Using Internet of Things Technology to Improve the Quality of University Education

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Abstract:

The term Internet of Things (IOT) has become one of the most familiar and popular expressions in recent times, due to the solutions, it offers in classroom management and easy access information which can contribute to ensure the quality of education by applying IOT technology, the education process can be better. The truth is that educational institutions need to develop educational technologies and performance evaluation methods through which the educational process becomes significantly more efficient and fruitful, and the continuous development of this sector, as programmatic accreditation in academic circles is a major tool for improving the quality of education, and also ensures the achievement of standards, which gives the academic university confidence in the existence of a strong accreditation system that meets the requirements. In this regard, the researcher conducted descriptive research to identify aspects of the Internet of Things and how to apply them to support some indicators that can achieve the standards of educational programs within the accreditation program. In this context, the advantages of IOT applications will be applied to bring about fundamental changes in educational programs and their quality. The research discusses the most important safety points that can be used to avoid risks and confront the challenges that limit the use of such technology. In general, this work is directed to develop the educational process, ensuring quality, and maintaining continuous improvement.

Keywords: *Internet of Things (IOT), quality of education, e-learning, Smart Educational Institutions.*

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استخدام تقنية تكنولوجيا إنترنت الأشياء لتحسين جودة التعليم الجامعي

الملخص:

أصبح مصطلح إنترنت الأشياء (IOT) أحد أكثر التعابير رواجاً وشيوعاً في الآونة الأخيرة، نظراً لما يقدمه من حلول في إدارة الفصول الدراسية وسهولة الوصول إلى المعلومات، مما يمكن أن يساهم في ضمان جودة التعليم، فمن خلال تطبيق تكنولوجيا IOT، يمكن أن تكون العملية التعليمية أفضل وأيسر. والحقيقة هي أن المؤسسات التعليمية بحاجة إلى تطوير التقنيات التعليمية وطرق تقييم الأداء التي من خلالها تصبح العملية التعليمية أكثر كفاءة وإثماراً بشكل ملحوظ، ولمواصلة التطوير لهذا القطاع، حيث يعد الاعتماد البرامجي في الأوساط الأكاديمية أداة رئيسية لتحسين جودة التعليم، ويضمن أيضاً تحقيق المعايير، مما يمنح الجامعة الأكاديمية الثقة في وجود نظام اعتماد قوي يلبي المتطلبات. وفي هذا الصدد أجرت الباحثة بحثاً وصفياً للتعرف على جوانب إنترنت الأشياء وكيفية تطبيقها لدعم بعض المؤشرات التي يمكن أن تحقق معايير البرامج التعليمية ضمن برنامج الاعتماد. وفي هذا السياق سيتم تطبيق مزايا تطبيقات إنترنت الأشياء لإحداث تغييرات جوهرية في البرامج التعليمية وجودتها. ويناقش البحث أهم نقاط السلامة التي يمكن الاستفادة منها لتجنب المخاطر ومواجهة التحديات التي تحد من استخدام مثل هذه التكنولوجيا. وبشكل عام فإن هذا العمل موجه لتطوير العملية التعليمية وضمان الجودة والحفاظ على التحسين المستمر.

الكلمات المفتاحية: تقنية إنترنت الأشياء، جودة التعليم، التعليم الالكتروني، مؤسسة تعليمية ذكية

1. Introduction

The Internet of Things (IOT) comprises a network of interconnected devices capable of sharing data both among themselves and with cloud systems. These devices encompass sensors, cameras, robots, and user interfaces like mobile phones. This interconnected device system can operate on a local or global scale. Organizations are increasingly embracing IoT technology to enhance operational efficiency, elevate customer service, and boost business value (Dake & Bada, 2023).

In fact, educational institutions are in need of developing educational techniques and performance evaluation methods that make the educational process more efficient and tangibly fruitful. Continuous improvement in this sector is crucial, as programmatic accreditation in academic circles is a main tool for improving the quality of education and also ensures the achievement of standards, which give academic societies confidence that there is a strong accreditation system that fulfills the requirements.

This is why the researcher endeavors to conduct this research, the aim is to elucidate the services offered by the Internet of Things and how they can be applied to support key indicators that enhance the quality of educational programs within the accreditation framework. The ultimate goal is to facilitate educational development, ensure quality, and foster continuous improvement.

2. Statement of the Problem

Dependence on the conventional educational system has lost its effectiveness in light of the rapid digital transformations. This traditional system encounters significant challenges in its ability to deliver contemporary educational opportunities and methods. Consequently, the research problem revolves around the employ of IOT technology to enhance specific benchmarks of educational program quality. Among the indicators addressed in this research are:

- Monitoring student teachers' attendance and their adherence to deadlines.
- Regularly tracking courses as a component of the ongoing assessment of educational programs.
- Avoid cheating and impersonation in the examination process, as integral elements of the study and examination system.

3. Related Studies

1. A study on the impact of IOT applications on education focused on their role in facilitating task completion, promoting deeper understanding, and reducing time and effort while keeping costs to a minimum. The research yielded several notable results, with preliminary findings highlighting the multiple advantages of IOT technology in significantly enhancing educational service delivery for institutions. As a result, the study recommends raising awareness about the pivotal role of the Internet of Things in improving education (Alaklabi, 2019).

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2. A study aimed to identify the importance of Internet of Things technology in enhancing and developing the educational system and thus ultimately raising its performance. The research also addressed critical challenges associated with implementing IOT technology in education. The researcher conducted a comprehensive examination that included a study of various studies and applications related to the Internet of Things. The study reached a pivotal conclusion, which is that Internet of Things technology contributes effectively and efficiently to support students and teachers, as well as enhancing and developing educational sector services. Moreover, it provides great opportunities to advance the teaching and learning process (Khalifa & Jeddawi, 2022).
3. A research paper aimed at enhancing interaction within educational materials through the use of Internet of Things technology and it focused in particular on smart classrooms, with the aim of evaluating their efficiency in achieving the desired results. The results of the study ultimately confirmed that IOT technology serves as the basis for smart classroom architecture. Furthermore, the paper addresses and discusses the main challenges associated with the application of this technology (Harmer & Szeles, 2022).

Reviewing the previous studies showed that they were agreed upon the same general aim which was the fundamental change that IOT had made in improving and developing the services in education. (Alaklabi's, 2019) study revealed that IOT develop digital communication skills of students and teachers. The previous studies also enumerated the problems that obstacle applying IOT inside educational institutions such as there are not IOT infrastructure and regulatory controls related to IOT. On the other hand, (Harmer & Szeles, 2022) focused on smart classrooms in particular. The only difference between previous studies is that a study conducted by (Khalifa & Jeddawi, 2022), was depended on applying survey method for group of studies and IOT applications. (Harmer & Szeles, 2022) conducted a comparative study between smart classrooms and the technology that used in regular classes, while (Alaklabi, 2019) utilized descriptive analytical method for last studies related to IOT. Therefore, through reviewing the differences and similarities between previous studies, the current research aims to embody and enhance the importance of quality of education by applying IOT. The present study also explores some safe solutions for IOT use which previous studies did not mention. These studies helped the researcher to determine requirements and necessary equipment's for applying IOT in educational programs.

4. IOT Implementation Mechanism

Higher education institutions consist of a group of different holdings (things) such as tablets, display screens, smart boards, printers, laboratories, classrooms, sensors, etc., and most of these institutions are now connecting to the Internet system; from here, these two can be linked. The two sides are interconnected so that the organization operates with the Internet of Things system and communicates with the cloud service

through some form of connectivity. Once the data reaches the cloud service, it is processed, and certain actions are performed without the need for user input or sending an alert.

The system used here is a learning management system based on cloud services (LMS) to provide effective e-learning, as this system does not require the installation of hardware or computer programs to access them but rather uses virtual resources that can be shared with users, can be accessed by the service provider, and represents an appropriate and effective solution as it is low-cost; it doesn't need infrastructure or software licenses; this system is easy to implement, secure, and adjustable and developable, like using the Moodle rooms system.

1. Monitoring student teachers' attendance:

a. Monitoring and assessing performance:

In the conventional educational setting, students are expected to provide many details when undertaking a specific task. However, these details often elude the teacher as acquiring them would necessitate their constant presence with every student, closely monitoring each step during task execution. Consequently, effective and comprehensive follow-up becomes a challenging endeavor. In contrast, employing an IOT-based monitoring system empowers teachers to observe and record the intricate details of students' task performance, including the time they take to complete specific assignments. This capability enables educators to assign grades for each task or activity. The mechanism for obtaining this information involves integrating sensors within the IOT unit, which is connected to the task at hand. These sensors record essential data and store it in a file on the Learning Management System (LMS).

The LMS utilizes each student's file to assess their performance based on the evaluation criteria established by the educational institution. Information is extracted from the sensor data, which is transmitted to the IOT unit prior to task execution. The teacher sets up and configures each IOT unit to save sensor data in the corresponding evaluation file. Upon task completion, the teacher reviews each file to thoroughly examine the execution details for each student or group. A group of sensors, affixed to the IOT unit, captures data that elucidates the steps taken by the students. Additionally, one or more LCD screens can be connected to the IOT unit to display task results. Another LCD screen can be linked to the IOT unit to exhibit sensor data, alerts, and task-related timing. The IOT unit collects data from the sensors and cameras at regular intervals and transmits this information to the LMS server. This facilitates the extraction of the follow-up and evaluation file's ID from the message, storing the information in the respective assessment profile. Subsequently, the IOT unit leverages the data collected by the sensors to gain insights into the procedures followed by each student while undertaking a specific task (Bakla, 2019; Mershad &Wakim, 2018).

b. Smart Presence:

IOT devices can automatically track the attendance of students and teachers and send reports to the administration and parents. This is done by following up on the

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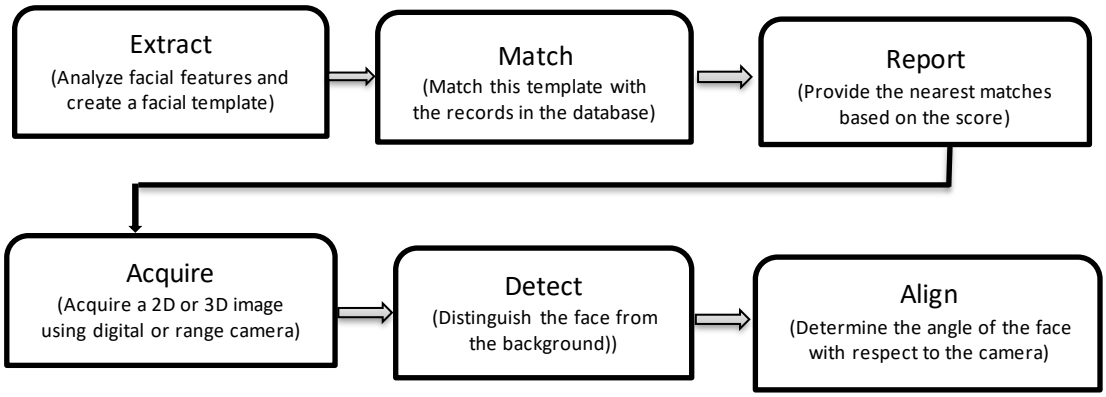
synchronized lectures, using the facial recognition system, and using the facial recognition algorithm, such as the principal component analysis (PCA) algorithm, which is generally summarized in the following steps: Stage of capturing the image, the stage of image alignment and standardization, the stage of extracting the basic features from the image, the matching stage, and the stage of issuing a report with the closest image (Yambor et al., 2002).

Figure 1. Phases of the PCA algorithm



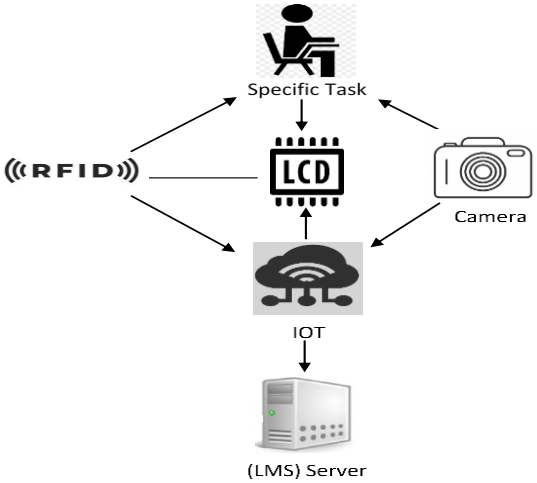
Source: Meliwiki, 2016, Face Recognition Using Principal Components Analysis (PCA), IEEE international Advance Computing Conference, Banglore, India.

In this innovative educational system, photographs are taken of each teacher affiliated with the educational institution as well as each student enrolled in the course. These images are then processed through photoelectric sensors to enable automatic facial recognition and image matching, facilitating the identification of individuals based on their captured. In this innovative educational system, photographs are taken of each teacher affiliated with the educational institution as well as each student enrolled in the course. These images are then processed through photoelectric sensors to enable automatic facial recognition and image matching, facilitating the identification of individuals based on their captured images. An LCD screen is connected to the system to display sensor notifications.

For instance, during activities within a lecture hall involving both teachers and students, the camera captures a three-dimensional image of the group of students present in a specific manner and format. These images are incorporated into facial recognition databases. Simultaneously, data from sensors, such as Radio Frequency Identification (RFID), which employs radio waves to transmit data, are collected. RFID tags are attached to students' identity cards and are sent to the IOT module. These tags are essential for identifying and matching data, ultimately confirming the identity

through the implementation of a facial recognition algorithm, such as Principal Component Analysis (PCA), and verifying attendance (Tan et al., 2018).

Figure 2. Use of IOT technology in identification



2. Course management:

The Internet of Things gives students the opportunity to access information remotely through their use of smart devices such as a phone or a tablet, where the scientific material is stored in videos on the education management system based on the cloud storage LMS, so the students can follow it up and benefit from it as long as they use their own smart terminals and by scanning the QR code (Chiemeka & Ola, 2021).

In addition, it was found that the LMS with IOT was able to create a continuous connection between devices and things, and this allows students to benefit from smart devices, where a QR code is generated for evaluation questions to show the student's understanding of the scientific material, and it also includes the ability to send inquiries from the student to the teacher, through audio recordings or in the form of an image, and vice versa, depending on the RFID system, where the RFID reader produces radio waves, which create an electromagnetic field. If the tag gets close to it, it will receive waves and release the information saved on the tag. The teacher can direct his alerts to the students in the same way (Bouslama & Kalota, 2013). In order to monitor the quality of the academic content, the QR code is distributed so that it is available to the authority authorized to follow-up anywhere and at any time by scanning the code with smartphones or any other smart device, to allow them access and follow-up in several aspects, the most important of which are:

- Quality of the practical content of the course.
- The style used in the lecture.
- Students' interaction and participation.
- Sound quality and surrounding environment.

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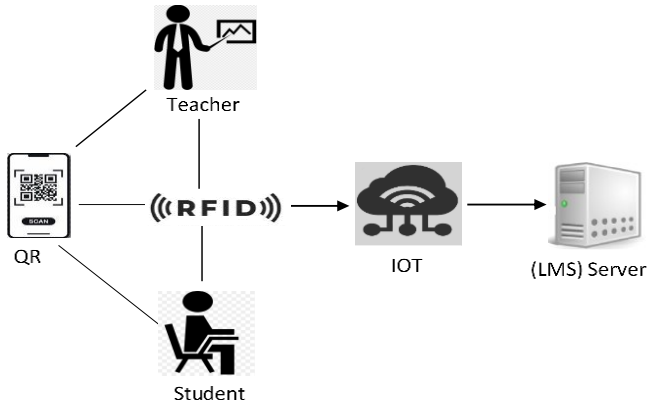
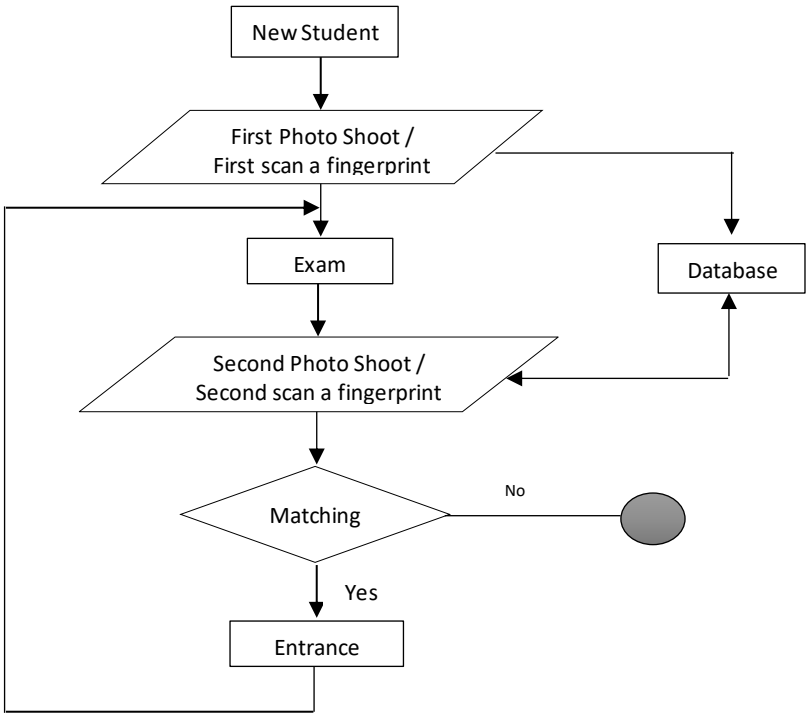
Figure 3. Use of IOT technology in monitoring courses



3. Avoid cheating and impersonating on the exam:

Cheating represents a major challenge within the education system, exerting profound effects on both society and the students themselves. To address this issue, the examination system, when integrated with IOT technology, employs a mechanism akin to the attendance monitoring system. This mechanism aims to verify the identity of the individuals and prevent plagiarism. It involves capturing a facial image or utilizing a fingerprint scanner to scan the students' fingerprint, subsequently comparing it with the fingerprint data stored in the database. Moreover, cameras connected to the IOT unit are activated within the examination venues to cross-reference these images with those previously registered in the system.

Figure 4. Student entry mechanism for the exam



Basic components of the Internet of Things application: The basic requirements for the Internet of Things application can be identified as shown in the table:

Table.1. Components of the Internet of Things application

Technology	Description	Research Requirements
Smart Devices	The device in IOT is the asset you want to control, monitor, or measure.	-Camera -Mobile -Tablet
Data Acquisition Module	This is the physical component of the IOT system that contains all the sensors that help obtain the readings and data. The type and number of sensors required will depend on your application.	-Self-powering sensors -RFID
Data Processing Module	The main unit processes data and performs operations such as local analytics, storing data locally, and performing other computing operations.	Server (LMS)
Communication Module	The part that enables communication with your Cloud Platform. IOT protocols are standards that enable the exchange and transmission of data between devices and the Internet.	-Internet protocols (Wi-Fi, Bluetooth, NB-IOT) -Data transmission protocols(AMQP, COAP, HTTP)
Network Technology	A network of physical objects embedded with sensors, software, and other technologies for interconnecting and exchanging data	- Grid/Cloud network -software-defined network -Service-based network
Software and algorithms	Software is the set of programs that enable communication between devices on a network, and enable devices to exchange data and messages.	- Goal oriented software -Distributed intelligence -Self-reusable software
Security &Privacy Technologies	Privacy policies are activities designed to protect the use and integrity of the network and data. This field includes both hardware and software technology.	-Low cost, secure, and high performance identification (Firewalls, Email security, Antivirus software) - Intrusion prevention systems (IPS)

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5. SAFETY GUARANTEE WHEN USING THE IOT:

The following steps and tips allow safe usage of the IOT network:

1. Protect devices and develop security systems by using an appropriate firewall while constantly changing the password.
2. Using a virtual private network (VPN) makes it difficult to trace the user and thus reduces the risk of hacking.
3. Using the guest network for all devices connected to the IOT, its powers are limited, and therefore hacking it will not be a gateway to access the devices.
4. Network-level Threat Monitoring: a vast Smart Life uses artificial intelligence and machine learning to detect and eliminate threats and keep your network secure (Alharbi & Aziz, 2023; Taherisadr et al., 2021).

6. BARRIERS TO USING IOT:

1. Infrastructure.
2. Fear of breaching data confidentiality.

7. RESULTS AND DISCUSSION:

The integration of Internet of Things (IOT) technology into educational programs has heralded a notable transformation, bringing forth a range of advantages and benefits for higher education institutions. Among the most significant of these benefits are:

1. The quality of the educational program: the application of electronic mechanism helps in the commitment of students and teachers to the attendance and appointments and helps in following up and developing the academic content of the courses.
2. Precision and Real-Time Feedback: IOT applications ensure precision in student learning and evaluation by offering real-time electronic monitoring and tracking of task performance, as well as immediate feedback and corrections.
3. Cost Reduction: The connection of smart devices and products to the Internet streamlines access and management, leading to cost savings across various operational, cognitive, and physical aspects.
4. Time Efficiency: IOT simplifies task execution, thereby saving substantial time and effort for both teachers and students. This efficiency extends to functions like attendance recording and simultaneous task performance monitoring for all students.
5. Self-Paced Learning: IOT applications enable the utilization of educational platforms, facilitating learning anywhere and at any time, whether inside or outside the educational institution.
6. Collaborative Education: IOT technology enhances cooperative learning by providing students with increased opportunities for collaboration and

participation. Integration of devices with the Internet heightens motivation and deepens comprehension through shared experiences.

8. RECOMMENDATIONS:

1. Addressing more researches in the field of the Internet of Things and integrating it into the educational environment system.
2. Providing the necessary environment to apply Internet of Things technology in educational institutions.
3. 4. Finding the necessary solutions to the obstacles of using the Internet of Things technology.
4. Increase awareness of modern technologies and their effective role in the quality of the educational system.

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