Internet of Things for Education Field

Sura I. Mohammed Ali¹, Marwah Nihad²

¹Department of mathematics & computer application Collage of science /Al-Muthanna University , ²College of Science, University of Kirkuk, Kirkuk, Iraq

The corresponding author’s e-mail address: suraibraheem@mu.edu.iq

Abstract. Tracking student attendance and location information are at the heart of a pervasive internet thing. Several approaches are used to identify student locations in the classroom, Infrastructure and increased services are considered expensive requirements and hardly meets the need for the required room-level location accuracy. An accuracy of specifying the student’s location by Smart Entity( inertial sensors on hand) of improving the quality of service. Location information forms a core context to determine student location. The location of classroom access control using different parameters provides useful information and improves teaching and learning in the educational organization. Based on the recent IoT integration of smart entities and sensors, this paper uses new value-added proposals to monitor the actions of students inside the classroom location.

Keywords:- Internet of Things, IoT architecture, smart classroom, Location-Based Services

1. Introduction

In recent years, one of the elements that have greatly affected education is IoT. We’re living in an environment today where the set of data, learning, and technical methods are changing. Kevin Ashton first invented the term Internet of Things (IoT) in the field of supply chain management in 1999. Embedding sensors and mobile devices into IoT as a good director in teaching methods can promote interaction between people (teachers and students) and (virtual and physical) structures in the academic environment. This flexible approach that structures can communicate with each other and with people in these academic settings, providing a different estimate of the potential study. In their procedures for teaching and learning.

The learning pattern of conventional learning has been turned into digital learning through information and communication technologies [1][2][3]. One such paradigm that leads to such initiatives is IoT. Security and privacy are the main IoT issues, availability, mobility, reliability, efficiency, interoperability, scalability, trust, and commitment [1]. There are a variety of physical items such as (books, laboratory tools, computers) that are given for the everyday use of teachers and students to execute various learning and teaching tasks, most often in academic environments such as labs and classrooms. The IoT-based learning environment will permit increased types of activities that enhance the level of academic processes.
By incorporating sensors and mobile devices into the world, IoT has altered university classrooms. This has provided a great opportunity in learning and teaching for enhanced student participation and collaboration. To attract students, IoT is a highly exciting and stimulating subject and a perfect forum for teaching concepts in computer science [15]. All university campuses are connected to the Internet, and there are several items on each campus, such as projectors, printers, classrooms, laboratories, parking, buildings, etc. These entities can be transformed into Smart entities using IoT technologies such as (NFC, sensors, QR tags, RFID) [4]. Three of the layers of the Internet of Things can be recognized. "It describes the first layer as "Hardware". The components of this layer are sensors, actuators, and embedded communication hardware. Identified as "Middleware" second layer. It consists of data analytics tools for on-demand storage and cloud computing, and the third layer is described as' Presentation', which provides interpretation and visualization resources for different applications that can be widely accessed on various platforms [5]. Figure 1 is shown the Architecture of the Internet of Things.

![Figure 1. Architecture of (IoT)](image)

While IoT vision has a great promise for future technologies, many dynamic technological, economic and social issues remain unresolved. The position of hardware and software platforms which promote the reduction of ideas for working with prototypes is of interest in the field of IoT technologies [8]. Our motivation in this paper, It is very necessary to ensure that students who send attendance reports are actually in the classroom by using Smart Entity (inertial sensors on hand). For the implementation of the new integration model, an adapted architecture is proposed. This architecture is basically an evolution to previous architectures in certain IoT applications. Section II sets out the background information needed for the writing of this paper. Section III reviews several academic papers on the IOT-based e-Learning area. Section IV outlines a Proposed Model based on the IoT Smart Curriculum Concept and the IoT Architectures. Finally, Section V outlines conclusions.

2. Background

This section includes the background material required for the writing of this paper. This covers smart education, the Internet of Things and the software infrastructure.

2.1. Educating the Internet of Things generation

To increase demand, fundamental and educational shifts in the technology environment involve new computer science education methods [6]. The positive effects of attempts to reshape undergraduate computer science according to the principles of the Internet of Things have Wide-reaching implications:

- Implications for Online Education. While there is considerable enthusiasm for online education and online courses that are massively available, most of the course offers are restricted to topics that can be readily taught online. This indicates that courses focus on topics that can solve with products hardware in computer science, such as laptops and desktops. Experiences related to approximately 2000 students per cohort show that teaching subjects requiring specialized
equipment is possible. It's time to explore vast and scalable online education infrastructures that vary from cloud computing to the Internet of Things for computer science education. The creation of in-house infrastructure for individual universities is also challenging. The new course on the Internet of Things involved a multi-year project by a massive community of dedicated teachers and a critical investment in technology and people by the Open University. A scratch-built networked sensor board, which is particularly noteworthy for the board's development and distribution to all students. Without which the delivery of the course would not be feasible, the cloud infrastructure is equally notable.

- **Implications for Computer Science Education.** The Internet of Things has been shown to be a viable platform for teaching computer science concepts. While the introductory courses concentrate on more fundamental topics or 'closer to home' computing technologies such as web programming and PCs, the conventional teaching of sensor networks, programming for embedded systems, and related subjects are transferred to higher-level courses. Although the Internet of Things guides students into the future of computing and culture, the definition of the Internet of Things is not known correctly. It is inflow, and the early introduction of the Internet of Things into computer science education is possible (and necessary).

- **Implications for Internet of Things Research and Industry.** In IT, the next movement is the Internet of Things. The Internet of Things, which initially originated from an industrial background, is still primarily connected, in the public view, to the interests of large industrial players. However, there is a possibility that the Internet of Things will fall brief of its inherent unless it willingly broadens the debate and gives as much importance to ordinary citizens' needs, wishes, and fears as the requirements of industrial players. According to the Open Source Sensing Foundation (http://www.opensourcesensing.org/), "A long and costly battle is looming" over safety, precision, ownership and autonomy "between those using sensors to collect data and those whose data is being collected." The most reliable way to mitigate those issues is to connect more deeply and substantively with individuals and customers. As the course has shown, there is a vast but unexploited source of creativity and excitement around IoT technologies and ideas. User-led imagination will play a vital part in the potential development of the Internet of Things, as belief, [7][8][9]. The concerns that will be relevant in the coming years are how to guarantee that the modern Internet of Things facilitates user-led creativity and enables ordinary people and citizens.

By finding that the software toolkits and latest hardware do not meet essential criteria, including:
- **Scalable manufacturing:** Since the course receives several thousand students, a stable, regular schedule generates hardware in large quantities.
- **Low cost:** wanted to reduce hardware costs as much as possible as a goal was to get a full "Internet of Things in a box" for each of the students.
- **Long-term future:** Therefore, the Sense Board and Sense's programming environment was paramount to ensure that the toolkit for P and redesign P could be developed for as long as possible. It is planned for many more years to be used in education. Therefore, to reduce dependency on external platforms. Such as, while Pachube affords a convenient cloud storage platform, the unknown future of the business (or any different IoT start-up in that regard) made it hard to depend on their service (certainly, Pachube has been sold since started this project with anonymous long-term consequences for their platform).
- **Extremely simple tool chains:** It can be quite a time to diagnose and correct and expensive to help with small discrepancies in student configurations and minor technical challenges in online education. Students are using hardware and software at home.
2.2. Interaction System Based on Internet of Things

Supporting the teaching management and enhance students’ academic performance, in [10], a framework enables students to communicate as a tool with surrounding physical objects virtually connected to a learning subject, the Internet of Objects. Also, through the Internet of Things, using actual items and associating them as a learning resource encourages meaningful learning. It enables necessary information to be connected to an authentic context.

Students enhanced their learning using the Internet of Objects method in the experimental community, which was illustrated by the effects of calculating academic results relative to the control group.

2.3. Applications in E-Learning

There are several IoT applications in education like personalization through learning analysis, security, attendance management system, environment monitoring system etc.

In [11] the focus of this paper is to expose the benefits and accompanied issues of those applications and to investigate the recent IoT applications in the field of education.

- **Smart Classrooms**: Smart classroom System is an application of IoT in teaching learning environment. These are technology enhanced environment equipped with computers, specialized softwares, audience response technology and Audio/Visual capabilities. Such systems also determine if the available environment is conducive for monitor and learning some parameters like oxygen, CO2 level in air, temperature, noise, odour and other eco-friendly conditions [12].

- **Education through Gamification**: A player can also experience learning while playing which is a better learning exercise, as Gamification engage a user while getting entertainment and increase their concentration towards the game. Applying gamification techniques to the Internet of Things will make the education system smart, gamification motivates the user to play more and more which makes a user addictive! A smart education system has three important fundamentals which are: Smart Pedagogies, Smart Learners and Smart Learning Environments [13].

- **Wearable Technology**: Wearable devices are hands-free technology which facilitate students and other users to free-up their hands to interact with the real-world environment. Wearable technology is defined as those digital wearable gadgets that are remotely connected to exchange and provide seamless information. The wearable device that is beneficial in teaching learning are: Virtual Reality (VR), Muse headband and Google Glass. One of the most popular Virtual Reality (VR) system is Oculus Rift, which fully engulf a user. The impact of VR in the field of teaching learning processes is significant. It allows a user to experience learning without risk. It takes a user to the places which are difficult to access in real life. Medical education, archaeology courses, space studies are more difficult in real time but VR made it easy to learn. Muse headband is a wearable technology which measure and sense brain activities through electroencephalography (EEG) sensors and sends the produced data to smartphone through wireless connectivity. It facilitates an educator to monitor how the students are focused and engaged on study. “Google Glass” an important gadget used for teaching learning process that allows students to remotely watch and listen a lecture without physical presence. It also facilitates medical students to watch a surgery process. It has the functionality of receiving alerts and notifications related to their studies [14].

- **Attendance Monitoring System**: Attendance Monitoring System is one of those applications which have been implemented in the field of education. This application uses RFID tags to monitor student attendance. As a student comes in to the classroom, their attendance could be automatically logged by using IoT devices like smart band that uses the ECG pattern of the user to authenticate their identity [12].

- **Personalisation through feedback**: A mobile application “Socrative” is used to receive real-time feedback from a huge number of students [12], this occurs by the Personalization through feedback which is an IoT characteristic that involves mobile technology to acquire real-time feedback.
2.4. The Learning System Based on Technology

In paper [15], Design of a technology-based learning system primarily designed for postgraduate and undergraduate students in the control lab. For learning IoT, this scheme is suggested. This system provides low-cost creation using standard industrial controllers ideal for prototyping industrial and business applications.

The advanced system is a full industrial-grade mix, include communication, physical, control, and cloud layer compatibility. The best solution is given by these features, as this kind of platform is not accessible anywhere. This current project-based learning approach could become an alternate industrial route in the teaching of IoT technologies. This study assumes that it is essential to expose the student to the latest control technology updates to improve industrial control techniques. It is sufficient to use this new technology-based learning method to meet industrial demand in the future for commercial students. This learning platform is the perfect way to help students survive and control the IoT industry after graduation.

2.5. The Six Skills

Paper [16] discuss, several suggestions for the fair use of IoT in any area, including eLearning. For instance, the article "Six Essential Skills for Mastering the Internet of Connected Things" [17] suggests six skills. The first skill is to consider the device's characteristics and capabilities, the applications able to access the thing, and the data flowing from and to the thing with your linked things. The second skill is the flexibility to model stuff with new apps and items that come online every day, each needing to be seamlessly folded into the network. The third skill is the abundance of modeling relationships that depend on a simple understanding of all things and their relationships. The fourth skill in the SQL or graph database is to solve the query. The fifth skill is to master and collect vast quantities of information because every sensor and thing continuously transmits and manages real-time data from the IoT sensors. By combining all to construct the right applications, the sixth skill is to develop linked applications.

In [18] demonstrate that, Real-time, limited-area IoT Platforms with Cloud Computing services are the perfect technological solution for academia.

2.6. University Education Management

In contemporary colleges and universities, curriculum management is an essential feature of talent education. The education repair under the Internet of Things technology generates favorable conditions for college education management's long-term advancement [19]. With the comprehensive popularization of the technology of the Internet of Things, highlighting the characteristics of education management and capturing the times' opportunities, it will be the root focus of university education management's future growth. It is essential to resolve many conflicting problems in education practice, university education management, and studies. It is of high importance to encourage the practice levels of recently advanced talent to a new height [20]. A significant prerequisite for IoT technology growth is accurate positioning. Educational management in colleges and universities must use cloud computing's specific characteristics to conduct innovative educational management activities scientifically. The usage of Big Data information management tools in education changes the traditional education management system [21] since it ultimately affects the conventional approach of education management in universities and colleges.

The article [22] focuses on the technology of the Internet of Things, combines the management of education of colleges and universities with the Internet of Things, puts together the Internet of Things,
teachnology, students, and schools, innovates and creates things in the management of education in the context of the Internet of Things.

2.7. Enhancement of educational facilities by the use of Internet of Things apps

In [23], several conclusions emerged from the examination of the statistical evidence accompanying the study: providing security and privacy with the presence of surveillance cameras, finding modern security alternatives, databases and security records, expectations of developing financial and economic components through dealing with financial unemployment available to students of talent and intelligent schools and achieving additional income with products (Services) the educational sector, the increase in WiFi, Bluetooth and WLAN connections. A smart generation has emerged that has a promising future that enables them to deal with skills for using the Internet of Things, and with the availability of reports and medical records within approved medical records and databases, easy methods of detecting disease among students and the possibilities of reducing it, and the presence of system algorithms Smart, analytical programs and data transfer protocols contributed to raising the administrative level in these schools, to be replaced by electronic administration, finding means and methods to reduce effort and save time spent and investing it in increasing the educational product, the practice of teachers for these schools of smart education and in all study investigations contributed to a simple spread of the use of the Internet of Things in directorates Education, as it showed A study on the need to strengthen the smart school environment and the possibility of applying it in a wider and comprehensive manner. There are some concerns among the lack of an electronic pharmacy in the schools of the talent and intelligent at present and the sample community about violating the privacy of the student, reduced the percentage of enrolment in these schools in a small way, so conducting effective studies to find out the obstacles of the Internet of Things to be employed in the educational process and ways to overcome them.

2.8. Integration with Virtual Academic Communities of Objects

The paper[24] proposes a new model for integrating objects into Virtual Academic Communities (VAC) by carrying out a case study to test the proposed model. Plus, the results show that applying IoT gives students a more enjoyable learning environment and more data from the learning process to help teachers improve their understanding of their students’ learning speed and learning challenges.

2.8.1. Educational services

Below some educational services are displayed:

- **Reliable wireless connection (Wi-Fi):** No one denies the constant need for modern technologies and the importance of them for education without sudden interruptions or stops, and the most important of these technologies is high-speed wireless networks, that make available bandwidth for audio and video issuing of educational classes in an orderly and high-quality manner [25].

- **Security and privacy in the educational sectors:** Various data that are transferred through the Internet are preserved in the systems that rely on these modern technologies. They mainly consist of various devices connected to them, as these devices begin to collect and measure data from students, which exposes the security of the privacy of the student at risk. Any safety breach can reveal a student's private data associated with a family economic background, individual's medical record, or any other secretive data [26], [27].

- **Cost:** The cost of devices and equipment represents another challenge for the educational sectors and institutions. Therefore, the complete preparation of the existing educational institution can be these advanced modern technologies with all its devices necessary to create an integrated educational system at an expensive price.
• **Health**: The sick student can be observed and whether he has a shift or a temperature, the case can be recorded in the student’s medical record, through the spread of surveillance cameras and remote sensors.

• **Smart classrooms**: Various reasons might impede educational sectors and institutions to apply this modern technology in their educational institutions due to the incompatibility of some applications and devices, which might be a reason that hinders the institution’s ability to apply and rely on it so that it is presented to all customers, students and teachers, the educational organization must ensure that both IT tools and education methods boost using Internet of Things in the virtual classroom, for the effective operation of the Internet Things. Although potential risks and obstacles are related to technology, informative institutions might gain benefits from experimenting and exploring with IoT options [28].

3. Proposed Model Based on Virtual Learning

The proposed solution for monitoring in this work carried out by students in the classroom or lab as a task in the lab. The module is based on a mediator that records spatial data and sensor data as descriptive data. This data can be a path for the student to find and archive and then retrieve from the server a weekly schedule for the student's position via an Adjusting algorithm to improve the accuracy of the positioning result. Where the server contains a file that involves the student's activity actions inside the laboratory or classroom. Our key module can be divided into four Phases as Figure 2.

![Figure 2. Model overview](image)

- **Phase 1**: The mediator receives position coordinates directly from the Smart Entity (SE), and the processed sensor data must also be read and registered.
- **Phase 2**: Precise location coordinates and sensor data are submitted to the server as metadata. The server tracks with day behaviours and responsiveness actions of students, such as the student's route.
- **Phase 3**: Obtaining uploaded data and running a behaviour identification algorithm to list the regular schedule. The location of the student is determined by the characteristics of the data of
the sensor and the speed information. The probability distribution of the position mode at a given
time, and the features of the various location modes that decide the student's current location mode.

- **Phase 4:** The collection of regular schedules has been adapted as a Virtual Entity (VE). The teacher
will then track this data by reviews, which help the teacher monitor the work that the students have
completed in the lab or classroom, plus it track the students who have access to the lab class.

4. Conclusion

Monitor students in a classroom have always been complicated. The model is divided into three parts:
the Smart Entity, the Server, and the Visual Entity are designed to capture location-related information,
such as location coordinates and sensor data. We used the adjustment algorithm existing to improve the
accuracy of the position. We used inertial sensors on hand in this job. The accuracy of the data obtained
by the device could be maximized by adding a real-time position. In comparison, embedding sensors in
hands of students can receive information about the student's location from sensors. The aim of this
model is to provide intelligent assistance to lecturers and universities in student monitoring.

References

[1] S. I. Malik and M. Al-Emran, “Social factors influence on career choices for female computer
science students,” Int. J. Emerg. Technol. Learn., vol. 13, no. 5, pp. 56–70, 2018, doi:
10.3991/IJET.V13I05.8231.
[2] S. A. Salloum, M. Al-Emran, and K. Shaalan, The impact of knowledge sharing on information
systems: A review, vol. 877. Springer International Publishing, 2018.
[3] N. Al-Qaysi, N. Mohamad-Nordin, and M. Al-Emran, “A Systematic Review of Social Media
Acceptance From the Perspective of Educational and Information Systems Theories and
Models,” J. Educ. Comput. Res., vol. 57, no. 8, pp. 2085–2109, 2020, doi:
10.1177/0735633118817879.
[4] S. Yang, Y. Song, H. Ren, and X. Huang, “An automated student attendance tracking system
based on voiceprint and location,” ICCSE 2016 - 11th Int. Conf. Comput. Sci. Educ., no.
August 2016, pp. 214–219, 2016, doi: 10.1109/ICCSE.2016.7581583.
[5] H. M. Reeve, A. M. Mescher, and A. F. Emery, “Experimental and numerical investigation of
polymer preform heating,” Am. Soc. Mech. Eng. Heat Transf. Div. HTD, vol. 369, no. 6, pp.
321–332, 2001.
[6] G. Kortuem, A. K. Bandara, N. Smith, M. Richards, and M. Petre, “Educating the Internet-of-
Things generation,” Computer (Long. Beach. Calif.), vol. 46, no. 2, pp. 53–61, 2012.
[7] I. P. Cvijikj and F. Michahelles, “The toolkit approach for end-user participation in the Internet
of Things,” in Architecting the Internet of Things, Springer, 2011, pp. 65–96.
[8] G. Kortuem and F. Kawasr, “Market-based user innovation in the Internet of Things,” in 2010
Internet of Things (IOT), 2010, pp. 1–8.
[9] M. Roelands, “Orientation towards Do-It-Yourself Internet-of-Things Mass Creativity: What Can
the Internet of Things Do for the Citizen?,” 2010.
[10] J. Gómez, J. F. Huete, O. Hoyos, L. Perez, and D. Grigori, “Interaction system based on internet
of things as support for education,” Procedia Comput. Sci., vol. 21, pp. 132–139, 2013.
[11] N. Ullah, “Enhancing Teaching Learning Processes by using Internet of Things.”
[12] S. Meacham, A. Stefanidis, L. Gritt, and K. T. Phalp, “Internet of Things for Education:
Facilitating Personalised Education from a University’s Perspective,” 2018.
[13] Z. AjazMoharkan, T. Choudhury, S. C. Gupta, and G. Raj, “Internet of Things and its applications
in E-learning,” in 2017 3rd International Conference on Computational Intelligence &
Communication Technology (CICT), 2017, pp. 1–5.
[14] B. Attallah and Z. Ilagure, “Wearable technology: Facilitating or complexing education,” Int. J.
Inf. Educ. Technol., vol. 8, no. 6, pp. 433–436, 2018.
[15] M. A. Akbar and M. M. Rashid, “Technology based learning system in internet of things (iot)
education,” in 2018 7th International Conference on Computer and Communication Engineering (ICCCE), 2018, pp. 192–197.

[16] S. Charmonman, P. Mongkhonvanit, V. N. Dieu, and N. Linden, “Applications of internet of things in e-learning,” Int. J. Comput. Internet Manag., vol. 23, no. 3, pp. 1–4, 2015.

[17] “Info.neo4j.com. ‘Six Essential Skills for Mastering the Internet of Connected Things’. http://info.neo4j.com/rs/neotechnology/images/Neo4j_WP_SixEssentialSkills_ENA4.pdf.”.

[18] L. Banica, E. Burtescu, and F. Enescu, “The impact of internet-of-things in higher education,” Sci. Bull. Sci., vol. 16, no. 1, pp. 53–59, 2017.

[19] M. Pisonova, P. Brečka, V. Papcunová, and B. Jaslovská, “Historical-philosophical aspects of professional communication in education management,” XLinguae, vol. 13, pp. 171–184, Jul. 2020, doi: 10.18355/XL.2020.13.03.14.

[20] E. ElKaleh, “Leadership curricula in UAE business and education management programmes,” Int. J. Educ. Manag., 2019.

[21] H. Lyu et al., “Evaluation of RFID technology to capture surgeon arrival time to meet american college of surgeons committee on trauma verification guidelines,” ACI Open, vol. 3, no. 01, pp. e13–e17, 2019.

[22] X. Qi, “University Education Management Based on Internet of Things Technology,” in International Conference on Machine Learning and Big Data Analytics for IoT Security and Privacy, 2020, pp. 805–810.

[23] D. K. A.-R. Al-Malah, H. H. K. Jinah, and H. T. S. ALRikabi, “Enhancement of educational services by using the internet of things applications for talent and intelligent schools,” Period. Eng. Nat. Sci., vol. 8, no. 4, pp. 2358–2366, 2020.

[24] J. Marquez, J. Villanueva, Z. Solarte, and A. Garcia, “IoT in education: Integration of objects with virtual academic communities,” in New Advances in Information Systems and Technologies, Springer, 2016, pp. 201–212.

[25] E. Khorov, A. Lyakhov, I. Nasedkin, R. Yusupov, J. Famaey, and I. F. Akyildiz, “Fast and Reliable Alert Delivery in Mission-Critical Wi-Fi HaLow Sensor Networks,” IEEE Access, vol. 8, pp. 14302–14313, 2020.

[26] K. R. Sollins, “IoT big data security and privacy versus innovation,” IEEE Internet Things J., vol. 6, no. 2, pp. 1628–1635, 2019.

[27] S. M. M. Najeeb, H. T. S. Al Rikabi, and S. M. Ali, “Finding the discriminative frequencies of motor electroencephalography signal using genetic algorithm,” Telkomnika, vol. 19, no. 1, pp. 285–292, 2020.

[28] M. F. H. Sarker, R. Al Mahmud, M. S. Islam, and M. K. Islam, “Use of e-learning at higher educational institutions in Bangladesh,” J. Appl. Res. High. Educ., vol. 11, no. 2, pp. 210–223, 2019.