented the issues and challenges of ICT technology in an e-learning environment. The study has proposed a framework for smart education. Furthermore, emphasize the ideology for making the better education. In presented framework includes smart teaching, smart learning, and many other aspects of smart learning. In order to implement, framework associated with the RFID, WiMAX, NFC, xDSL, PLC, Bluetooth, etc. In the future, it can be an extension in a secure framework for interconnectivity, accelerating the initiative of integrating emerging technologies.

Garcia-Tudela et al. (2020) [30] built a framework for thinking about smart learning settings using the infrastructure for the internet of things. This study has taken the SLE as reference enable the services for smart education. In the future, the proposed framework can be taken as a reference framework and make the e-learning platforms capable of supporting big data management techniques.

Ane et al. (2020) [31] have discussed the evaluated and potential key issues related to the integration of IoT in education. The authors reviewed and mined suitable technologies and projected them for use in the education sector. In the future, the integration of suggested technologies with the latest technology and techniques can be designed as a hybrid approach for smart education.

Chawla et al. (2021) [32] Utilising a suggested interoperable architecture based on the Internet of Things in education to determine outcomes in real time. In order to implement the proposed system, a three-layer high-level architecture for the plugin the sensors, discovering nodes, and data processing. Moreover, the study describes the general efficiency, network of teachers and students, campus safety, and smart classrooms. In the future, the proposed work can be enhanced to consider the security and privacy parameter and data management.

John et al. (2020) [33] have proposed a digital system for university campuses that is capable of dealing with Attendance, Mess Bill, Digital payment, etc. To implement the proposed system, they used Fingerprint, iris scanner, RFID, and another embedded system. They also try to improve the system's security with the help of MQTT and Cryptographic techniques. In the future, the proposed system can be enhanced in terms of security, data management, education content delivery.

Francisti et al. (2020) [34] have proposed the IoT-based smart E-Learning model, which helps to evaluate the health, Interest and comfort of students. They have used heart rate measurement, eye tracker, and RFID systems. There are a lot of different ways that eye-tracking technology can be used in schooling. They have conducted an experiment and compared the results with existing studies. The work can be enhanced to integrate with smart education systems along with the latest devices and technologies.

Eeshwaroju et al. (2020) [35] have proposed the smart healthcare, smart education system. The proposed system includes the job system, education system, and Health system. Moreover, the study defined the strategy for tracking and analyzing the various parameter like comfort, security, delivery of content, etc., to enhance the skill and education. In the future, the proposed system can be enhanced by using Artificial Intelligence and other latest security techniques.

Anamika Rana & Sushma Malik (2021) [36] have proposed a model which aimed to design the IoT-Enabled Campus. For making the model successful, they use various technologies like 3-D printers, E-Books, Student ID Cards, Temperature Sensors, Wireless networking, etc. Their model includes the smart classroom, smart classroom attendance system, NFC based attendance in Lab. This study can be enhanced by considering security, privacy, scalability, and data representation parameters.

Moharkan et al. (2017) [37] the authors have presented the Model for Smart Education using Gamification. Further, the study provides an overview of IoT and E-learning management systems. They enlist the IoT-Application in E-Learning and how utilized properly. They provide an amplified view of E-learning techniques and the requirements for these techniques. The proposed system can be enhanced using the latest technology and security techniques like Hashing, AES-DES, etc.

Dinesh Mohanty (2019) [38] has presented the challenges with the integration of IoT in Education. The author tries to find the key to integrating the IoT with the existing Education system. Security and privacy are important factors for any digital system. Based on the challenges provided by the author, the study can be extended in the form of implementation.

Martin et al. (2019) [39] have discussed the four key areas of smart education. The key areas are identifying, managing, analyzing, and creating a virtual environment. Moreover, the study provides an overview of existing work in this field. In the future, we can make a hybrid model by using all the suggested approaches and the latest technology/techniques.

Wang et al. (2021) [40] have proposed a Smart Education Learning (SEL) platform to analyze the teacher's and students' behaviour. The SEL analyses the behaviour and attention of students in an online class by using facial detection and analysis algorithm. Furthermore, the authors have compared the results with existing techniques like AIED-ENG, BC-IoTF, LMS-Moodle, and RTV-SVM. In the future, the accuracy of the SEL system can be enhanced by using various machine learning algorithms.

Kreculj et al. (2021) [41] have emphasized the importance of IoT in the education system. The use of various digital platforms like Facebook, Twitter, posting videos, Audios and digital classrooms have opened a new door to make 24x7 availability of education material. The IoT makes the education system better, simple, flexible, and more efficient as one can monitors actual time activities of students and can track their homework/assignments with the help of various IoT sensors, actuators, cloud, web cameras, etc. The author focused on the importance of smart education during any emergency like the Covid-19 pandemic.

Galina Ilieva& Tania Yankova (2020) [42] in this paper, IoT based framework has been proposed to make remote learning more flexible and student-friendly. In this framework, the real-time data has been recorded from IoT Devices like microphone webcams. This real-time data is stored and analyzed by using a machine learning algorithm in the cloud. For the teaching and examination purpose, the face recognition and deep learning technique can be used, laboratory class face recognition with classification algorithm can be used, and for the attendance purpose, only face recognition is needed. The proposed work can be extended with the help of a machine learning algorithm, and updating is possible in security registers.

IoT for Smart School Management

It is important for energy management to follow the concepts of interoperability and interconnectedness if they want to reach the goal of sustainability. Colleges and universities could save millions of dollars by controlling how much energy they use more efficiently. When schools place sensors that are connected to the internet of things, they can only use the

electricity they need and stop other types of energy from being wasted. Instead of using as much energy, schools can save money and reduce the amount of carbon dioxide they release by using less. It is possible for a communication architecture built on the internet of things to give the management system the data it needs. The Internet of Things (IoT) has been used to create a platform for controlling energy that can be used by educational institutions [43]. A demand resource energy management (DR) method is built into the platform because of this. [44] for more information on an interesting new way to handle smart school buildings. Using an open-source Internet of Things (IoT) system, this paper sets up a low-cost way to track energy use and the environment. Many schools in Germany have the answer. School areas can be dangerous for students, teachers, and staff, especially when the school is very big. Infrastructure at most schools is not safe enough. Instances of sexual assault, theft, arson, or physical abuse are almost impossible to report on schools because of this. Campus safety can be improved by devices and real-time cameras put in place by the school's leadership. School officials can quickly get to the scene of the event and start making plans for how to respond right away this way. For security systems that use the Internet of Things [45], some of the things that are needed are sensing technologies, sensitive cams, powerful cellular technologies, wireless communication, and cloud-based networks.

Watching over kids system another thing the researchers did was create a system for keeping an eye on kids that uses the Internet of Things (IoT). As part of this system, Internet Protocol (IP)-based closed-circuit video (CCTV) is used along with Bluetooth low-energy technology (BLE) cards. Face recognition technology is used to find out who the student is, and fingerprinting technology is used on the beacon chips to find out where the thing is. Using this method, it would be easier to see and keep track of the students who had BLE cards [46]. Teaching students who need more help: Some kids have special needs that are hard for schools to meet. There needs to be a wide range of educational support for students who have both physical and mental disabilities. People can make learning settings that are personalized and easy for them to use with the help of the Internet of Things. New studies show that the Internet of Things (IoT) could help kids with special needs. [47]. Gloves with sensors and a tablet for making words is a good example of this. Students who are deaf or mute can use this setup to help them talk and connect with their classmates in the classroom. Some kinds of learning technology, like screen readers, can help students who have trouble seeing use text-to-speech processing. This study shows a wearable Internet of Things device that can help find autism early on and manage relevant data. Other features of screen readers include on-screen keyboards that make it easier for learners with mobility issues to type, screen magnifiers that make the content of the screen look bigger, and on-screen alerts that send visual messages to help learners who are deaf or hearing impaired [48].

Smart transport for schools: The school administration can use the Internet of Things (IoT) to make sure that the kids have safe ways to get to and from school. Based on the Internet of Things, the piece [49] talks about a way to keep an eye on vehicles. As was said, the idea described explains a system made up of a microcontroller and a mobile app. The global positioning system (GPS) and a smart phone can be used to find out where the school bus is right now. For the kids' safety, the mechanism has both an alcohol sensor and a panic button. Either the parents or the school officials can see where the car is right now in real time. Another IoT-based bus-monitoring system has been created. It has both a website and an app for Android that parents, school staff, and bus drivers can use to keep track of the school buses. [50].

Student health monitoring system: The state of a learner's health affects how well they succeed in their studies. Because it is so difficult for a student who is dealing with health issues to concentrate on their coursework, the student's overall academic performance is likely to

decrease as a result. In this scenario, the Internet of Things plays a crucial role. Wearable devices are used by IoT sensors to collect data relating to one's health. Following collection and processing of the data, precise measurements of the students' health parameters are generated. A student's health monitoring system was proposed in research published in [51], which proposes an ambient intelligence-assisted health monitoring system (AmIHMS) based on Internet of Things sensors. The authors of the study [52] proposed a health monitoring system that was cloud-based and based on the internet of things. Long short-term memory (LSTM) and physiological inputs are combined in the research described in reference [53], which presents an emotion detection system. A paradigm for healthcare that is based on the internet of things has been presented by researchers who are focusing on remote learning during the pandemic. at [54], there is a proposition for a data-driven air quality forecast system at educational institutions.

IoT for Teachers

Autonomous attendance system: Every day, it's hard for teachers to make sure that every single student in the class is present. Teachers should mainly be responsible for teaching and helping students learn. An automatic attendance system called a biometric attendance system uses a student's ID card with a number to keep track of who they are. Face recognition technology works with this technology to make sure that each student is identified. The students' teachers and parents will be told if the kid is there or not [55].

Advanced pedagogies: There are many places to learn besides standard classrooms these days. People can now learn in regular classrooms, digital classrooms, and mixed classrooms that have parts of both. The school can be in the real world or online. The same idea is known by a number of different names, such as e-learning, mobile learning, online learning, digital learning, and internet learning. As a result, teachers need to come up with new ways to teach that work in online classes. It is very important for teachers to use more advanced ideas and methods when they are helping students learn and teaching them. In a "flipped classroom," for example, the teacher's job is to help and direct the students. The flipped classroom was used as an Internet of Things part of this lesson where students were learning about computer networks. [56].

Assessment, evaluation, and feedback system: It's possible that the Internet of Things (IoT) could be used as an embedded device to test, grade, and advise students. In addition to making work faster and easier, these kinds of automated testing tools can also give teachers a lot of information about how well their students are doing. A way to measure how well students interact with each other in e-learning using an attention score was described in the study paper [40]. With the help of the internet of things, another study [57] showed a way to use real-time data mining to test students. [58] Suggested an IoT-based and Raspberry Pi-based way to measure how involved students are in school.

IoT-based STEM education: IoT devices can be used in STEM (Science, technology, engineering, and mathematics) classes to have hands-on experiments and learning experience. Moreover, the learners can analyse the data collected through sensors or devices. Students can use IoT kits for design-based learning and can develop design thinking, which is one of the STEM skills [59]. IoT tools can be used in physics education and performing laboratory experiments. A research study in [60] proposed methods to integrate IoT in STEM learning. Multimodal data collected through IoT devices can be used for developing analytical skills. Research work in [61] shows IoT-based smart learning environments help learners to develop critical thinking and problem solving skills.

IoT for Students Distance learning: Distance learning has emerged as a solution in the pandemic era, when contact learning was impossible. Distance learning or online learning can be enhanced effectively by IoT [62]. IoT tools can benefit distance learning and help in uplifting student performance and efficiency by up to 20 percent, as reported in [63]. IoT sensors measured the brain activity during learning sessions and recorded the feedback. In this research [64], IoT sensors measured level of tiredness and keep brain active by sending signals.

Enhanced productivity and interaction: Smartphone-based online classes, virtual classes, or e-classes develop more interactivity in students. Interactive learning makes students more interested in doing a range of tasks and getting involved in the evaluation and feedback processes. As a result, using the internet of things to set up learning spaces makes students more productive and social. For example, e-books with barcodes let students read in a way that involves them. IoT device Scanmaker can quickly scan editable text from books, papers, and other types of documents straight into a phone, tablet, or computer. This device can translate text into forty different languages.

Customized learning environments: There is a growing interest in digital learning spaces that can be customized for each student. Blackboard is a digital learning environment that has become a useful option to online classes for both teachers and students. Blackboard, a technology that uses an interactive learning management system (LMS), can be thought of as a virtual classroom that makes collaborating and learning easy. Individualized digital learning spaces let parents and students know about each student's grades, events, and school news. Online-based wearable tech also makes it possible to create learning that is fluid. For example, Internet of Things-enabled wearable tech could use a person's location information, workout history, and social media use to make the learning process more personalized for each person. [65] An good example is the IoT-ready platform that was created as part of the MaTHiSiS H2020 EU project. Network-connected sensors are used to keep track of how students react to educational material that is presented in the form of a game. This Internet of Things app used mobile devices like tablets and smart phones to get people involved [66]. First, wearable Internet of Things devices receive data from the students. This data is then processed and used to help tailor the student's learning environment to their specific needs.

School and home management: At school and at home, both students and their parents can use the Internet of Things to assist with management. An example of managing both your home and your child's school is using a smart school bag that is connected to the internet of things (IoT). They suggested using IoT to make a smart bag for students in their study that was released in [67]. With this bag, students could easily keep track of their schedules, and parents would be notified if any books or other school-related items were forgotten at home instead of being taken to school.

Challenges in IoT Adaptation in Education

Although implementing IoT in schools could lead to big changes, there are still a lot of problems that need to be fixed [68]. This part is supposed to talk about the problems that stop the internet of things from being used in schooling.

Security and Privacy

Everybody knows that when they connect their computer to the internet, they are more likely to be attacked by hackers. Any part of the school system could be attacked by students or outsiders, putting the whole system at risk. Such attempts could make the organisations useless.

Anytime the internet goes down, the whole school system stops working. Security-related data theft is another big issue. So, if any of this data were to be stolen, it would be a very big security hole because IoT devices would collect a lot of data over time. Ensuring data privacy and security also includes issues with integrity, end-to-end security, identification, and keeping data private [69]. When safety and stability standards are met, the Internet of Things (IoT) can be used in schools. Lots of data is collected by tools and apps for the Internet of Things (IoT) using technologies and gadgets like NFC, 4G, and 5G. That gadget is the RIFD. And because of this, keeping info safe is hard. Answers to the problems that come up in this situation need to be thought about. Below are some examples of these kinds of questions: The info belongs to whom, and who will use it? Therefore, the most important things should be managing, keeping track of, and protecting data. Important things to think about also include the accuracy and privacy of the data. People or machines who have been given permission should only be able to view the data that has been collected. During the gathering and handling of data, there shouldn't be any theft, tampering, or breaches. This could happen if the data are handled safely and if the system being used is reliable and security-focused.

Interactive Learning

The effects on schooling and actual use of the advantages of these days, learning is more than just reading comments and looking at pictures. Many textbooks have been moved to the web and updated with extra video lessons, extra tools, animations, ratings, and other information to make learning easier. With this broader view, students can learn about new things and get a better understanding of things they already know. They can also speak better with their teachers and with their peers. Professionals in the field talk about their real problems in the classroom, and the students come up with solutions [70].

Security

It can be hard and take a lot of time to keep track of where each student is and what they are doing because there are so many student groups that go to classes. Because institutional students are more likely to be hurt on the job than other people, IoT schools, colleges, and other learning centres can learn a lot from this fact. Students in institutions need smarter safety measures than other people at work. With techniques like 3D positioning, which also lets students report their appearance, teachers can keep an eye on their students at all times and from anywhere. These technologies can also give you the choice of a panic button that will set off alarms of the right places. Many important improvements have been made to computer vision technology in the past few years. These improvements have made it possible to watch signatures more quickly. You can automatically stop unexpected things from happening by taking part in this action.[71].

Educational application

There is growing awareness of the Internet of Things as a powerful creative tool, which is causing big changes in how education is provided. Trainers and students can make their own 3D graphic texts and take notes in them using video. This software stands out from others because it gives you access to so many educational games. The many parts of these games make them great for teaching and learning in new and exciting ways. Since this happened, education is more appealing than it ever has been. [72].

Increase efficiency

Most schools spend money on things that aren't related to their main purpose a lot of the time. Example: Students have to be present more than once a day. For certain reasons, this information also needs to be sent to the central office. Through the Internet of Things, this

inefficient set-up can be thrown out. Together with the data collected by IoT end devices, this data is then sent to a central data server. This means that there is no need for data disturbance. The work that teachers and students have to do can be made a lot easier by this big improvement in the Internet of Things. Since this is the main point of school, students will pay more attention to what they are being taught and improving their skills[73].

These are some significant territories where the IoT can be applied

Poster-boards into IoT-enabled boards in this case, there are a lot of problems. It's okay to use both the display board from the past and the multimedia poster board from now on. You can compare presenting boards from that time to poster boards that have multimedia technology built in. It is definitely hard to compare the old-fashioned time introduction loads to the newer sight and sound warning loads. This process is now much easier thanks to web software like Glogster, which lets users make digital posters that mix video, still images, text, hyperlinks, and audio without any problems. Then, these kinds of dynamic whiteboards could be emailed to each student's class and teacher. [74].

Interactive gaining of knowledge

These days, getting to know someone isn't just a matter of combining pictures and texts; it's more than that. For the students, it gives them a bigger picture, which helps them understand things better and interact with their teaching staff and coworkers. To make the test more interesting, the instructional experts are adding problems from real life and letting the students find the answers on their own. [75].

Learning at any-time and any-where

The Internet of Things (IoT) is a key part of the process and can help build a great web-based system. Using cutting-edge technology, the expert can show how the researchers have grown over time. The great thing about Edmodo is that it makes it easy for teachers and students to talk to each other. People who are new to the site can use Edmodo to get information from anywhere anytime. The Internet of Things (IoT) makes it possible for students and teachers to talk to each other in a great way. While they're not in the study hall, students can read messages and look ahead to future events while responding to posts. It also protects users' privacy by letting them save their own thoughts and class work without worrying about losing them. [76].

Higher safety features

This application is important because it has the ability to help prepare areas and bring high-quality technological solutions into classrooms. This makes researchers and other staff feel safe by offering crisis signs, sound amplification, Wi-Fi tickers, and alarms for people who are hard of hearing [77]. A lot of trades were possible thanks to the Internet of Things. There are also different situations where structure can be used, like setting up different crisis tones, live announcements, and pre-recorded educational messages to get workers and students together during a crisis [78-79]. A student GPS tracker is a small, movable device that can be hidden in a student's pocket, backpack or even their coat. It is possible to find out where a student is by using satellite-dependent tracking. [80] It's also possible to hide a GPS tracker in a pram or another discreet place. This means that a student can be followed with a GPS tracker.

IV CONCLUSION

For students, the Internet of Things is helpful because it speeds up and simplifies the learning process. This makes it an important part of the teaching field. Another thing is that it could change someone's physical place because it brings about new changes in the field of education. Using IoT technology in the right way will improve the learning experience and create a good learning environment. This study's goal is to look at the Internet of Things'

(IoT) possible benefits for the education sector and how it can help that sector get past problems and reduce the risks that come with them. We should work on bringing the Internet of Things to higher education in the future. In conclusion, the examination of techniques and methods for implementing Smart Education Systems integrated with IoT from 2016 to 2022 reveals a dynamic landscape of advancements in educational technology. The comprehensive review encompassed original, full versions of relevant reports, focusing on their contributions to the field.

The integration of IoT in education has showcased a paradigm shift, offering opportunities to revolutionize traditional educational approaches. The benefits include enhanced accessibility, personalized learning experiences, and streamlined administrative processes. However, this transformative journey is not without challenges. Security, privacy, scalability, reliability, and concerns about dehumanization emerged as prominent bottlenecks in the implementation of IoT applications in educational settings. Addressing these challenges will be crucial for realizing the full potential of Smart Education Systems. As we move forward, the findings of this study emphasize the need for a thoughtful and balanced approach in leveraging IoT technologies for educational purposes. Continued research, collaboration, and adaptability will play pivotal roles in harnessing the power of Smart Education Systems to create a more engaging, accessible, and effective learning environment for students, educators, and administrators alike.

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