

Prospects of Internet of Things in Education System

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Abstract

The rapid growth of production of low power, small, inexpensive computing hardware, and its availability makes it possible to embed it in any physical objects and connect these objects to the Internet. These objects are called Internet of Things (IoT). IoT can interact with anything, anytime, and anywhere bringing people, processes, data and things together. It is used to ease some of our daily activities and gradually touching every facet of our lives, opening new opportunities for growth and innovation. While it is expanding in many sectors, it is gaining grounds in educational sectors opening enormous opportunities to facilitate teaching and learning processes. This paper introduces IoT technology, its potential application in education system, and discusses benefits and challenges of IoT. IoT technology would promote a smart education system or intelligent learning environment.

Introduction

The internet is a constantly evolving and a multifaceted tool consisting of vast range of information resources and services to serve billion of people worldwide. People primarily use the Internet, specifically the World Wide Web (WWW), as a tool for communication and information gathering. Internet access or online activity mirrors much of what people do in physical space—chat, play games, share pictures and videos, and shop (Sanders & Burt, 2016). As Internet progresses, four major technology revolutions have occurred. Pew Research Center (2014) mentioned three technology revolutions: broadband communication technology, mobile communication technology, and social media technology.

Four major technologies that revolutionized Internet are:

- a) Broadband Communication Technology
- b) Mobile Communication Technology
- c) Social Media Technology
- d) Cloud Computing Technology

The next technology revolution is Internet of Technology (IoT).

The broadband communication technology is a high-speed internet technology that is always on. People spend more time online these days playing games, watching videos, and themselves become content creators. The rise of broadband communication technology changed the way people got information and shared it with each other. Mobile communication technology through

smartphones, tablets, laptops, made any time-anywhere access to information. Social media and social networking has affected the way that people think about their friends, acquaintances, and even strangers. They allow people to plug into those networks more readily and more broadly – making them persistent and pervasive in ways that were unimaginable in the past (Pew Research Center, 2014). Cloud computing technology introduces on-demand computing services like application, storage, processing etc., over the internet on pay-as-you-go basis eliminating the need to build and maintain in house computing and networking infrastructure. It utilizes the resources in most cost-effective way by outsourcing data to a third party, which are available on demand basis over the internet.

The next step of technology revolution is the Internet of Things (IoT) and this represents the most potentially disruptive technology revolution of our lifetime (Feki et al., 2013). This technology is the beginning of an emerging era where ubiquitous communication and connectivity is not a dream or challenge any more. IoT focuses on seamless integration of people and devices to converge physical realm with human-made virtual environments (Buyva & Vahid, 2016). It is revolutionizing the way people live and work through new and innovative services greater than that of internet.

Internet of Things (IoT)

The term “Internet of Things” was first coined by Kevin Ashton during his presentation about radio frequency identification (RFID) in Procter & Gamble (P&G) in 1999 (Ashton, 2009). Since then, IoT has been a rising trend in information technology (IT) arena attracting attention from various world communities including consumer electronic industries, business, government, and academia. These world communities have their own interpretation of IoT and defined IoT appropriate for their application. There is no single agreed definition of IoT. This is because IoT covers wide range of technologies, processes and applications. According to Rose, Eldrige, and Chapin (2015), IoT generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention.

Gartner, Inc. (2016) estimated that 20.4 billion connected things will be in use worldwide by the end of 2020. Gartner, Inc. (2014) also mentions that a typical family home could contain more than 500 smart devices by 2022. This means very soon everything around us will become smart and an enormous amount of information will be exchanged between devices and people. While it is expanding and transferring every aspect of human activity, it is also affecting the education system. This will open many potential opportunities of teaching and learning experience for both students and educators.

The Cisco systems forecasts IoT in education system has a 10-year net present value of US\$175 billion, which will be used for the personalized instructions, data collection for making efficient decisions and decreasing the overheads on the educational resources (Selinger et al., 2013).

IoT in Education System

In recent times, the advent of internet and social media technologies have dramatically changed education system. It has changed the way of interaction between educators and students with the

aid of digital technologies that helps to improve teaching and learning process. Educators are continuously exploring opportunities and possibilities for application and services that can enhance teaching and learning process. Digital technologies such as multimedia projectors, interactive smart boards, and content management had already revolutionized teaching and learning systems. Content management tool, a centralized software application, which provide course creation, delivery, management, tracking, reporting, and assessment, made reality of distance education and online courses. Educational systems embracing learning environment methods rather than focusing only on the learning contents, in a peer-learning environment is quite important (Kamar & Ali, 2017).

Abbasy and Quesada (2017) says IoT is transforming traditional education system into a scalable, adaptable with rapid dynamic changes, flexible and more efficient e-learning with a topology where the huge number of physical and virtual interacting objects are involved in the process of learning. Making use of IoT in learnings systems would open up new pathways to proffer effective learning. It helps to create energy-efficient and cost-efficient education system through automation of common tasks outside of the actual education process. The influence of IoT can be seen in many aspects of education from student engagement in learning and content creation, helping teachers in providing personalized content and improve student outcomes (Wellings & Levine, 2009).

IoT is one of the aspect of technology that have major applications in STEM education (Lakshminarayanan & McBride, 2015) namely:

- a) Virtual Reality
- b) Personal electronic systems aka 'clickers'
- c) Flipped classrooms
- d) Mobile learning 'm-learning'
- e) Massive Open Online Courses "MOOCs"
 - i) Khan Academy
 - ii) Google Apps for Education
 - iii) Coursera
 - iv) edX
 - v) myHomework
- f) Internet of Things "IoT"
- g) Cloud Computing

Internet Access and Smart Devices

Internet access is a necessity not a luxury (Zondervan, 2018). So, learning places, classrooms, schools, are provided with wireless internet access for mobile devices used by educators, learners, and staff.

Access to the internet provides connectivity to many smart devices. Smart devices such as smart phones, tablets, wearable devices, smart whiteboards, smart table, attendance tracking, are becoming more commonplace in the classroom. Smart devices throughout the school send data and receive instructions over the wifi network. This makes physical environments of classroom smarter and more interconnected than ever before.

Smart Classroom

Classrooms deployed with IoT devices can be used to monitor and measure students' performance and efficiency. For example, IoT devices can automatically track the student's attendance. Teachers and educators can also conduct exams and assignments digitally. Students well-being can also be monitored with IoT wrist bands during athletic activities. Inside the classroom, airflow, air quality, temperature, and humidity can also be constantly monitored and optimized in every possible learning space. This will keep the facilities functioning smoothly and support higher level of personalized active learning for students.

IoT Devices for Smart Classroom/School

Many different types of IoT devices are available easily on the market these days. For example, smart devices like eBooks, tablets, fitness bands and wearables, virtual and augmented reality headsets, smart lights, smart locks are common in smart classroom. Some other common IoT Devices include:

- Multi-touch tables (smart table)
- Smart white boards
- Student Smart ID Cards
- Facial Recognition Cameras
- Smart Cameras
- Attendance tracking systems
- Smart HVAC System
- Smart Temperature Monitoring
- Smart Lighting
- Telepresence Robots
- Smart School Bus
- Smart TVs, CCTVs
- Connected Sports Equipment

Potential IoT Applications in Smart Classroom/School

With proliferation of the IoT devices, smart and intelligent learning environment, we can revolutionize the entire field of teaching and learning process. Following are some potential IoT applications that can enhance operation efficiency of every type of learning environment:

- As students walk into the classroom, student's attendance could be logged automatically using a smart device such as the Nymi, a wearable "smartband" that uses the wearer's ECG pattern to authenticate student's identity (Meyers, 2014).
- Touch boards could be connected to the internet, where information can be downloaded directly on to the board and instructor and students will be able to interact by touching objects on the boards.
- Smart cards could be used to gain access into the college premises, labs, classrooms, libraries, canteen etc.
- Student's submitted work could be maintained and could be analyzed to give customized advice for students.

- RFIDs, Beacons, wifi could be used to identify students entering campus with automatic notifications regarding the availability of the library books, his day wise schedules, etc.
- RFIDs, Beacons could be also used for indoor location tracking and automatic attendance.
- Smart camera and facial detection could be used in automatic attendance.
- Automatic control of temperatures in labs and lab equipment could be achieved.
- Customized alerts could be sent about the student's abnormal behavior or any types of security and personal privacy issues arises, administrators can reach out and act more quickly to resolve issues.
- Smart devices could be used to alert staff and providers to service equipment before a problem occurs.
- Personalized learning at a students own pace and intellectual ability could be achieved easily.

Benefits and Future Possibilities

Following are the benefits of IoT in the education system:

- It allows schools to improve the safety of their campuses, keep track of key resources, and enhance access to information.
- It creates smart lesson plan for anytime, anywhere access.
- It optimizes the cost of heating, ventilation and air-conditioning (HVAC) system. Auto opening/closing of windows, smart registers and blowers to control the conditioned air-flow based on the occupancy (number of persons) in the classrooms create intelligent HVAC system. It maintains the comfortable room temperature without wasting the energy.
- It optimizes the cost of lighting based on the room occupancy and the natural lighting from windows and door by automatically turning on/off/dim the lights.
- It provides aid to educators by minimizing manual works like automatically turning on projectors, dimming the lights when slides shows are active etc.
- It helps to enhance the performance of each students.
- All the information from each sensor over the period are collected and stored in the cloud or database which can be analyzed to find more efficient ways.
- It provides personalized and adaptive education which is a customization of education that allows student what they need.
- It allows context-aware ubiquitous learning environment.
- It enhances collaboration among educators and learners.
- It improves learner's performance.
- It increases learner's accountability.

Selinger, Sepulveda, and Buchan (2013) termed the Internet of Everything (IoE) as the next step in the evolution of smart objects - interconnected things in which the line between the physical object and digital information about that object is blurred. According to Evans (2013), IoE brings together people, process, information, and things to make networked connections more relevant and valuable than ever before-turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunities for businesses, individuals, and countries. The expected developments and benefits of IoE support in educational purposes (Selinger, Sepulveda & Buchan, 2013) in 2017 are presented as:

- Scale teachers and best quality of instruction-any device, anywhere;

- Scale content recordable and replicable instruction any time, any venue;
- Learn at your own pace, focus on relevant content only, richer interactive content;
- Access to crowd-sourced content, ability to customize curriculum;
- Data driven decision-making and continuous improvement.

Challenges of IoT in Education

Currently, IoT is one of the main accelerators of technological innovation, being one of the areas with greater potential of transformation of society and the economy. As such, all the involved stakeholders, ranging from technologists to developers, companies, and users, face several challenges that remain to be tackled (Hassan et al., 2018). Some of the challenges in education system are as follows:

- Lack of generic frameworks of context-aware ubiquitous learning environment.
- Needs to rethink existing pedagogical theories like cognitive theory, constructivism etc.
- Educators reluctance to adopt new technology.
- Difficulty in maintaining secrecy and privacy of the IoT devices.
- Cost of deploying IoT may be expensive.
- Some IoT devices and applications are not compatible making it difficult to deploy.

Conclusion

The use of IoT technology will open the doors for new and innovative education system. Sooner, the idea of smart education and intelligent learning system will become a reality. There are also numerous other possibilities in education system along with technical (may be non-technical, not sure?) challenges which still remain to be addressed.

There are enormous values in the adaptation of IoT system throughout the education system. Use of this technology will open the doors for new and innovative education system to be more relevant and effective, and the idea of smart education and intelligent learning system will become reality.

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