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IoTs for Data Collection and Trends Prediction of Online Learning Courses

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Abstract: The rapid growth of educational data mining (EDM) is an emerging field in the academic world of research and studies focusing on collection, archiving, and analysis of data related to delivery methodology, quality of materials and student learning and assessment. The information analyzed informs the learning institution on how to improve learning experiences and how to run the institutional effectively. The people responsible for making decisions in the learning institution will able to make informed data-driven decisions. This paper explores the value of the Internet of Things (IoT) in capturing and mastering massive data for online courses to assess and identify typical learning scenarios for learners. We hope this would be a useful instrumental tool for the range of approaches in education institutions to help their struggling learners to succeed in the academic field.

Keywords: Internet of Things (IoT), ICT, Sensors, IoE, Big Data Mining, Data-Driven Decision Making, E-learning

1. Introduction

Education in the past was based on the traditional classroom method where the teachers/tutors had to collect data regularly on student performance via observations, classroom assessments and assignments [1]. Today the system of education has been transformed by the evolution of Internet, Information and Communication Technology (ICT), Internet of Things (IoT), new learning scenarios where e-learning environments are expanded from only virtual learning environments to both virtual and physical ones. The learning scenarios are pervasive where they allow mixed virtual and physical learning environments [2]. Internet of Things (IoT) is defined by ITU and IERC as a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual personalities, use intelligent interfaces and are seamlessly integrated into the information network [3, 4].

The smart classrooms integrated with smart things such as microphones, cameras, projectors, light monitor and other sensors can measure the concentration of the learner depending on the things they are being taught. With the help of the devices, the management of the classroom becomes easier to understand. Information is collected by the smart devices that will be mined, analyzed and report about the learner's environment and their contexts will be used to understand and optimize learning and its environment in which it occurs.

Academic institutions are adopting data-driven decision making collected from the real-time streamflow in sensors and other devices to guide a choice of decisions to help improve the success of students and institutions [1, 5]. The education institutions and educators are always researching new ways on how to maintain the connection with their students through engaging lesson plans, relevant discussions, fresh classroom projects, and new teaching methods. The IoT technology is transforming education through processes such as the flipped classroom, in which students watch lectures via live video feeds, recordings on YouTube or a similar venue at home, and discuss what they learned and engage in hands-on projects related to the lesson [6]. The education sector must understand how learners connect to the Internet in order to increase their learning and apply their knowledge as a result. The institutions are applying sensors to collect information on what the learner is doing, at what time, how long and later analyze the data to improve on their delivery of information.

The educational sector in Africa is facing a lot of challenges in implementing these applications that can help in data mining and analyzing. The sector is more dependent on the finances of the donors in developed countries [7]. The education sector still faces more challenges in collecting and analyzing data from various institutions on issues of privacy, safety, and security which are very rare in other disciplines.

In addition, the sector lacks the computational infrastructure, tools, and human capacity required for effective collection, cleaning, analysis, and distribution of large datasets [8]. The Internet of Things has enhanced e-Learning by reducing costs and improving learning outcomes. They provide new opportunities for the content designers and instructors for those interested in experimental learning. Through tests, they do take advantage of the new capabilities by developing pedagogical approaches that leverage the technologies emerging in environments [2, 9].

IoT has gained increased performance as a new technology-driven research approach in e-Learning. Teaching analytics that investigates data and information that instructors/tutors receive in a dynamic learning environment. The information collected and analyzed allows the instructors to have deeper insights into learning process to access new knowledge on how to provide feedback and guidance to learners.

2. Objectives

The study has the following major objective:

1. To determine whether the Internet of Things can collect and store the data of students interacting with the online courses.

3. Specific Objectives

1. To connect the smart objects in the institution's Local area network (LAN)
2. To create a database to store the collected data
3. To propose an architecture to implement for helping students with the required information

4. Expected Outcomes

1. Determine the contents the learners are interested in while interacting with the online learning management system (LMS)
2. Measure the impact of information provided by the smart objects in improving the contents provided on online courses
3. An architecture to integrate with an online learning management system

5. Related Works

The adaption of new technologies for learning has thrived in the emerging of the world of the Internet of Everything (IoE) as illustrated in figure 1-the networked connection of people, process, data, and things-which is becoming the basis for the Internet of Learning Things [9, 10]. Several researches have been carried in the field of E-Learning on how to improve the learner's performance academically and to sustain the institution's reputation on education. In the UK, eight schools participated to find out how the Internet of Things can enhance learning in science, technology, and Geography in a scheme worth $1.2M [11].

The teachers and students were taught how to measure and share data using IoTs technology in ways that that help make learning fun, link directly to the curriculum, and ultimately inform the design of the next generation of schools [10]. IoTs places big challenges to the educators and technology developers of the future to develop new ways to make sure that the new learning strategies based on their use are appropriate for students in the 21st century.

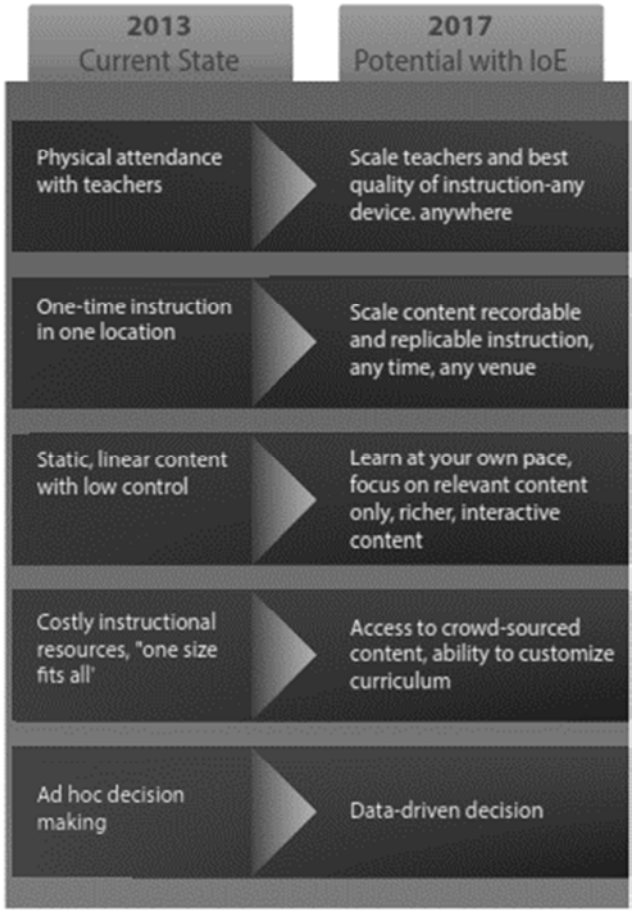

Figure 1. *Changes in instruction through IoE.(Source: "Connected Learning: IoE Value at Stake in the Public Economy, Cisco 2013).*

In healthcare, the IoT has been used to collect information about the patient remotely through wearable sensor devices. Sensors transmit the collected data to the server which has a medical application called WANDA (an end to end remote health monitoring and analytics system is presented for supervision of patients with high risk of heart failure) [12].

Higher educational institutions are also using drones (Parrot AR. Drone 2.0) 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[1]. Through use of the device the learner can maneuver all areas without risk his/her life in the most dangerous regions.

By the year 2017, the smart objects/devices will become ubiquitous in higher education as it's predicted by the 2013 Horizon Report. The technologies are user-friendly for example Twine and sensor kits already in the market to be [2] used extensively in K-12. The IoE in education has a 10-year net present value of US$175 billion, which will be delivered through streamlined and personalized instruction, and through the collection of data for making better decisions and reducing expenditure on instructional resources as predicted by Cisco.

6. Methodology

We aim to explore how smart objects can be connected to the online courses to enhance on collecting data and use of intelligent agents to analyze it and give feedback without human intervention. Our research methods are divided into three parts which include a) conducting a preliminary research study in order to understand students' online learning styles and attitude, b) designing an a system that will be able to be integrated to the online learning management system (LMS) using the results of the preliminary research study, c) developing a prototype of the educational learning system.

7. Proposed Solution

To implement our proposed solution we will establish a three-layer level connection within the learning institutions as illustrated in figure 2. The connection will be having a network of heterogeneous sensors that will be connected to the Online learning platform. The sensors will be collecting data that will be having a timestamp when the data was captured. The collected data will be transmitted to the data concentration center (Database System) through the HTTP protocol to send data back and forth between sensor devices and the central database system. The data is stamped with the time series for the accuracy, completeness and sorting it's in the storage area within the database system. Within the database system the data is organized and analyzed to look at the trends of the flow of the information. An algorithm developed in the database analysis's the data and produces customized reports for the management to help to make informed decision on what needs to be improved/changed for better learning of the institutions. In addition, customized feedback for the learners is also provided to avoid e delays in responding to the needs/ queries. some challenges. The major challenge is how to determine how many sensor devices to be connected and how the data will be stream either real-time or batch. The method selected should be able to provide value for the intended course of work being implemented by the higher learning institutions.

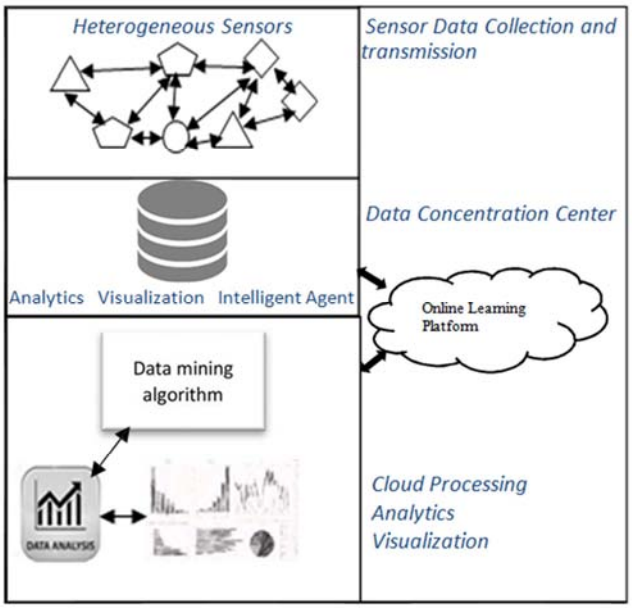

Figure 2. *Proposed solution Design.*

8. Conclusion and Future Work

In this paper, we aim to understand how to utilize the Internet of Things (IoT) to capture/collect the massive data and mastering it. In addition train the intelligent agent to master the huge data and how to give customized feedback to the users. The future work is to develop an algorithm that will be integrated in the IoTs devices to process the massive data that is being streamed across the devices. The application will be able to provide feedback without human intervention as it will be inbuilt with intelligent agents. The IoT paradigm brings new set of data collection and storage in education data mining. To capture the hidden treasure of knowledge from various heterogonous sensors is a challenging task that requires a lot resources. We are currently at the primary stage of this research study and a lot of work still remains that needs to implement in the future. The work presented in this article faces

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