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REVIEW ARTICLE

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Combining Internet of Things and e-Learning Standards to Provide Pervasive Learning Experience

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ABSTRACT

(IoT) is the new technology developing in the recent years is quickly in the computing world. In Internet of Things, every day devices become smarter every day processing becomes intellectual day by day, and communication becomes very informative. This has transformed the way people interrelate and Internet of Things shaped a radical change in the field of education and has created new forms of communication between teachers and students. This lay concrete on the enhancement in the teaching and learning process and develop the perspective in which students learn. The incorporation of objects to the Internet leads to modernization that could assist the teaching-learning process. IoT provides more attractive learning atmosphere for students and more information about the learning process to aid teachers to augment their knowledge about the learning pace of their students and their learning complications. So, IoT and eLearning will have to be used to instruct more people in ICT as well as other domains.

Keywords: Internet of things, eLearning, ICT, Communication

I. INTRODUCTION

Internet of Things (IoT) is the arrangement of all kinds of things entrenched with sensors, electronics, software, and so on, connected to the Internet, based on the International Telecommunication Union's Global Standards Initiative [1, 2]. Internet of Things (IoT) is a element of the potential Internet which comprises of billions of sensor-based and actuator based smart devices, with data-processing capability [3]. According to the Gartner statement, over 26 billion of devices will have been associated to the Internet by the end of 2020 [4]. This paper will discuss utilities of IoT, architecture of IoT, six skills for IoT applications, IoT in eLearning and instructional design, Internet of Learning Things, IoT potentials to renovate education, and IoT to progress student performance.

II UTILITIES OF IoT

IoT may be categorized as the owner of key utility factors as below [5].

- Dynamic and self adapting: IoT devices and systems should have the capability to dynamically adapt with the varying contexts and take actions based on their functioning conditions, user's context, or sensed environment.
- Self-configuring: IoT devices may have self-configuring ability, allowing a large number of devices to work mutually to provide positive functionality. These devices have the facility to configure themselves in alliance with IoT infrastructure, setup the networking, and obtain latest software upgrades with smallest physical or user interference.
- Interoperable communication protocols: IoT devices may maintain a number of interoperable communication protocols and can communicate with other devices and also with the infrastructure.
- Unique identity: Each of IoT device has a unique identity and unique identifier such as IP address or URI. IoT systems may have intellectual interfaces which become accustomed based on the context, allow communicating with users and environmental contexts. IoT device interfaces let users to query the devices, observe their status, and manage them remotely, in association with the control, configuration and management infrastructure.
- Integrated into information network: IoT devices are typically integrated into the information network that permits them to communicate and exchange information with other devices and systems. IoT devices can be dynamically discovered in the network, by other devices and/or network, and have the potential to illustrate themselves to other devices or user applications.
- Context-awareness: Based on the sensed information about the physical and environmental parameters, the sensor nodes gain knowledge about the surrounding context. The decisions that the sensor nodes take thereafter are context-aware [6].
- Intelligent decision making capability: IoT multi-hop in nature. In a large area, this feature enhances the energy efficiency of the overall network, and hence, the network lifetime increases. Using this feature, multiple sensor nodes collaborate among themselves, and collectively take the final decision.

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III THE ARCHITECTURES OF IoT

The two IoT architectures are (i) 3–layer architecture and (ii) 5-layer architecture.

3.1 THE 3-LAYER ARCHITECTURE

This comprises of three layers which are called perception, network, and application. The principle of perception layer is to recognize each object in the IoT system. This is done by collecting information about every object. This layer have RFID tags, sensors, cameras, etc. The second layer is the network layer. The network layer is the hub of the IoT. It sends the data collected by the perception layer. It comprises the software and hardware instrumentations of internet network along with the management and information centers. The third layer is the application layer. The application layer's objective is to congregate between the IoT social needs and industrial technology [7].

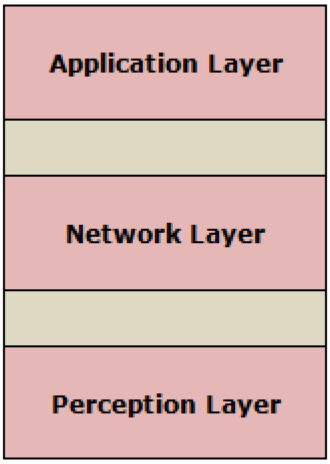

Fig 1: The IoT 3 – Layer Architecture

3.2 THE 5-LAYER ARCHITECTURE

The 3-layer architecture is not adequate due to the expected IoT development. Consequently, 5-layer architecture is proposed.

The primary layer is called business. The idea of this layer is to classify the IOT applications charge and management. It is also accountable for the user's privacy and all research associated to IOT applications. The second layer is called application. The objective of this layer is to resolve the types of applications, which will be used in the IoT. It also extend the IOT applications to be more intelligent, authenticated, and safe. The third layer is called processing. Its responsibility is to handle the information gathered by perception layer. The handling process comprises storing and analyzing. This layer utilizes method such as database software, cloud computing, ubiquitous computing, and intelligent processing in information processing and storing.

The fourth layer is called transport. It transmits and receives the information from the perception layer to the processing layer and vise versa. It contains many expertise such as infrared, Wi-Fi, and Bluetooth. IPV6 is used for addressing. The fifth layer is called perception. The objective of this layer is to define the physical meaning of each object in the IoT system such as locations and temperatures. It also gathers the information about each entity in the system and convert this data to signals. Technologies like RFID and the GPRS are adopted in the layer [8].

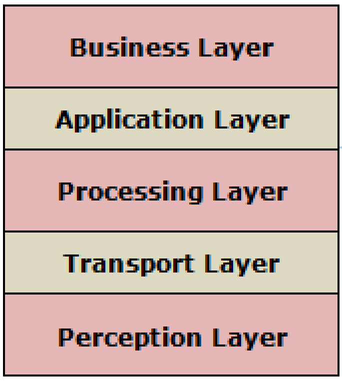

Fig2: The IoT 5 **– Layer Architecture**

IV. IoT IN ELEARNING AND INSTRUCTIONAL DESIGN

The article "IoT and e-Learning" [9] presented the potential ways to leverage IoT in eLearning. It also presented a good impact of the Internet of Things on eLearning. The activity tracker would send data about an employee's erroneous action back to the company's learning management system (LMS). The LMS then automatically assign a refresher course on safety procedures for that employee. It also stated that IoT can enhance eLearning in improving completion, reducing costs, and improving learning outcomes.

One of the most important part of eLearning is "Instructional Design" and IoT can definitely used in Instructional Design. The Internet of Things affect the instructional design in 1) Spatial information (place), 2) Temporal information (time), and 3) Persistence information (history). The three features of information should be used in instructional design to show the place and time of the student taking the course and compare with the historical data to select the most appropriate part of the learning to be done next, either in providing repeated learning of the previous topic or in proceeding to the next topic.

V. USEFUL E-LEARNING STANDARDS

5.1 IMS Learning Design (IMS-LD)

The IMS LD specification is developed by IMS GLC (IMS Global Learning Consortium) in 2003. It is the only available interoperability specification in the area of technology enhanced learning that allows the definition and orchestration of complex activity flows and resource environments in a multi-role setting . The IMS LD is based on the principle that considers a Learning process as a play metaphor [10]. Each person has a role and performs a set of activities. A method is the main element of an LD scenario. It helps coordinating the activities of each role. It consists of one or more play(s), acts and role-parts. A rolepart contains a reference to a role and a reference to a particular structured activity. An activity is either simple or composed. It has a learning or a supporting purpose.

5.2 IEEE Learning Object Metadata (IEEE LOM)

Learning Object Metadata [11] is an e-Learning standard published in 2002. It is considered as the most adopted content tagging specification. It is used for learning object annotation using metadata. LOM proposes classification of metadata elements into nine groups: General, lifecycle, metametadata, technical, educational, rights, etc. The advantages of adding metadata to learning objects aim to ensure interoperability and re-use of LOs, adaptability as well as sustainability.

VI. INTERNET OF LEARNING THINGS

The use of IoT in "learning" is called "Internet of Learning Things". From the article "Internet of Learning Things" [12], students and teachers would be taught to measure and share data – using new Internet of Things technology – in ways that help make learning fun, link directly to the curriculum, and ultimately inform the design of the next generation of schools". As an example of "Internet of Learning Things'', the Parrot AR.Drone2.0 enables students to survey an area using a mobile phone. HD video is shot and stored on a USB memory stick, or relayed directly back to the phone. In one package, Science (e.g. physics of flight); Technology (e.g. OS, networking, control); and Geography (e.g. surveys, observations) can be delivered, in a way that is completely engaging for children of all ages.

VII. IoT POTENTIALS TO RENOVATE EDUCATION

The article "Internet of Things in Education: The possibilities are numerous" [13], the author suggested four points to consider in using IoT to transform education. The first point is that "IoT will enable students to connect with teachers and access to full-time educational tools. It will also facilitate collaboration with teachers and other students. Parents can also have access to learning analytics through IoT". The second point is that "Schools are vulnerable places, with IoT possibly, we can reach a stage that with just the hit of a button a lockdown system can be initiated which can be used in case of an emergency. Moreover, the system can send alerts to the police, fire stations and hospitals to fasten the response in case of an emergency. Surveillance will become extremely easy with IoT. The third point is that "IoT can help schools streamline mundane operations such as attendance, fee alerts, and student reports which can be automated easily. It can also bring down energy costs. ". The fourth point is that "Children with special needs can also benefit from IoT. Specialized software can help students with specific problems. For example, it can recognize visually impaired or hearing impaired students and make changes accordingly such as increasing font size or more visual cues. It will also save valuable time of the teachers which can be used to enhance the teaching experience."

VIII. IoT CAN PROGRESS STUDENT PERFORMANCE

In the article "Interaction System Based on Internet of Things as Support for Education" [14], it was stated that IoT could provide motivation and could allow students to be playful. IoT also allows teachers to teach students according to their aptitude. Teachers can choose the basic materials to suit students. Students also learn at their own pace according to their capabilities, so they are not limited by a one-size-fits-all program. The authors of the said article conducted an experimental validation which yielded evidence that IoT could improve the student's learning outcomes.

IX THE COURSE STRUCTURE

The goal of the IoT pilot course is to introduce and educate students with a background in business informatics in using the hardware, operating systems, software, and tools for automation of smart environments. The course may consists of four units as shown in below figure 3.

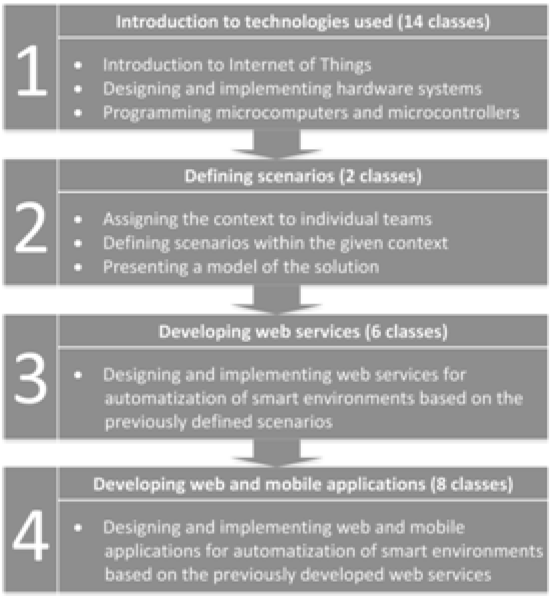

Fig3: The IoT Course Structure

X. CONCLUSION

Internet of Things (IoT) is the network of all kinds of things embedded with sensors, electronics, software, and so on, connected to the Internet, based on the International Telecommunication Union's Global Standards Initiative. The number of things in IoT will be 20.8 billion by 2020 and IoT spending will be 3,010 billion US$. IoT has also gained popularity in e-learning. This paper presented IoT in e-learning and instructional design, six skills for IoT applications, Internet of Learning Things, IoT potentials to transform education, and IoT to improve student performance.

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