Overview of Internet of Things Structure and Implementation Issues in Higher Education in Nigeria

Dickson Makasda Solomon[1],Amaka Charity Okoye[2]

[1]*Department of Computer Science National Institute for Nigerian Languages, Aba, Abia State, Nigeria.*
[2]*Department of Educational Foundation Prince AbubakarAudu University, Anyigba, Nigeria.*
[1]dicksonsolomon1988@gmail.com

Abstract: The Internet of Things (IoT) is being increasingly viewed as a pillar of modern development, having a wide range of potential applications in a variety of fields, including the education sector. Nigeria is an important case study for the effect of IoT implementation in higher education as it faces challenges, such as a lack of resources and infrastructure, which impede effective utilization of the latest technologies. This study aim to conduct a comprehensive review of the current IoT structure and the implementation issues for higher education in Nigeria.

Keywords: Structure, Implementation, Internet of Things.

Introduction

The Internet of things (IoT) is one of such technologies discovered by man in communication and information technology. In 1999, IoT was launched/ discovered as one of such devices founded in the area of information dissemination [1]. A member of Radio Frequency Identification Development Community (RFIDC) developed it to fast-track communication in the area of cloud computing and data analytics because of its fast rate of coverage especially in radio coverage. IoT could be classified into three major categories; IoT engaging people to people, IoT engaging people to things or machines and IoT involving things and machines to things or machines. All of these are various interacting devices involving IoT through the Internet mechanism. The most important features of IoT include artificial intelligence, connectivity, sensors, active engagement, and small device use, a brief review of these features is given below:

Artificial Intelligence: IoT essentially makes virtually anything “smart”, meaning it enhances every aspect of life with the power of data collection, artificial intelligence algorithms, and networks. This can mean something as simple as enhancing your refrigerator and cabinets to detect when milk and your favorite cereal run low, and to then place an order with your preferred grocer.

Connectivity: New enabling technologies for networking, and specifically IoT networking, mean networks are no longer exclusively tied to major providers. Networks can exist on a much smaller and cheaper scale while still being practical. IoT creates these small networks between its system devices.

Sensor: IoT loses its distinction without sensors. They act as defining instruments which transform IoT from a standard passive network of devices into an active system capable of real-world integration.

Active Engagement: Much of today's interaction with connected technology happens through passive engagement. IoT introduces a new paradigm for active content, product, or service engagement.

Small Devices: Devices, as predicted, have become smaller, cheaper, and more powerful over time. IoT exploits purpose-built small devices to deliver its precision, scalability, and versatility [2].

Firstly, this study highlights the various elements of an IoT structure and discusses the challenges associated with implementation issues of IoT for smart education in Nigeria higher education system.

Nigeria educational system is an important case study for the effect of IoT for smart education, implementation in higher education as it faces challenges, such as a lack of resources, infrastructure, inadequate training, limited access to digital resources, complex technologies and cultural challenges, which impede effective utilization of the latest technologies.IoT therefore, is one of such internet based technology developed to ameliorate the nagging challenges facing this critical sector.

The study evaluated IoT structure enabled higher education in Nigeria (IoTHEN). The study intended to review

i. Deliverables of IoT structure in relationship to higher education in Nigeria
ii. Practicality and challenges of implementing IoT in higher education Nigeria
iii. Potential prospects solution of implementation of IoT in higher education Nigeria

The study is restricted to review of structure of internet of things in higher education. It highlights the handshake IoT structure and implementation issues share with higher education in Nigeria.

This study will benefits organizations saddled with the management of higher educational system. The government through the Ministry of education would find this work useful as they would apply such theories as embedded system theory of skill and context to achieve desired successes in the sector. This skill emphasizes the need for one's skill in the context of circumstances.

Researchers and other students would also find it useful the research results. This would motivate studies and promote learning. Policy makers and other stakeholders in Nigeria interested in the IoT would design compactable curriculum for study in this area.

Research Methodology

The method adopted in this study was the incremental descriptive model (IDM)

Literature Review

This section highlights with critical evaluation scientifically connect to the research problem.

A.Embedded System Theory

[3]Proposed special purpose computer system which is designed to perform a small number of dedicated functions for a specific application. Embedded systems theory is concerned with all aspects of the system development including hardware and software engineering. Therefore, activities such as specification, design, implementation, validation, deployment and maintenance will all be involved in the development of an embedded application. A design of any system usually starts with ideas in people's mind. These ideas need to be captured in requirements specification documents that specify the basic functions and the desirable features of the system. The system design process then determines how these functions can be provided by the system components. For successful design, the system requirements have to be expressed and documented in a very clear way. Inevitably, there can be numerous ways in which the requirements for a simple system can be described.

Once the system requirements have been clearly defined and well documented, the first step in the design process is to design the overall system architecture. Architecture of a system basically represents an overview of the system components (i.e. sub-systems) and the interrelationships between these different components. Once the software architecture is identified, the process of implementing that architecture should take place. This can be achieved using a lower-level system representation such as an operating system or a scheduler. Most embedded systems involve several tasks that share the system resources and communicate with one another and/or the environment in which they operate. This theory is related to the current study because IoT is an embedded system.

B. IoT Structure Theory

[4] Proposed this theory of IoT structure. It claims that knowledge about the world has been an integral part of education, computer science and cognitive science. In the past, computer scientists (and logicians) could define the semantics of items in their knowledge representation models and methods for describing the world largely without an explicit connection to reality. However, as networked devices are not only aware of the world (they are able to perceive the world via sensors) but are also able to trigger change in the world via actuators, need to update previous theoretical foundations of data management and logical education that did not consider these new dynamic scenarios in which pieces of software perceive and act in the real world in an automated way. In the scenarios, surrounding the Internet of Things in particular, changes in the represented world immediately affect changes in the real world, and vice versa. The theory identified the following aspects to help provide theoretical foundations for the scenarios that emerged in the context of the Internet of Things, education and cyber-physical systems; inter-subjectivity between machines and humans: On the Internet of Things, education, machines should carry out tasks for humans. For that to work, humans need to be able to communicate with machines, and vice versa.

The symbol grounding problem comes into play when we consider the proverbial light bulb connected to the internet of things.

Dynamic Ontologies: Currently widely used knowledge representation education, such as the Web Ontology Language (OWL) are suited for representing how the world is, not how the world evolves. Emerging technologies try to combine these current knowledge representation education with the network protocols for communication used on the internet and the web, with varying degree of success. How can we represent dynamic knowledge (related to grammatical aspects) in a machine-interpretable way?

The goal is to survey the ideas and theories from philosophy to address use cases in the area of education and computer science. Specifically, want to find practical implications of choosing one theory over the other in the context of the Internet of Things for smart education.

C. Internet of Things Structure for Smart Education Implementation in Nigeria

Basically, this structure consists of 3 layers that are sensor layer; transport layer, application layer and the functions of these layers are below:

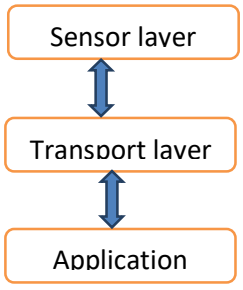

Figure1. IoT Structure (Source: study 2023).

1) *Sensor layer:* One of the challenges of the sensor layer is to obtain automated and real time transformations of the figures of actual world educational manufacturing into digital transformation or information which could be processed in virtual world through different or various means. The data that they collect are:

a. Sensor information: gateway, nodes, pressure etc.
b. Products information: name, model, price and features.
c. Working condition: operating parameters of different equipment's, apparatus etc.
d. Location information

The major challenge of Information layer is to mark diverse kinds of information or data and gathering the information and marked information in the actual world by means of techniques of sensing, after which remodels them for processing into digital information. This sensor layer includes some strategies- RFID tags, cameras, two dimension code labels, sensor networks.

2) *Transport layer:* This layer's task is to acquire and summarize the data of education acquired from the above layer for processing. It is believed as the nerve center of IoT. This layer includes the combination of telecommunication management center and also internet network, information centre, smart processing centers.

3) *Application layer:* The function of this layer is to analysis and process the information collected for the cultivation of digital awareness of actual world. It is considered as a fusion of IoT and educational market intelligence.

D. Implementation Issues for IoT in Higher Education

The challenges associated with the implementation of IoT in Nigerian's higher education system, focusing on

*Lack of Resources:*There is a lack of resources to implement smart education in higher education system is correct and usable in written IoT instruction. This is the situation whereby devices and tool for implementing IoT for smart education is not available in higher education system.

Inadequate Training: This is the situation whereby staff and lecturer are not adequately trained to handle or work with IoT devices and tools for smart education in Nigeria.

Limited access to digital resources: Today, there is inadequate access to digital resources for smart education in Nigeria due to high cost of IoT tools and skills for implementing smart education.

Complex technologies: IoT devices are dynamic in nature and change with aspiration of time. The objects for smart education change with time and current trend for new technology. These include speed, location monitoring and structure put in place by higher education system in Nigeria for smart education.

*Cultural challenges:*Cultural challenges also known as cultural difference can lead problem between team members, whereby their values and different styles or methods of doing things can be misinterpreted, misunderstood due to some cultural reason, if this is not resolved can lead to poor or inadequate implementation for smart education in Nigeria higher education system.

E. Potential Solutions

This study provides some potential solutions that can be implemented to address the current challenges. These suggestions include increasing funding and resources for digitalization, improving training and access to digital resources, and introducing new technologies that can be used for IoT implementation.

Increasing funding and resources for digitalization: There is a need for government and stakeholder in Nigeria higher education system should review budget for higher education upward for the purpose of achieving smart education and digitalization.

Improving training and access to digital resources: Training is a very important issues that need to be addressed before generally adopting and implementing smart education in higher education

in Nigeria, to enable the end users of the IoT devices to have adequate skills needed to do their work smoothly and smartly.

Introducing new technologies that can be used for IoT implementation: This is very importance for the organization saddle with responsibility of implementing smart education in Nigeria should take the issue of introducing new technologies for smart education very useful as they towards implementing IoT for smart education in Nigeria.

Conclusion

The study provides an overview of the current situation of IoT structure and implementation issues in higher education in Nigeria. It also suggests a range of solutions that can be implemented to address the challenges and proposes best practices to improve the effectiveness of IoT implementation in Nigerian higher education system for smart education.

References

[1] Point, O. (2016). Handbook on internet of things. Tutorialspoint.com.

[2] Marco, Z. (2016). Introduction to the internet of things. Telecommunications/ICT4D Lab The

Abdus Salam International Centre for Theoretical Physics Trieste.

[3] Mouaaz, H. & Ahmed. M. (2000). Embedded system theory. *Department of Electrical Engneering, College of Engineering and Islamic Architecture.* Https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119456735.ch18

[4] Michael, F. (1999).*Theory of internet of thing: Department of computer science.*Michael.faerber@cs.uni-freiburg.de