IJEMD-SS, 5 (1) (2026) https://doi.org/10.54938/ijemdss.2026.05.1.685

International Journal of Emerging Multidisciplinaries: Social Science

Research Paper
Journal Homepage: www.ojs.ijemd.com
ISSN (Online): 2958-0277

AI-Enabled Mobile Attendance System for Higher Education: Enhancing Accuracy, Scalability, Student Engagement, and Academic Performance

[1]Sidra Nazish, [2] Izharul Haq

1. MBA Global Business Administration, University of Gloustershire, United Kingdom
sidra.nazish14383@gmail.com

2. College of Sciences and Human Studies (CSHS), Mohammad Bin Fahd University, Al Khobar Dammam, Saudi Arabia

Ihaq@pmu.edu.sa

Abstract

Student attendance is widely recognized as a key indicator of academic success, classroom engagement, and institutional effectiveness. Accurate and timely attendance recording enables educators to monitor student participation and identify learners who may require early intervention. However, attendance management remains a challenging task in many higher education institutions, particularly in large classes where manual attendance recording is time-consuming, disruptive to teaching, susceptible to human error, and places a considerable administrative burden on instructors.

Existing attendance management solutions, including manual roll calls, card-based systems, biometric devices, QR codes, and facial recognition technologies, often suffer from limitations such as scalability issues, infrastructure requirements, high implementation costs, privacy concerns, susceptibility to misuse, or increased processing time as class sizes grow. Moreover, many of these systems simply record attendance without motivating students to attend classes punctually or providing meaningful real-time feedback to support student success.

This paper proposes an innovative AI-enabled attendance management system that leverages the widespread availability of smartphones to automate attendance recording in higher education. As smartphones have become an indispensable part of students' daily lives, they provide a convenient, accessible, and cost-effective platform for implementing an intelligent attendance solution without requiring specialized hardware. The proposed system is accurate, fast, scalable, and fully automated, performing consistently regardless of class size. Whether a class comprises fewer than 10 students or more than 200, the system records attendance efficiently without increasing the instructor's workload. It incorporates an incentive-based mechanism that rewards punctual and regular attendance, encouraging greater student engagement and accountability. In addition, the system provides students with real-time access to their cumulative attendance records and utilizes AI-driven analytics to examine the relationship between attendance and academic performance. The findings demonstrate a strong positive correlation between regular attendance and improved academic achievement. The proposed solution offers a practical, intelligent, and scalable framework that enhances teaching efficiency, supports data-driven decision-making, and contributes to improved learning outcomes in higher education institutions.

Keywords: AI-Enabled Attendance System, Mobile Based Attendance, Smartphone-Based Learning, Incentive-Based Learning, Educational Technology

1. Introduction

Attendance refers to the systematical procedure in assessing the class participation, for recording and tracking the presence of individual within an educational institute. Students who remain punctual and regular tend to achieve higher marks in class participation grading **(Haq et al., 2020).**

It is a fundamental administrative function that performs several key functions as monitoring the presence of individual, compliance with educational policies, support educational planning

within the higher educational institutes **(Abiodun et al., 2026).** The accuracy and efficiency of tracking student data are crucial elements that directly or indirectly influence educational outcomes, resource allocation, and institutional accountability **(Ajayi & Letseka, 2026).**

Several digital systems are available in this modern age, each serving different functions; Educational institutions adopt and integrate these systems to align with their organisational needs, pedagogical objectives, and administrative requirements. Such systems are generally categorized into several modern digital attendance technologies, including CCTV-based capturing, face recognition, QR-code scanning, ID card scanners, fingerprint biometrics, and shared-code verification methods. These technological represent the most commonly used approaches in universities today, and provide many benefits like, accuracy, time saving and convenience for managing student attendance etc.

Despite of several technological benefits these, modern digital attendance system in universities face many limitation related to privacy, accuracy, security concern, computational delays in large classroom, slower response in real time processing **(Al-Dabbagh, 2025**), Furthermore, the high cost of application development, expenses related to training and infrastructure, the allocation of additional time and resources, and multiple commands running on a single system can delay systematic responses. These factors create significant hurdles, affect desired outcomes, and reduce the efficiency of essential operations.

2. Digital Technologies in Attendance Management Systems in Higher Education and their Limitations

In modern era, numerous digital system have been mobilized to address student attendance in higher education. These systems can be divided into two primary categories: biometric and non-biometric system A biometric system primarily employs physical and structural characteristics as facial features, voice recognition, retina scan and fingerprints to recognize individuals. A salient benefit of these systems is the elimination of additional requirements for individuals to carry items for authentication, while providing quick and accurate identification through unique physical traits, on the other side, non-biometric attendance systems use alternative mechanisms for verifying attendance. These methods typically include QR codes, barcode identification, camera-based systems, ID cards, shared codes, password and wireless technologies such as Bluetooth communication **(Otta et al., 2023**).

These technological frameworks operate in different ways and carry certain functional limitations depending on their implementation **(Hasan et al., 2020).**

2.1 Face Recognition Attendance System

Facial recognition technology is increasingly being used to monitor classroom attendance. However the practical deployment facial recognition attendance system face significant

challenges including privacy risk, data risks, ethical and legal concerns, demographic bias, spooking risks, limits computing resources **(Herodotou et al., 2023).**

A primary concern is the risk of false recognition, where the system fails to detect the actual student and instead generates an incorrect result. Such inaccuracies can adversely affect the reliability of attendance records and reduce the overall effectiveness of the system **(Jain et al., 2016)**

2.2 QR Code Scanning Attendance System

QR code-based system has two systematical dimension barcodes that students scan with their mobile devices and record their appearances. The system preserve identity, data, and time in the database system and offer low cost and fast alternative as compare to manual attendance system. **(Jain et al., 2016)**

Despite systematical efficiency, QR systems have security concern as static codes can be copied or shared, enable proxy attendance. The system depends upon smartphone availability, access to the internet connection, and camera quality. Since QR codes merely rely on code verification instead of the individual, the system cannot ensure physical presence without additional verification such as biometrics, GPS, or facial recognition. **(Jain et al., 2004).**

2.3 ID Card Scanning Attendance System

ID card-related system interconnects with barcode, RFID, and NFC technologies to automate attendance recording. Every student carries a card with unique digital information that they scan to retrieves identity details and mark attendance. RFID/NFC systems are commonly use in universities as they offer fast identification, reduce administrative workload, and support large-scale data **(Al-Dabbagh, 2025).**

Instead these benefits, ID card systems have several limitations as they only verify card possession rather than the student. The card can be lost, shared with other students, and can get damage or duplicated. Additionally, RFID/NFC systems require appropriate hardware requirement, maintenance, and security measures for preventing unauthorized cloning

2.4 Share Code Verification Attendance System

Share-code produce a temporary verification code and sends to authorized users by registered devices or application. The users input the code on the device and confirm identification. This method commonly used in multi-factor authentication for adding extra security feature beyond password **(Kotevski et al., 2018).**

Although effective, share-code has several operational and security issues as the system rely on stable network connection and access to registered device. Share-code may get delayed due to expire or incorrectly entered codes. Security risks of phishing, social engineering, or device

compromise allow hackers to obtain verification codes. In large classrooms, manual code entry can reduce efficiency as compare to automated biometric method.

Based on my experience, when a teacher shares a QR code in a class of approximately 200 students, some students forward the QR code to classmates who are absent. Consequently, absent students can scan the shared QR code and be marked as present. This practice reduces the effectiveness of the attendance system and compromises the accuracy and reliability of the collected attendance data.

2.5 Fingerprint Biometric Attendance System

Fingerprint biometric system identity students by analyzing their unique fingerprint feature and match them with stored templates. As unique fingerprints are difficult to replicate, such system provide stronger authentication as compare to cards or passwords. Fingerprint is widely use in educational institutes **(Kulkarni & Gkountouna, 2021).**

Despite high accuracy result, the system have limitation as it can effect performance due to dirty sensors, damage or low quality fingerprints or environmental condition, additional cost is required for implementation of system, system require strong encryption, secure storage and compliances with regulation, further it raise hygiene issues due to multiple fingerprint contacts **(Lwande et al., 2025).**

3. Mobiles for Data Capture About Student Learning and Engagement

The widespread availability of mobile phone devices provides great opportunities for performing classroom teaching and learning through bring-your-own-device strategies. Almost every student carries a mobile phone, which can be used as an effective educational tool instead of only a communication device. Upon entering the classroom, a student can mark himself as present, which eliminates the need for the teacher to call names or maintain the attendance record. This method helps save valuable time and ensures accuracy in the records. Furthermore, it enables the automatic tracking of attendance patterns, punctuality, and classroom presence **(Li et al., 2023).**

Beyond attendance, mobile phone applications can engage students in learning activities throughout the lesson. Students can answer questions, take participation in quizzes and topic discussions, and the system can automatically detect and save the participation of each individual **(Lwande et al., 2025)** because each mobile phone device is uniquely associated with a specific student. Further, the unique application can identify the interest of each student, their frequency in participation, level of engagement, etc. Moreover, classroom activities can also be digitalized, as students may complete an exercise, take a snap, and submit it within seconds for evaluation **(Muir, 2009).** The convenience, speed, and availability of mobile devices make them

a desirable platform for collecting academic data and engaging students within the learning process.

The ongoing and single-instance collection of attendance, participation, assessment, and classroom activity data contributes to a detailed learner profile for each student. AI integrated into the mobile application can analyze this data to identify trends, learning patterns, strengths, weaknesses, and individual progress over time. Such insights help teachers implement different strategies in learning and provide immediate intervention for those who are at risk further make evidence-based pedagogical decisions **(Patel et al., 2025).** Consequently, the proposed AI-enabled mobile learning system will not only automate routine learning but also support data-driven teaching strategies and personalized learning, ultimately enhancing student engagement, academic performance, and overall learning outcomes.

3.1 AI for Data Analysis and Inference

Artificial intelligence (AI) has changed the methodology through which educational data are collected, analyzed, and interpreted. In a mobile-enabled classroom, students actively participate by using their own smart phones to answer questions, engage in discussions, respond to polls, and submit quizzes. Each interaction generates authentic data, including participation frequency; answer accuracy, response time, attendance records, and overall engagement levels. AI algorithms can easily process these large volumes of data in a short time, providing valuable insights that are difficult for educators to obtain manually.

AI-based data analysis examines statistical modeling and pattern-recognition techniques to identify trends and patterns within classroom participation data **(Ajayi & Letseka, 2026).** For example, the system can identify students who participate regularly, analyze those who demonstrate minimal participation, examine their level of involvement during a lecture, and measure participation trends over time.

In addition to descriptive analysis, Al enabled support predictive inference by predicting future academic performance using past participation data [20]. Students who frequently arrive late and take less participation in classroom activities can be identified as being at risk of underachievement. Early identification helps instructors intervene promptly by providing personalized support, additional learning resources, and constructive feedback before academic difficulties become severe. Such predictive analytical contributions significantly help improve student retention, motivation, and overall learning outcomes **(Sarker, 2021)**

AI supports analytical prescriptive processes by recommending appropriate instructional strategies **(Ajayi & Letseka, 2026).** For example, if the system detects that a student is losing concentration while studying, it may suggest strategies such as introducing interactive quizzes or incorporating collaborative activities. Consequently, teachers can identify topics that students find difficult to learn and adjust their teaching accordingly. Additionally, dashboards provide visual insights, engagement metrics, and patterns of student participation, along with learning

indicators that support evidence-based decision-making throughout the semester **(Tang & Su, 2024).**

One important advantage of AI is its ability to identify the relationship between classroom participation and academic performance. Statistical and machine learning models can help quantify the correlation among participation, attendance, assessment performance, and final examination results. These strategic approaches help educators to evaluate teaching strategies, improve course design, and develop personalized leaning pathways. Consequently, AI transforms raw classroom data collected with the help of mobile devices into actionable educational intelligence, ultimately benefiting students, instructors, and institutional administrators **(Tang & Su, 2024).**

While AI provides substantial educational benefits, ethical considerations remain an important factor. There should be transparency in the collection of student data, and all data must be analyzed in compliance with privacy regulations **(Want, 2006).** Al system should ensure fairness among student, minimize algorithmic biasness, and offer explainable recommendations where educational decisions remain transparent and accountable **(Rehman and Ferraro 2026).**

3.2 Innovative and AI-Enable Mobile Attendance System

Smartphones in educational technology are increasingly reshaping teaching and are viewed as valuable educational resources rather than distractions. Historically, smartphones were treated as the ultimate enemy of focus and were banned or hidden in the back pocket. Educators are now embracing the importance of BYOD (bring-your-own-devices) as the infrastructure for such a technological revolution already exists with the students.

Instead of fighting the fact that almost every student carries a mobile phone which is now recognised by educators as an emerging and powerful educational tool, educators can reach students more effectively. It is a total game changer for students, who can use their own devices more comfortably to boost their academic lives.

The foundation of such whole revolution is simply and ubiquity, as the infrastructure arrives through the classroom doors every morning in students' pockets. A significant untapped resource exists within schools. Consider tedious time consuming roll calls that just eat up valuable instructional time and resources.

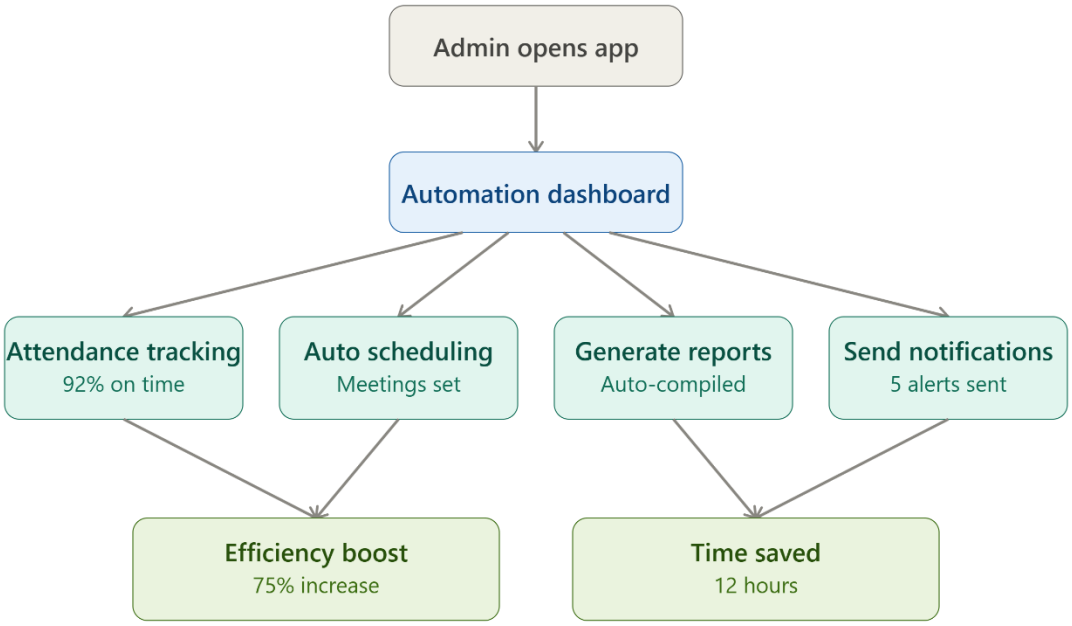


Figure 1: Flow Chart Automating Administrative Task

Despite knowing the fact that other modern systems have several limitations, AI-enabled attendance apps provide an immediate solution that helps reduce excessive administrative tasks and make the process more efficient and automated. Upon entering the classroom, a student can open the mobile app and tap a button that records their attendance. Whether there are ten students or two hundred, attendance is captured instantly and accurately. The system uses geofencing technology, which ensures that students can only mark their attendance when they are physically present within the classroom vicinity. If they are outside the designated area, the app restricts access, preventing false or proxy attendance. This intelligent feature enhances reliability, transparency, and accountability in the attendance process while minimizing administrative workload.

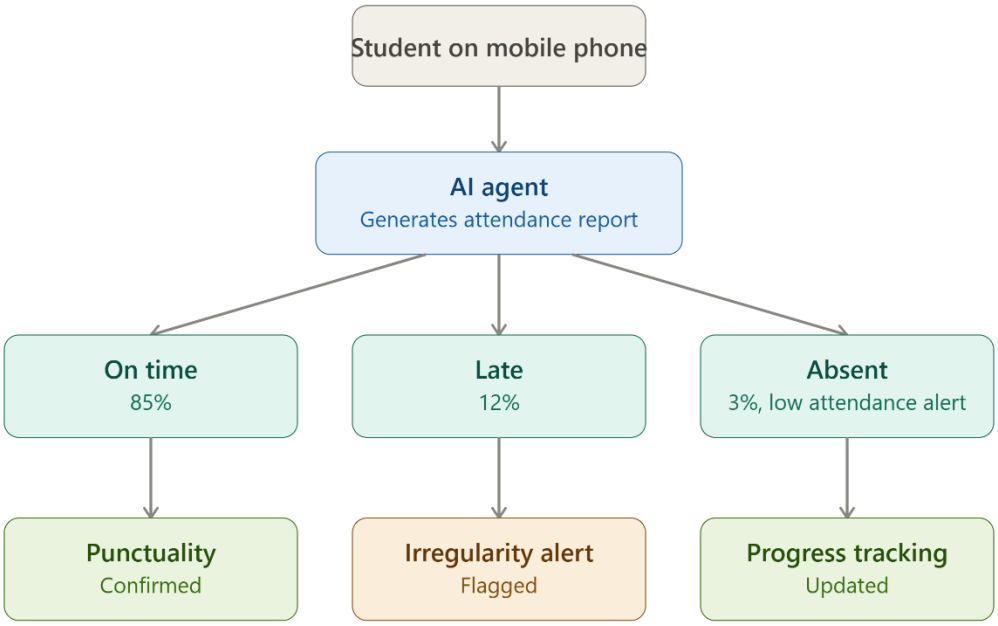


Figure 2: Process Flow of the AI Mobile Attendance Reporting System

AI agent in the mobile phone can consistently monitor and support individual improvement as the attendance app can track each student's attendance behavior. It records punctuality and notifies irregularity to both the student and the teacher. Such early intervention will help take preventive action before it becomes a serious issue at the end of the semester.

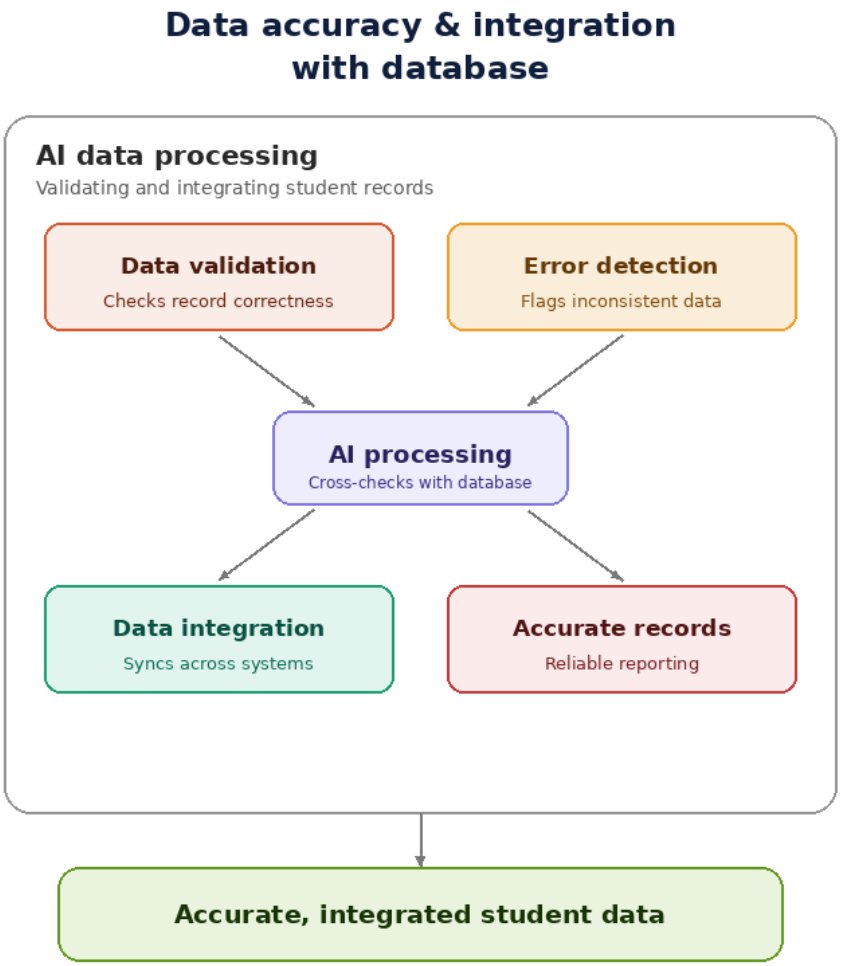


Figure 3: Data Accuracy Diagram

AI-enabled mobile attendance app improves accuracy and data efficiency by eliminating human or other systematical errors, preventing proxy attendance, and breach of academic attendance policy because the system verifies identity through features like device authentication, time stamps, or location checks. The attendance data becomes more efficient, fast, reliable, and consistent. The automated process also synchronizes data more correctly with academic databases, making the entire attendance process more precise, efficient, and difficult to manipulate.

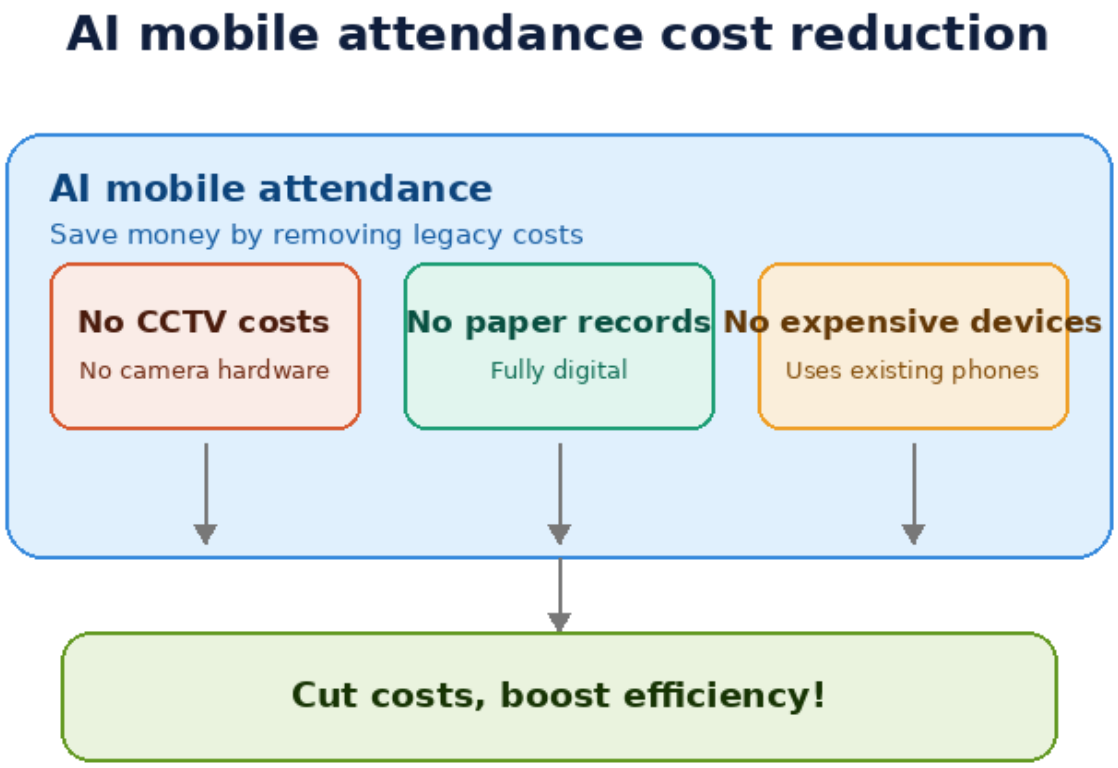


Figure 4: AI-Driven Mobile Attendance Cost Reduction Framework

AI-enabled mobile attendance apps significantly reduce operational costs by eliminating excessive record-keeping, excessive DATA , CCTV-based monitoring, attendance machines, and additional manpower for administrative tasks. No additional infrastructure is required, and there is no extra cost for training or other resources.

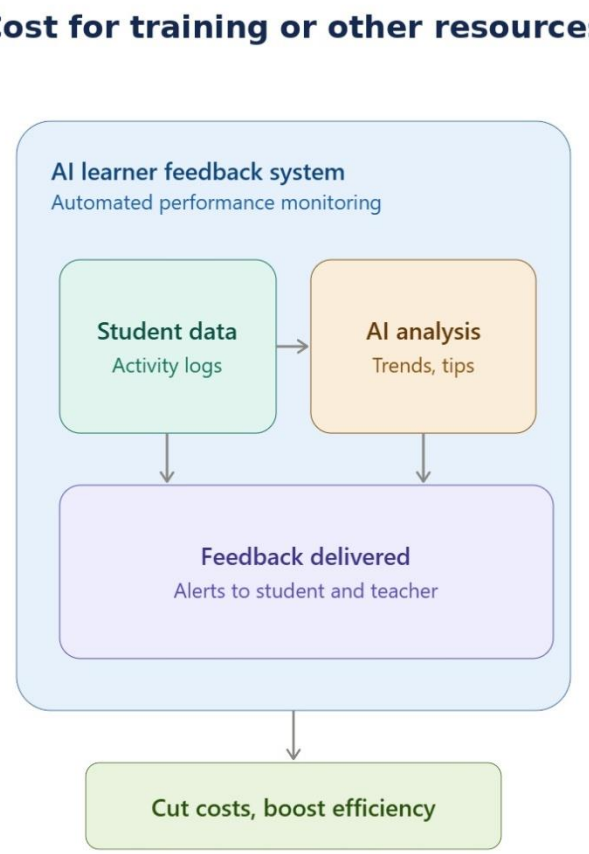


Figure 5: Process Diagram for Feedback Delivery

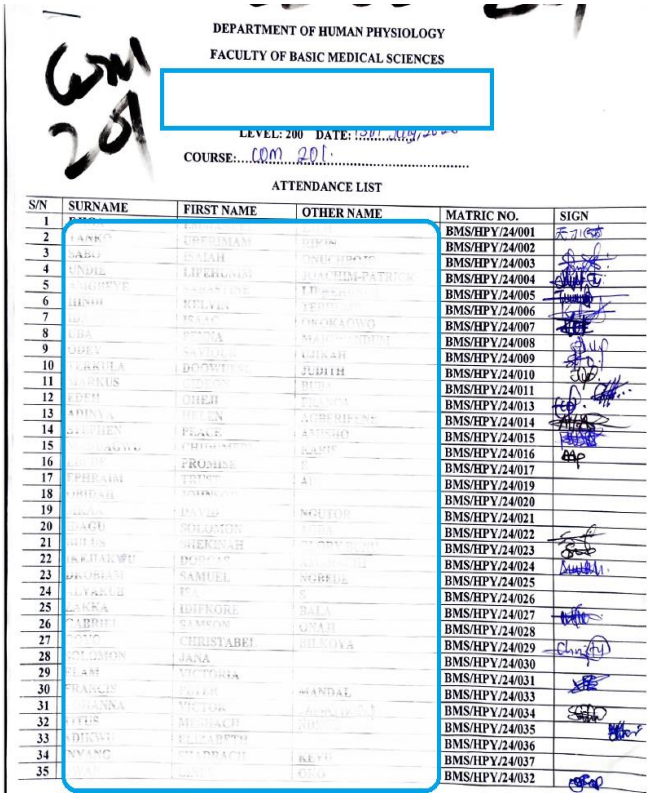
AI enabled mobile attendance systems help in the development of complete student profiles by collecting constant data on attendance, engagement, and participation. Because this device can provide individual student data, the system can monitor the participation of each student and their performance and involvement in class activities. This system also provides teachers with personalised feedback through the app. This system also provides teachers with personalized feedback through the app. In addition, the device system generates behavioral patterns, highlights areas for improvement, looks at performance trends, and helps educators adopt the right instructional approaches. It also supports teachers in making informed decisions that are beneficial for overall student performance.

6. Results and Discussion

A pilot implementation of the proposed AI-enabled mobile attendance system is planned across diverse set of higher education institutes, including two African universities, one university in Pakistan and subjected to feasibility on university in the United Kingdom. The primary goal of

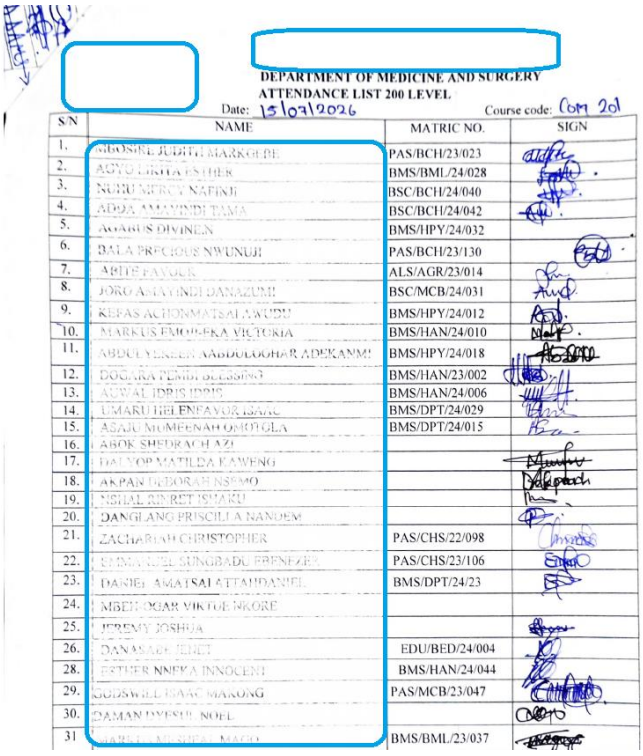
the pilot is to examine how effectively, accurately, and reliably the AI- enable mobile attendance solution performs, as well as its usability and scalability in diverse institutional settings.

A preliminary review of current attendance management practices reveals that many universities continue to depend on manual attendance systems, even though advanced digital attendance systems do not accurately record the exact arrival of students or distinguish between punctual and late attendance. Although such systems simplify attendance recording, they often lack advanced features such as real-time verification, intelligent analysis, and comprehensive student performance monitoring



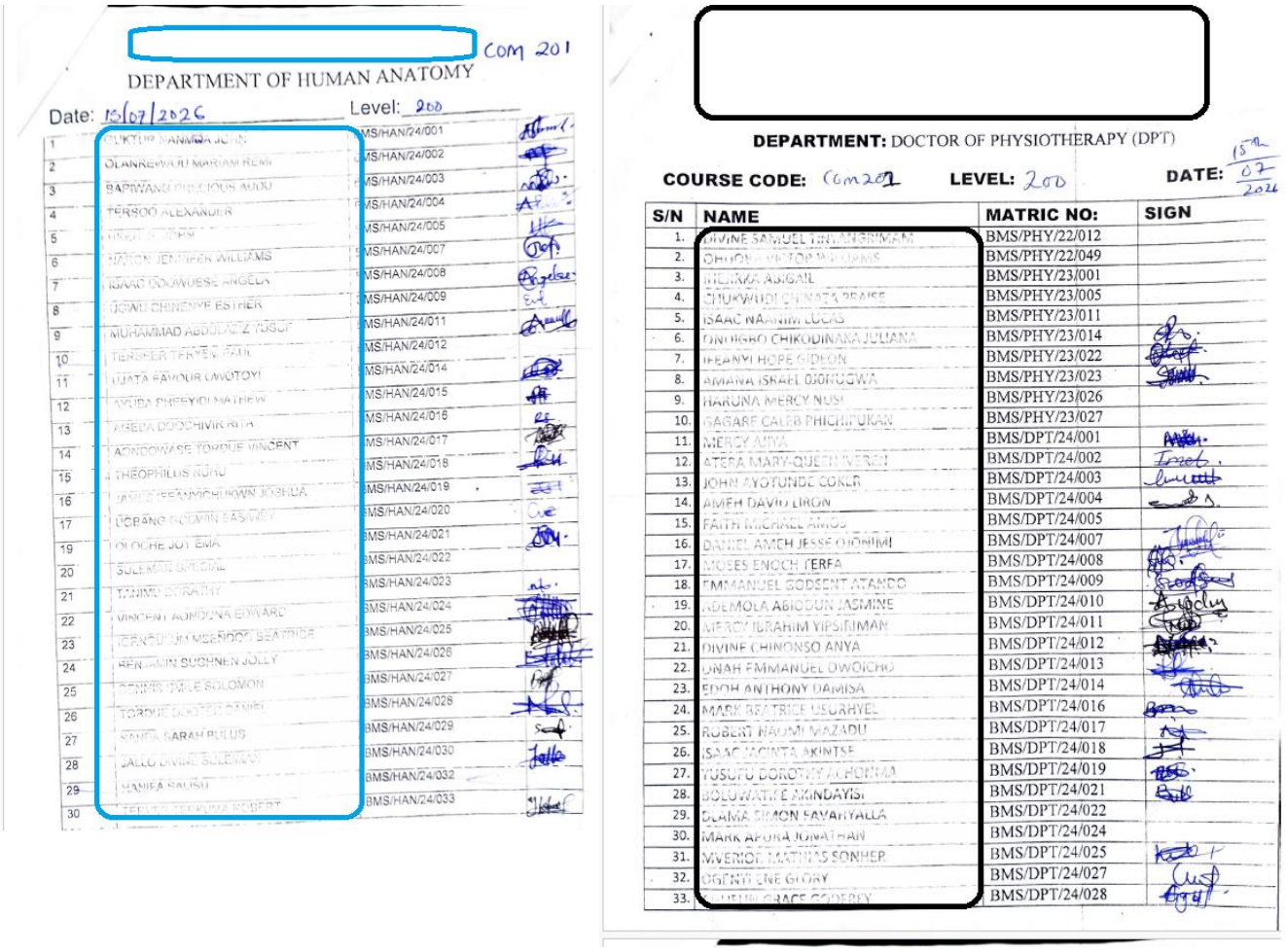
DEPARTMENT OF HUMAN PHYSIOLOGY
FACULTY OF BASIC MEDICAL SCIENCES
LEVEL: 200 DATE:
COURSE: COM 201
ATTENDANCE LIST

S/N	SURNAME	FIRST NAME	OTHER NAME	MATRIC NO.	SIGN
1				BMS/HPY/24/001	
2				BMS/HPY/24/002	
3				BMS/HPY/24/003	
4				BMS/HPY/24/004	
5				BMS/HPY/24/005	
6				BMS/HPY/24/006	
7				BMS/HPY/24/007	
8				BMS/HPY/24/008	
9				BMS/HPY/24/009	
10			JUDITH	BMS/HPY/24/010	
11				BMS/HPY/24/011	
12				BMS/HPY/24/013	
13				BMS/HPY/24/014	
14				BMS/HPY/24/015	
15				BMS/HPY/24/016	
16				BMS/HPY/24/017	
17				BMS/HPY/24/019	
18				BMS/HPY/24/020	
19				BMS/HPY/24/021	
20				BMS/HPY/24/022	
21				BMS/HPY/24/023	
22				BMS/HPY/24/024	
23				BMS/HPY/24/025	
24				BMS/HPY/24/026	
25				BMS/HPY/24/027	
26				BMS/HPY/24/028	
27				BMS/HPY/24/029	
28				BMS/HPY/24/030	
29				BMS/HPY/24/031	
30				BMS/HPY/24/033	
31				BMS/HPY/24/034	
32				BMS/HPY/24/035	
33				BMS/HPY/24/036	
34				BMS/HPY/24/037	
35				BMS/HPY/24/032	



DEPARTMENT OF MEDICINE AND SURGERY
ATTENDANCE LIST 200 LEVEL
Date: 15/07/2026 Course code: Com 201

S/N	NAME	MATRIC NO.	SIGN
1.	MBOSIRE JUDITH MARKGEBE	PAS/BCH/23/023	
2.	AOYO LISTA ESTHER	BMS/BML/24/028	
3.	NURU MERCY NAFINI	BSC/BCH/24/040	
4.	ADOA AMAVINDE TAMA	BSC/BCH/24/042	
5.	AGABUS DIVINEN	BMS/HPY/24/032	
6.	BALA PRECIOUS NWUNUH	PAS/BCH/23/130	
7.	ARTIE FAVOUR	ALS/AGR/23/014	
8.	JORO ATAYINDI DANAZUMI	BSC/MCB/24/031	
9.	KEFAS ACHONMATSALAWUDU	BMS/HPY/24/012	
10.	MARKUS EMOBEKA VICTORIA	BMS/HAN/24/010	
11.	ABDULYEKEEN ABDULGOHAR ADEKANMI	BMS/HPY/24/018	
12.	DOGARA TENDI BLESSING	BMS/HAN/23/002	
13.	ACWAL IDRIS IDRIS	BMS/HAN/24/006	
14.	UMARU HELENFAVOR ISAAC	BMS/DPT/24/029	
15.	ASAJU MUMEENAH OMOTOLA	BMS/DPT/24/015	
16.	ABOK SHEDRACH AZI		
17.	DALYOP MATILDA KAWENG		
18.	AKPAN VICTORIAN NSEMO		
19.	YUSUF ASHIRET IYIMARU		
20.	DANGLANG PRISCILLA NANDEM		
21.	ZACHARIAH CHRISTOPHER	PAS/CHS/22/098	
22.	EMMANUEL SUNGBADU EBENEZER	PAS/CHS/23/106	
23.	DANIEL AMAISAI ATTAHDANIEL	BMS/DPT/24/23	
24.	MBEH OGAR VIRTUE NKORE		
25.	JEREMY JOSHUA		
26.	DANASABE JENET	EDU/BED/24/004	
28.	ESTHER NNEKA INNOCENT	BMS/HAN/24/044	
29.	GODSWILL ISAAC MASONG	PAS/MCB/23/047	
30.	DAMAN DYESU NOEL		
31	[illegible]	BMS/BML/23/037	



DEPARTMENT OF HUMAN ANATOMY

Date: 15/07/2026 Level: 200

COM 201

DEPARTMENT: DOCTOR OF PHYSIOTHERAPY (DPT)

COURSE CODE: COM201 LEVEL: 200 DATE: 15/07/2026

S/N	NAME	MATRIC NO:	SIGN
1.	DIVINE SAMUEL TINI ANSINMA	BMS/PHY/22/012	
2.	OHUOBA VICTOR WILLIAMS	BMS/PHY/22/049	
3.	NWAKA ABIGAIL	BMS/PHY/23/001	
4.	NWUKWUDI CHINAZA PEARL	BMS/PHY/23/005	
5.	ISAAC NAANIM LUCAS	BMS/PHY/23/011	
6.	ONUIGBO CHIKODINAKA JULIANA	BMS/PHY/23/014	
7.	IFEANYI HOPE SIDEON	BMS/PHY/23/022	
8.	AMANA ISRAEL OJONUGWA	BMS/PHY/23/023	
9.	HARUNA MERCY NUSI	BMS/PHY/23/026	
10.	SAGARE CALEB PHICHINUKAN	BMS/PHY/23/027	
11.	MERCY AIYA	BMS/DPT/24/001	
12.	ATERA MARY-QUEEN IVEREN	BMS/DPT/24/002	
13.	JOHN AYOTUNDE COKER	BMS/DPT/24/003	
14.	AMEH DAVID ELIJON	BMS/DPT/24/004	
15.	FAITH MICHAEL AMOS	BMS/DPT/24/005	
16.	DANIEL AMEH JESSE OJONIMI	BMS/DPT/24/007	
17.	MOSES ENOCH TERFA	BMS/DPT/24/008	
18.	EMMANUEL GODSENT ATANDO	BMS/DPT/24/009	
19.	ADEMOLA ABIODUN JASMINE	BMS/DPT/24/010	
20.	MERCY IBRAHIM YIPSIRIMAN	BMS/DPT/24/011	
21.	DIVINE CHINONSO ANYA	BMS/DPT/24/012	
22.	JONAH EMMANUEL OWOICHO	BMS/DPT/24/013	
23.	EDOH ANTHONY DAMISA	BMS/DPT/24/014	
24.	MARK BEATRICE USGAHYEL	BMS/DPT/24/016	
25.	ROBERT NAOMI MAZADU	BMS/DPT/24/017	
26.	ISAAC HACINTA AKINTSE	BMS/DPT/24/018	
27.	YUSUFU DOROTHY ALHONMA	BMS/DPT/24/019	
28.	SOLUWATIFE AKINDAYISI	BMS/DPT/24/021	
29.	DAMA SIMON FAVOUYALLA	BMS/DPT/24/022	
30.	MARK APUNA JONATHAN	BMS/DPT/24/024	
31.	MVERIOT MATHIAS SONHEP	BMS/DPT/24/025	
32.	OGENTI ENE GLORY	BMS/DPT/24/027	
33.	[illegible] GRACE GODFREY	BMS/DPT/24/028	

Figure 6: Current Attendance System Illusion for Universities

The proposed AI-enabled mobile attendance system effectively overcomes these limitations by introducing a fully automated, fast, accurate, and reliable system. Upon entering the designated classroom, students receive an attendance prompt on their devices, while the system automatically records their attendance status and timestamp without requiring assistance from instructor. The pilot study will gather quantitative and qualitative data to evaluate improvement in the attendance management system, reducing excessive workload, processing time, user satisfaction, and operational efficiency.

The proposed system represents a substantial advancement over both traditional manual attendance methods and existing electronic attendance systems. In contrast to current attendance practices that significantly depend upon instructor participation and consume valuable teaching time, the proposed system enables automated attendance recording while simultaneously capturing precise timestamps for every student.

With the availability of accurate and punctual attendance data, institutions can enable advanced, AI-based learning analytics. Such data can be correlated with classroom participation, assessment performance, pedagogical strategies, and final academic outcomes to identify student behaviour patterns and predict students who are at risk of poor academic performance. Such insights provide instructors with opportunities to make early interventions, enhance personalized academic support, and strengthen evidence-based decision-making.

The multi-country pilot implementation will evaluate the robustness and adaptability of the proposed solution across different institutional contexts, technological infrastructure, and cultural environments. The evidence-based outcomes demonstrate whether the system can be deployed successfully at scale in higher educational institutions.

7. Conclusion

This research introduces an innovative AI-enabled mobile attendance system which design to eliminate the limitations of traditional attendance method. The proposed system automatically capture and record accurate real time attendance data without the instructor involvement, contributing to enhance the efficiency of teaching methodology, improve data reliability and enhance AI driven educational analytics.

8. Future Work

Future work will advance toward broad implementation and comprehensive evaluation of the proposed AI-enabled mobile attendance system among selected universities in Africa, Pakistan, and the United Kingdom. The pilot study will generate empirical evidence regarding the system's operational effectiveness, stability, scalability, and user satisfaction. As part of automation attendance evaluation, future research will investigate the integration of attendance data with AI-driven learning analytics for assessing the relationship among attendance, classroom learning participation, instructional engagement, punctuality, and educational performance.

The outcomes of the pilot are expected to confirm the proposed methodology, improve fault-free system functionality, and advance the institutional adoption of intelligent attendance systems as a key pillar of next-generation smart classrooms and AI-enabled digital universities.

References

[1] Haq, I., Haq, R., & Ahmed, M. (2020). Using the ROFSET framework in tracking, measuring and analysing student participation and engagement in class. *INTCESS 2020 – 7th International Conference on Education and Social Sciences*. https://share.google/6VDMWN4rVyzWCa7eS

[2] Abiodun, E. O., Abiodun, O. I., Alawida, M., Abu Shawar, B., & Mehmood, A. (2026). LaED: A novel lightweight, edge-aware and explainable deep learning model for privacy-preserving facial attendance tracking in resource-constrained educational environments. Scientific Reports, 16, Article 15215. https://doi.org/10.1038/s41598-026-42051-8

[3] Ajayi, O. E., & Letseka, M. (2026). From engagement to outcomes: AI-driven learning analytics in higher education—Insights for South Africa. Trends in Higher Education, 5(1), 16. https://doi.org/10.3390/the5010016

[4] Al-Dabbagh, M. M. (2025). A review of students attendance management systems. Eurasian Journal of Science and Engineering, 10(3), 136–145. https://doi.org/10.23918/eajse.v10i3p13

[5] Otta, S. P., Panda, S., Gupta, M., & Hota, C. (2023). A systematic survey of multi-factor authentication for cloud infrastructure. *Future Internet*, *15*(4), Article 146. https://doi.org/10.3390/fi15040146

[6] Hafeez-ur-Rehman, & Angelo Viglianisi Ferraro. (2026). Artificial Intelligence and Big Data in Disaster Risk Management from a Socio-Legal Perspective. *International Journal of Emerging Multidisciplinaries: Social Science*, *5*(2), 273–290. https://doi.org/10.54938/ijemdss.2026.05.2.682

[7] Hasan, M. M., Islam, M. M., & Karim, M. R. (2020). Smart attendance system using QR code. In 2020 9th Mediterranean Conference on Embedded Computing (MECO) (pp. 1–4). https://doi.org/10.1109/MECO49872.2020.9134225

[8] Herodotou, C., Maguire, C., Hlosta, M., & Mulholland, P. (2023). Predictive learning analytics and university teachers: Usage and perceptions three years post implementation. In Proceedings of the 13th International Learning Analytics and Knowledge Conference (LAK23) (pp. 68–78). Association for Computing Machinery. https://doi.org/10.1145/3576050.3576061

[9] Jain, A. K., Nandakumar, K., & Ross, A. (2016). 50 years of biometric research: Accomplishments, challenges, and opportunities. Pattern Recognition Letters, 79, 80–105. https://doi.org/10.1016/j.patrec.2015.12.013

[10] Jain, A. K., Ross, A., & Prabhakar, S. (2004). An introduction to biometric recognition. IEEE Transactions on Circuits and Systems for Video Technology, 14(1), 4–20. https://doi.org/10.1109/TCSVT.2003.818349

[11] Kotevski, Z., Blazheska-Tabakovska, N., Bocevska, A., & Dimovski, T. (2018). On the technologies and systems for student attendance tracking. *International Journal of Information Technology and Computer Science*, *10*(10), 44–52. doi.org. MECS-Press Digital Archive

[12] Kulkarni, A., & Gkountouna, O. (2021). Demonstrating REACT: A real-time educational AI-powered classroom tool. In Proceedings of the 14th International Conference on Educational Data Mining (EDM).

[13] Li, L., Chen, C. P., Wang, L., Liang, K., & Bao, W. (2023). Exploring artificial intelligence in smart education: Real-time classroom behavior analysis with embedded devices. Sustainability, 15(10), 7940. https://doi.org/10.3390/su15107940

[14] Lwande, M., Muchemi, D., & Raymond, C. (2025). Integrating mobile learning technology for engagement and baseline assessments in science learning. In Proceedings of the International Conference on Education and New Developments (END) (pp. 588–592). https://doi.org/10.36315/2025v2end127

[15] Muir, J. (2009). Student attendance: Is it important, and what do students think? CEBE Transactions, 6(2), 50–69. https://doi.org/10.11120/tran.2009.06020050

[16] Patel, J., Gandhi, S., Katheriya, V., Pataliya, P., & Majumdar, A. (2025). Enhancing classroom attendance systems with face recognition through CCTV using deep learning. Procedia Computer Science, 258, 3031–3041.

[17] Sarker, I. H. (2021). Data science and analytics: An overview from data-driven smart computing, decision-making and applications perspective. SN Computer Science, 2(5), 1–22. https://doi.org/10.1007/s42979-021-00765-8

[18] Tang, L., & Su, Y.-S. (2024). Ethical implications and principles of using artificial intelligence models in the classroom: A systematic literature review. International

Journal of Interactive Multimedia and Artificial Intelligence, 8(5), 25–36. https://doi.org/10.9781/ijimai.2024.02.010

[19] Want, A. (2006). An introduction to RFID technology. Pervasive Computing, 5(1), 25–33. https://doi.org/10.1109/MPRV.2006.2