# ระบบตรวจสอบบัณฑิตในพิธีรับปริญญาด้วยเทคโนโลยีอาร์เอฟไอดี

# Name Verification System for Graduation Ceremony using RFID Technology

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**บทคัดย่อ**

บทความนี้อธิบายเกี่ยวกับการพัฒนาและการนำระบบตรวจสอบชื่อด้วย RFID นำมาใช้ในพิธีรับปริญญาของมหาวิทยาลัยราชภัฏสวนสุนันทา กรุงเทพมหานคร ประเทศไทย โดยระบบดังกล่าวประกอบด้วยกระบวนการหลัก 5 ขั้นตอน ได้แก่ การเตรียมข้อมูลบัณฑิตในรูปแบบไฟล์ CSV การจัดเก็บข้อมูลลงในฐานข้อมูล MySQL การเรียกค้นข้อมูลสำหรับการตรวจสอบผ่านเว็บแอปพลิเคชัน การตรวจสอบข้อมูลบัณฑิตขณะผ่านประตู RFID และการบันทึกข้อมูลการเข้าร่วมงานในรูปแบบเวลาจริง ระบบนี้ได้รับการประเมินผ่านการทดลองเพื่อวัดประสิทธิภาพ และการใช้งานในช่วงพิธีรับปริญญาจริง ผลลัพธ์แสดงให้เห็นถึงประสิทธิภาพในการปรับปรุงกระบวนการทำงาน การรับรองความถูกต้อง และการปรับปริมาณงานให้เหมาะสม งานวิจัยนี้นำเสนอวิธีการที่สามารถปรับขยายเพื่อเพิ่มประสิทธิภาพ และความน่าเชื่อถือของพิธีรับปริญญาในอนาคต

***คำสำคัญ:*** ระบบตรวจสอบชื่อ, พิธีรับปริญญา, อาร์เอฟไอดี

**Abstract**

This article outlines the development and implementation of an RFID-based name verification system for graduation ceremonies at Suan Sunandha Rajabhat University in Bangkok, Thailand. The system comprises five key steps: preparing graduate data using CSV files, storing the data in a MySQL database, retrieving the data for verification through a web application, validating graduates' information as they pass through RFID gates, and recording attendance data in real time. The system was evaluated through experiments to assess its performance and its application during an actual graduation ceremony. The results demonstrated its effectiveness in streamlining operations, ensuring accuracy, and optimizing throughput. This

research offers a scalable solution to enhance the efficiency and reliability of future graduation ceremonies.

*Keywords:* Name verification system, Graduation ceremony, RFID

## 1. Introduction

Radio Frequency Identification (RFID) technology is a system used to identify and track objects by communicating data through radio waves. It operates by attaching a small tag to the object being tracked. When the tag interacts with radio waves emitted by a reader, it transmits the recorded data back to the reader, enabling the identification of the object. Many universities have implemented RFID technology to verify the names of graduates during graduation ceremonies. For example, Maejo University in Chiang Mai Province, Thailand, introduced the use of passive RFID wristbands for graduate identification [1]. Another study examined the detection accuracy of multiple tags used to identify certificate recipients on stage during graduation ceremonies [2]. Graduate identity verification via Walailak University's Smart Check-In machine [3]. Verifying names and reporting the results help prevent errors in the ordering of degree certificates. Additionally, a database has been developed to store and validate the data, improving the speed of name verification and reducing mistakes in certificate issuance.

In the past, university graduation ceremonies in Thailand were lengthy, often requiring participants to wait for hours, making the experience both tiring and time-consuming. The traditional graduation ceremony at Suan Sunandha Rajabhat University involves checking graduates' names manually using paper and transmitting the names via a radio communication system. This approach has a high risk of data inaccuracies and mismatches between degree rankings and the graduate list. Additionally, this system significantly increases the time required to verify graduates' names.

This paper presents a name verification system for graduation ceremony using RFID technology. The objective of this research is to design and implement a name verification system for the graduation ceremony of Suan Sunandha Rajabhat University, Bangkok, Thailand using RFID technology and evaluate the system. The system operates in five steps: 1) Prepare graduated student data by uploading a CSV file with details and RFID codes. 2) Store the data in a MySQL database. 3) Retrieve and display data via a web application for verifying student details during RFID scanning. 4) Verify graduates' attendance using RFID scanners. 5) Record attendance when RFID data is transmitted to the

web application. The application compares the received data with the database records and updates the attendance status of the graduated students in the system. The proposed system enhances the quality of the university graduation process by increasing the accuracy of graduation reporting, accelerating the display speed on the real-time Seating Plan Page of the web application, and reducing the staff workload. Additionally, it serves as a prototype for technology that can be further developed in the future.

The organization of this paper is as follows: Section 2 reviews the theory and related work; Section 3 discusses the design and implementation of the RFID-based name verification system for graduation ceremonies; Section 4 outlines the experiments; Section 5 presents the results; and finally, Section 6 provides the conclusion.

## 2. Theory and Related Work

### 2.1 Related Work

There are many research projects that use RFID technology in academic applications for identification, tracking, verification, or counting, as outlined below. An RFID wristband system was introduced for rehearsal and graduation ceremonies at Maejo University [1]. A study examined the detection accuracy of multiple tags when certificate recipients are tagged consecutively on the graduation stage [2]. Graduate identity verification was implemented through the Smart Check-In machine at Walailak University [3]. Based on the review of these three related studies, it was found that RFID technology offers outstanding features that help address delays during graduation ceremonies.

### 2.2 RFID Technology

Automatically reads the data stored in the transponder to transfer the data via radio waves between the reader and the transponder, called RFID technology [1]. The transponder, commonly known as the RFID tag, can be divided into two standard groups: Passive RFID tags, which have a small induction circuit as a power source and a maximum data communication distance of 1.5 meters; and Active RFID tags, which use a battery power supply, have a maximum data communication distance of 6 meters, and are more expensive than Passive RFID Tags.

RFID system has three parts as shown in Fig. 1: reader device, RFID tag and software in a computer. There are two types of reader devices: Desktop readers that read one item at a time. And the station reader is gate type, can read multiple RFID tags at the same time. The internal reader device consists of three parts: an antenna, a decoder to translate the data to a computer, and

an RFID tag, which is a device for receiving radio signals and automatically transmitting them.

## 3. Name Verification System Design and Implement

### 3.1 System Overview Design

The overall design of the system is divided into five steps as shown in Fig. 2. The details are as follows: Step 1: Prepare the graduate student data. The administrator uploads a CSV file containing the data and RFID codes linked to the graduate student ID cards. Step 2: Store the data in the MySQL database. All graduate student data is saved in the system's database. Step 3: Retrieve data from the database. The web application pulls data from the MySQL database to check the list of graduate students. This information is displayed on the screen and used to verify student details during RFID tag scanning. Step 4: Verify the list of graduates. Graduates must present their ID cards with attached RFID tags and walk through the RFID gate reader to validate their information. Step 5: Record attendance data. When the RFID gate reader reads the tag data, it sends the information to the web application, which compares it with the database records and updates the attendance status of the graduates in the system.

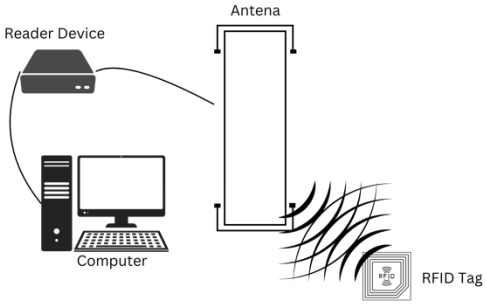



Fig. 1 RFID System

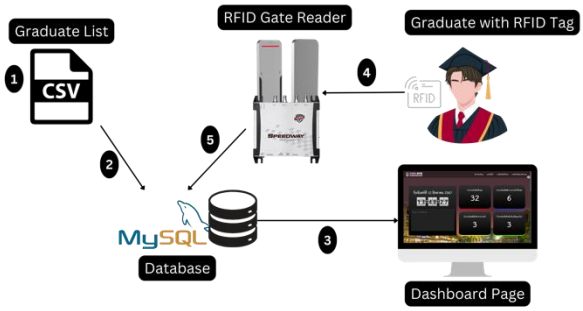



Fig. 2 Overall Design of System

### 3.2 RFID Gate Reader

The design of RFID gate reader is used for checking graduates who attend the graduation ceremony. The RFID gate reader has two doors of the same size, as shown in Fig. 3, divided into two parts: 1) The door frame, which is 10 cm wide, 30 cm long, and 172 cm high; and 2) The door base, which is 35 cm wide, 60 cm long, and 10 cm high.

The internal design of the RFID gate reader, as shown in Fig. 4, consists of a UHF antenna that supports a frequency range of 902-928 MHz. It is 2 cm wide, 9 cm long, and 46 cm high. The UHF RFID decoder supports a

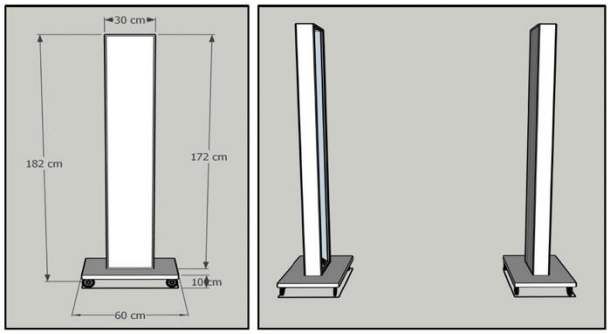



Fig. 3 RFID Gate Reader Design

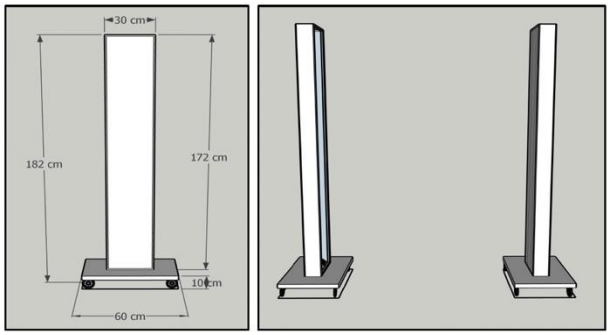



Fig. 4 Internal Design of RFID Gate Reader

frequency range of 920-925 MHz, can connect to up to four antennas, and supports the power over ethernet technology. It has a width of 3 cm, a length of 18 cm, and a height of 19 cm. It also includes a power supply for the UHF RFID decoder, an extension antenna cable for the UHF antenna, an ESP32 microcontroller, and two inexpensive buzzers commonly used in embedded systems [4].

### 3.3 Passive RFID Tag

The passive RFID tags use a sticker with a thickness of 0.1 mm and support UHF signal frequency 860 – 960 MHz as shown in Fig. 5.


Fig. 5 Passive RFID tags sticker

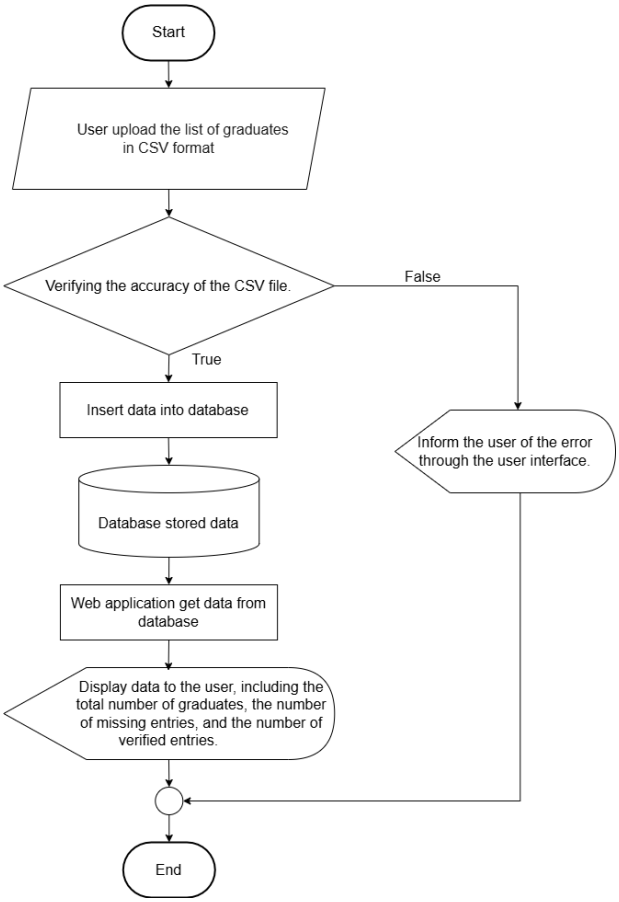



Fig. 6 CSV File Data Management System

### 3.4 Software System Design

This section presents the software system design, divided into two parts: a flowchart of the CSV file data management system via a web application, and a flowchart showing the number of graduates in the reporting room and the number of graduates who attended the graduation ceremony via a web application. Details are as follows.

The flowchart of the CSV file data management system via web application is shown in Fig. 6. It consists of seven steps as follows:

1) *Initialization*: The user initiates the process by uploading a CSV file to the system.

2) *File validation*: The system validates the uploaded CSV file to ensure it is complete and meets the required standards. If any errors are found during validation, the system will notify the user.

3) *File processing*: If the file is valid, the system sends the data from the CSV file to the database for storage.

4) *Database storage*: The data from the validated CSV file is stored in a pre-designed database.

5) *Data retrieval*: The web application retrieves the data stored in the database for use as required by the user.

6) *Data display*: The list of stored data will be displayed on the web application screen, allowing the user to check and manage it.

7) *Process termination*: The process is complete, and the system terminates the operation.

The graduate verification process using RFID technology flowchart, as shown in Fig. 7. It comprises six steps, as follows:

1) *Start*: The process begins, marking the initiation of the verification procedure.

2) *Graduate* decision *at RFID gate reader*: The system evaluates whether an RFID signal is detected. Beep sound: If the RFID system detects a valid signal, the process advances to subsequent steps. No sound: If no signal is detected, the process terminates without further action.

3) *Database update*: Upon detecting a valid signal “beep sound”, the system updates the database. At this step, the graduate's status value is set to TRUE, indicating successful verification.

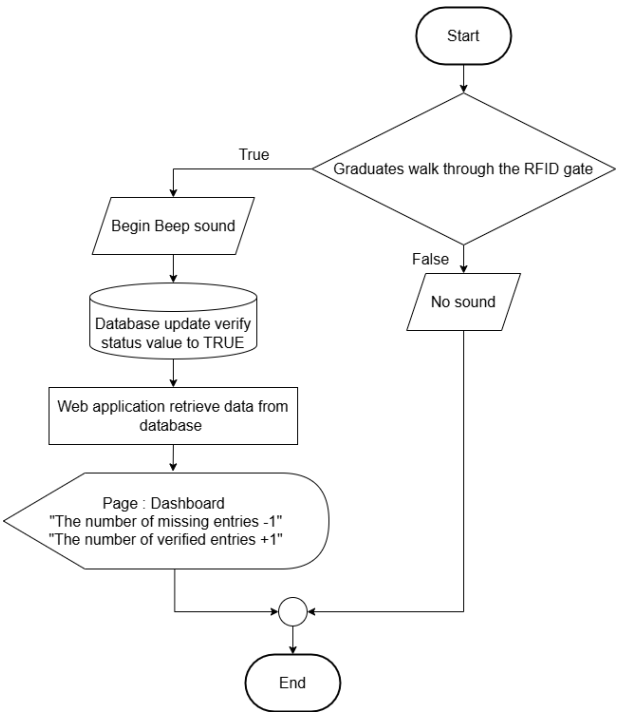



Fig. 7 Graduate Verification Using RFID Technology

4) *Data retrieval*: The web application retrieves the updated data from the database,

ensuring that the verification status is available for display and analysis.

5) *Dashboard update*: The retrieved data is used to update the dashboard interface of the web application. The system performs the following actions: Decrements the "number of missing entries" by 1. Increments the "number of verified entries" by 1. These updates provide real-time tracking of graduates' verification statuses, enabling efficient monitoring and reporting.

6) *End*: The process concludes, marking the completion of the verification flow.

### 3.5 Web Application UX/UI Design

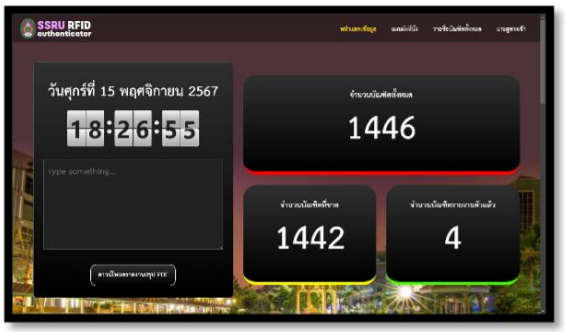
Web application design prioritizes delivering an excellent user experience by emphasizing modernity, simplicity, and ease of use. For design and development, we chose Figma, a widely used web-based design tool [5]. The web application consists of four pages: the dashboard page, the seating plan page, the all-graduates list page, and the graduation ceremony list page. The details are as follows.

1) The dashboard is the main page that displays information about the number of graduates. It is divided into two sections: the top and the bottom. The top section shows an overview, including the total number of graduates, the number of graduates who have reported, the number who have not reported, and a summary report, as shown in Fig. 8(a). The bottom section is organized by degree names for easier verification, as illustrated in Fig. 8(b).

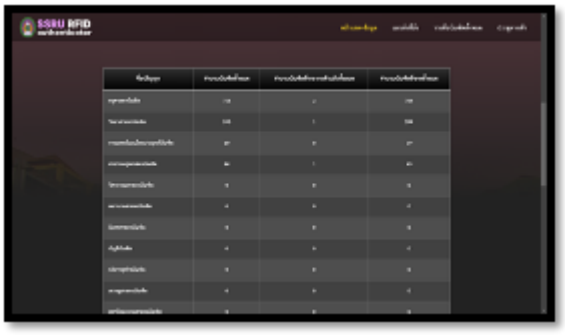
2) The seating plan page displays the seating positions of each graduate. The seating chart changes to green to indicate that a graduate has reported. We use Google Sheets to enable the Student Development Division Officer (SDD Officer) to edit or create a new seating plan for the graduation ceremony each year, as shown in Fig. 9.

3) The all-graduates list page contains specific information for each graduate, as shown in Fig. 10, such as graduate number, student ID, full name, degree name, and seat number. The SDD Officer can add, delete, or edit graduate list data and import data in CSV file format. The SDD Officer can also view the list of graduates who have not reported or those who have reported. All data can be downloaded in XLSX file format.

4) The graduation ceremony list page will be displayed after graduates pass through the RFID gate reader, as shown in Fig. 11.




(a) Top Section



(b) Bottom Section

Fig. 8 Dashboard Page

Fig. 9 Seating Plan Page

Fig. 10 All-graduates List Page

In addition, the designed web application was evaluated for its modernity, simplicity, and ease of use by eight SDD officers via Google Forms, receiving an average score of 84.09 out of 100. The backend design of the web application is designed and developed using JavaScript language with Express.js framework.

### 3.6 Implementation

The hardware and devices implement in the name verification system for graduation ceremony using RFID technology research as shown in Fig. 12. The implementation of this system is divided into two parts:

Part 1: The laptop is connected to the RFID gate reader via the router. The RFID gate reader consists of the IMPINJ R420 RFID UHF Speedway Reader, which supports multi-RFID tag reading using the TCP/IP protocol [6], and four antennas: the IMPINJ THRESHOLD RFID UHF Antenna [7]. In this part, the IP addresses of the devices are set as follows: laptop IP 192.168.1.104, router IP 192.168.1.1, and reader IPs 192.168.1.100–102. Part 2: The laptop is connected to two buzzers via the ESP32 microcontroller.

The cost of developing this system is approximately 500,000 baht, with an estimated break-even point of 4 to 5 years compared to the cost of hiring employees for traditional graduation ceremonies.

## 4. Experimental

The experiment was divided into two parts: one to evaluate the system's performance and another to apply it during a graduation ceremony. The details are as follows.

Fig. 11 Graduation Ceremony List Page

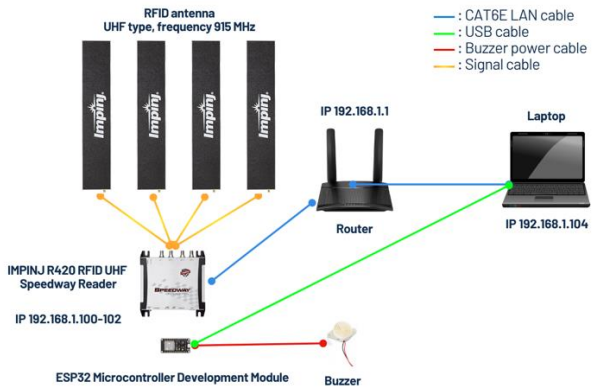
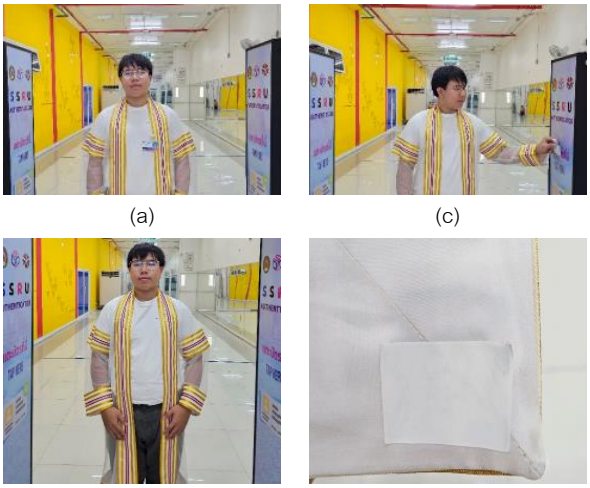



Fig. 12 Hardware and Devices Implement

### 4.1 System Performance Evaluation

The experiment to evaluate the system's performance is divided into three parts: RFID tag reading from the RFID gate reader, web application testing, and system user satisfaction assessment.

1) Reading RFID tags from various sticker locations involved walking through the RFID gate reader. The experiment included three scenarios, with a total of 100 trials: (1) attaching RFID tag stickers to graduate ID cards and walking through the gate, as shown in Fig. 13(a); (2) attaching RFID tags to the edge of the graduation gown and walking through the gate, as shown in



(a) (c)

(b)

Fig. 13 Reading RFID Tag from RFID Gate Reader

Fig. 13(b); and (3) attaching RFID tags to the card, touching the card to the gate, and then walking through the gate, as shown in Fig. 13(c).

2) Web application testing is divided into two parts: testing on browsers such as Google Chrome, Mozilla Firefox, Microsoft Edge, and Safari. Testing 13 functions, including login, navigation bar, note creation, editing the seating plan page, importing a graduate list in CSV format, adding graduates to the name list, editing graduate information, deleting graduates from the name list, clearing the name list, downloading summaries as PDF files, downloading name lists as XLSX files, searching for graduate names, and pagination. In addition, the system has a weakness in its login mechanism, as it does not support user registration. Instead, it relies on a single username and password for each account. Consequently, anyone with access to the credentials can log in.

3) The satisfaction assessment of eight SDD staff members was conducted via Google Forms, comparing the new system to the traditional graduation ceremony. The assessment was divided into six topics: (1) overall system efficiency, (2) speed of data summarization, (3) reduction of personnel workload, (4) resolution of issues from the old system, (5) ease of use, and (6) value for investment. Each item in the satisfaction assessment was scored on a scale of 5 points.

Table 1 Graduation Ceremony of Suan Sunandha Rajabhat University

| No | Degree | Amount |
|---|---|---|
| 1 | Bachelor's Degree | 4,024 |
| 2 | Master's Degree | 91 |
| 3 | Doctor's Degree | 75 |
| | Total | 4,190 |

### 4.2 Use in Graduation Ceremony

Two RFID gate readers with identical functions were installed at the entrance of the graduation ceremony room to verify graduate names. In the academic year 2022, the graduation ceremony at Suan Sunandha Rajabhat University will include four days of minor rehearsals, from September 14 to 17, 2024, and two days of major rehearsals, from September 19 to 20, 2024. The graduation ceremony will be held on September 23, 2024, at Nakhon Pathom Rajabhat University, in Nakhon Pathom Province. A total of 4,190 graduates from 28 degree programs, as shown in Table 1, ranging from bachelor's to doctoral degrees, are divided into two groups.

The first group consists of 2,175 graduates from 12 degree programs, including Bachelor of Education, Bachelor of Engineering, Bachelor of Science, and more. Group 2 consists of 2,015 graduates across 16 degree fields, including Bachelor of Accountancy, Bachelor of Business Administration, master's degrees, and doctoral degrees.

Therefore, the designed system can support ceremonies, seminars, or exhibitions with 4,000 to 6,000 participants. The main challenge lies in the installation process of the RFID gate reader prior to use.

## 5. Results and Comparisons

From the experiments presented in the previous section, the experimental results are as follows.

### 5.1 System Performance Evaluation Results

1) Reading RFID tags from various sticker locations and walking through the RFID gate reader, as shown in the Table 2. The results indicate that the placement and handling of RFID tags significantly impact the accuracy of the RFID

system. Scenario 3 demonstrated the best performance due to the direct interaction between the tag and the reader, which minimized external interference. In contrast, Scenario 1 exhibited the highest failure rate, likely due to suboptimal tag placement on ID cards. Scenario 3 is implemented in graduation ceremonies.

Table 2 RFID Tag Reading Result from RFID Gate Reader

| Scenarios | Results | |
|---|---|---|
| | Success (times) | Failure (times) |
| (1) attaching RFID tag stickers to graduate ID cards and walking through the gate | 68 | 32 |
| (2) attaching RFID tags to the edge of the graduation gown and walking through the gate | 97 | 3 |
| (3) attaching RFID tags to the card, touching the card to the gate and then walking through the gate. | 100 | 0 |

2) The usability testing of the web application presented in the previous section was successful.

3) The results of the user satisfaction evaluation, comparing the new system to the traditional graduation ceremony, were divided into six topics: (1) overall system efficiency, 4.45 points; (2) speed of data summarization, 5.00 points; (3) reduction of personnel workload, 3.35 points; (4) resolution of issues with the old system, 5.00 points; (5) ease of use, 5.00 points; and (6) value for investment, 5.00 points.

Fig. 14 Graduation ceremony on September 23, 2024

### 5.2 Results of Use in Graduation Ceremony

On September 23, 2024, at 6:00 AM, graduates will go to the registration point to check in. They will attach RFID tags to their cards, touch the cards to the gate, and then walk through the RFID gate reader to identify themselves, as shown in Fig. 14. At 10:00 AM, the afternoon session will begin. Graduates will go to the registration point to check in and will follow the same steps as in the morning. The results of using the name verification system in the graduation ceremony using RFID technology in the graduation ceremony are shown in Table 3.

Table 3 Results of Use in Graduation Ceremony

| | Period | | Average |
|---|---|---|---|
| | Morning | Afternoon | |
| Graduates Amount | 2,175 | 2,015 | 2,095 |
| Begin Scan | 6:00 AM | 10:00 AM | - |
| Finish Scan | 9:15 AM | 1:00 PM | - |
| Duration | 3.15 hrs | 3.00 hrs | 3.08 hrs |
| Person per hour | 690 | 672 | 681 |
| Error | No | No | - |

The system processes graduates efficiently in both time periods, with a slightly higher workload in the morning. The absence of system errors underscores the reliability and stability of the scanning system. The difference in the processing rate (graduates per hour) between the morning and afternoon periods may be attributed to the slightly lower number of graduates in the afternoon. This information is critical for planning and improving future graduation ceremonies, ensuring the process remains fast and error-free while optimizing throughput rates.

### 5.3 Comparison Results

The proposed system was compared with RFID wristbands [1]. It was found that our system offers a web application that enables real time identification, tracking, and management of the number of graduates, as well as checking which graduates have reported through the Seating Plan Page.

Table 4 Comparison of Graduation Ceremony Results

| | Academic Year | |
|---|---|---|
| | 2021 (Average) | 2022 (Average) |
| Technology Used | No | Proposed system |
| Graduates Amount | 2,105 | 2,095 |
| Duration | 3.28 hrs. | 3.08 hrs. |
| Person per hour | 653.5 | 681.0 |
| Summary report submission period | 30 min | Real time |

Table 4 presents a comparison of the results from graduation ceremonies at Suan Sunandha Rajabhat University conducted in the academic years 2021 and 2022. The introduction of the proposed system in 2022 resulted in notable improvements in the efficiency of the graduation ceremony. Although the number of graduates slightly declined, key metrics such as event duration, processing rate, and real time reporting showed significant enhancements, demonstrating the effectiveness of the new system.

## 6. Conclusion

This research successfully designed and implemented a name verification system for

graduation ceremonies using RFID technology. The system demonstrated its ability to enhance efficiency by streamlining the identification and attendance recording processes. Divided into five key steps from preparing graduate data to verifying attendance the system ensured accuracy and reliability, critical for large-scale events like graduation ceremonies.

Testing revealed that proper RFID tag placement significantly affects performance, with Scenario 3 achieving 100% success due to direct interaction between tags and the reader. The web application further facilitated real time tracking, management, and reporting, proving valuable for event coordination. User evaluations of the system's web application design highlighted its simplicity, modernity, and usability, with high satisfaction scores.

Applied during Suan Sunandha Rajabhat University's graduation ceremonies in 2022, the system demonstrated notable improvements in event duration, processing rates, and error reduction compared to previous methods. Additionally, evaluations across six usability dimensions revealed that the system performed excellently in summarizing data quickly. It effectively resolves the issues faced with the old system, is very user-friendly, and offers high value for the investment made. These results underline the potential of RFID technology to optimize complex processes, providing a model for future ceremonies.


## Acknowledgment

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