Internet of Things (IoT): Game Changer for Education and Learning Technology

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ABSTRACT

Internet of Things is the buzzword in the IT industry and has found its applications in almost every sphere of our lives. Education, being an important part of today`s economy, can be revolutionized by the introduction of the technology. This paper discusses the importance of Internet of Things and how it affects our daily lives. It further discusses how Internet of things has opened new doors for the technology to be incorporated in our education system and investigates the various possible applications of incorporating IoT in our education system.

Key Words: *Energy grid, healthcare, Internet of Things*

INTRODUCTION

We have witnessed a technological revolution in the last few decades of the magnitude comparable to the transition from Middle Ages to the modern world. The Internet of Things or IoT has become a buzzword in the IT industry and its popularity has increased multiple folds in the recent past. It is a technological revolution which allows all the objects around us, called "things", to seamlessly integrate with each other, exchanging data and improving the living standards. IoT has the potential to change the way how we live, how we work and how we study by improving sustainability, communication, efficiency and economy in

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every aspect of our lives. According to Brendan O'Brien who is the Chief Architect & Co-Founder of Aria Systems, "If you think that the internet has changed your life, think again. The IoT is about to change it all over again!"

The term "Internet of Things" was coined by Kevin Ashton in 1999 but it has attracted lot of attention because of convergence of multiple technologies like artificial intelligence, machine learning, real time analytics, embedded systems, wireless sensor networks etc. All these fields have contributed to the development of the Internet of Things. IoT is a network of physical objects like vehicles, home appliances, cell phones, wearable devices and almost anything that one can think of, which can be embedded with electronic circuitry, sensors and actuators enabling these objects to connect to the internet and also provide some computational power to these objects. Each of these things forms a part of IoT and is uniquely identifiable through a uniform resource identifier or an IP address.

Earlier it was expected that 50 billion devices will be connected to the internet by 2020. Even some had predicted the number to cross 100 billion by 2020. But because of the various complexities surrounding the Internet of Things, these numbers have been revised and as per latest estimates by the analyst firm, Gartner, 30 billion devices are expected to be connected to the internet by 2020 (Amy, 2016). It is also estimated that the global market value of the IoT will be 7.1 trillion by 2020 (Hsu, Chin-Lung; Lin, Judy Chuan-Chuan). There are various reasons which led to this drastic reduction in the expected number of devices being connected to the internet with the most notable being the

security concerns. 2017 was very challenging in terms of the security vulnerabilities being exploited by the hackers. Fall in the sales of wearable devices and delay in the commercialization of driverless vehicles can be attributed to the security issues. One of the security rules states that, "If anything is connected, it is exposed". As IoT connects more and more devices to the internet, strong security measure needs to put in place to avoid any security breach and protect the personnel data of the masses.

IoT is useful in almost every sphere of our lives especially in industries like healthcare, education, energy management, transportation, farming, industrial internet, smart grid etc. IoT applications can be extended to the educational environment also. Education system has witnessed some major changes with the proliferation of the open universities and increased use of electronic gadgets in classrooms. This paper focuses on the effect of IoT on the modern education system and how IoT can be used to further improve the education system. The rest of the paper is organized as follows: Section II specifies the applications of the Internet of Things. Section III concentrates on the potential of the IoT in education and section IV describes the importance of IoT in education and how it can help to reshape the education system.

IoT Applications

There is a huge hype surrounding the Internet of Things and it seems every day some new IoT based product is launched (Lueth, 2015). With 30 billion devices being connected to the internet, there could be countless scenarios where IoT could make an impact in our daily lives. For

example: a smart car could book a parking slot for us before we start out journey, the alarm could wake us up in the morning and at the same time notify the coffee maker to start brewing coffee, a wearable device could be used for health monitoring sending the various body parameters to the doctor in real time or a smart refrigerator could add eggs to our shopping list when we run out of eggs. There are innumerable such scenarios where IoT can be extremely helpful. The reality is that IoT allows for endless opportunities and some of the most popular applications are enumerated below:

1. **Smart Home:** A residence is called a smart home if it uses internet connected devices for remote monitoring and management of various home appliances and systems. Home automation provides security, comfort, energy etc to the home owners. Its applications include automation of heating, lighting, cooking, washing, shopping, surveillance, security etc.

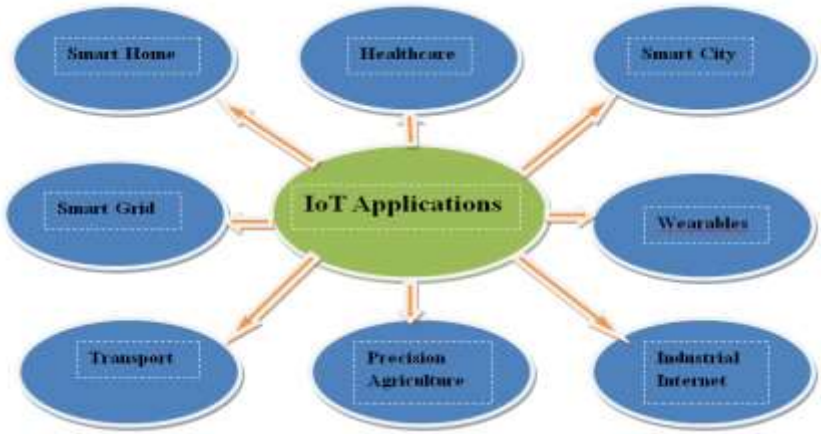

Figure 1: Application areas of IoT

2. **Healthcare:** It remains one of most important applications of the IoT with enormous potential not only for the companies but for well-being of the people also. It is expected to grow by 25% annually from 2016 to 2020 (Arsene, 2017). IoT enables check-up of patients while they continue to sit in the comforts of their homes. It also enables the doctors to monitor their patients 24x7 remotely. Even medicine intake can also be remotely initiated.

3. **Smart city:** Smart city encompasses a wide variety of use cases like traffic congestion problems, waste management, security, energy optimization etc. It improves the quality of life and foster economic growth. Smart street lights are operated automatically. Use of Drones have increased the security and brought down the number of criminal cases.

4. **Smart Grid:** All the systems responsible for delivering the electricity from the power plants to our homes are collectively termed as "grid". Smart grid is expected to

automate and manage the increasing complexities of the modern energy grid. IoT improves the availability, reliability, efficiency and load adjustment/load balancing of the grid which can contribute to the economic and environmental health.

5. **Wearables:** Wearable technology is an umbrella term used for all the electronic devices that can be worn on the body. It includes fitness bands, smart watches, activity trackers etc all of which have some sensors fitted to measure a certain environmental or body parameter like heart rate, temperature etc. Smart jewellery, smart clothing and VR headsets are also a part of wearable technology.
6. **Transport:** Smart transportation ensure inter-communication among vehicles which can lead to smart traffic control, smart parking, road safety, reduction in traffic congestion, automatic toll collection etc. Smart transportation can save fuel and reduce the travel time and greatly reduce the traffic jams. Amsterdam has its own virtual traffic manager which enables traffic to be managed almost automatically.
7. **Precision agriculture:** IoT has contributed significantly towards agriculture with various innovative farming methods. Various sensors which are capable of collecting vital information about environmental conditions like temperature, rainfall, humidity, nutrients in soil etc are integrated with the mobile apps and cloud platform. This data can be used to take informed decisions to improve the soil quality, increase the crop yield and reduce the effects of drought.

8. **Industrial internet:** The industrial internet is the integration of industrial and physical equipment with internet which gives rise to the idea of intelligent machines. These intelligent machines enable rapid manufacturing of products, monitoring and controlling various operations, improve quality of service etc.

IoT for education

The day is not far when the youngsters will be inseparable from their computers and mobile phones. Sooner or later, they will be considered as a single entity given the exponential growth witnessed by Internet of Things. This omnipresence of the technology has affected most of the areas of society in positive ways including education. The disruptive influence of the technology has changed the knowledge transfer model between teacher and students (Bagheri and Movahed, 2016). Abundance of data and the exponential growth in the development of new knowledge is forcing institutions to rethink about their teaching and learning process. But educational institutions are yet to incorporate the technology into learning actively (Ralhan, 2017). The potential of the IoT can be fully realized in the field of education only with the adoption of technology on a massive scale in the educational institutions. The digital revolution has caused the students to move away from paper textbooks towards e-books and online lectures. IoT has made e-learning commonplace making the educational experience more efficient (Mehta, 2017). IoT has improved the learning experience by making the study material available on mobile devices which is more engaging and interactive. It allows the students to go through the course at their own pace increasing the course completion rates and satisfaction among students (Peters). IoT can also

relieve the educational institutions from the space and time constraints and ensure the delivery of educational services anywhere and anytime (EduRoute World University). Physical libraries may soon be replaced by digital libraries.

The tech companies like SMART and IPEVO have introduced the interactive white board replacing the dusty chalkboards in the educational institutions. A mobile app called Bounce has been developed to bring the educational experience online. Radio Frequency Identification (RFID) equipped ID cards and GPS enabled systems have improved the security scenario in the institutions (Gupta, 2017). Some of the schools in California have already introduced ID cards with RFID chips to detect the presence of the students in the campus. The information collected through various analytical tools like SNAPP, Khan Academy, Open learning initiative, LOCO-Analyst etc help to have deeper insights into the learning process and different ways to improve it (Njeru, Omar, Paracha and Wannous, 2017).

Applications of IoT in education

1. **Improved Teaching/learning:** IoT can help the institutions to improve the teaching/learning experience by proving the optimal learning environment with customizable environmental variables like temperature, noise, humidity, brightness etc. IoT devices like fitness bands, GPS enabled tracking systems, e-books, tablets etc have dramatically improved the learning experience of the students. In Universitat Politecnica de Valencia, lecturers collect information about students using Google Glass and Sony Smart watches enabling them

to improve the learning efficiency of the students by providing personalized explanation to the students (Bagheri & Movahed, 2016).

2. **Health monitoring:** Wearable technology plays an important role in monitoring and preventing a range of health care issues. The wearable devices like fitness bands and smart watches can be used to monitor various body parameters like blood pressure, blood-sugar levels, ECG etc in non-invasive and non-obstructive manner (Marques, Ribeiro, Colunas & Cunha, 2011). The Oral Roberts University is using wearable devices to monitor the health and physical education progress for online students (Bagheri & Movahed, 2016). Fog computing may further improve the benefits of using IoT in healthcare (Bala & Chishti, 2017).
3. **Connecting learners worldwide:** Students can contact and meet their counterparts across the world through video conferencing. Digital scanners are used to transfer the text to smart phones. Interactive boards and digital highlighters are some of the latest devices being used in the field of education.
4. **Energy management and ecosystem monitoring:** IoT can be used to optimize the energy usage in the campus and a system similar to the smart grid can be used for this purpose. Intelligence can be imparted to the existing infrastructure with the help of sensors and actuators. Energy management project called "Comfort Sense" has been implemented in University of Turin which takes advantage of IoT technologies

to improve the building energy efficiency (Bagheri and Movahed, 2016). A school district in Pennsylvania also used IoT for energy monitoring and control program saving a fortune on energy.

5. **Advanced security measures:** IoT could provide a safe and secure environment in the universities and ensure controlled access to classrooms and laboratories. Digital wrist band and RFID ID cards can be used to track students, staff and visitors in the campus. Instant notifications and alerts in case of any suspicious activity can be generated, significantly improving the security and safety of educational institutions. GPS enabled buses make the journey to and from institution safer and can be tracked remotely.

CONCLUSION

Internet of Things has been billed as the most disruptive technology and is bound to revolutionize our lives. It can also play an important role in reshaping our education system. This paper includes applications of the Internet of Things, the potential of IoT in education system and how it can be used to improve our education system. Internet of Things has already been introduced in multiple educational institutions across the world reaping huge benefits like reduced cost, personalized learning, increased safety and more efficient research.

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