



Student attendance and evaluation system: A review

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Article information

Article history:

Received 05 December ,2024

Revised 14 January ,2025

Accepted 28 January ,2025

Published 26 June ,2025

Keywords:

Student evaluation
attendance system
Arduino

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Abstract

In the modern education environment, technologies are the key driver that leads to significant change. The change is for the improvement and effectiveness of the teaching process. Traditional manual systems have various wastes and drawbacks related to the time and the loss of data and human errors. Therefore, the current trend is the implementation of technology-centered systems that combine RFID with Arduino, facial recognition, and machine learning systems to ensure accuracy and efficiency by automation. Earlier studies have taken into account several methods and methodologies toward that very end, which are using RFID to make the system automatic, using Arduino systems to make the tests automatic, and using machine learning algorithms to automate the analysis of academic performance. Such systems, for example, are also threatened by their cost, by privacy issues or cannot be implemented on a large scale. Hence, this paper synthesizes studies to date, method, result, and obstacle breakdowns.

DOI: 10.33899/csmj.2025.155461.1158, ©Authors, 2025, College of Computer Science and Mathematics, University of Mosul, Iraq.

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1. Introduction

The set of affairs and the manner in which things happen have never been simple, fast, or smart to a greater degree. It is now more than ever which poses a great challenge for all other fields in their attempts at adjustment to higher education and scientific research. This fact has been growing in the awareness of countries, which are increasingly acknowledging the priority of the digital transformation of everything, especially in higher education due to its place within society development and advancement [1][2][3]. This meant that the Iraqi universities needed to turn into an important task of the priority in order to globalize and catch up to the newest digital trends. This transformation would implement advanced electronic management systems as a way to improve education quality on one side and to push for sustainable development on the other. Such a system would combine and compare the student attendance with his or her performance, thus overcoming the drawbacks of each of the two stand-alone systems. The systems' manner of operation in this paper relies on the process of data collection and analysis by which errors are minimized, thus increasing

accuracy in the results of assessment reports, and also saving time while enhancing the teaching and learning processes. It will facilitate not only analysis at the institutional level of academic performance but it will also facilitate better academic performance through analysis provided in a crystalline form in the reports[4][5][6].

The accurate information provided through periodic reports has made easy the meeting of academic accreditation standards. Academic institutions require meeting academic accreditation standards by having complete and reliable data. Traditional methods are inefficient since they are time-consuming and more prone to errors. Compared to the traditional method, the electronic student attendance recording method is more accurate and takes much less time to process reports and statistics; therefore, there are fewer errors [7][8][9].

The aim of the review paper is to highlight the different types and technologies of electronic assessment and attendance systems in order to push the education sector towards electronic assessment and attendance systems and abandon traditional paper systems. The research paper included an introduction to digitization and its importance, an

introduction to electronic assessment systems and electronic attendance systems, then a classification of previous studies according to the technologies used. Then we made a comparison between these studies to highlight the results and challenges that the systems faced in these studies, then a summary of the review paper.

2. Related Works

A full analytical review was done, with studies chosen carefully based on set criteria. The paper discusses research work on the automation of the attendance and performance assessment systems in education. It also presents, under a bright light, new technologies for these electronic systems, like RFID, Arduino, Facial recognition, and machine learning algorithms. The paper draws upon studies undertaken in different countries between 2018 and 2024. These studies are divided into major classes based on technologies and methods used or main goals of the systems. Findings and challenges encountered are also discussed to give a complete insight into electronic assessment and attendance systems for students.

2.1 Attendance Recording Systems

2.1.1 Systems Predicated on RFID Technology

The student swipes the card on the reader, which captures the information and sends it to a central database using Wi-Fi or GSM networks. An Android application that integrates with the system proved to be very efficient in recording attendance while reducing administrative burdens. The major drawbacks of this system are the short reading distance of the RFID reader and very high hardware costs involved [10]. An RFID-GSM-based student attendance system was designed by Addagatla (2019) that interfaces using an LCD display to Arduino for giving the feedback of student attendance. The major drawback is very short detection distance, less than 5 cm, and it requires very accurate swiping of the card [11]. In the development, a student entry and exit management system by Wen (2020) utilized RFID technology and an Arduino Mega 2560. The system scanned student cards at the school entrance, and all data was saved in the XAMPP database. A message was to be received by the parents on their WhatsApp application. There were issues with signal interference when cards were swiped simultaneously, which in turn would have affected the

accuracy of the data. Anti-collision algorithms are considered the optimal solution for this problem[12].

2.1.2 Facial and fingerprint recognition systems

Abd El-Mawla et al. (2022) A smart attendance system that integrates facial and fingerprint recognition with the Internet of Things was developed. The system was implemented using advanced algorithms. Although it performed well in terms of accuracy and speed, in the implementation within vast educational institutions, the upscaling started posing several challenges. Majorly, the high cost of the hardware and the constant Internet requirement by the system [13]. Jha et al. (2023) According to Haar Cascade and Local Binary Pattern Histograms (LBPH) algorithms integrated with facial recognitions in their system, the recording of attendance proved more accurate. The system proved effective but very particular about light angles and face angles in a bid to realize an efficient system. Researchers that also keen to set up operating conditions for setting up security measures for protecting students' biometric information [14].

2.1.3 Arduino-based systems

One such system was developed by Mahajan et al. in 2019. In this system, the fingerprints of students were stored in a database compatible with Excel so that results could be easily displayed. It was found that the system was easy to use and quite accurate, though it did not have send alert feature [15]. Sunehra developed a system in 2019 which integrated Arduino with Raspberry Pi 3, for recording student attendance by fingerprint. Data used to be sent to an Amazon Web Services server and the system could send text alerts via GSM however the system required continuous internet access and had fingerprint sensor errors [16].

2.2 Student Performance Evaluation Systems

2.2.1 Performance Evaluation Using Intelligent Algorithms

Al-Ruwais et al. (2023) used the support vector machine (SVM) and gradient boosting machine algorithms in the classification of student performance. It was able to be achieved with the GBM model at a high level of 98% accuracy[17]. Ahmed (2024) reported results on comparing the performances of several algorithms in classifying student performance. These studies found that the SVM performed well, giving an accuracy of 96%, with the next best being

decision trees at 93.4%. Researchers in this case sought to shift the focus to improving the prediction of student performance [18]. Chen et al. (2024) introduced an automated assignment correction model based on the random forest algorithm and support vector machines that were able to identify pattern within the assignment data through textual features. The results present high accuracy in assessment that the authors would note, however, the system would note face lags in terms of taking extensive data sets and against cyber threats [19].

2.2.2 Student Activity Analysis

Guerrero et al. (2018) In this work, data extracted from Git repositories was tested, including the frequency of comments and the duration of interactions to assess student performance. A study carried out to measure engagement in student software projects wherein the implementation was based on Random Forest and CART algorithms and the same input data, provided an algorithm-wise Random Forest fairly high, about 90% accurate results. However, the stability of this study was limited since the sample consisted of only 46 students [20]. (Guerrero et al., 2018) Shivani (2024) This study links academic performance metrics to extracurricular engagement through analytics and

machine learning algorithms. While the approach presumes a holistic perception of student assessment, it fails to embody state-of-the-art predictive modeling that can precisely forecast future performance outcomes [21].

2.3 Integrated Performance Assessment and Attendance Recording Systems

Shaikh et al. (2023) designed an automated system comprising web-based interfaces and a MySQL database for attendance monitoring and evaluation. It had good accuracy and reduced errors within the process of assessment, although it was noted to be attendant to slow performance in computation with large volumes of data [4]. Liu (2023) installed a database that was current and fully functional to record attendance and grade calculations. Results proved much greater data efficiency though calling for the beefing-up of security controls to retain the integrity of data. [22].

3. Related Works Analysis

In order to identify the issues or weaknesses faced by student evaluation and attendance systems and to determine the challenges encountered. A comparison of the methodology, results, and challenges of previous studies has been presented here, as illustrated in **Table 1**.

Table 1. Comparison of the systems used

Topics	The researcher and the year	Methodology	Results	Challenges
RFID based systems	Nidhi Malhotra,2018	Use RFID with a stable internet network	Record student attendance quickly and efficiently	The constant need for a stable internet, which limits the possibilities of expanding the system
	Prashanth Addagatla,2019	RFID system recording attendance	More efficient in recording student attendance	Problems of signal interference and short detection range
	Matthew Khoo Kah Wen,2020	applied RFID to improve performance	Ease of use and faster data recording	Limited range and signal interference problems
Facial and fingerprint recognition -based systems	Nesma Abd El-Mawla ,2022	Facial and fingerprint recognition in educational institutions	High accuracy in identifying students and recording attendance	High cost and difficulty of expansion in large institutions
	Phul Babu Jha et al.,2023	Facial recognition systems with improved lighting and environment	Excellent performance in recording student attendance	Need to improve lighting and environment conditions
Arduino based systems	Ayush Mahajan ,2019	Use Arduino to record student attendance	Easy to manage the system and the efficiency of the system in addition to the low cost	Lack of advanced features such as sending alerts

	Dr.Dhiraj Sunehra	Merge the Arduino with Raspberry Pi and AWS	Integrated and efficient system	Difficulties in continuous internet connection
Machine Learning Algorithms and Data Analysis	Nuha Alruwais et al.,2023	Machine learning algorithm using SVM with GBM	High accuracy in data analysis and high accuracy in performance classification	Relying on the size and quality of databases
	Esmael Ahmed,2024	Machine Learning for Big Data Analysis	Improving performance evaluation using databases	Limited size of available databases
	Ángel Manuel Guerrero-Higueras et al.,2018	Integrating performance analysis with extracurricular activities	Providing a comprehensive view of student performance	Inability to make accurate predictions of the future
	Chinthala Shivani et al., 2024	Analyzing student performance using big data	Improving the performance of academic and extracurricular activities	Challenges in the accuracy of future predictions
Embedded systems	Amira Shaikh et al., 2023	Integrated systems that combine attendance and performance evaluation	Improve accuracy and reduce errors	Poor performance when dealing with big data
	Donghao Liu, 2023	Integrated system for recording attendance and analyzing student performance	Provide a more comprehensive and effective system	Need to improve security and data analysis

Conclusion

This study has noted that the systems of recording attendance and evaluating student performance can develop considerably because of technological development, though however to implement these systems the challenges of the electronic mode yet have to emerge on such aspects as privacy, data analysis, and cost. To demonstrate a greater degree of efficiency, the researchers in the current study proposed the integration of technological solutions that comprise RFID, facial recognition, and Arduino to build hybrid systems. An open-source system, Arduino, has easy programming features, and is normally relatively cheap, thus very suitable for systems integration with various components like sensors and machine learning algorithms. The cheapness of Arduino due to its open-source with the usage of other technologies makes it easy to be accessed and used widely, particularly in the academia due to limited financial resources. Arduino encourages the implementation of machine learning algorithms. Through improving the integration of Arduino with algorithms such as SVM and GBM, the accuracy of student data analysis can be made more precise and assessments can be provided. Though there is a need for improved security, Arduino systems provide a flexible platform that can add strong encryption protocols to ensure the protection of personal data of the students, especially in biometric systems. Arduino-based systems will not only help to reduce human errors but will, in addition, based on the efficiency and cost-

effectiveness provide solutions that fit the requirements by educational institutions.

Acknowledgement

The authors would express their thanks to the College of Computer Sciences and Mathematics - University of Mosul for supporting this report.

Conflict of interest

None.

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