

IoT Based Educational Model for Better Teaching-Learning Environment

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Abstract- Internet of Things is a technology that has been growing every second and has an impact on various sectors. Internet of Things helps to connect physical objects with each other with the use of internet. In the education sector, internet of things can be used to bridge the gap between the teacher and the student. From lectures and memorization to internet-enabled learning to knowledge-producing education to innovative education, educational sector has been developing continuously. Educational sector has reached its fourth revolution, also known as education 4.0. In relation to education sector, some of the latest technologies advancements are interactive whiteboard, 3d printers, eBooks, tablets, augmented reality, attendance tracking system, virtual reality, cloud computing, hologram, biometrics, paper-thin smartphones, multi-touch LCD screen etc. Many students face problems with the traditional way of teaching, such as slow speed of learning and not able to attend school due to family problems. This paper addresses the previous works done in the field of education using Internet of Things to help overcome these problems and proposes an IoT Based Educational Model for Better Teaching-Learning Environment. This model suggests that there should neither be complete digitalization nor complete verbal assistance.

Keywords: Internet of Things (IoT), education 4.0, industry 4.0, RFID, Wireless building lighting control (WBLC).

I. INTRODUCTION

Education is the foundation of any economy. Educating the citizens is the basic requirement to establish a good economy. Education helps citizens to take decisions that will benefit them as well as the economy. To run an economy effectively and efficiently, the citizens in the economy need to be educated and aware about the aspects of economic growth and economic development. Without people being educated, the economy will be left to be doomed. Education is the right of every citizen of the country. The government provides various initiatives and right to education to every citizen of the country.

The industry started with steam engines and went through multiple revolutions –production line, the computer, and now is in its fourth revolution with the internet and connecting computers, also known as industry 4.0[1]. Almost every business is implementing industry 4.0 methodologies to achieve its goals and continue to grow and develop. To keep up with the revolutions happening in the industry, the educational sector also needs to develop.

With the continuously developing technology and industry, students need to be taught and trained accordingly. They don't just need to be taught theoretically in classrooms but also need to be exposed to practical knowledge and experiments. The education sector has experienced various

revolutions. It went from lectures and memorization to internet-enabled learning to knowledge-producing education and now is in its fourth revolution of innovative education, also known as education 4.0 [2].

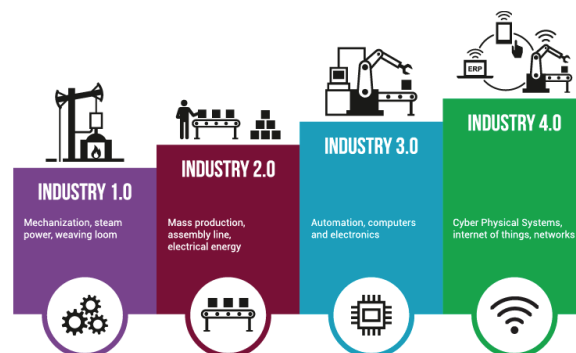


Fig. 1. Industry revolution [18]

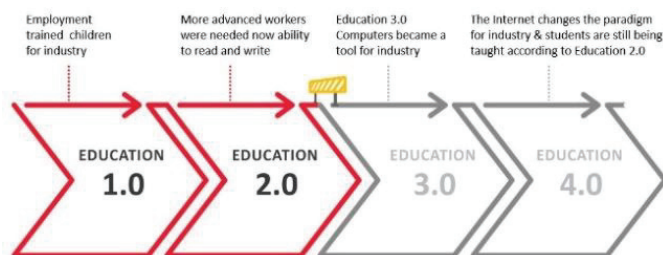


Fig. 2. Education revolution [19]

Internet of Things (IoT) is a continuously growing and developing technology that is used to connect physical things with the use of internet. Internet of things helps in collecting data through various sensors and communicates the data to be converted into meaningful information. This information is then analysed, measured and stored for future use as a means of knowledge. The use of internet of things has simplified day to day activities. It reduces the time and efforts required to carry out any activity and increase the efficiency of the work done.

Internet of things has changed the face of industry as well as the educational sector but the students are still being taught in the traditional way. They sit in the classrooms and learn about things theoretically and have mere exposure to practical experiments. To produce resources that can work with the technologies being developed every day, the educational sector needs to expose students to the technology and practical knowledge [3]. The new strategies need to be developed keeping in mind both categories of students: the ones who attend classes daily and the ones who are not able to attend the classes daily due to various reasons such as

healthcare problems, family problems, transportation problems and many more.

The rest of the paper is organised as follow: second section covers the literature review of the researches and the work done in the field of educational sector, in the third section an IoT equipped model is proposed for better education and finally, the fourth section covers the conclusion and outcomes of the paper.

II. LITERATURE REVIEW

IoT is not limited to any one or two domains. It has applications in multiple domains such as education, healthcare, environment monitoring and many more [4] (figure 3).

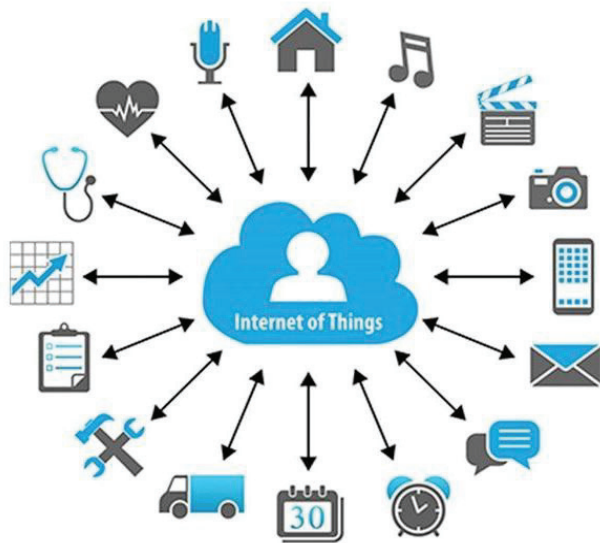


Fig. 3. Applications of IoT [20]

A system to monitor environment uses various sensors that collect data related to air quality, humidity, moisture, temperature and communicates this data over to raspberry pi to process, analyse and store the information for future use [5]. This information may help in detecting any natural calamity beforehand which would in turn help avoid any casualty. To control and monitor the usage of electricity, a wireless system is used that is connected to an automated system [6]. A fog-computing oriented framework is used to monitor and analyse the data collected [13]. This framework helps in reducing the traffic caused due to huge amount of data being transferred over the network. Fog computing allows to analyse and process the data near the source from where the data is being collected from which results in reducing traffic and time required for the complete process. Garbage collection is one of the problems that cause illness and force students not to attend classes. A garbage monitoring system alerts the administrator once the bin fills up to a certain level and makes sure the garbage is removed [7].

Industry 4.0 technologies cannot be implemented on the spot without any prior preparations. In order to implement industry 4.0 tomorrow there is a need to educate and produce qualified and trained individuals today [8]. With the everyday advancements in the industry, students need to focus towards learning about these technologies and how they work. Some of the latest technologies advancements are interactive whiteboard, 3d printers, eBooks, tablets, augmented reality,

attendance tracking system, virtual reality, cloud computing, hologram, biometrics, paper-thin smartphones, multi-touch LCD screen etc. [9,10] (figure 4).



Fig. 4. IoT in education sector [21]

Beacon is an IoT based information dissemination system that is used to send information to the students in the form of notifications [11]. The teacher can upload the assignments and other information on the application. When the devices of the students come in the reachable range of beacon, they receive a notification containing the information and updates uploaded by the teacher. The improvements or revolution in industry has forced the education sector to change the way of information transfer from teacher to student [12]. IoT has helped in transforming the way of learning from face to face classrooms to virtual classrooms. Instead of going to classroom daily to learn something, students can learn from anyplace and anytime according to their comfort. There are mainly two categories of students: school/university going students and students who are not able to attend classes due to personal reasons [14]. The interactive learning techniques used for students going to school/ university is associative way of learning, centralized lab servers and constant analysis of student's progress. On the other hand, for the students not able to attend classes, the interactive learning techniques used are gamification of test and assignment, social networking as an education medium, school-home connectivity and virtual classrooms. Smart glasses are the eye-worn IoT enabled device that is used for implementing virtual and augmented reality, documenting the lecture, on-site report preparation, telemonitoring, video and image capturing, evaluation, real-time teaching and tracking [15]. Student attendance and monitoring system is based on RFID technology. The students are provided with RFID enabled identity cards. When a student enters the classroom the RFID tag reader collects and forwards the information to the application where the attendance is stored [16]. It also records the time for which the student has been out of the classroom. If the student does not return to the classroom after 5 minutes, it gives an alert to the teacher about it. This way the teacher can monitor student's movement around the building and know if any student has tried to bunk any lecture. Sensate benches help in improving the education sector [17]. The student benches consist of interactive screens which are used for multiple tasks. The system will be unlocked only through students' fingerprint which also helps in recording attendance. Students

can use this system to share information with each other and can see the presentation or data that the teacher wants the students to see for better understanding. This system helps in improving multi-touch interactions, attendance system, collaboration of resources and content view ability.

III. PROPOSED MODEL

While going through the researches done by various researchers in the field of IoT in education sector and various other sectors, an idea came to mind and it is presented in this paper as an institute model for better education for students.

Complete use of digitization may lead to removal of handwritten work as all the work will be done using the computer and internet so all the data will be in digital form and no handwritten records will be made. Various challenges will be created for teacher as keeping record of students' performance as basic communications or behavioural science. Students will not be able to get their personalities developed as they will only be engaged in digital work. Human to human communication is lost due to all activities being done through system. Cyber bullying may increase as a result of digitization. The more someone learns about a thing, the more he is likely to find loopholes. Open window for cheating will be created for the students. Students can't study and learn things only by visual display, they also need human teachers. Lack of physical activities may lead to health issues. A lot of time of the day is consumed by the computers and students don't get to connect with the environment.

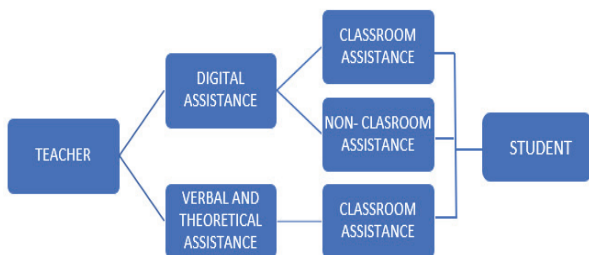


Fig. 5. A Diagrammatic representation

Figure 5 illustrates a diagrammatic representation about the model proposed. Only digital assistance brings a lot of problems and only verbal and theoretical assistance is not enough for the students. This paper proposes that digital and verbal & theoretical assistance should go hand in hand. The teacher would provide both digital and verbal assistance in the classroom and outside the classroom anytime and anywhere the students can take help of the digital assistance for better understanding and studying purposes. In the traditional way of schooling, teachers are required to do a lot of time consuming work such as taking attendance, marking students' tests, gathering all the information about each student, making records about each and every student in each semester, meeting parents of each student to deliver the report of the specific semester etc. A lot of these process that are time consuming will be made digital so that teachers can get more time to focus on the needs of the students. Making all such process digital will save a lot of time. Teacher and student, both will be able invest more time in exploring thing in a better and easy way. Students will have better understanding of the concepts and will be exposed to practical knowledge that will help in making them industry ready.

The first sub-point of this section discusses the infrastructure and the benefits of the IoT equipped institute for the environment and the second sub-point covers student management and benefits to the student. It is illustrated through figure 6 and 7.

Infrastructure: When constructing the institute various sensors are placed in the building for various management purposes. Each sensor has a battery and an alert system that is wireless and helps to transmit data over the network to the maintenance engineer.

- **Environment management:** Among the sensors placed in the building while construction, there are various sensors that collect data related to the environment such as air quality, humidity, temperature, any calamity detection etc. The data collected is transmitted over the network for storage and can be further processed to extract meaningful information.
- **Garbage management:** Cleanliness is one of the major issues and reason for a number of students not being able to attend their classes. To maintain cleanliness and avoid absence of students, smart garbage monitoring system is used. The sensor on the head of the garbage bin sends an alert to the helping station when the garbage bin gets filled up to a specific level. The helpers can then remove the garbage. This helps in taking care that no garbage bin is left unattended.
- **RFID technology:** Students, teachers and other staff members of the institute are provided with ID cards with RFID tags. RFID readers are installed at the entrance of classrooms, library, art room etc. This helps in keeping track of the movement around the institute.
- **WBLC:** Wireless building lighting control system is used to monitor and control the electricity usage. The lights are switched on in the morning at the specified time and switched off after the classes are over. This helps in taking care that all the electric appliances are switched off are working hours and there is no electricity wastage.

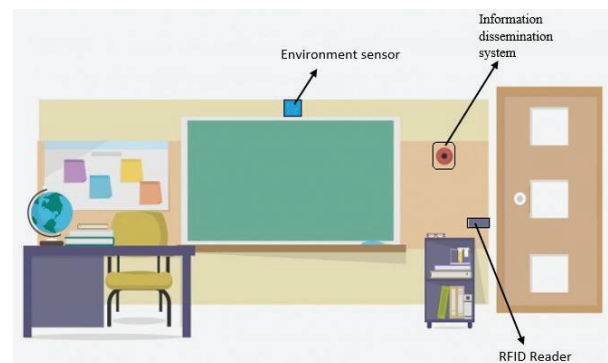


Fig. 6. Infrastructure

Student management: The data collected through various sensors and technologies implemented are transmitted over the network to the management, who monitor the movements and activities around the institute. All the data collected is uploaded and stored on cloud from where the

respective management and teaching staff can access the data for further use.

- RFID technology: The students are provided with RFID tag equipped ID cards that they are supposed to have on them all the time in the institute. When entering any room, the RFID reader, present at the entrance, reads it and stores the data. This helps in avoiding the need for the teacher to invest time in taking attendance and helps to track the movement to students around the institute.
- Information dissemination system: Sometimes students miss out on the important information provided by the teacher in class due to various types of interruptions. An air freshener sized device is installed in the classroom which is connected to an app. The teacher can upload and update information related to assignments, tests and other important information for the students on the app. When students' devices come in the specified range of this system, they get the information in the form of a notification. This makes sure that no student misses out on any important information.
- E-Learning management system: There is an application where the teacher regularly uploads and updates the information related to the topics being covered in the classroom. The students, who are not able to attend any specific class or are unable to understand the topic in the class, can refer to this information to understand the topic and learn. Students can also refer to these for revision before any test or examination.
- I-glasses: Smart eye-worn glasses are used to implement virtual and augmented reality in the institute.
- Smart benches: The classrooms are equipped with smart benches that have interactive screens which are used for multiple tasks. The system will be unlocked only through students' fingerprint. Students can use this system to share information with each other and can see the presentation or data that the teacher wants the students to see for better understanding.

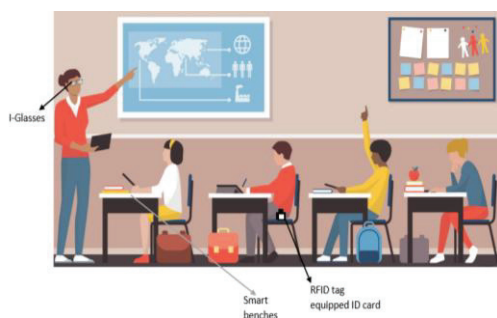


Fig. 7. Student management

IV. CONCLUSION

In this paper, we discuss the various research and study done related to internet of things in educational sector and propose an IoT Based Educational Model for Better Teaching-Learning Environment. The industry is advancing everyday but the students are stuck at the same traditional

way of learning. To make students capable of working with the new technologies, there is a need to expose them to the available technologies first and make them learn about how and where to use these technologies. No new architecture or framework can be implemented in just a day; there should be prior planning and preparation done. To effectively and efficiently make use of the new technologies, students need to be taught and trained today, so that when they graduate, they are able to work with any kind of technology without any hesitation.

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