

A Quantitative Survey on Smart Classroom with IoT

Md. Tareq Hasan

Sr. Lecturer,

Department of Computer Science and Engineering
University of Development Alternative,
Dhaka, Bangladesh.

E-mail: tareq.hasan@cse.uoda.edu.bd

Tahmina Akter

Sr. Lecturer,

Department of Electronic and Telecommunication
Engineering, University of Development Alternative,
Dhaka, Bangladesh.

E-mail: tahmin033@gmail.com

Abstract—In our education system within school, college and university, students waste time by doing some daily process like entering the classroom in queue, putting or taking their materials, sit down or up while answering to questions and it is so much difficult for a teacher to control huge number of students without any proper technology. IoT will help teachers to focus students learning rather than killing time to maintain large procedure when handling students in classroom. Connected devices would save time so that the teacher could focus on developing some extra qualities in students. In this paper, we will know about the benefits of IoT based smart classroom and how it helps the teachers and students to build a better world.

Keywords: *IOT, RFID, Smart classroom, e-learning, e-notes.*

1. INTRODUCTION:

In 1995, only 1% people of world population used internet. But today 47% of the world population has an internet connection. Usage of internet is increasing rapidly. With the rising percentage of internet usage, number of smart devices in the market also is increasing and researchers estimate that by 2020, the number of active connected smart devices will exceed 40 billion. The term Internet of Things abbreviated as IoT first coined by British researcher Kevin Ashton in 1999:

"I could be wrong, but I'm fairly sure the phrase "Internet of Things" started life as the title of a presentation I made at Procter & Gamble (P&G) in 1999. Linking the new idea of RFID in P&G's supply chain to the then red-hot topic of the Internet was more than just a good way to get executive attention. It summed up an important insight which is still often misunderstood."

While speaking at Fortune's Global Forum last month Kevin Ashton predicted that, 500 billion devices would be connected to the internet by 2025. (This prediction massively exceeds other predictions estimated by various stakeholders.)Take BI

Intelligence, for example, which estimates that the number of IoT devices will hit 34 billion by 2020. Tech research firm, Gartner, which conservatively pegs it at 21 billion devices. So 500 billion is a particularly headline-grabbing number. Well, whether it's 21 billion, 34 billion, or 500 billion, it doesn't matter. (For instance if we take Business Intelligence as an example, it estimates IoT device will reach 34 billion and Gartner (tech research firm) argues that the number will be 21 billion devices. Irrespective of the number to be reached all the Stakeholders predict a rise in the IoT connected devices. The Internet of Things is going to increase exponentially as more devices get smarter and more consumers get tech savvy. Gartner predicts that, by 2020, the IoT market will be comprised of 20.8 billion things—up from 6.4 billion connected things in 2016. Experts estimate that the IoT will consist of about 30 billion objects by 2020. [1] In this paper, we will learn how to build a smart classroom where everything could be controlled via internet. The roll call system, lecture notes circulation, automatic feedback etc will be done automatically though the internet which could save the time and increase the accuracy in classroom.

2. SMART CLASSROOM CONCEPT:

The smart classroom concept has come into the literature as Internet based distance education system; or as intelligent environment issued with an assembly of many various types of hardware and software modules. In the process of everyday teaching, teachers or professors are usually trying to find out if the students (or more general the listeners) were satisfied with the lecture, which section of the lecture was interesting, which presentation techniques and methods were more effective and attractive than the others. Previous studies have exhibited that approximately or roughly after 10 minutes students' attention begins to decrease. And as a result at the end of a lecture, students remember about 65% of the information presented in the first ten and only around 25% of the last ten minutes. Integrating the IoT technology with the social and behavioral analysis, a standard classroom can be transformed into a smart classroom that actively listens and analyze the voices, conversations, movements, behavior, etc., in order to come to a conclusion about the lecturers' presentation and listeners' gratification. This will help the lecturers

to consistently deliver good presentations and make a better impact, while the audience or students will benefit from interesting lectures thus making the overall learning process shorter, more efficient as well as more pleasant and even entertaining. The recent research that was conducted at MIT (Massachusetts Institute of Technology) shows that it is possible to combine computer and social science in order to analyze human behavior. [2]

2.1. Requirements:

Before analyzing parameters, the system requirements along with the concerns related to a system realization are presented. System must be able to extract required information from the ambient.

Sensor	Parameter	Output
PIR Sensor	Fidgeting	Motion Existence
Microphone	Noise	Noise Existence
Camera	Fidgeting	Motion Level
Sound Sensor	Sound Level	Sound Level

TABLE I – PARAMETERS

Hence, it requires processes such as: scene capturing, sound recording, motion detection, and interpretation of extracted parameters in real time. Scene images that are captured with camera will be processed for fidgeting – small differences between picture frames; for avoiding the third party influence (e.g. someone is entering or has entered the classroom), or movements that are not fidgeting. Sound level will be obtained with the help of sound sensors. **Real-time feedback** can be described as a chart in real time; demanding the time correlation and data fusion of multi-modal data (such as visual, audio, environmental, etc.). Its existing and timely dispersed patterns must be correlated and synchronized in terms of a time scale. **Real vs. laboratory world:** Experimental research is usually conducted in laboratory conditions, those results with a small armory of techniques available for a real world battle. To get more intended measurements, training conditions should be as similar as possible to that of conditions in a real world. It is still unsuitable to extract cues from a “live” environment, due to the limitations of the technology. **Social interaction integrity:** From the sociological perspective, the students’ unawareness of sensors presence is advised: the sensors can be located anywhere inside the classroom, but preferably not worn by the students. It is important not to affect the social interaction integrity of the students as they may not behave naturally when they are known that they are being observed. Hence, an approach with less invasive sensors is mandatory. **Open architecture:** Observed parameters may contain sensitive information that can be used by different platforms, or for later researches in social and computer sciences. This generally requires

certain openness of the system architecture which is based on Cloud computing technology that will enable IT services over the IP and will also include dynamic, scalable and virtual resources.

2.2. Parameters Analysis:

Our primary focus is to constantly monitor the level of satisfaction of the audience or the students with an ongoing presentation. To accomplish that, it is important to find the parameters that need to be measured and monitored. As a part of this research, a questionnaire is conducted among 230 students from two different universities. Results state that fidgeting and noise are the two most common way of expressing the lack of interest. Accordingly, in Table I, parameters as well as sensors that can be used for observation of the given phenomenon are presented. [2]

3. ADVANTAGES OF IOT BASED SMART CLASSROOMS:

From many point of views we could see the beneficiary side of IoT based smart classroom in many ways:

3.1. Modern Learning Practices with IoT:

Internet of Things can be considered as a new method for managing the classroom with advanced tools. Here is a short list of the most common IoT devices that has changed the education sector.

a) Poster Boards Evolved into IoT enabled board

It is indeed very difficult to compare the older generation presentation boards with today’s multimedia posters. Web tools like Glogster has changed this experience and allows creating the virtual posters easily combining with the images, audio, video, text and hyperlinks. This allows sharing them electronically with others and monitoring the activity of the student very easily. These digital posters can then be shared with classmates and teachers via email, simply accessed through the poster’s URL address and posted on class blogs.

b) Interactive Learning

Learning today is not limited to the combination of texts and images but beyond that. Most of the textbooks are paired with web-based sites that include additional materials, videos, assessments, animations and other materials to support the learning. This gives a broader outlook to the students to learn new things with a better understanding and interaction with teachers and their friends. The educational professionals are bringing the real world problems in the classrooms and allow students to find their own solutions.

c) Mobile Devices and Tablets Educational Apps

iPod is truly changing the way to teach and learn which can be considered as a very powerful creative

tool. It also allows the students and teachers to create 3D graphics textbooks featuring videos and gives the ability to take notes. It can be considered as a game changer which provides tons of educational games and makes education more appealing than ever before. It is bundled with many features that provide interesting possibilities in learning as well as teaching. The motion sensor of such devices is bundled with intriguing applications which provides the best way to learn new things.

d) eBooks providing a better way to Learn

eBooks are portable that allows the students to carry library of hundreds of books with them with greater ease. Mobile devices can hold hundreds of textbooks, plus quizzes, homework and other related files thus eliminating the need for physical storage of books. For all the students who are very excited to watch the videos, diagrams or Info graphics, eBooks provide with very richer experience and expanding learning opportunities to students.

e) Other Learning Sources

Advanced technology helps the students to learn new things by supporting instructional objectives. Tools such as Google Apps allow the students and teachers to share the documents online and make changes in real time on a screen. Course management tools such as Canvas help the teachers to organize all the resources of the students. Panoptic which is a lecture capture tool helps to record lectures directly from the computer. It also helps the students to access any information they need with a single Google search.

f) Evolution of Communication

Technology helps the students to communicate with the teachers using different modalities. It helps the teachers to keep a proper track on each of the students and assign them with home works through different online tools and track their performance. Teachers remain connected with the students all the time and remove any gap of communication between them. Communicative use of technology helps the students to take on several roles and bear their own responsibility for learning. It also gives them freedom of speech and action in a modern and safe environment.

g) Wireless door locks

Due to the advanced techniques, all doors of the schools and education centers are well integrated with the push of a silent panic button. It also includes pre-existing fireproof doors that lock immediately in the event of a school lockdown measure. The security measure of the schools includes the door access control system which verifies visitors before unlocking outside doors for entry. One can unlock or lock doors remotely using mobile devices and also receive the notification for the same when someone has arrived on the door. This is indeed very useful feature for the school authorities and helps them to avoid any

mishaps. One can program the doors to check the status of a remote door lock via mobile device, lock automatically at specific times and program buttons on your security system's interface.

h) Education at anytime and anyplace

IoT plays a vital role in building a community using different web based platforms. Advanced technology helps the teachers to monitor the progress of the students. Edmodo is one of the best means of teacher-student communication. Edmodo makes possible for the learners to gain knowledge from any place at any time. It allows students and teachers to stay connected via different means, checking messages and upcoming events while away from the classroom and even replying to posts. It is a very powerful app that provides safe network and full privacy. It also allows storing your unique ideas and classing project without worrying and guaranteeing you full confidentiality.

i) Advanced Security Measures

Implementing the advanced technology solutions in the classrooms and education sector is very useful. It includes emergency alerts, audio enhancement, wireless clocks and hearing impaired notifications that provide the students and staff with a sense of security. It can also minimize the devastation and save lives that can result in the wake of a crisis situation. The schools and education centers are adopting different security measures that help to secure the campuses. The communications console can also be utilized for different emergency tones, live announcements, multiple bell schedules and pre-recorded instructional messages that will direct the staff and students during emergency.

j) Bye Bye to Chalk boards

Students now a day makes use of a very powerful platform such as Smart Boards. It helps the teachers to explain the lectures more easily with the help of online presentations and videos. Students are encouraged with interactive gaming as a powerful platform. Web-based tools and programs help to teach the students more effectively that was once paper or chalkboard based. Smart technology let teachers and students surf the web and even edit video and share assignments.

k) Temperature sensors

According to a recent study, temperatures of the classrooms have a great impact on the student's cognitive abilities, memory and attitude. A very hot weather can make students and teachers feel as though they lack energy. There are some advanced temperature sensors that allows schools to monitor different conditions in any environment. It not only saves the thousands in utility costs but also enhances the learning capabilities of a student. Remote monitoring solution helps to monitor all the classrooms at once at any time from anyplace.

1) Attendance tracking systems

A strong school attendance system ensures the security of an educational organization and can help schools and education centers in many ways. It helps the teachers to input the necessary information directly into the system. It can also help to track the number of times a student has reported to the doctor and keep a check on student's medical needs and medication they may be taking. It also gives the choice to the student to confirm their meal for the day. [3]

3.2. Outcomes IoT in Subject Note's sharing [4]

Internet of things helps in multiple way to use in learning process. Encircle factor like easy way to capture data, Storing of data, manipulate it, assessment of students, avoiding delay of transmission, frequency of usage. .Etc.

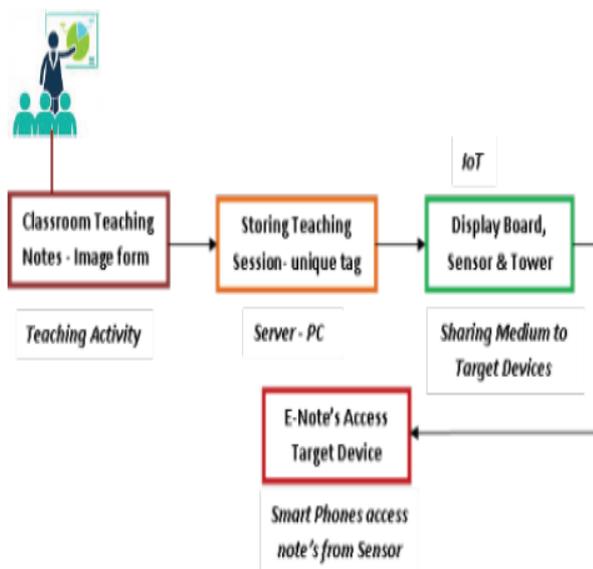


Fig.1. Classroom Note's sharing using Smart E-Learning & IoT -Concept Data Flow

"The Internet of Things doesn't function without cloud based applications to interpret and transmit the data coming from all these sensors." It reflects the importance of using cloud with IoT technology. This architecture depicts the same note sharing data storing in cloud to synchronize with IoT Tower sensor.

3.2.1. Importance of using IoT enabled Smart Classroom for E-Learning Application [4]

➤ **Easy to share with others outside classroom using smart classrooms:** Admin can share any form of converted notes to others through this E-Learning application to make them easily accessible. It widely creates a great impact on learning circles.

➤ **Collaborative Learning can achieve in Classroom Environment:** This will effortlessly allow us to create collaborative learning environments in classroom with more number of Students in different

classroom in different region easy to make available virtually in single classroom, all in one place.

➤ **Improves Institutes Reputation next level by affording Top Professor's Lecture from well-esteemed organization:** "Potential to extend the reach of effective teachers" Students can attend Top Professor's Lecture through this IOT Enabled smart classroom system easily.

➤ **Increase Competitiveness between Local & International Students:** Students can have direct competition with international students in all form of activities.

➤ **Easy to Setup Blended learning environments:** Due to sharing classroom with one region to another place in the world makes easy to give blended learning classroom with the different set of students from an entire world. "Flex - Most of the curriculum is delivered via a digital platform and teachers are available for face-to-face consultation and support"

➤ **Enhances communication with IoT Device's in Classroom:** It allows teachers to send announcements and start lecture discussions instantly. At single instance, it can handle easily more than one Classroom.

➤ **Affordable to all Students for Subjects E-Notes from top professor:** This application makes easiest way of collecting and sharing subjects e-notes to everyone in that particular network easily throughout world.

3.3. IoT Device's for Smart Classroom [4]

Device's enhancement using microchip in performance plays an imperative role to transform classroom into smart Classroom.

➤ **Smart Whiteboard using IoT:** Predominant main device in this setup is smart whiteboard. Its role is to become hub of all devices to get connected in single point of IOT sources.

➤ **Standard Communication Techniques for New Model Setup:** Data and communication flow between all data collection sources.

➤ **Smart Classroom Monitoring:** Admin can monitor all activities of classroom and smart whiteboard can updates & synchronize with e-learning.

➤ **Collaborating Classroom using New Model Setup:** Amalgamating multiple smart whiteboard from different locality of classroom to create collaborate learning environment by using smart classrooms.

➤ **Energy Consumption to IoT device's:** Conserve more energy consumption while devices are in ideal state. Monitoring system used to conserve device energy efficiently.

➤ **E-Notes Management:** Lecture notes collected from smart board to share using eLearning application. Device will help for collecting notes, it will be in digital data to share easily in common platform.

➤ **Automation of Subject's Notes Sharing:** Platform used to share notes using admin activities in spite of that notes shared through automation activity using device to e-learning application from smart classroom.

➤ **Useful Gadgets in this New Model Setup:**

Apart from standard smart classroom devices additional gadgets can be added to this setup for sharing basic information like alert, alarm, short description of notes, augmented visuals, .etc.

➤ **Data Congestion:** Notes sharing use enormous data traffic in smart classroom. It's very significance to use congestion algorithm for proficient usage, free of traffic blockage which get out of slow down data rate. "Data management is a crucial aspect in the Internet of Things. When considering a world of objects interconnected and constantly exchanging all types of information, the volume of the generated data and the processes involved in the handling of those data become critical."

➤ **Interoperability in the Internet of Things:** The advancement of future Internet depends on Internet of Things. Smart board things connected to multiple classrooms for sharing notes resources. On the basis interconnecting various things, machines, and smart objects to network its interoperability depends. "As for the IoT, future networks will continue to be heterogeneous, multivendor, multi-services and largely distributed."

3.4. Iot Based E-Learning Application Model [4]

a) Smart classroom is user centric to carry forward notes to next level through e-learning on source collecting from IOT devices: "The development of the IoT is expected to come along with a new range of user-centric services, based on the interaction of day-to-day processes with the network." "Social Learning application is challenging task to integrate various functionalities in one system. The smart classroom takes a key step in the development of smart e-learning system. Teaching is most important activities in traditional learning process for colleges and universities. So this can be used to share with smart e learning system in social networking." "The business model for the delivery of those services will require the interaction and collaboration of several organizations." The delivery of those services will be frequently seamless for the user, requiring no specific interaction with them. In particular "event-driven" middleware and sensor "dynamic service capability declaration" is required.

b) Augmented reality with IOT enabled Smart Classroom: AR enables Smart Classroom to Store and share context based data collection when students come into closeness to sensor devices; it depends on locality and connected things. Such data may possibly displayed on mobile phone, any wearable gadgets or using well located smart display boards.

c) 3D Virtual objects with IOT: IOT devices possibly used to display 3D virtual visual to students in smart classroom. Inputs for this visual can be captured in real time from physically located materials or can be accessed from already recorded 3d visual. Data can be collected in both ways from real 3D virtual world or from the real location.

d) Smart Information Display Board using IOT:

Student outside classroom can access subject data notes using information sharing Display board and it can be controlled by administrator for adding updates.

e) Smart Phone devices and Smart Display Board using IoT:

Interaction among mobile phone and display board to share subject notes using IoT which data is collected from smart classrooms. So it connects student even from outside learning session.

f) Intelligent IOT objects: IOT things connected among each other for efficient smart class room. Classroom activities are key factor to centralize, control and updates information gathered from classrooms. Intelligence level to IoT enabled smart classroom is highest priority, then 2nd level importance to smart display board to share all gathered notes to students using this thing. Interactive display device is installed in standard defined network setup is key one.

g) Administrator for IOT smart classroom: Standardized role is defined for admin activities on basis of architectures used; Data sharing schemes, protocols is used.

4. FUTURE WORKS:

Smart Classroom Notes can be improvising in many ways like

- Adding audio to that notes,
- Allow to add short video clips,
- To make live chat session while accessing notes, Etc.
- In terms of Sharing Medium to Target Devices STD IoT

H/W we can make centralized STD h/w which can communicate to multiple STD's h/w and share's data among each other's. "A next generation Learning Management System and Experience APIs may enable real IoT integration and propel business training to the next level." LMS is part of E-learning technology in future E-learning will be enabled with IoT.

a) Robotics: Connected everyday objects and sensor networks are key enablers for robots. Onboard wireless communications may be critical for interconnecting robot systems.

b) Geotagging / geocaching: Geographic information systems (GIS) play a role in locating things. An Internet of Places (IoP) can arise as more systems recognize where they are and can access GIS.

c) Mirror worlds: Electronic media – whether a simple display or a complex virtual-reality platform – can help people visualize distant events and situations. Software can use icons and other abstractions to help visualize the location of real world objects. Objects including vehicles, personnel and

equipment can self-report via various types of sensors, machine vision and other technologies [4].

5. CONCLUSION:

In this research paper, the concept of smart classroom is discussed in details so that the advantages of IoT features in smart classroom are shown clearly. In many aspect of learning, it is a helpful way to build time saving environment for teaching and learning. Easy to find weak students and talent students within many. Real time feedback is another important thing to improve lecture quality and student's skill. Lecture notes sharing and gathering information is a vital issue that spreads their knowledge worldwide. The main contribution of this paper is to proof that the IoT based smart classroom is a mandatory thing in educational institutes to build efficient and knowledgeable students without wasting valuable times to rule the modern upcoming world.

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