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Applications of IOT in educational sector

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Abstract: *The Internet of things shows the potential to transform numerous areas of our day to day lives. Internet of things has the potential to provide solutions which improve service efficiency. Use of IOT in educational sector is a new wave of change that has brought new possibilities and opportunities for the improvement of learning as well as teaching process. This paper will discuss architecture, working of internet of things, how internet of things can improve traditional teaching and learning process through different devices like RFID, SCRCS, HVAC, wireless door lock, magic mirror, pressure sensor pad, smart notes maker etc. Moreover it will discuss the challenges of educational institutes in implementing IOT embedded campus.*

Keywords: *IOT, RFID, SCRCS, HVAC, magic mirror, pressure sensor pad, smart notes maker etc.*

I. Introduction

The education can be defined as a way which makes people informed and wiser through acquiring skills and knowledge. The education played an important in all spheres of life and society progress. It demand for continues betterment of academic or education sector. The progress in technology has a great impact on education, remarkable transforming the way of learning and teaching on a wide scale. Use of such advanced technology in education makes its activities more student centric, issue focused and effective [1].In recent years Learning Management System using Information and Communication Technology(ICT) solutions completely change the traditional teaching process leading to the improved modern educational system at various learning levels. There are many strategies, technologies and tools are there who are responsible for revolution in educational sector, like visualization technologies, social media technologies, internet technologies, learning technologies etc.[1].As a part of internet technology IOT ie. Internet of Things is considered as a hottest topic now a day.

Internet of Things has enabled everything/devices become connected to the internet. Almost all, everydevice, every area, every software, every sensor are connected to each other. The ability through which we can access these devices through a computer or a smartphone is called IOT or Internet of Things [2]. We can access these devices remotely. This technology basically a platform through which we can connect everyday things like software, electronic devices and different sensors to the internet which enables them to gather and exchange their data .Because of this technology different devices will be learning from the experience of other devices just like humans. The 'Thing' in Internet of Things can refer to any device that might comprise any kind of built in sensor with the ability to gather and transfer data over a network on internet without any manual intervention[2].Use of such powerful technology in education sector can successfully bridge the gap between modern education system and traditional education system requirements by transforming traditional classrooms which are separated by time and locations into modern connected classroom embedded with internet and communication tools. Hence IOT played a vital role in enhancing the teaching and learning methodologies in many ways.

In this paper we will discuss the role of Internet of Things in educational field. Section 2 presents architecture of IOT technology. Section 3 presents working of internet of things and applications of IOT devices used in academics. Section 4 presents challenges related to integration of these devices in educational institute. Section 5 presents conclusion.

II. Architecture of IOT

In early days the data which is available on the internet was created and captured by human beings.But the problem is, humans have limited time, accuracy and attention means they are not very good at capturing data about things in the real world so the solution is if we had smart computers that knew everything there was to know about things,they can gather data without any human interventions,because of which we would be able to keep count and track of everything,which reduces cost and time and that is what Internet of Thing is.
IOT architecture is made of four major components sensor, devices, gateway and cloud.

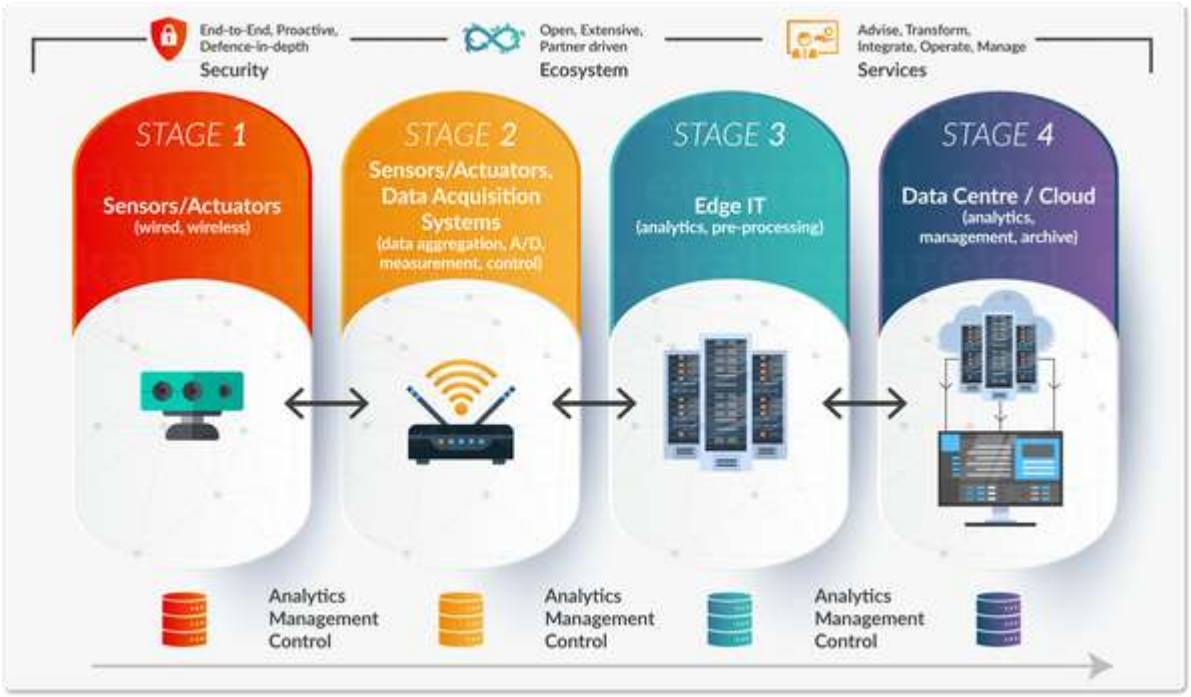

Figure 1. Four stage architecture of IOT [3].

Stage 1:
Sensor: Sensor collects data from the object under measurement and turn this data in a useful information.
Actuators: It can also intervene to change the physical condition that generate the data.eg. Adjust an air flow valve, shut off a power supply.
Stage 2:
Data Acquisition system:
At this stage data collected from sensors and actuators feed into a data aggregation device that convert that data into digitized data.After this conversion server process this data and forward it to the stage 3.
Stage 3:
Once data which is collected from IOT device has been digitized and aggregated, it is ready to cross into the realm of IT.Next step is storing this data into data center but before this storage data may require further processing. This processing is done by IT system which performs more analysis.This IT processing system may be located in remote office or other locations, but generally these sit in the same location where sensor reside closer to the sensors.
Stage 4:
The data collected from stage 3 is forwarded to cloud based system or physical based systems, where IT system can manage, analyze and stored the data with security. It takes time to get results when you wait until data reaches to this stage, but we can get deeper insights because we can combine data from one sensor with the data from other sensors. This stage processing may take place in the cloud or in a hybrid cloud system or on premises but the type of processing executed at this stage remains same regardless of platform [3].

III. Working of IOT

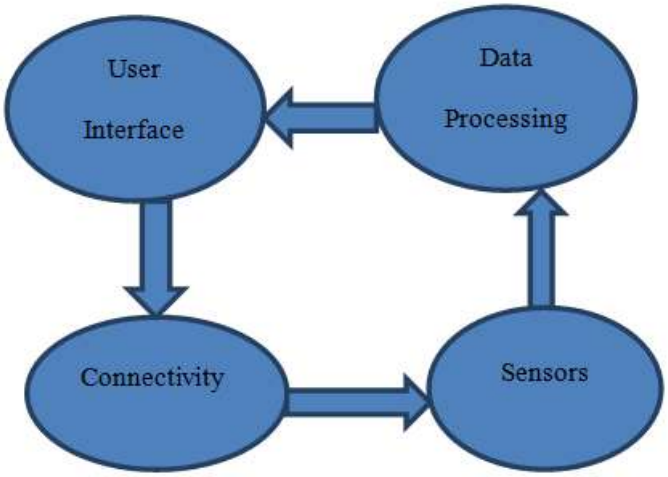

Figure 2. Four components of IOT [4].

3.1 Internet of things works on four major components

1. Sensor/Devices:

Sensor are the devices who help in collecting very minute data from the environment. This collected data can have various levels of complexities ranging from a simple temperature monitoring sensor or a complex full video feed. A device can have multiple sensors that can bundle together to do more than just sense things. The important role of this component is to collect different data from sensor which might be standalone or multiple devices.

2. Connectivity:

The data which is collected by sensors need to be sent to a cloud but it needs a medium for transport. For this sensors can be connected to the cloud through various medium of transport and communication such as Wi-Fi, satellite networks, cellular networks, wide area network ie WAN, Bluetooth and many more. All of these options have some specification and trade-off between bandwidth, range and power consumption. So ultimately choosing the best connectivity option is the most crucial task.

3. Data processing:

Once data is collected and it is stored on the cloud, data processing component performs the processing on the acquired data. This data can be ranging from simple to complex such as checking temperature reading on devices like heaters or AC to identifying objects using computer vision.

4. User Interface:

This is the last component which made information available to the end user in some way. This can be achieve by notifying users through texts or emails or by triggering alarms on their phones.Sometimes user might get interface through which he can easily get access to their IOT device e.g. If user has an installed camera in his house, he can check video recording through web server. Sometimes user may also be able perform an action that may backfire and affect the system eg. User can remotely adjust the temperature of refrigerator remotely via their smart phones.

3.2 Application of Internet of Things in Educational sector

Use of technology in education has played a major role.Now a days IOT is a technology which has important impact on education field. Internet of things not only improved traditional way of teaching practices but has also brought infrastructural changes in educational institutes [6].In education sector the term IOT is considered two faceted because it is use as a course or subject to teach fundamental concepts of computer science as well as a technology tool to enhance academic infrastructure [7].

Smart classroom:

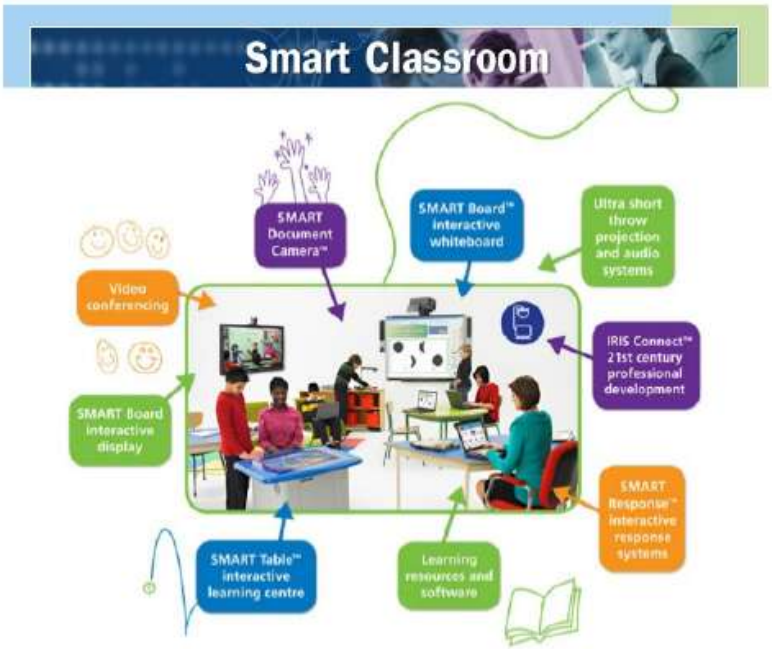

Figure 3: Smart classroom [8]

In traditional classroom teacher is use to control or manage her classroom alone. The smart classroom is a classroom which is embedded with smart devices which have made teacher's job easy [5].The use of IOT devices for teaching and learning purpose is a new trend among institutes which provides a innovative approach to education and classroom management. Some of them are successfully utilized few of them are listed below:

1. Student ID cards.
2. Attendance tracking system.
3. Interactive white boards.
4. Wireless door lock system.
5. Electric lighting and maintenance.
6. 3-D printers.
7.Security cameras.
8. E-books/E-learning.
9. Smart Heating, Ventilating and Air Conditioning (HVAC).

1. Student ID cardsusing RFID:

In any educational institute or in school there are hundreds to thousands of students. It is very difficult for the management or teachers for monitoring the locations and activities of each of the student. IOT device Radio Frequency Identification (RFID) chips can be used to do this challenging task without any human intervention.RFID chips use radio waves to read and capture data that is stored as a tag which is attached to an object and can be read from several feet away.It helps management and parents to monitor students at any given point of time, RFID adding an immense value in terms of enhancing security.

2. Attendance tracking system:

In traditional attendance tracking system teacher use to take attendance many times in a day and they have to maintain it as well , which is a time consuming job and they have to spend more time on it. For stream lining such day to day activities IOThelps to focus more on actual teaching activities, Smart Classroom Roll Caller System (SCRCS) IOT based device automatically detect the student presence in the college or school .RFID cards are attached to students' ID card, SCRCS can be installed in every classroom which can read the students' ID card collectively. It shows total attendance on LED display at the beginning of the class as well as on multiple slots of SCRCS.This attendance record is send to parents as well as one copy is saved for administrative purpose.

3. Interactive white boards:

Interactive white boards have brought significant improvements in the teaching and learning process. Such smart boards can be in the form of a standalone touchscreen computer or a connectable apparatus with touchpad used to control other computers from a projector.Benifits of Interactive boards are as follows,

1. Makes the learning process more interesting.
2. Makes it easier for the teacher to structure lesson plan.
3. Increase the level of engagement between student and teacher.
4. Makes revision of lessons more convenient.
5. Saves on teaching cost and many more

4. Wireless door lock system:

Through this IOT device teacher can avoid unwanted visitors in class. Sensors used in this technology are used to unlock doors only for verified entries and send alert message to the management.

5. Electric lighting and maintenance through HVAC device:

In educational institute energy conservation is a big task. Institutes can implement Heating Ventilation and Air Conditioner (HVAC) in there campus. IOT enabled HVAC usually takes the form of smart thermostats and sensors which monitoring environmental changes and communicating back and forth with this HVAC device, which dynamically adjusting temperature as needed.

6. 3-D printer:

Addictive manufacturing or 3D printing is a process of making three dimensional solid objects from a digital file. Developers seek to create more networked product to sense, collect, analyze and communicate data through new technology such as 3D printing.

7. Security cameras:

IOT played a major roles in security system. In educational institutes security of their students is always on a high priority .Such Internet of Things embedded cameras give greater visibility over who enter and leaves a college or school campus in real time. Institute authority can consistently and securely monitor facility conditions from any location with WI-FI access. Such smart cameras can act quickly on important security alerts delivered right to their mobile device.

8.E-books/E-learning:

Now a days learning is not limited only to the combination of texts and pictures or images but much more than that. Many e-books are joined to web-based sites that incorporate additional videos, animations, assessments and other materials to aid the learning process. Such learning provides a broader perspective to the students in gaining knowledge with a better understanding.

9.Smart libraries:

In Libraries we use to have long queue of shelf which having stack of different books. Students have to go to particular rack for the reference book which they want. Smart libraries are embedded with IOT devices which uses to connecting media such as physical object and wireless sensor network to connect device with minimal human intervention to deliver service that meet the needs of academic libraries[9].

Magic Mirror:

The system consist of a display device and a camera which is connected to server, processing unit through wireless sensor network. This mirror is made up by a digital screen like a computer monitor which is a sensory device like a webcam. When a person /student holding a book enters the field of view of sensing camera, that camera starts capturing images and the system will start tracking the information regarding the title or caption of the book along with additional information like reviews, related books etc and the monitor shown the results[9].

Pressure Sensor pad:

This IOT device is yet another innovative technology gives the library a count of students in the library, it also help for automatic turn ON and OFF light bulbs which indeed save energy and make library as a smart library. For using this smart devise a thin sheet of sensor pads are placed under the floor of passage. The sensors which are fitted in these thin sheeted pad records the movement of the student through wireless network, recorded information is monitored.If no movement occurs the light bulbs, fans and energy related devices will remains off, so this device also ensures efficient saving of energy.

Smart Note Maker:

Many students use to prefer highlighter for making notes in their textbook,these notes would help them to improve readability and also offer a quick go through before exam. This process is inefficient and time consuming in many ways. IOT devices help students to make this process easier using digital note makers. It look like a pen, which can transfer text that it highlights on any text book in form of digital text on a web page or a notepad which is 30 times faster than the usual notes making[10].

Helping hand for physically disabled students:

If any students is deaf, it is very difficult for him to communicate with other students who are not knowing his sign language. With the help of Internet of Things sign language is now converted into speech and text. Whenever deaf student with the gloves on makes a sign, the sensors fetch the signal, analyses it and provide a feedback based on his accuracy.

Internet of Things also be used to aid the students which are visually challenged.The system in the college or school campus could be programmed to identify students with visual challenges from their login ID and present the notes or text in larger font, it can also enable text to speech modules for improving their learning experience.

10. IOT as a helping hand in Mathematics problem solving:

Many students have less interest in mathematical subject, because for solving/proving mathematical equation they have to go through step by step procedure for arriving at solution.IOT can help students to make this procedure more interesting through their smart phone's camera, they just point their camera to the page containing the mathematical equation, typically aligning it within the square box of the QR code scanner it solves the equation and returns the value .The best part of this device is that it can show you a step by step procedure for arriving at the results.

IV. Challenges in integration of IOT devices in Educational sector

In educational sector task of successful integration of IOT devices in a classroom may face many difficulties like reliable WI-FI connections, security, privacy, network bandwidth, availability of devices for teacher training, students and cost of equipment etc. [5]. Some of the challenges are enlisted below,

1.WI-FI connection reliability:

High speed WI-FI connection with strong bandwidth is the first requirement for latesttechnologies for education.

2.Privacy and security:

Since in Internet of things environment, storage od data is at internet-based network of connected devices, as these devices start to measure and gather data from students, their privacy and security is at risk[5]. Any security breach could disclose student's private information like their family background, individuals medical record etc.

3.Cost involved in setup:

IOT based setup for educational institution can be expensive. Therefore the cost of equipment and devices is another challenge for institute.

V. Conclusion

Use of latesttechnology and especially IOT is transforming almost all aspects of our lives. In education sector IOT opens new doors for innovative and new ideas which improve both learning as well as teaching. Use of internet of things concepts in libraries of institutes can enhance their services in an efficient manner. IOT emerging technology makes students learning, reading more interesting so their concepts will be clearer, this technology also assist teacher for innovative teaching so they can creatively plan their lessons.Educational institutes can handle differently abled student's need very efficiently if they implement IOT based technology in their campus.

In educational data mining predicting students' performance on the basis of their day to day activities which will be one of the difficult task for the teacher because teacher has to keep records of individual student's record and then perform analysis, if we integrate this process with internet of things it will give great ease in teacher's activities .Because internet of things uses sensors which automatically sense, record, and analyze students activities. Internet of things might also help in many aspects of educational data mining.

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