Journal of Technical and Vocational Education (JTVE), Vol 11 No 1 (April, 2026)
e-ISSN 2682-0821 http://upikpolimas.edu.my/ojs/

GRADVIEW+: Development of A Digital Graduate Identification System for Convocation Events

Sa'adiah Binti Mohamad[1], Muhammad Khairi Bin Saad[2], Ts. Abdul Aziz Ab Nasir[1]
[1]Department of Information and Communication Technology, [2]Electrical Engineering Department,
Politeknik Sultan Abdul Halim Muádzam Shah (POLIMAS), Kedah

Abstract: Convocation ceremonies are important events in higher education institutions. However, they often face operational challenges such as manual graduate verification, inaccurate name announcements, and inefficient ceremony management. These challenges may lead to delays, increased human error, and a less satisfactory experience for graduates and attendees. To address these issues, this study introduces GRADVIEW+, a graduate identification system developed using an Agile development approach that supports iterative design, continuous testing, and ongoing improvement. The system aims to improve the efficiency, accuracy, and coordination of convocation events across higher education institutions. GRADVIEW+ uses barcode technology as a unique identifier for each graduate, enabling faster and more reliable verification while retaining limited manual intervention where required. Compared with RFID-based solutions, the system offers advantages in cost efficiency, ease of deployment, and compatibility with existing infrastructure, making it a practical option for institutions with limited resources. GRADVIEW+ is integrated with a web-based application developed using Python and the Flask framework, enabling centralized management of graduate data. Graduate information is retrieved from a centralized database and displayed in real time on multiple screens to support accurate and timely communication during the ceremony. The system emphasizes reliability, scalability, and flexibility, allowing adaptation to institutions of different sizes and technical capacities. GRADVIEW+ has been successfully implemented in actual convocation ceremonies, demonstrating its practicality and effectiveness. Overall, the findings show that the proposed system provides a reliable and cost-effective solution for improving convocation operations and enhancing the graduate experience.

Keywords: Convocation Management, Graduate Identification, Barcode Technology

1. INTRODUCTION

1.1 Background of the Study

Convocation ceremonies are significant events in higher education that celebrate the achievements of graduates. Behind the formal proceedings, these events require careful coordination to ensure that each graduate is correctly verified and announced without disruption. Despite ongoing digital transformation in higher education, many institutions continue to rely on manual or semi- digital processes for convocation management, which can introduce errors and delays.

Traditional practices often lack real-time integration and centralized data management, meaning that even small errors can affect the flow of the ceremony and the overall graduate experience. As institutions strive to improve operational efficiency and reduce human error, the need for a practical, reliable, and cost-effective digital identification system becomes increasingly important.

1.2 Problem Statement

Convocation ceremonies require accurate graduate verification and timely announcements to ensure smooth execution. Although some institutions have adopted digital technologies, such as RFID-based systems, challenges remain that limit their effectiveness and often necessitate manual or semi-automated interventions. For instance, RFID technology is commonly used for basic functions, such as robe tracking or identification, rather than providing comprehensive, real-time verification and flexible visual display of graduate information (Sinar Harian, 2022). At Politeknik Sultan Abdul Halim Mu'adzam Shah (POLIMAS), the previous RFID-based system faced practical limitations in its implementation. These included high operational costs, fixed display layouts, and the absence of a mechanism for graduates to verify or double-check their information before stepping onto the stage. Such limitations increased the risk of errors in name announcements and disrupted the ceremony flow.

Research also indicates that technological integration and flexible system design remain major challenges in higher education, with many institutions still experiencing fragmented systems, partial automation, and inconsistent adoption of digital tools (MDPI, 2023). These constraints hinder real- time data coordination and reduce the reliability of convocation operations. Taken together, these issues highlight the need for a cost-effective, flexible, and reliable identification and display system. The proposed system, GRADVIEW+, addresses this gap by introducing a barcode-based approach that supports real-time graduate verification, customizable visual displays, and scalable deployment suitable for institutions with limited resources.

1.3 Research Objectives and Research Questions

The specific objectives of this study are:

i. To design and develop the GRADVIEW+ system as a barcode-based solution for graduate identification and convocation management, incorporating system flexibility, cost-effectiveness, and personalized real-time display of graduate information during ceremonies.

ii. To evaluate user acceptance of the GRADVIEW+ system in terms of the practicality of the barcode card, efficiency of the scanning process, and overall usefulness during live convocation implementation.

The study addresses the following research questions:

i. How can the GRADVIEW+ system be designed and developed as a barcode-based solution for graduate identification and convocation management?

ii. How do graduates perceive the GRADVIEW+ system in terms of the practicality of the barcode card, efficiency of the scanning process, and overall usefulness during convocation ceremonies?

1.4 Organization of the Paper

The remainder of this paper is structured as follows: Section 2 reviews related literature; Section 3 explains the research methodology and system development; Section 4 presents the implementation and evaluation results; and Section 5 concludes the study and outlines future improvements.

2. LITERATURE REVIEW

2.1 Digital Transformation in Convocation Management

Recent studies in educational technology and event management emphasize the need to modernize manual processes through automated identification and tracking systems. While digital tools are widely adopted in academic administration, convocation ceremonies often still rely on printed lists, spreadsheets, and manual sequencing. Such approaches are prone to delays, duplication errors, and coordination issues, particularly in large-scale events. These limitations highlight convocation management as an underexplored area for digital automation.

2.2 Barcode and QR Code Technologies in Educational Contexts

Barcode and QR code technologies are now commonly used as simple and cost-effective identification tools in educational settings. QR codes allow information to be stored and quickly accessed using smartphones or scanners. Studies have shown that QR-based systems can help reduce administrative work and improve the accuracy of attendance records (Gupta et al., 2025).
Malaysian research also supports the use of QR code systems in higher education. For example, Abdul Karim and Abdullah (2020) found that students responded positively to a QR code attendance system used at Universiti Utara Malaysia. The system was seen as easy to use, time-saving, and cost-effective. However, most studies focus on classroom attendance. The use of QR code systems for larger academic events, such as convocation ceremonies, has not been widely studied. Therefore, more research is needed to examine how QR technology can support convocation management.

2.3 Comparison with RFID-Based Systems

RFID technology offers automated, contactless identification and high-speed detection. However, its implementation requires specialized tags, readers, and supporting infrastructure, leading to higher costs and maintenance requirements. In contrast, barcode and QR systems are more economical, easier to deploy, and compatible with existing mobile devices
QR codes offer good flexibility because they can be generated and updated easily if there are last-minute changes to participant lists. Security features such as unique or encrypted QR codes can also help prevent proxy scanning or unauthorized duplication. This helps ensure that attendance records remain accurate and reliable (Zakaria et al., 2021). Because of these advantages, QR-based systems can be useful for managing large events such as convocation ceremonies, especially in institutions with limited resources.

2.4 Python and Flask Integration

System architecture is important in developing an automated convocation management system. Python can support QR code generation, database integration, and data processing, while Flask allows the system to run as a web-based application with routing and real-time validation. Previous studies show that QR code attendance systems can manage data efficiently and synchronize attendance records in real time (Gupta et al., 2025). However, most existing systems are designed for classroom attendance monitoring. This shows that there is still a need for systems that are specifically designed to support convocation management processes.

2.5 Research Gap

Although QR and barcode technologies are widely used in educational settings, their use in formal academic ceremonies is still limited. Events such as convocation require accurate verification, real-time sequencing, and coordinated information display. Therefore, this study proposes GRADVIEW+, a barcode-based graduate identification system integrated with Python and Flask to improve verification accuracy and support more efficient convocation management.

3. METHODOLOGY

3.1 The Development of GRADVIEW+

This study adopted an Agile development methodology to design, implement, and evaluate GRADVIEW+, a barcode-based convocation management system. Agile emphasizes iterative development, continuous feedback, and incremental delivery, making it suitable for technological systems that must closely align with user needs (Maulana et al., 2022; Rafai et al., 2024).

Unlike conventional linear development models, the Agile methodology is an iterative and incremental framework that enables project work to evolve through repeated cycles of planning, design, development, testing, deployment, and review. This approach supports continuous refinement, stakeholder feedback, and adaptability to changing requirements, making it well-suited for software and system development projects (Laoyan, 2022; Mar'atuttahirah et al., 2025)

Figure 1: Agile Methodology Framework (Laoyan, S.,2022)

3.2 Plan

A structured needs analysis was conducted to evaluate the limitations of the previous RFID-based convocation system at Polimas. Data were collected through workflow observations, interviews with administrative staff, and review of operational procedures. The key issues identified are summarized in Table 1.

Table 1: Limitations of the Previous RFID-Based Convocation System

Problem	Description	Impact on Convocation System
High operational cost	RFID hardware and maintenance are expensive	Increases overall convocation budget
Limited display capability	Cannot dynamically show graduate information	Reduces ceremony engagement and efficiency
Lack of verification mechanism	No real-time check for correct sequencing	Higher risk of errors in announcements

These findings informed the planning phase of GRADVIEW+, establishing key priorities such as cost-effectiveness, real-time data synchronization, verification controls, and operational reliability.

3.3 Design

The design of GRADVIEW+ was developed using a modular architecture to support systematic graduate identification, real-time verification, and synchronized multi-screen display during convocation ceremonies. The design consists of four main components: (1) Graduate Barcode Card Design, (2) System Architecture Design, (3) Operational Workflow Design, and (4) Multi-Screen Display Configuration.

3.3.1 Graduate Barcode Card Design

The first component of the design involved the development of individualized barcode cards for graduates. Each barcode encodes the graduate's identification number (IC), which functions as the primary key for database verification during the ceremony.

The barcode generation process was designed to support bulk production and operational efficiency. Graduate IC numbers were compiled into a text file (.txt format) and uploaded to a bulk barcode generation platform. The system generated corresponding barcodes in spreadsheet format (.xlsx), which were subsequently formatted for printing. The barcodes were printed, cut to appropriate dimensions, and inserted into card holders for distribution to graduates before the ceremony.

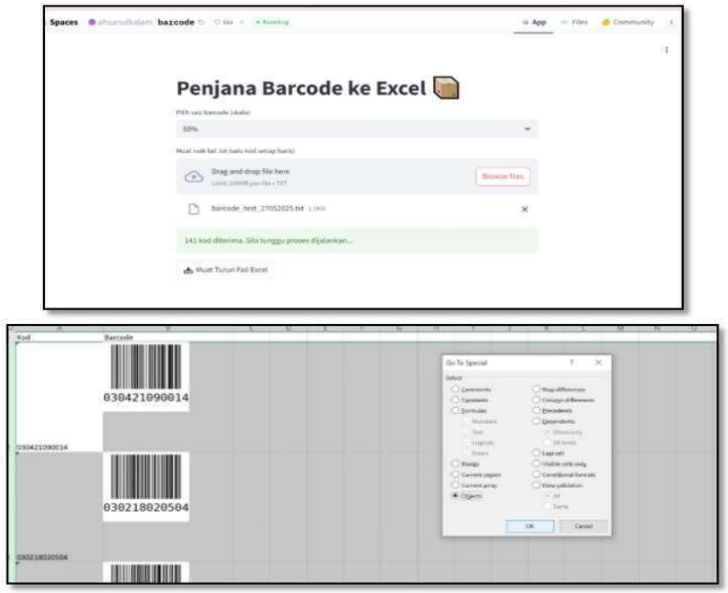

Figure 2: Implementation of Bulk Barcode Generation Interface

3.3.2 System Architecture Design

GRADVIEW+ was developed as a web-based system using a modular architecture to ensure scalability, reliability, and efficient data processing. The system architecture consists of multiple integrated layers, as summarized in Table 2.

Table 2: GRADVIEW+ System Architecture Components

Architecture Layer	Function	Technology Used
Barcode Input Layer	Captures encoded IC data through barcode scanning devices and transmits input to the backend system.	Barcode Scanner Interface
Backend Processing Layer	Decodes barcode data, performs database queries, prevents duplicate scans, detects input errors, and formats output for display	Python
Server and Routing Layer	Coordinates communication between the scanning interface, backend logic, and display modules.	Flask Framework
Centralized Database Layer	Stores structured graduate records, including identification details and verification status, with role-based access control.	Relational Database
Verification Control Mechanism	Maintains correct sequencing and allows reinsertion of graduate records in case of technical interruption.	Backend Logic Control

The workflow begins with system initialization, followed by barcode scanning and real-time database verification. The system then manages display control, queue sequencing, and post-display verification to ensure smooth ceremony execution.

3.3.3 Operational Workflow Design

The operational workflow was designed to ensure systematic and controlled execution during live convocation ceremonies. The process begins with server initialization and access to the main display interface. Staff configures visual settings before the ceremony.

During the event, barcodes are scanned to trigger real-time database verification. A control interface allows staff to display graduate information, activate audio announcements, adjust display timing, and clear content.

A queue interface enables graduates to verify their sequence, while a post-display interface allows staff to manage reinsertion in case of technical issues. Graduates may also verify their stored information through a self-check interface. This structured workflow reduces sequencing errors and enhances overall operational efficiency

3.3.4 Multi-Screen Display Configuration

GRADVIEW+ uses synchronized multi-screen displays to improve coordination during convocation ceremonies. The main screen shows graduate information to the audience in real time, while secondary screens allow staff to manage scanning and control the display process. A separate queue display helps graduates confirm their order before going on stage.

As illustrated in Figures 3 and 4, this multi-screen setup ensures smooth communication between staff and graduates. The synchronized display reduces sequencing errors and supports a more organized and efficient ceremony flow.

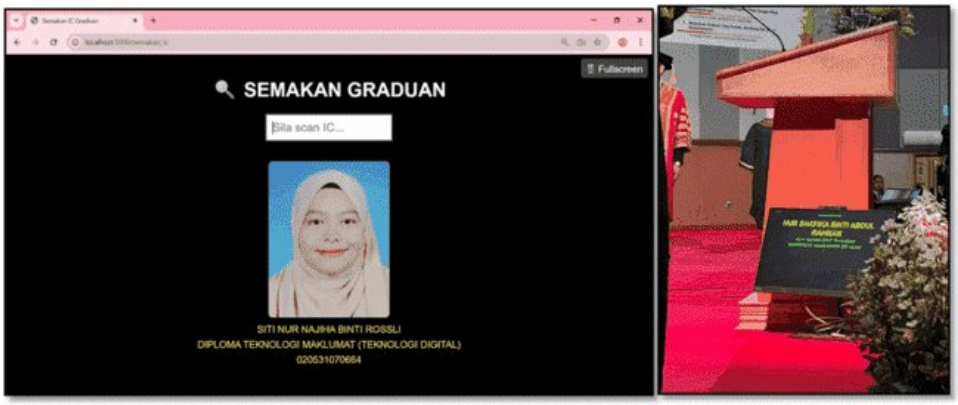

Figure 3: Graduate Verification and Queue Display Interface of GRADVIEW+

Figure 4: GRADVIEW+ Multi-Screen Staff Control and Queue Management Interface

3.4 Develop

Following the Design phase, the Develop phase focused on implementing the conceptual architecture into a functional system through incremental coding and module integration. System development followed an iterative approach consistent with Agile principles. Individual modules, including barcode scanning, backend processing, database management, and display interfaces, were coded and tested independently.

The implemented modules were progressively integrated into the full system architecture to ensure compatibility and stable communication between components. Interfaces such as layout configuration, barcode scanning, queue management, and display control were developed and refined through continuous collaboration with administrative staff. This incremental implementation ensured that each module met functional requirements and operational expectations before full system deployment.

3.5 Test

GRADVIEW+ was validated using a three-level evaluation framework, as summarized in Table 3. Testing was conducted during rehearsal sessions before each convocation to simulate real operational conditions, ensuring that the system could handle high-frequency scanning and synchronized display demands.

Table 3: System Testing and Validation Framework

Evaluation Level	Purpose	Description
Functional Testing	To verify system functionality	Validated barcode detection, database retrieval accuracy, and display synchronization performance
Performance Testing	To assess system stability and responsiveness	Measured system response time and stability under continuous barcode scanning to simulate actual convocation conditions
Usability Evaluation	To evaluate user interaction and interface clarity	Administrative personnel assessed interface clarity, operational efficiency, and ease of use during system operation

This multi-layered evaluation ensured the system operates reliably in real-world event environments and aligns with best practices in barcode-based system development (Perwitasari et al., 2024).

3.6 Deploy

The Deploy phase involved implementing GRADVIEW+ during live convocation ceremonies across multiple academic sessions (2024–2025), managing a total of 3,361 graduates from POLIMAS and Kolej Komuniti Kedah. During deployment, the system operated in a real-time environment, supporting barcode scanning, database verification, queue management, and synchronized multi-screen display. A centralized dashboard was used to monitor system performance, while backend verification logic ensured accurate

sequencing and immediate handling of operational anomalies. The live deployment allowed evaluation of system stability, scalability, and functional performance under actual convocation conditions.

3.7 Review

The Review phase was conducted following live deployment to evaluate system performance and user acceptance, in alignment with Agile principles of continuous improvement. A structured questionnaire was administered to graduates during the 2025 convocation ceremony to assess perceptions of practicality, efficiency, and overall usefulness of GRADVIEW+.

As the host institution and system developer, POLIMAS coordinated and managed the survey administration during the event. A total of 208 graduates representing nine Kolej Komuniti in Kedah participated in the study. The detailed findings of this evaluation are presented and analyzed in Section 4.

4. ANALYSIS AND FINDINGS

The research instrument is a questionnaire distributed to respondents via the Google Forms application. This instrument consists of three parts. Part A collects demographic data from respondents, while Parts B, C, and D are shown in Table 4.

Table 4: Distribution of Questionnaire items

Section	Aspect	Explanation	Item No
B	Barcode Card Usability & Accuracy	Measures practicality, information accuracy, and ease of identifying convocation session.	Q1, Q2, Q3
C	Perceived Operational Efficiency	Measures scanning speed and confidence during the stage process	Q4, Q5
D	User Acceptance & Future Intention	Measures overall usefulness and willingness to recommend for future events	Q6, Q7

4.1 Analysis of section A

A total of 208 respondents participated in the survey, representing graduates from nine Kolej Komuniti in Kedah during the 2025 convocation ceremony. The majority of respondents were male, followed by female graduates.Most responses were received from Kolej Komuniti Bandar Darulaman, followed by Kolej Komuniti Langkawi and Kolej Komuniti Padang Terap. The participation from multiple colleges shows that the data represents graduates from various institutions, supporting the reliability of the study findings.

4.2 Analysis of sections B, C, and D

Table 5: Interpretation of mean scores for Likert Scale

Aspect	Mean Score	Interpretation
Barcode Card Usability & Accuracy (Q1– Q3)	4.76	Strongly Agree
Perceived Operational Efficiency (Q4–Q5)	4.77	Strongly Agree
User Acceptance & Future Intention (Q6– Q7)	4.77	Strongly Agree

Based on Table 5, the overall perception of graduates toward the GRADVIEW+ system is at a very high level, as all three aspects recorded mean scores above 4.50, interpreted as Strongly Agree. The interpretation of mean scores was based on equal-interval classification for a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), as commonly applied in Likert-scale data reporting.

For the first aspect, Barcode Card Usability & Accuracy (M = 4.76), graduates strongly agreed that the barcode card was practical, easy to carry, and contained accurate information. This indicates that the physical design and informational reliability of the card met user expectations.

For the second aspect, Perceived Operational Efficiency (M = 4.77), respondents strongly agreed that the scanning process was fast and that the display of their names increased their confidence before going on stage. This reflects smooth operational implementation during the convocation ceremony.
For the third aspect, User Acceptance & Future Intention (M = 4.77), graduates strongly agreed that the system simplified the graduation process and recommended its continued use in future events. This demonstrates high acceptance and positive behavioral intention.

In conclusion, all three aspects are categorized at a Strongly Agree level, confirming that the GRADVIEW+ system is highly accepted, operationally effective, and suitable for continued implementation.

5. CONCLUSION & RECOMMENDATIONS

This study addressed operational challenges in convocation management, including high RFID costs and limited verification mechanisms, by developing the GRADVIEW+ barcode-based system using a Python–Flask framework. The system was designed to provide a cost-effective and efficient solution for managing graduate information during convocation ceremonies.

The findings supported the expected outcomes of the study. Based on responses from 208 graduates across nine Kolej Komuniti in Kedah, all evaluated aspects recorded mean scores above 4.50 (Strongly Agree). This indicates that graduates perceived the system as practical, efficient, and suitable for continued use.

However, this study has some limitations. The evaluation was based only on questionnaire data and did not include technical performance measurements such as actual scanning speed or system

response time. In addition, the study was conducted within Kolej Komuniti institutions in Kedah, which may limit generalization to other higher education institutions.

Future research should incorporate objective technical performance analysis and expand implementation to different institutional settings to further validate the system's scalability and effectiveness. Overall, GRADVIEW+ demonstrates strong user acceptance and operational effectiveness, supporting its continued implementation and further enhancement in future convocation ceremonies.

REFERENCES

Abdul Karim, W. N. F., & Abdullah, R. (2020). *Student acceptance towards QR Code Attendance System in Universiti Utara Malaysia. Symposium on Technology Management and Logistics (STML Go Green) 2019: Management of Technology, 1*(45), 110–111. https://repo.uum.edu.my/id/eprint/28527/

Gupta, S., Bhagat, H., Uphale, R., Patel, S., & Mankar, D. (2025). QR code based attendance system. *International Journal for Research in Applied Science and Engineering Technology*, 13(4), 2576–2582. https://doi.org/10.22214/ijraset.2025.68710

Laoyan, S. (2022). What is Agile methodology? (A beginner's guide). Asana. https://asana.com/resources/agile-methodology

Maulana, M. A., Natasia, S. R., Prambudi, D. A., & Fiqar, T. P. (2022). The development of QR code-based mobile attendance information system using Scrum framework. JUTI: Jurnal Ilmiah Teknologi Informasi, 19(3), 1–13. https://doi.org/10.12962/j24068535.v19i3.a1015

MDPI. (2023). Challenges and opportunities in higher education digital transformation. https://www.mdpi.com/2673-4060/6/3/100

Mar'atuttahirah, M., Miftahulkhairah, & Barik Alfito, R. (2025). Development of student e- attendance system using QR-Code and WhatsApp Gateway with the iterative model based on Android. Jurnal Teknologi Elekterika, 21(2). https://doi.org/10.31963/elekterika.v21i2.5026

Rafai, M., Solikhun, S., & Safii, M. (2024). Perancangan absensi QR code mahasiswa berbasis website pada STIKOM Tunas Bangsa Pematang Siantar menggunakan metode Agile. Jurnal Manajemen Informatika Jayakarta, 4(1), 51–60.* https://doi.org/10.52362/jmijayakarta.v4i1.1303

Sinar Harian. (2022, June 15). UUM perkenal sistem e-Konvo guna RFID.

https://www.sinarharian.com.my/article/192433/berita/nasional/uum-perkenal- sistem-e-konvo-guna-rfid

Smart attendance system using QR code and Python–Flask framework. (2025). International Journal of Computer Applications, 185(4), 22–27. https://www.ijprems.com/uploadedfiles/paper/issue_4_april_2024/33494/final/fin_ijprems1714414620.pdf

Zakaria, N., Yazid, M., Nasir, A., Hamzah, N., & Rubani, S. N. K. (2021). Student's attendance system using QR code. Research and Innovation in Technical and Vocational Education and Training, 1(1), 133–139. https://publisher.uthm.edu.my/periodicals/index.php/ritvet/article/view/26