



## Application of Internet of Things (IoT) to Improve Learning, Work Activities and Security in Nigerian Tertiary Institutions

**Nwosu, John Nwachukwu PhD**  
Department of Computer Science  
Federal Polytechnic  
Oko, Anambra State, Nigeria  
**E-mail:** drnwachukwunwosu@gmail.com  
**Phone:** 08035902385

### ABSTRACT

We are in an era that is witnessing continuous increase of data in the Internet which can be harvested for many positive decisions in the education sector. This paper examined how Internet of Things (IoT) which involves integration, interconnection and interoperability of physical and virtual devices will improve learning, work activities and security in Nigerian higher institutions. The paper identified areas IoT will be utilized in higher institutions to include enabling management of institutions to analyse the way certain models are utilized, interactive learning, determination of each student's need, tracking of staff and students for security purposes, dissemination of important information to staff and students, establishing new form of attendance taking and providing deeper learning to students. The paper identified the challenges to IoT to include lack of adequate funds to higher institutions, lack of infrastructure, inability of different devices to interoperate with one another, lack of teachers who can effectively manage emerging technology and isolation of students. The paper concluded that IoT will greatly enhance activities in the education sector and recommends that management of educational institutions will increase funding for integration and interconnection of resources for effective IoT to be actualized.

**Keywords:** data harvest, interconnection, integration, interoperability, Internet of Things

### iSTEAMS Conference Proceedings Paper Citation Format

Nwosu, J. Nwachukwu (2018): Application of Internet of Things (IoT) To Improve Learning, Work Activities and Security in Nigerian Tertiary Institutions. Proceedings of the 14<sup>th</sup> iSTEAMS International Multidisciplinary Conference, AlHikmah University, Ilorin, Nigeria, Vol. 14, Pp 139-144

### 1. INTRODUCTION

The internet is greatly expanding in reach, usage and applications. The new trend however is on how to integrate the different areas such that there will be a global access to more resources. Whereas this trend is growing tremendously in areas such as industries and agriculture, it has not recorded much awareness and breakthrough in the education sector. Ravindra (2018) defined Internet of Things as a network of several devices which are attached with miscellaneous software, electronics, and network connectivity of distinct orientations aimed at exchanging and compiling of any kind of information. To Meha (2018), Internet of Things deals with connection of devices other than products like smartphones and computers to the web. According to ITU (2016), Internet of Things (IoT) is a global infrastructure for the information society enabling advanced services by interconnecting physical and virtual things based on existing and evolving interoperable information and communication technologies. Internet of Things (IoT) is a network of connected devices and other materials through the Internet that interact and share resources by sending and receiving data.

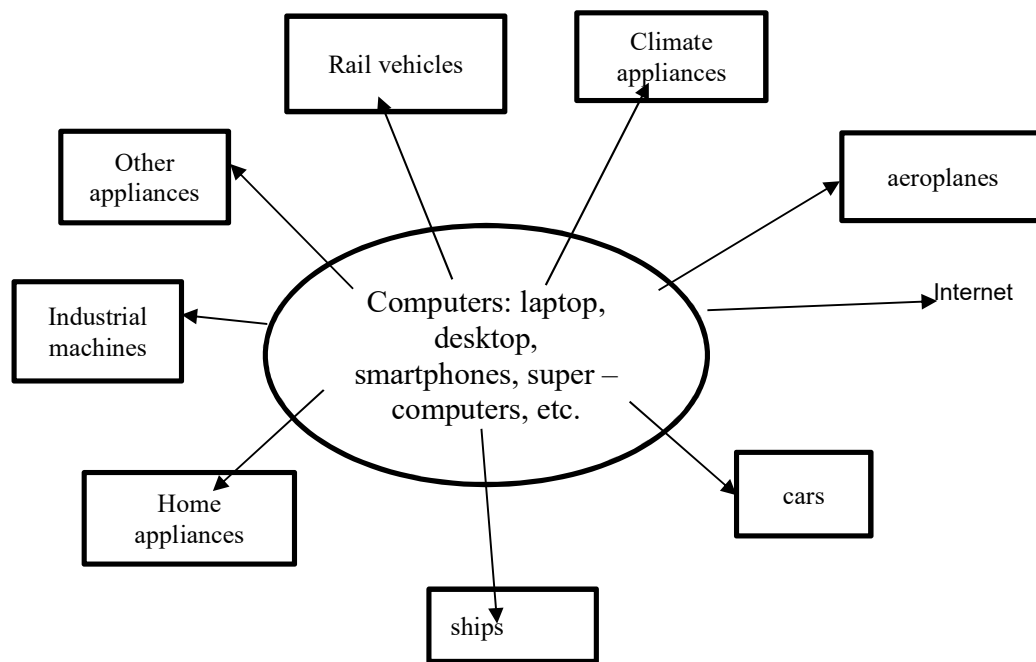
Panchel (2018) enumerated the five areas IOT will influence things in 2018 includes soaring in popularity of smart home devices, prominence of edge computing over cloud computing, healthcare, security and artificial intelligence. Roe (2018) averred that big companies like Microsoft were dedicating significant resources to building IOT incubators that would focus on enterprise, industry and smart cities. Bradley, Barbier & Handler (2018) wrote on the concept of internet of everything IOE as conceptualized by Cisco to include five main areas: asset utilization (reduced cost), employee productivity (greater labour efficiencies), supply chain and logistics (eliminating waste), customer experience (addition of more customer) and innovation (reducing time to market).

Roe (2018) also opined that advances in IOT-connected biotechnology will take healthcare to the next-level with around –the-clock monitoring, targeted treated, and even automated doses of medication. And in smart cities where the autonomous vehicles will eliminate car crashes caused by human error and intelligent enterprise will connect the global supply chain enabling proactive replenishment and predictive maintenance. The trend is overlapping into what is known as industrial internet of things (IIOT). Even though IIOT is simply sectionalizing IOT, yet the industries are getting more integrated with the education sector pervasively neglected. Peters, (2018) also enumerated the areas IOT have major presence to include home automation, smart living, energy saving and security. These assertions clearly suggest that research on the application of IOT in education is meagrely undertaken this paper therefore examine how IOT can be effectively utility in the education sector so as to holistically improve the sector.

## 2. CONCEPT OF INTERNET OF THINGS

Internet of things as a concept was coined by Kevin Aston in 1999 to describe the network connecting objects in the physical world to the Internet (Gabbai, 2015). The fundamental drive for IOT is propelled by the desire to adequately utilize the enormous resources that are available on the internet and the believe that integrating and interconnecting several computing devices will create more avenue to access and utilize resources which broadens data for decision making. Internet of things dwell on the premise that there is possibility of developing software structure that will interact and interoperate with sectors from physical devices.

Internet of things dwell on the premise that there is possibility of developing software system that will integrate and interoperate with sensors from physical devices. Already, the internet has amassed large chunk of data. This resulted from the successes recorded during digitization and conversion period. The period saw the conversion of several resources such as books, journals, films, videos, etc into a digital form that enables them to be transported via the internet. A diagrammatic representation of the concept of Internet of Things can be seen below:



**Fig. 1: Internet of Things (IoTs)**



There is already a cloud which involves using a network of remote servers hosted on the internet to store, manage and process data rather than a local server or a personal computer. Cloud computing allows enterprise to get this application up and running faster with improved manageability and less maintenance and it enables IT teams to adjust this resources to meet fluctuating and unpredictable demand (Banburajan, 2011). With cloud computing, companies don't need to pay for IT infrastructure as they are provided and maintained by the companies that own and provide the cloud infrastructure, rather companies for the consumption of resources. Such arrangement provides a good economics of scale for the cloud provider and the consumer. The availability of high-capacity networks, low-cost computers and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing has led to growth in cloud computing (Knorr, 2018).

Having achieved the feats, it become apparent that integration of non-computing devices into the internet will improve access to data and information. IOT integrates cloud computing, edge computing, fog computing and internet. The major components of IOT include computer systems, telecommunication equipment, and sensors from integrating machines, appropriate software and the Internet. Computer system include high powerful computer system, these could be ordinary computer systems like laptop, desktop, note pad, etc., complex systems such as super computers and smart phones. The concept of IOT entails building smart cities across the globe. These smart cities will communicate with smart phones.

Telecommunication equipment is any hardware used for telecommunication purposes. It includes a widespread of communication technology, from transmission lines and communication satellite to radio, answering machines, telecom toners, switches, routers, private branch exchange (PBX), voice over internet protocol (VOIP) equipment, base stations, LAN and WAN. The three different kind of telecommunication equipment public switching equipment (analogue and digital); transmission equipment-transmission lines, base transceiver stations, multiplexer, satellite, etc; and Customer premises equipment (private switches, modems, routers etc).

A sensor is a sophisticated device that is frequently used to detect and respond to electrical or optical signal. It converts physical parameters such as temperature, humidity, speed into a signal which can be measured electrically. There are different types of sensors, each is tailored to the physical devices that has it. Temperature sensors collect information about temperature from a source and converts it into a form that is understandable by other devices. Two basic types of temperature sensors are non-contact sensors that requires direct physical contact with object that is being sensed and non-contact sensors which does not require any physical contact with the object being sensed. While contact sensors are used in solids, liquid and gases, non-contact sensors are good for non-reflective solids and liquids, but not good for gases because of natural transparency. Examples of sensors that sense temperature include thermocouple, resistance temperature detectors (RTD), and thermistors.

Another type of sensor is infrared sensor (IR). Generally, every object emits thermal radiation which is sensed by IR sensors. IR sensor is effectively utilized in thermography, heating, spectroscopy, meteorology, photobiomodulation, climatology and communications. Another type of sensor is ultraviolet (UV) sensor. They measure the intensity of ultraviolet radiation of materials. They are applied in automobiles, robotics, printing industry and chemical industry. Then there is Touch sensor which acts as a variable resistor when placed at a location. They are applied in home appliances, transportation, industrial automation and consumer electronics.

Proximity sensor detects the presence of objects that are nearly placed without any point of contact. They are highly reliable since there is no contact between the sensor and sensed object. They are applied in shock detection, machine monitoring, vehicle dynamics and nuclear instrumentation. There is also advanced sensor technology which include bar-code identification, transponders, electronic identification of manufactured components, surface acoustic waves and optical character recognition. These different sensors when integrated with Internet and physical devices involved gives the concept of Internet of Things. The major essence of sensor is to connect a machine to the internet. These machines include industrial machineries, home appliances, farm tools, cars, rail vehicles, climate control and forecasting equipment, etc. Software is the collection of instruction that tell the computer what to do. At the lowest programming level is the machine language instruction which is supported by a processor – the Central Processing Unit (CPU) or Graphics Processing Unit (GPU). At the higher leve are instructions that are written in high level layers and protocols. Protocol defines how data are exchanged in the Internet. The several communication software are developed to enable data exchange among devices on the Internet. Special software are developed to interact with sensors and other communicating devices in the internet to obtain the goal envisaged for Internet of Things.



### 3. APPLICATION OF IOTS IN THE EDUCATION INDUSTRY

The impact of Internet of Things has not been enormously felt in the education industry as have been felt in other sectors, like the enterprise sector. Some of the benefits of Internet of Things in the education sector are:

#### **Enabling management to analyse the way certain models are utilized.**

Some schools are migrating from the conventional pen and paper to computer based testing (CBT). Advantages of computer based training according to Lim, Ong, Wilder-Smith & Seet (2014) include allowing teachers to make online changes to questions and answers before the commencement of examination, little chance of security risks as only the 'webmaster' in charge of the examination will have access to the paper and it minimized the risks of cheating. However, managers of schools can utilize IoTs to know how Computer Based Test is meeting its required objectives. From the result obtained, the management can know whether to continue with CBT or revert back to pen and paper.

#### **Interactive learning**

Several companies have invested and come out with devices that will improve learning through interactive processes. For instance, SMART is a company that has invested in IOT and came up with SMART board which is used for interactive learning. IPEVO also developed a wireless interactive board. These devices will enable students to interact effectively with the teacher and their fellow students on subject of discussion. Also, communication and discussion between teachers and students will be faster. For instance, a teacher can use digital pen to write something on the digital board and what is written is displayed smartphone no matter how far a student can be.

#### **Determination of each student's need**

The fundamental aim of teaching is to encourage learning. There are children who have challenges in the process of learning and need peculiar attention. Certain physical devices can be interconnected and used to analyse the student's problem. The result will enable the teacher to adjust his lesson plans.

#### **Tracking of staff and students for security purposes**

Security is a major challenge among the institutions of higher learning in developing countries like Nigeria. There are cases of kidnap of staff and students in some institutions in Nigeria. The crime cuts across kindergarten, primary, secondary and tertiary institutions in Nigeria. Identity cards of staff can be embedded with RFID chips which be used to track staff and students when the arises.

#### **Dissemination of important information from the management of a school**

With connected devices, students and teachers can be notified of important activities such as:

- ❖ when school bus arrives or takes off so as to enable them adjust their schedules
- ❖ time for lessons, practical, discussion period, etc.
- ❖ when there is need for emergency meeting of staff or students, or when the managers of a school want to address them.

#### **New form of attendance taking**

It is important for teachers to take attendance of his or her students. With special band attached on a wrist, each student can automatically send attendance information to a teacher to enable the teacher know the students who are present or those who are absent from school.

#### **Security**

Facial recognition can be installed around a school which will scan faces of people and search them in a database for matching and authentication. This will enable a school know and monitor movements of people around their premises.

#### **Providing deeper learning**

Connecting academics around the world will provide a deeper learning experience for students to gain knowledge (kalluri, 2017). Students can learn at their own pace. Also, students facing problems can be identified and appropriate mechanism for assisting such students effectively established. Khachenko (2018) posits that IOT in school can improve individualization, more opportunities to learn, engagement and results. It will enable students to look at real time data rather than focusing on textbook. For instance, students can practice natural language processing concept using Google voice recognition system. This real time practical approach will enable students to have easier understanding



of the concept of natural language processing. Such understanding can be extended to other areas such as weather forecast.

### **Challenges to effective utilization of IoTs in Education Sector**

Lack of adequate funds

Fund is a major factor in adjusting to the new emerging trend of Internet of Things. Fund is needed for infrastructural development, training and complete migration. Unfortunately, the fund that is appropriated to tertiary institutions in Nigeria is not enough.

#### **Lack of adequate infrastructure.**

Existing infrastructures in tertiary institutions in Nigeria are not adequate for realizing the potentials of Internet of Things. Most schools in Nigeria do not have adequate electricity supply with full energy load and adequate security ring network system for interconnection of Closed-Circuit Television (CCTV) cameras and other security devices.

#### **Inability of different devices to interoperate with one another.**

The concept of Internet of Things required that machines are integrated to Internet via their sensors. At times, there are instances of inability of devices to interoperate with other devices. Most of these machines are costly and the replacing them becomes uneasy.

#### **Lack of Enough teachers who can effectively manage the emerging technology**

The Internet of things involves integration of machines to the Internet. It requires software installations and new operational activities.

#### **Isolation of students**

The Internet of Things can lead to isolation of students. Students can be comfortable to operate from his or her room neglecting the benefits attached to socialization.

### **4. CONCLUSION**

Internet of Things (IoT) is an emerging technology which has made tremendous impact in the enterprise industry but its presence has not been felt effectively in the education sector. It has a lot of potentials which include enabling management of institutions to analyse the way certain models are utilized, interactive learning, determination of each student's need, tracking of staff and students for security purposes, dissemination of important information to staff and students, establishing new form of attendance taking and providing deeper learning to students. When these are effectively implemented in higher institutions in Nigeria, it will improve learning, work activities and security.

### **5. RECOMMENDATIONS**

1. Government should increase funds available to schools. Without enough funds, implementation of Internet of Things cannot be actualized.
2. Government should also ensure that infrastructures are properly provided to schools. Also, management of schools should make provision of infrastructure a priority in making their budgets.
3. Purchasing officers and those in charge of purchasing equipment would consider compatibility and interoperability as top considerations before making purchases. Equipment which are obsolete or cannot interconnect with other devices should be avoided.
4. Educators or teachers should be properly trained on the use of technology. Technology becomes useless if there are no competent hands to handle. Being an emerging concept, there is need for educators or teachers to be properly trained on how to utilize the huge potentials offered by Internet of Things. Teachers will be trained on how to manage some of the devices that are interconnected to the Internet.
5. Isolation of students  
Management of schools should ensure that students are encouraged to socialize among themselves within the campus. This is because isolation can lead to psychology problems.



## REFERENCES

1. Baburajara, R. (2018). The rising cloud storage market opportunity and strengths Vendors. <https://www.tmcast.com>. Retrieved 20/11/2018.
2. Bradley, J., Barbier, J. & Handler, D. (2018) Enhancing the internet of Everything to capture your share of 14.4 Trillion Share. [https://www. IOE-Economy.pdf](https://www.IOE-Economy.pdf). retrieved on 10/10/2018.
3. Gabbai, A. (2015). Kevin Ashton describes "Internet of Things". <https://www.smithsonianmag.com>. Retrieved 5/12/2018.
4. Gupta, P. (2017). Internet of Things (IOT) and its significance in education. <https://www.edtechreview.com>. Retrieved on 15/11/2018.
5. Kachim, R. (2017). The applications of Internet of Things in Education. <https://www.mse238blog.stanford.edu>. Retrieved on 15/11/2018.
6. Kharchenko, N. (2018). How Internet of Things could change education. <https://www.iotevolutionworld.com>. Retrieved 2/11.2018.
7. Knorr, E. (2018). What is cloud computing? Everything you need to know now. <https://www.inforworld.com>. Retrieved on 4/11/2018.
8. Kurzweil, D. (2016). The Internet of Things for Education and Learners. <https://www.educause.edu>. retrieved on 12/11/2018.
9. Lim, E. C., Ong, B. K., Wilder-Smith, E. P., & Seet, R. C. (2014). Computer based versus pen-and paper testing: students' perception. <https://www.researchgate.net>. retrieved on 12/11/2018.
10. Melita, R. (2018). Five ways Internet of Things is changing education and learning. <https://www.customerthink.com>. Retrieved 2/11/2018.
11. Panchal, J. (2018). Top 5 IOT trends to look forward to in 2018 <https://www.globalsign.com>. Retrieved on 8/11/2018.
12. Peters, J. (2018). What are the recent trends in IOT? <https://www.quora.com>. Retrieved on 19/10/2018.
13. Ravindra, S. (2018). Role of IOT in Education. <https://www.kdwidgets.com/2018/04/education.html>. Retrieved 2/11/2018.
14. Roe, D. (2018). 12 Emerging internet of things trends that will become mainstream in 2018 <https://www.conswire.com>. Retrieved on 8/11/2018.