

Internet of Things for Smart Classrooms

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Abstract— Much of the time is wasted while entering the classroom in queue, picking up their own materials, sit up and down while answering to questions and it makes very much difficult for teachers to handle huge number of students without any technology. On an average, an American student spends about 1025 hours each year just for following instructions given to him/her. Connected devices and emerging trending technologies will help teachers to focus on student's learning needs rather than wasting time for managing large group procedures because of which they cannot give enough time for developing some extra qualities in students. Connected devices would definitely help teachers to transform classroom experience. This paper consists of some practical scenarios of about how I.O.T can be implemented for a better classroom experience and how teachers can focus on student's skills and which will help to save the time of both.

Index Terms— Internet of Things (IoT), Smart Classroom, Practical Implementation, Smart Board

I. INTRODUCTION

The Internet of things is a recent communication paradigm that shows us the near future where the everyday life objects or devices will be equipped by various devices such as microcontrollers, sensors, transceivers and appropriate protocol stacks that will make these objects able to communicate with one another and among the users thus becoming an important part of internet. The IoT concept, therefore, aims at making the internet even more immersive and pervasive. Today the IoT vision is more aspiring and focuses on enabling smart and context-aware applications for people everywhere in the world. In addition, by providing easy access and interaction with a wide variety of devices, for instance, home appliances, cameras, monitoring sensors, vehicles, displays and so on, the IoT will encourage the development of a number of applications that make use of the possibly enormous amount and variety of data that is generated by such objects to yield new services to people, students, companies, and public administrations.

However, such a diverse field of application makes the

identification of solutions capable of satisfying the requirements for feasible application scenarios a formidable challenge. This difficulty has led to the growth of different, and sometimes, incompatible schemes for the practical realization of IoT systems. Therefore from a system's prospect, the realization of an IoT network, along with the required backend network services, protocols and devices, still lacks an established best practice because of its originality and complexity.

In this paper, we label the possibility of using IoT to build a smart classroom, i.e. a classroom that enables real-time, automatic feedback on the quality of a lecture and the level of satisfaction of the auditorium with the lecture and the lecturer. Such real-time feedback will allow the lecturer to adapt the lecture during the presentation so as to achieve the maximum impact as well as to modify the future lectures based on the "lessons learned" from the past cases.

II. 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 behavioural analysis, a standard classroom can be transformed into a smart classroom that actively listens and analyze the voices, conversations, movements, behaviour, 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.

III. PREVIOUS WORK

Previous work is not directly related to this subject, as it focuses mainly on enhancement of learning in a different manner. The perspective of the existing work is oriented towards digitization of the ambient, conversion of written materials into electronic form, tele-education, web based distance learning, human to computer interaction, interaction in a classroom or a conference, etc. To our knowledge, this will be the first attempt to define the problem of live feedback on the quality of lecture and analyze the requirements. In [6], automated capture of audio, video, slides, and handwritten notations during a live lecture is proposed. A system for locating and tracking a lecturer in the room using acoustic and visual cues is also described in [7]. Platforms that are developed at MIT can measure several aspects of interaction, including non-linguistic social signals by analyzing the person's voice tone, facial movements, or gestures utilizing wearable device. Similar research was conducted in MIT Media Laboratory where wearable sensors were used to create group social index of interest. These devices should be worn in order to provide parameters for measurement. This is not considered as the most prominent solution as the individuals do not behave naturally when they know that they are under observance. Nevertheless, previous work can be a good starting point for later research. In this paper, we mainly address the problem of real time feedback on the quality of lecture, by observing the parameters available in audience and also their digital representation in time scale.

IV. 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. 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, that results with a small armoury 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. [5]

V. 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 states 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. [4]

TABLE I – PARAMETERS

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

VI. PRACTICAL IMPLEMENTATION

For maintaining records of student’s attendance, Nymi a wearable smartband can be used which uses ECG patterns to authenticate identity. A warm-up exercise can be directly pushed to the students using beacon. So because of this teachers can now focus more fully on students and more incisively. Neurosensors can provide insights to students. It can be used to measure the brain activity of students and also can be used to measure pulse. [2]

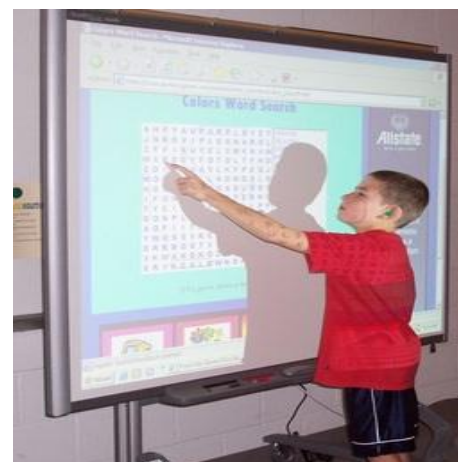
Teachers can dedicate attention to those students who really need it by identifying which students disburse more energy. If teachers want to pass some information to students then they can send “haptic” vibrations on to that particular student’s smartband. Pattern recognition software or data analytics will definitely help teachers for contextual understanding, to map record of behavioral incidents related to student or classroom temperature. [2]

IoT can be implemented using sensor gloves. It is already being used in Australia.It is used for helping students to learn Auslan Language (Australian Sign Language).The one who wants to learn that language wears it and after that the signal is sent to the computer

machine which converts it into written language and it provides feedback in return to the learner.[1]

Many of teachers may not be aware of smart boards which is one of the most important teaching tool.Computer allows images from the digital screen to be displayed on a board which can also be changed or modified on the screen itself using some tools like pen or any other highlighting tool.It makes easier for the teacher to run the application by touching it or by scrolling it with his/her finger.[3]

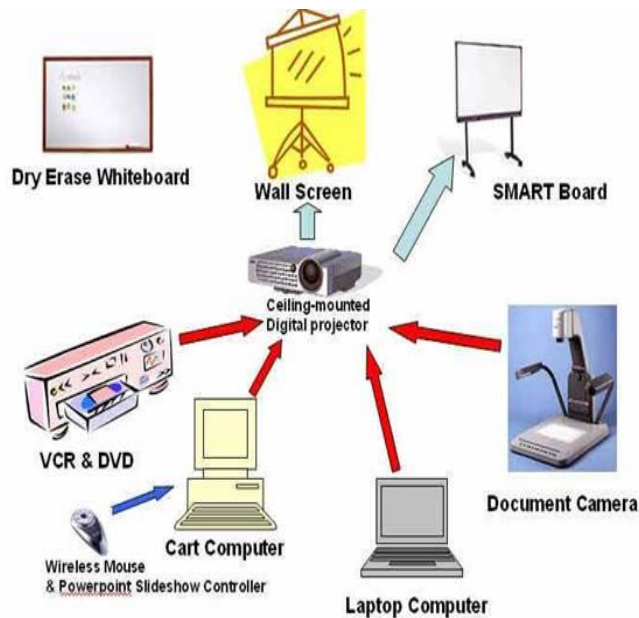
Some of the reasons why smart boards are becoming an essential part of smart classrooms are as mentioned. Different learning styles can be accepted.Learners can learn by touching the board and visual learners can help themselves by observing the teaching on the board. It is very easier to maintain and it is very clean. This can be used as a tool for note taking. Students can use this board for writing some important points. One student can be appointed for writing points which are discussed in the class so that the other students in the class can view that point simultaneously. Images, videos can also be displayed on this board as well as some important diagrams can be drawn on this board which expands the range of content that is used for teaching. This board can also be used to play some classroom games. [3]



1) Smart Board

In Australia project termed as "The School Of The Air" is responsible for connecting students across various

geographical regions. Bosch has contributed for Austria in terms of implementing IoT for classrooms. They have done this with their quantified art of installation. It contains small sensors which are responsible for monitoring co2 levels, humidity, pressure, room temperature. It also notifies students about the colour changes in pictures. It also helps students to identify changes in environment.[3]



II) Flow of smart board

Even implementation of social media can contribute to a great extent. It will help teachers to know youngster's reality. By using social media teachers can encourage students to participate and collaborate long after the bell has rung. Even cameras can be used in classroom. The lectures which are conducted in class can be recorded and can be used for future purposes. Even activities of students can be tracked using this cameras. [3]

VII. LIMITATIONS OF IoT

It can be categorised into four categories which are Platform, Connectivity, Business Model and Killer Applications. [8]

Platform: It includes scalability which includes the use of ipv6 protocols for horizontal markets and vertical markets. It even includes form and designing of products and many tools which are used for analysis. [8]

Connectivity: M2M communications has proven to be more dominating. It includes smart wearables, smart homes. [8]

Business Model: This category is always a sufferer of regulatory and legal inspection. Goldman Sachs have mentioned many verticals which are impacted because of it.[8]

Killer Applications: "Things", "Collect Data" and "Analyse Data" are the three things which falls in to this category. [8]

VIII. CONCLUSION

In this research paper, the smart classroom concept is described from a completely new perspective i.e. real-time feedback on lecture quality by using Internet of Things (IoT). The main contribution of this paper is an innovative approach to a smart classroom environment and multidisciplinary research subject. This perspective demands an understanding of problem statement so as to define parameters with further aim to create a better prologue for the system implementation. Our paper mainly focuses on use of the monitoring and sensing technology to explore the listener's behaviour in an intelligent environment. The information collected can provide insight into classroom activity level by correlating the sound and the movement's existence and intensity. Such an intelligent environment could actively observe students' response to a lecture, and can be useful to a lecturer to improve the lecture quality. Practical examination of the Smart Classroom subject will present new issues for consideration and research.

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