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Internet of things(IOT) in education: Opportunities and Challenges

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Abstract—Nowadays, the Internet has become an indispensable part of life, Internet of Things (IoT) devices are growing rapidly in many aspects by allowing the connection and remote control of a network infrastructure that makes human life more convenient and easier. The trend of IoT in education has started to prevail, which leads to the need to design suitable educational activities. A widely adopted educational model that responds to this demand is the STEAM education model. The Internet of Things (IoT) has the potential to transform education by profoundly changing the way schools, colleges, and universities collect data, interface with users, and automate processes. IoT refers to the networking of physical objects through the use of embedded sensors, actuators, and other devices that can collect and transmit information about campus activity in real time. When IoT is combined with technologies such as user mobility and data analytics, it brings a new paradigm to education. This research aims to gather evidence and document the Internet of Things (IoT) in education and the main aim is to elaborate on the opportunities and challenges of IoT in education.

Keywords—IoT, education, challenges, opportunities, technology.

I. INTRODUCTION

The launch of global 5G has brought new driving forces to the Internet of Things (IoT) industry, and countries around the world have already adopted IoT as their national strategic industry. The Internet of Things (IoT) is a technology that enables objects to connect to each other using the Internet, in order to offer the collection and transfer of data without the need for human intervention. This technology allows objects connected to the Internet to exchange information and be controlled remotely. The spread of IoT nowadays has risen to a high intensity, penetrating everywhere such as cities, homes, universities, factories, organizations and other places. This technology has brought many benefits in daily life by providing smart services anytime and anywhere. These changes in people have changed the way of life, making it easier and more efficient [1]. The innovation of IoT technology has fueled the growth of the social economy and is having a transformative impact on society. In the final analysis, the competition of IoT technology among countries is the competition of technological innovation talents [2] Therefore, universities around the world have begun to build new IoT engineering degrees and explore teaching new curricula. Affected by the reform of engineering education, researchers from various countries have focused on engineering practice for the IoT engineering branch and developed various forms of curriculum design. Many teachers still use the past experiment teaching model of imitation in the creative course. The teaching process lacks innovation and design, which is not suitable for cultivating the student's innovative spirit and creativity [3]. Therefore, the advantages of applying innovative courses in engineering education are reflected in open innovation, exploration experience and allow students learn practical skills in the product manufacturing process. The disadvantage of this method is that it pays attention to the production of products in practice and ignores the teaching of theoretical knowledge and lacks a useful teaching model. From the perspective of interdisciplinary innovation, "Engineering(E)"in science, technology, engineering and mathematics (STEAM) is a "bridge" that connects the knowledge of scientific, mathematical and technical disciplines. The integration of STEAM education and creative education will comprehensively promote the cultivation of students 'innovative ability and high-level thinking ability, and compensate for the lack of theoretical knowledge learning in the creative course [4]. This research will examine the use of the Internet of Things (IoT) in education. The focus of this research is on the opportunities and challenges of IoT in education.

II. LITERATURE REVIEW

According to [5] IoT is not a specific industry, but a new stage of intelligence and information development. IoT includes every field in the science and technology system, and its technologies cover most subjects. It is a challenge for schools and universities to assign the IoT major to undergraduate students. The term "Internet of Things" (IoT) according to [6] has recently become popular to emphasize the vision of a global infrastructure that connects physical objects/things, using the same Internet Protocol, allowing them to communicate and exchange information.

According to [7] the term "IoT" was coined by Kevin Ashton in 1999 to refer to "uniquely identifiable

objects/things and their virtual representations in an Internet-like structure". According to the analytics firm [8], 8.4 billion "things" were connected to the Internet in 2017, excluding laptops, computers, tablets and mobile phones. This number is set to grow to reach 20.4 billion deployed IoT devices by 2020[7]. In 2020, the number of IoT devices continued to grow along with mobile IoT, which now operated on 2G, 3G, 4G and 5G as well as in LoRaWAN and the long-term evolution for machines, or LTE-M. Various IoT architectures have been proposed by researchers. For the Internet of Things (the merging of the physical world and the information world), [9] proposed an autonomy-oriented architecture for the IoT; and [10] described a practical realization of an IoT architecture at the University of Padua. For the Internet of Service (connecting the physical world and the Internet to provide services to things) [11] proposed a system architecture for the Web of Things; and [12] provided an implementation of the Web of Things vision. For the Internet of Brain Computing (cyberworld meets brain computing). IoT is also being used for more pragmatic scenarios in education. For example, an IoT-based system aimed at increasing children's knowledge of agricultural food production and consumption was proposed. Other studies on deploying IoT to educate students with special needs exists according to [6] for children with autism spectrum disorders.

III. PROBLEM STATEMENT

This research aims to gather evidence and document the Internet of Things (IoT) in education. Impact and application of IoT in education, opportunities, challenges etc. The results of this research are expected to be knowledge about IoT technology in education as well as the possibilities of future application of this technology. The main aim is to elaborate on the opportunities and challenges of IoT in education. The problems that bring us to this research are:
• Lack of knowledge regarding IoT technology.
• What impact does and will the application of IoT technology in education have?
• What are the possibilities?
• The main challenges of applying IoT technology.

IV. IOT - THEORETICAL BACKGROUND

The IOT concept was created by a member of the Radio Frequency Identification (RFID) development community in 1999 and has recently become more relevant to the practical world mainly due to the growth of mobile devices, integrated communication and ubiquitous, iCloud computer and data [3]. Imagine a world where billions of objects can sense, communicate and share information, all interconnected through public or private Internet Protocol (IP) networks. These interconnected facilities have data regularly collected, analyzed and used to initiate action, providing a wealth of intelligence for planning, management and decision making.

This is the world of the Internet of Things (IOT). The common definition of Internet of Things is defined as: Internet of Things (IOT) is a network of physical objects. The Internet is not just a network of computers, but it has evolved into a network of devices of all types and sizes, vehicles, smartphones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all of connected, all communication and information exchange based on defined protocols to achieve intelligent rerouting, positioning, tracking, security and control and even real-time online personal monitoring, online improvement, control and process administration[13] .
We define IoT in three categories as follows: The Internet of Things is an Internet of three things: (1). People with people, (2) People with car/things, (3) Things/cars to things/cars, Internet interaction.
Internet of Things Vision: The Internet of Things (IoT) is a concept and a paradigm that considers the pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and collaborate with other things/objects to create new applications/services and achieve common goals. In this context, the challenges of research and development to create a smart world are great. A world where the real, digital and virtual are converging to create intelligent environments that make energy, transport, cities and many other areas smarter. [13].

Figure 1. Internet of things (IoT) [13]

The Internet of Things refers to the general idea of things, especially everyday objects, that are readable, detectable, localized, addressable through information sensing equipment, and/or controllable via the Internet, regardless of the means of communication (either via RFID, wireless LAN, wide area networks, or other means). Everyday objects include not only the electronic devices we encounter or the products of the highest technological development such as vehicles and appliances, but things we do not usually think of as electronic at all - such as food, clothing, chairs, animals, trees, water, etc. [14]

A. Technologies Enabling IoT

The Internet of Things (IoT) is a global infrastructure for the information society, enabling advanced services by

connecting things (physical and virtual) based on existing and emerging interoperable information technologies and communication. With the Internet of Things, communication via the Internet extends to all the things that surround us. The Internet of Things is much more than machine-to-machine communication, wireless sensor networks, sensor networks, 2G/3G/4G, GSM, GPRS, RFID, WI-FI, GPS, microcontrollers, microprocessors, etc. These are considered as the technological possibilities that make possible the applications of "Internet of Things" [13]. The technologies that enable the Internet of Things are considered and can be grouped into three categories: (1) technologies that enable "things" to receive contextual information, (2) technologies that enable "things" to process contextual information, and (3) technologies to improve security and privacy. In this context, it is possible to scale the level of diversity to a number of manageable connectivity technologies that address the needs of IoT applications, adopted by the market, they are already proven to be usable, supported by a strong technology alliance. Examples of standards in these categories include wired and wireless technologies such as Ethernet, WI-FI, Bluetooth, ZigBee, GSM and GPRS [14].

B. Characteristics and structure of IoT

More broadly about the structure of IoT are presented the following technologies which influenced the development and innovation of IoT.

• Network connectivity- Network technologies enable the communication of objects in different locations, there are a large number of network technologies used for different purposes depending on the application, eg: Personal Area Networks (PANs)

• Systems of embedded - Today one of the big challenges is also in embedded systems which in a system (computers) are equipped with processors, memory, peripheral devices, etc.

• Sensors and actuators - Sensors are technical components which are used to measure the quality or the amount of any physical or chemical property such as: temperature, speed, etc.

• Cloud Computing - Cloud Computing is a technology in which software, hardware, and other services are provided as a set of virtualized resources on a network, primarily the Internet.

• Increased data quality - Increased data quality improves business processes and models, providing better data quality provides better decision-making in various processes.

• New markets - A computerized world can open the door to innovations that help things and people interact, according to studies in 2025, IoT will have an economic impact of 11 trillion dollars per year [15]. To make the IoT concept clearer and more understandable, Figure 2 is presented, which describes the IoT structure in detail.
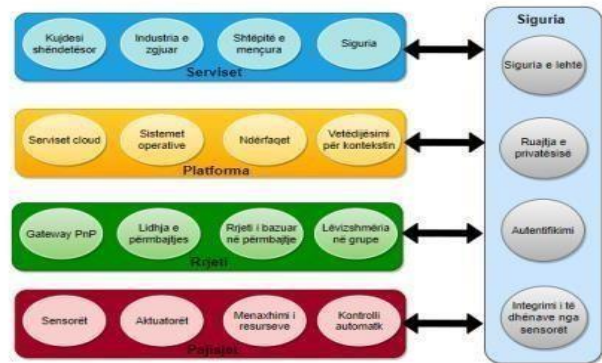

Figure 2. Structure of Iot **[16].**

From Figure 2 we understand that IoT consists of four layers which are: Service Layer (service layer), Platform Layer (platform layer), Network Layer (network layer) and Device Layer (device layer).

C. The application of IoT in various fields

Internet of things as a special field of great importance of the XXI century has entered our lives and is increasingly managing life processes. IoT is considered an ecosystem that contains intelligent objects equipped with sensors, networking, and various technology processes that all together provide an intelligent environment to end users. We all now know the impact of IoT, but to have a better 'view' about its application, Figure 3 is presented which shows the application of IoT in different spheres [17].
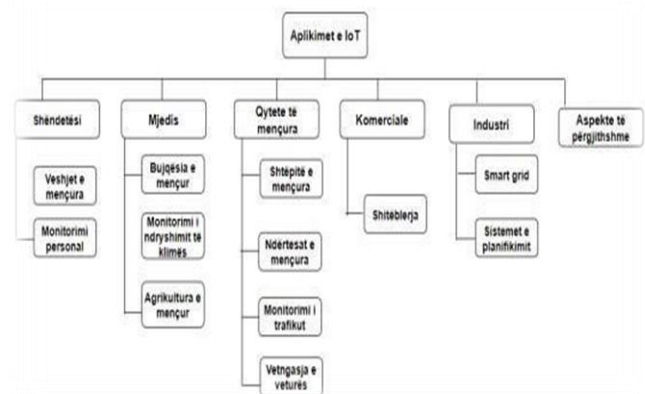

Figure 3. IoT application structure in different fields

Today IoT has wide applications which are quite useful to people. The fields in which IoT is applied, in addition to those mentioned above in Figure 4, are presented below.

The IoT application covers "smart" environments/spaces in areas such as: transportation, buildings, city, lifestyle, retail, agriculture, factory, supply chain, emergency, healthcare, user interaction, culture and tourism, environment, energy.
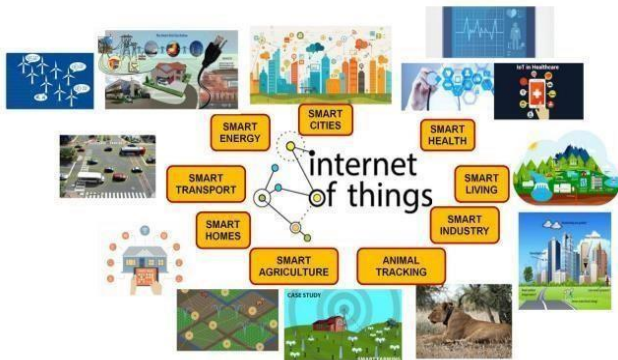

Figure 4. Application of IoT in different fields [13]

V. APPLICATION OF IOT IN EDUCATION

Education has changed from a knowledge transfer model to an active self-directed collaborative model due to the impact of technology in today's educational institutions. This has forced many institutions to rethink teaching and learning. The impact of technology can be seen in many aspects of education from engaging students in learning and content creation to helping teachers deliver personalized content and improve student outcomes. There are currently seven categories of technologies, tools and strategies that drive innovation in education:

1. Consumer Technologies,
2. Digital Strategies,
3. Enabling Technologies,
4. Internet technologies,
5. Learning Technologies,
6. Social Media Technologies and
7. Visualization Technologies

IoT is a subcategory of Internet technology that supports education in many ways. IoT solutions enable educational institutions to collect a large amount of data from sensors and devices which perform meaningful actions based on this data. Such systems allow the student to explore an environment using built-in sensors, QR codes, and other technologies. With IoT devices, teachers and administrators can collect data about a student's learning style, progress, and areas of difficulty. It is an interesting and innovative field in education that can help improve teaching and learning. A smart classroom can be defined as an intelligent environment equipped with various types of hardware and software modules. Video projectors, cameras, sensors, and facial recognition algorithms are examples of modules that monitor various parameters of the physical environment or student attributes such as concentration, performance, and achievement [18].

A. Benefits of IoT in Education

The biggest benefits of IoT in education is the personalized and unique interaction with the student. It helps the student not only get personal recommendations and academic topics, but also can solve learning issues when they are in academic difficulties by sending alerts to the administrators. Internet of Things (IoT) has brought great changes in the field of education and has provided many benefits to students, teachers and institutes Improving teaching and learning. IoT is in many universities in the form of "police cameras, temperature controls and

access to buildings, lights, energy". Intelligent objects can to be used in classes for him improved teaching and students. According to the current application of IoT in education, we will categorize the ways in which the benefits of IoT in education they are divided into four groups and discuss how the new platform can shape smart education for the next generation [18].

- The Management of Energize in University and Eco-Monitoring System
- Secure login control University and in the classroom
- Health monitoring students
- Improving teaching and learning.

VI. AVANTAGES AND DISAVANTAGES OF IOT IN EDUCATION

It is not logical nor will it be fair to compare traditional education with education in the Internet of Things environment, as education has not directly transitioned from classroom education to IoT education. Education has developed along with the development of technology gradually. One of the most important advantages of online education is access to the place of education from anywhere, in addition to the lack of cost. On the other hand, online education is perceived as the result of depriving students of social life at the university and the lack of direct orientation (face to face) as well as the non-preference for applied studies. With the development of IoT, education tried to take advantage of this development. Now, the educational environment has been able to take advantage of all the social media to compensate for the lack of social life. Students can get to know each other better, share their interests and build a social life on these social media as well as in real life [19].

The great benefit that has been the main reason for the development of education in the IoT environment is the possibility of using this technology to develop online applied education. The main advantage of IoT in educational institutions is the ability to collect and analyze

educational data. By connecting physical objects such as sensors and cameras, educational institutions can collect more comprehensive data on student performance as well as the effectiveness of their teaching methods. This data can be used to identify areas of improvement and optimize learning strategies. One of the most significant advantages of IoT in education is the ability to improve the learning experience for students.

IoT devices can collect and analyze data on student performance, allowing educators to customize learning plans and provide targeted support. Using IoT in education can help students develop technical skills, such as programming, data analysis and project management, that are important in the world of information and communication technology. Another advantage of IoT in education is the potential for increased collaboration between students, teachers and parents. IoT devices can facilitate communication and information sharing, making it easier for all parties to stay informed and engaged in the learning process. IoT also allows for increased automation of processes. For example, sensors and cameras can be used to monitor student attendance and alert administrators when a student is absent. Automated systems can also be used to manage classrooms and control access to resources. This makes it easier for teachers to manage their classrooms and for administrators to monitor student activities. In addition, IoT enables better communication between teachers, students and administrators. Through connected devices, teachers and students can communicate with each other in real time, allowing for more efficient collaboration and information exchange [20].

IoT is a great use for higher education. It has overcome the disadvantages of online education; moreover, it strengthens the advantages. The future will bring new developments every day, which can be useful for education; however, the most important point to conclude here is that we should use it in the right way. Understanding IoT with its advantages and disadvantages will bring its true vision and this is where we can benefit from it very well. IOT and advancement in technology can reduce barriers to technology adoption and increase its rate in higher education. IoT removes traditional barriers to teaching and learning and creates powerful, hybrid learning environments using smart devices, also allowing students to connect with experts from around the world, also developing social educational software within an IoT context in the future [19].

However, the disadvantages of IoT in education we can also mention some possible obstacles to consider when implementing IoT in educational institutions. For example, increased use of technology can lead to privacy issues as student data is collected and stored. Furthermore, the cost of IoT implementation can be a deterrent for many schools and universities in integrating IoT devices and systems especially for schools with limited budgets [20].

The use of IoT in education can create a huge dependence on technology, making students dependent on devices and internet connection to learn and to complete their tasks and if the use of IoT is not well planned and appropriate, it may happen that students revert to a passive learning, relying only on the information provided by the devices, instead of developing critical and analytical skills.

VII. CONCLUSIONS

In conclusion, technology has brought about changes in society at a dizzying pace. This has contributed to the challenge of the education system to immerse itself in new intelligent devices that have exploded in institutions, bringing a change in the way we have understood teaching until now. This paper will present the basic concepts in the technology called Internet of Things, the opportunities and challenges of IoT in education. In summary, this paper reorganizes the IoT architecture, based on which a dimension model is proposed to classify the complex IoT technologies, and a layer model is built for system presentation. After analyzing relevant issues on industry and education, we come to the conclusion that IoT is not a specific industry, but a new stage of intelligence and informatization development. IoT includes every field in the science and technology system and its technologies cover most subjects. From this work we can understand that this technology is quite innovative which is being used all over the world every day and more. The use of IoT is wide in many different fields, one of the fields in which it is applied is also in education. To better understand the operation of IoT in education we have described the potential benefits of IoT in education, then explained the opportunities and challenges of IoT in education. The main qualities that may pose a challenge for IoT in education are shown: security, scalability and humanization. In the rest of the paper, the advantages and disadvantages of IoT in education are explained. From the obtained results, it can be concluded that the implementation of IoT in education is still in its early stages, but it is shaping up to transform education and support the learning process, creating a multitude of opportunities for teachers, students and others.

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