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A Survey on Impact of IoT Enabled E – Learning Services

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***Abstract*—** Technical skills and knowledge gaining are taken care in today's learning scenario. Internet of Things (IoT) refers, to technological advancements in the networking with the help of which real-world entities can be connected to communicate with each other over the internet. In general, replacing the teacher or giving quick instruction is not the goal nowadays. To do so, academic institutes should investigate the future technologies that comes out. An IoTs enabled lecture hall, or Personal Computer is beyond question that is capable of serving custom-made training for learners with personal demands, connected with learning exposure, active evaluation, trouble-free right to take advantage mutually by both learners and teachers for the smooth progress of remote learning. From the managerial aspect the effectiveness and payback is also high. This paper, discuss about the study on impact and model of IoT based e-Learning system with technological advancements in the networking with the help of which real-world objects can be connected to communicate with each other over the internet and also conclude how machine learning algorithms enhance the performance of IoT enabled E-learning system.

***Keywords*—**IoT, applications of IoT, e-learning, IoT architecture, ubiquitous learning

I. INTRODUCTION

Some of the futuristic IoT artillery in education domain comprise of digital highlighters, smarter boards. It means the printed text could be digitally pass on to the smartphone or any other app at an unbelievable speed through tools similar to Scan marker and c-pen. Interactive boards can acquire recognize, and reciprocate data, make things easier and kindle the overall learning activity. Just visualize an outline where learner sitting in a classroom or in front of a PC at their home can interact with their friends, classmates, teachers, and educators scattered over the world. Now, let's suppose the lesson of the day has focused on sea life. To give students an especially exciting – and profoundly educational – experience, the mentor decides to access live information caused by sensors and live feeds monitoring a particular body of water. The IoT refers to a better vision whereby 'things' (objects) such as everyday objects (entity), places, and environments have interconnected with one another via the Internet. An example of a simple IoT object now available in some homes is a thermostat which can determine when people occupy certain rooms and alter levels of heating, lighting and other functions in the house accordingly. By widening the Internet from "a network of interconnected computers to a network of interconnected objects," the IoT will cover a vast and complex network of devices. These devices will add sensors to measure the data of environment around them, actuators which physically act back into their environment such as processors to handle, opening the door and store the massive data generated, nodes to send the information and organizers to help manage sets of these parts. Through this, it has the potential to significantly extend, enrich and even shift the relationship between people and the world around them. In fact, many are hoping that the IoT will play a pivotal role in addressing many of today's societal challenges such as an aging society, deforestation, traffic congestion and recyclability. This interconnection of physical objects is expected to magnify the profound consequences that large-scale networked connections are having on our organization, gradually resulting in a genuine paradigm shift [1]. In this paper, it has been review recent E-Learning-related literature associated with the IoT vision. One aim is to provide a resource for the E-learners to understand the current state of research associated with the new IoT agenda.

II. RELATED WORK

In this section, some of the earlier works on the subjects have cited. According to Cisco [2], the organizations have already experienced the Internet of Things (IoT) - the networked connection of things, soon some capabilities like context awareness, energy independence, and increased processing power are added to these things then IoT becomes IoE

(Internet of Everything). Also, according to their research, 99.4 percent of physical objects which can be a part of IoE is yet to be connected [3]. The whitepaper concludes by saying, "There is tremendous value in connecting the unconnected with intelligent networks across education. This paper demonstrates IoE's potential impact on making education more relevant, engaging and motivating learners, and enabling faster time to mastery. Neverthless to cognize the utility of joining mankind, processes, information and things with reliable network and uninterrupted access need to be guaranteed. More over for IoE to be acredited, both decisionmakers and instructors must be well-trained not only to work but also to realize possible risks. IoT will enable life-enhancing services, regarding the role of IoT in education say, "In education, mobile-enabled solutions will tailor the learning process to each student's needs, improving overall proficiency levels, while linking virtual and physical classrooms to make learning more convenient and accessible [4]. IoT might serve as the backbone for the universal learning environment and enable active smart environments to accept and identify objects and retrieve information from the internet to facilitate their adaptive functionality [5]. A learner may gain the knowledge not only by connecting to the learning contents via networks by using desktop computers or wireless handheld devices such as Personal Digital Assistants (PDAs) and mobile phones but also by communicating to the microprocessors (e.g., RFID – Radio Frequency Identification) embedded in devices." In the reference paper[R], two groups 25 students each were enrolled in a similar course. However, one group was taught using traditional methods and other using an interactive system of the internet of things. After conducting various tests and analysis, they concluded that "Internet of Objects, applied as a tool to support the teaching process, improves student academic performance".

III. IoT ENABLED APPLICATIONS

The following table 1 represents the related works done on the IoT enabled applications for different domains.

Table 1: *Related works done on the IoT enabled applications in different domains*

Authors	Title of the paper	Application	Description
Theodoridis, Evangelos, Georgios Mylonas, and Ioannis Chatzigiannakis [6]	Developing an iot smart city framework	Smart city	Monitor the parking places accessibility in the city.
Noel, Adam, et al [7]	Structural Health Monitoring using Wireless Sensor Networks: A Comprehensive Survey	Structural health	Monitor of ambience and objects conditions in buildings, bridges and historical monuments.
Majumder, AKM Jahangir A., et al [8]	A wireless IoT system towards gait detection in stroke patients	Smartphone Detection	Detect iPhone and Android devices and in general any device which works with WiFi or Bluetooth interfaces.
Ozger, Mustafa, Oktay Cetinkaya, and Ozgur B. Akan [9]	Energy Harvesting Cognitive Radio Networking for IoT-enabled Smart Grid	Electromagnetic Field Levels	Measurement of the energy radiated by cell stations and WiFi routers.
Jeyasheeli, P. Golda, and JV Johnson Selva [10]	An IOT design for smart lighting in green buildings based on environmental factors	Smart Lighting	Intelligent and weather adaptive lighting in street lights.
Keerthana, B., et al[11]	Internet of Bins: Trash Management in India	Waste Management	Detection of rubbish levels in containers to optimize the trash collection routes.
Shaikh, Faisal Karim, Sherali Zeadally, and Ernesto Exposito[12]	Enabling technologies for green internet of things	Forest Fire Detection	Monitoring of combustion gases and preemptive fire conditions to define alert zones.
Obara, Kazushige, et al[13]	A densely distributed high-sensitivity seismograph network in Japan	Earthquake Early Detection	Distributed control in specific places of tremors.
Weidhaas, Jennifer, Lian-Shin Lin, and Karen Buzby [14]	A case study for orphaned chemicals: 4-methylcyclohexane methanol (MCHM) and propylene glycol phenyl ether (PPH) in riverine sediment and water treatment processes.	Chemical leakage detection in rivers	Detect leakages and wastes of factories in rivers.
Gupta, Shikha	Automatic and Intelligent	Water Leakages	Detection of liquid presence outside

Pranesh, and Umesh Kumar Pandey [15]	Integrated System for Leakage Detection in Pipes for Water Distribution Network Using Internet of Things		tanks and pressure variations along pipes.
El-Din, Hemdan Ezz, and D. H. Manjaiah [16]	Internet of Nano Things and Industrial Internet of Things	M2M Applications	Machine auto-diagnosis and assets control.
Tsai, Yao-Te, et al [17]	Precise Positioning of Marketing and Behavior Intentions of Location-Based Mobile Commerce in the Internet of Things	Intelligent Shopping Applications	Acquiring notifications in the point of sale based on consumer practices, tastes, existence of susceptible elements for consumers or expiry dates.
Tao, Fei, et al [18]	Internet of Things in product life-cycle energy management	Smart Grid	Energy consumption monitoring and management.
Veeramanickam, M. R. M., and M. Mohanapriya [19]	IOT enabled Futurus Smart Campus with effective E-Learning: i-Campus	E-learning	In digital era our College campus need of IoT technology for classy environment to utilize effective E-learning.
Auer, Michael E., and Danilo G. Zutin, eds [20]	Online Engineering & Internet of Things: Proceedings of the 14th International Conference on Remote Engineering and Virtual Instrumentation REV 2017	Smart E-learning	IoT technology for classy environment to utilize effective E-learning

IV. THE IOT ENABLED E-LEARNING

E-learning is currently implemented using various techniques and technologies. Some technologies (Some of Listed in Table 1) have been specifically developed for the same while others can be used as successful E-learning tools. Some Technologies used in E-learning are:

Table 2: ***Related works done on IoT enabled E-Learning***

Authors	Title of the paper	Keywords	Description
Bystrova, T. Yu. Larionova, V. A. Osborne, M. Platonov, A. M. [21]	Introduction of open e-learning system as a factor of regional development	Information society Educational paradigm Regional development Lifelong learning E-learning Open e-learning Educational resources Massive open online course Nancial model Economic efect	The description is made of the cost options for open-type e-learning course development, investment parameters for their establishment, as well as costs of implementing educational programmes with the application of e-learning. The investigation of the tasks of Ural Federal University on e-learning application impart the possibility to further conceive the consequence from the launching of e-learning in other academic institutes.
Islam, Nurul, Martin Beer, and Frances Slack [22]	E-learning challenges faced by academics in higher education: a literature review	e-learning, higher education, academic challenges, e-learning in Middlesex Universit	This paper references some of the researc work on the limitations of e-learning technology, categorises it in five challenges that teachers are faced with and suggestions for a successful e-learning outcome. This literature reviw furthremore reviews the usefulness of e-learning techniques in Middlesex University and a

			few difficulties they face.
Kong, Siu Cheung, et al [23]	E-learning in School Education in the Coming 10 Years for Developing 21st Century Skills: Critical Research Issues and Policy Implications	E-Learning, School education, 21 st century skils, Research issues, Policy implications	This paper aims to discuss the research issues and policy implications critical for achieving such a curriculum goal. A review of literature in the related fields indicates that K-12 schools should take advantage of e-learning to maximize learning opportunities of learners for the development of 21st century skills.
Charmonman, Srisakdi, et al [24]	e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning	Educational paradigm Regional development Lifelong learning E-learning Open e-learning	e-Learning and the Science of Instruction is the ultimate handbook for evidence-based e-learning design. Since the first edition of this book, e-learning has grown to account for at least 40% of all training delivery media. However, digital courses often fail to reach their potential for learning effectiveness and efficiency.
Charmonman, Srisakdi, et al [25]	Applications of Internet of Things in E-Learning	Internet of Things, IoT in eLearning, IoT and instructional design, IoT and training, Skills for IoT, Internet of	This paper will discuss IoT in eLearning and instructional design, training employees on IoT technology, six skills for IoT applications, Internet of
		Learning Things, IoT to transform education, IoT to improve student performance	Learning Things, IoT potentials to transform education, and IoT to improve student performance

V. MACHINE LEARNING ALGORITHMS IN IOT

The following table 3 depicts the related works done in IoT by using Machine Learning algorithms.

Table 3: ***Related Works done on IoT using Machine Learning algorithms***

Authors	Title of the paper	Keywords	Description
Zou, Han, et al [26]	A fast and precise indoor localization algorithm based on an online sequential extreme learning machine	Biomedical monitoring, Biomedical monitoring, Sensors, Medical services, Smart homes, Logic gates, Assisted living, Ambient networks, Internet of things	This article differs from seamlessly linking multimodel data-collecting infrastructure and data analytics together in an AAL platform. This article also outlines a multimodality sensor platform with heterogeneous network connectivity, which is under development in the sensor platform for healthcare in a residential environment (SPHERE) Interdisciplinary Research Collaboration (IRC).
Lane, Nicholas D., et al [27]	An early resource characterization of deep learning on wearables, smartphones and internet-of-things devices	behavior and ambient context, IoT, Deep Learning, smartphones, wearable systems.	The aim of this investigation is to begin to build knowledge of the performance characteristics, resource requirements and the execution bottlenecks for deep learning

			models when being used to recognize categories of behavior and context.
Zou, Han, et al [28]	An online sequential extreme learning machine approach to WiFi based indoor positioning	IEEE 802.11 Standards, Calibration, Training, Accuracy, Testing, Mathematical model, Heuristic algorithms	A location algorithm based online sequential extreme learning machine (OS-ELM) to address the problems such as intensive costs on manpower, time for offline site survey and the inflexibility to environmental dynamics
Alsheikh, Mohamma d Abu, et al [29]	Machine learning in wireless sensor networks: Algorithms, strategies, and applications	Wireless sensor networks, Routing, Machine learning algorithms, Clustering algorithms, Algorithm design and analysis, Principal component analysis, Classification algorithms	An extensive literature review over the period 2002-2013 of machine learning methods that were used to address common issues in WSNs. The benefits and drawbacks of each suggested algorithm are assessed against the related issues like modest means of the web also the novelty of learning patterns that will provide solutions to the afore said issues.
Lane, Nicholas D., et al [30]	A large-scale web QoS prediction scheme for the Industrial Internet of Things based on a kernel machine learning algorithm	Kernel least mean square Quality of services (QoS) QoS prediction Pearson correlation coefficient (PCC) Industrial Internet of Things (IIoT)	Apply the derived coefficients for the prediction of missing web service QoS values. An extensive performance study based on a public data set is conducted to verify the prediction accuracy of our proposed scheme

VI. CONCLUSION

Internet of Things (IoT) by now distribute connectivity to a wide range of devices, enabling the progress of novel services and applications. In the field of education domain, IoT will carry E-learning to the next level. This paper elucidate the related works carried out on the implementation of IoT in different fields and the applications that make use of IoT and the comprehensive depiction of the work done on IoT based E-Learning system and the IoT using Machine Learning algorithms. In the future, this IoT based E-learning can leverage the power of IoT to implement a smart learning environment that facilitates better learning and higher retention rates. This advancement in education to fabricate enhanced folks with proficiency and know-how.

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