# FaceGuardVMAPA: Developing an Advanced IoT-Based Facial Recognition System Using Convolutional Neural Networks for Security and Monitoring at Victorino Mapa High School

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***Abstract***

*The study, titled "FACEGUARDVMAPA: Developing an Advanced IoT-Based Facial Recognition System Using Convolutional Neural Networks for Security and Monitoring at Victorino Mapa High School," aims to improve security measures and automate student attendance tracking at Victorino Mapa High School. The system leverages Convolutional Neural Networks (CNNs) for facial recognition to facilitate automatic identification and attendance management.*

*To assess its performance, a Likert scale survey based on the ISO 25010 quality model was conducted, focusing on functional suitability, performance efficiency, usability, and security. Feedback from students, parents, and teachers reflected positive reactions, with average satisfaction ratings of 4.41, 4.43, and 4.35, respectively. These results indicate high satisfaction with the system's features and functionality. Additionally, the inclusion of an SMS notification system, which sends real-time attendance updates to parents, strengthens communication between the school and families.*

*The findings highlight that integrating facial recognition technology and optimized classroom scheduling improves entrance security, enhances attendance monitoring, and supports more efficient resource management. For future improvements, the study suggests the development of more user-friendly interfaces, increased accuracy of the facial recognition algorithm, and the implementation of multi-factor authentication to further enhance security.*

***Keywords***: *IoT, Facial Recognition System, Convolutional Neural Networks, SMS Notification.*

## 1. INTRODUCTION

In traditional educational environments, entrance security and manual attendance systems continue to be a challenge, primarily due to their susceptibility to human error. These systems are often unreliable, time-consuming, and prone to inaccuracies, which not only lead to administrative inefficiencies but also hinder the overall operational effectiveness of schools. The conventional entrance security systems in schools lack adequate safety measures as they do not incorporate modern security technologies. Traditional methods often rely on manual checks and outdated surveillance techniques, making them vulnerable to breaches and unauthorized access[1]. Teachers spend a significant amount of time manually recording attendance, which could otherwise be allocated to more impactful instructional activities. For instance, research shows that schools lose valuable staff hours annually due to the labor-intensive nature of manual attendance tracking [2][3]. Moreover, these errors can lead to discrepancies in records, potentially causing disruptions in learning environments and administrative functions.

In schools like Victorino Mapa High School, traditional attendance methods are frequently circumvented by students, resulting in skipped classes and disciplinary issues. This further exacerbates gaps in students' learning, as these systems often fail to accurately monitor

students' whereabouts or detect unauthorized activities [4]. Automated attendance solutions, such as facial recognition systems, present a solution by significantly reducing errors and improving the accuracy of tracking, which in turn fosters student accountability and enhances school security [5].

The goal of this research is to implement an automated facial recognition system aimed at resolving the challenges associated with traditional school entrance security and traditional attendance tracking methods. This system seeks to improve security protocols and reduce undesirable behaviors, thereby creating a safer and more secure school environment. The FaceGuardVMapa project addresses these issues by integrating IoT and facial recognition technologies to deliver a precise and reliable entrance security and attendance tracking solution. This technological advancement will enable the school to manage its resources more efficiently and enhance the overall quality of education. By accurately recording each student's entry and exit from the campus, the system automates attendance, promotes student accountability, and encourages regular participation in school activities. Additionally, it will notify parents or guardians via SMS whenever their child enters or exits the school premises. This dual approach not only streamlines attendance management but also enhances communication between the school and families, promoting a more engaged educational environment[6].

The algorithm used in this project is Convolutional Neural Networks (CNN), which is highly effective for analyzing visual data. CNNs are widely used in image recognition, classification, and tasks involving visual inputs, such as facial recognition, object detection, and video analysis. This makes CNN particularly suitable for this research, as the FaceGuardVMapa project involves developing an IoT-based system for automated facial recognition. CNNs excel in detecting facial features and patterns from images due to their ability to learn hierarchical representations of data through multiple layers[7]. This characteristic allows them to identify subtle distinctions between individuals, ensuring accurate and reliable attendance tracking. Moreover, CNN's ability to process large volumes of visual data quickly is essential for real-time monitoring and security applications in a dynamic school environment. By employing CNNs, the system will be able to efficiently automate student entry and exit records, enhance attendance tracking of students, thereby enhancing both the security and operational efficiency of the school.

In summary, the FaceGuardVMapa system focuses on automating student attendance tracking and enhancing entrance security through IoT and facial recognition at Victorino Mapa High School. This system will capture real-time data on students entering and exiting the school, automating attendance management for students, and providing SMS notifications to parents. However, limitations include potential inaccuracies in facial recognition under varying environmental conditions, technological constraints, and network reliability. The system is also designed exclusively for Victorino Mapa High School, and its performance may differ in other educational institutions.

## 2. METHODOLOGY

### 2.1. System Development

The researchers used the Agile development methodology as it allows for efficient project management by breaking the project into distinct phases: planning, design, development, testing, deployment, and review. This method promotes ongoing collaboration and consistent progress throughout each phase.

### 2.2. System Software and Integration

The FaceGuardVMapa system will be developed using Visual Studio Code (IDE) for its flexibility and support for multiple programming languages. Python and PHP will handle core scripting tasks, providing a dynamic backend, while MySQL databases will manage data storage

and retrieval. Figma will be used for designing the user interface, enabling the creation of interactive prototypes. This integration of tools ensures an efficient and high-performance development process. The system is compatible with Windows 10 Home Single Language and requires basic peripherals like a mouse, keyboard, and a 5MP camera. For mobile devices, it supports Android 9 or iOS 9 with a minimum of 4GB of RAM to enable remote monitoring features in the mobile application.

2.3. System Architecture

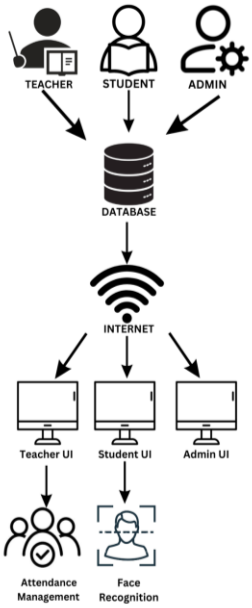


Figure 1. System Architecture

The system architecture for FaceGuardVMapa integrates key components for an advanced IoT facial recognition system, enhancing security and automating student attendance at Victorino Mapa High School. A central database securely stores facial images, attendance records, and user information, with data input from teachers, students, and administrators. Internet connectivity enables smooth data exchange across three user interfaces (UI) tailored to each group's needs: Teacher UI for managing and monitoring attendance, Student UI for checking attendance and receiving notifications, and Administrator UI for account management and system maintenance. The system automates attendance tracking using facial recognition, improving accuracy and reducing manual errors while streamlining the process.

*2.3.1. Application-Based for Entrance Security System*


Figure 2. Application-Based Entrance Security System

The FaceGuardVMapa system uses facial recognition technology to enhance security and keep parents informed of student movements. When a student's face is successfully captured, an automatic SMS notification is sent to the parents, confirming the student's entry or exit from the school. If the recognition is successful, the student is allowed to proceed. However, if the system fails to identify the face, entry or exit is denied. This process ensures both security on the premises and parental awareness of their child's whereabouts. CNNs have revolutionized facial recognition in security and monitoring by providing powerful tools for feature extraction, detection, and identification, enabling real-time and accurate monitoring. Their adaptability and efficiency make them essential for enhancing security measures in various environments. However, ethical considerations and responsible use are crucial in deploying these technologies.

*2.3.2. Web Page Consists of Attendance Tracking*


Figure 3. Web Page Consists of Attendance Tracking

The process for the teacher panel login and attendance management system begins with the teacher entering their username and password. These credentials are authenticated by the system. If the login is successful, the teacher is directed to their dashboard, where they can view their profile, access the attendance sheet, and verify attendance data. If the login attempt fails due to invalid credentials, the system prompts the teacher to re-enter the correct username and password. Once the teacher completes their tasks, they can log out to securely end the session. This process ensures both secure access and efficient attendance management for teachers.

*2.3.3. Class Scheduling*

The process for the administrative panel system begins with the user entering their username and password, followed by an authentication check. If the login is successful, the user is granted access to the admin page. From there, the admin can manage various functions such as viewing their profile, creating user accounts, monitoring teacher and school-wide attendance, and scheduling classroom activities. After completing tasks, the user can log out to securely end the session. If the login attempt fails, the system prompts the user to re-enter valid credentials, ensuring secure access. By leveraging predictive analysis, educational institutions can create more responsive and effective class schedules that meet the needs of students and faculty while optimizing resources. This approach not only enhances the educational experience but also improves operational efficiency.

## 3. RESULTS AND DISCUSSION

This study utilized a mixed-methods research methodology, using qualitative and quantitative methods to evaluate FACEGUARDVMAPA's effectiveness. This dual method guaranteed objectivity and precision while analyzing the system's performance. A targeted sampling methodology was used to choose respondents, including students, teachers, and parents, who were regarded as qualified to provide informed evaluations of the application.

The principal research tool was a survey questionnaire designed in accordance with ISO/IEC 25010 standards. The questionnaire measured four essential evaluation criteria: functional sustainability, performance efficiency, security, and usability. These criteria provided a thorough framework for evaluating the efficacy of FaceGuardVMAPA from several angles.

The survey was distributed to 100 people, including 60 students, 30 parents, and 10 teachers from Victorino Mapa High School. Respondents rated the system on a 5-point Likert scale, with 1 representing "Poor" and 5 indicating "Satisfactory."

After gathering survey responses, the average score for each criterion was determined to assess the system's effectiveness in certain areas. In addition, an overall mean score was calculated to determine the application's general approval. This feedback is critical for assessing the quality and performance of the established system, considering it allows researchers to measure both FACEGUARDVMAPA's strengths and areas for improvement. This process yielded valuable insights that can help guide future system improvements.

Table 1. Evaluation of FACEGUARDVMAPA

| Overall Acceptance of the System | | |
|---|---|---|
| **Criteria** | **Mean** | **Verbal Interpretation** |
| Functional Suitability | 4.36 | Satisfactory |
| Performance Efficiency | 4.29 | Satisfactory |
| Security | 4.5 | Satisfactory |
| Usability | 4.43 | Satisfactory |
| **Overall Mean** | **4.40** | **Satisfactory** |

Table 1 showcases the overall acceptance of the system and displays the full evaluation of FACEGUARDVMAPA by students, parents, and teachers at Victorino Mapa Roxas High School. Usability received the highest mean score of 4.43, categorized as "Satisfactory." The security aspect of the system followed closely with a mean score of 4.5, also rated as "Satisfactory." Functional suitability and performance efficiency were rated at 4.29 and 4.36, respectively, both falling within the "Satisfactory" category. The system obtained an overall mean rating of 4.40, indicating a "satisfactory" level of acceptance on the satisfaction scale.

## 4. CONCLUSION

The "FaceGuardVMAPA" system achieved an overall mean score of 4.40, categorized as "Satisfactory" based on a Likert Scale evaluation. This rating was derived from diverse respondents at Victorino Mapa High School, indicating that the project successfully met its research objectives, particularly in enhancing the security and monitoring systems within the school. By leveraging IoT-based facial recognition technology and the Convolutional Neural Networks (CNN) algorithm, the system can accurately recognize and identify students based on their facial features. This integration of advanced image recognition techniques ensures precise detection, enhancing the system's efficiency in verifying student identities. Furthermore, the system's automation of attendance tracking has demonstrated improvements in administrative efficiency, reducing manual errors. The SMS notification system effectively keeps parents informed, adding a valuable communication layer for student safety. Overall, the project offers a reliable solution to modernize school security and monitoring practices.

Several recommendations, based on user feedback, are proposed to improve the "FaceGuardVMAPA" system. It is recommended that user-friendly interfaces be designed to simplify management and enhance interaction with facial recognition features. Additionally, advanced algorithms and machine learning techniques should be employed to increase facial recognition accuracy, potentially incorporating technologies such as retinal recognition. Finally, the system could be enhanced by adding multi-factor authentication, combining facial recognition with other security measures like biometric fingerprints or PIN codes to further strengthen security.

## 5. AUTHORS' CONTRIBUTION

Author Kurt Lorenz B. Verzosa led the study's conceptualization and design, carried out data analysis, and drafted the initial version of the manuscript. Also participated in revisions.

Author Angel Danielle F. Cruz supported study design, gathered data, and helped with data analysis. Provided input through reviewing and editing the manuscript.

Author Richelle O. Mendoza offered expertise in methodology and statistical approaches. Contributed to drafting specific sections and made substantial edits.

Lastly, all three authors conducted the literature review, assisted with data interpretation, and contributed to the preparation and refinement of the manuscript. They also oversaw the project, secured funding, and critically revised the manuscript, adding essential intellectual contributions.

## 6. ACKNOWLEDGMENTS

We would like to express our profound appreciation to everyone who has played a role in the successful completion of this Capstone Project. Their support, guidance, and encouragement have been essential, and we are truly thankful for their contributions.

First and foremost, we owe a great deal to our adviser, Prof. Mark Anthony Mercado, whose expertise, patience, and ongoing encouragement were crucial in guiding this research. Your insightful feedback and constructive criticism have significantly enhanced the quality of this work.

We also wish to acknowledge the faculty members of the Information Technology department at Pamantasan ng Lungsod ng Maynila for their dedication to educational excellence and for fostering an environment conducive to academic growth.

Our appreciation extends to the Principal, administrators, teachers, parents, and students of Victorino Mapa High School who participated in this project. Your cooperation during the data collection process and system testing, and evaluation has been invaluable. Your engagement has

provided essential real-world insights and has strengthened our connection to the community, making this project even more meaningful and relevant.

We are also grateful to our friends and colleagues for their unwavering support throughout this journey. Your encouragement and camaraderie have made the challenges easier to face and the successes more gratifying.

We wish to express our heartfelt gratitude to our families. Your love, encouragement, and faith in our abilities have been a constant source of motivation. Your steadfast support during both the highs and lows of this journey has been immeasurable.

Lastly, we are profoundly grateful for the divine guidance and wisdom that have accompanied us. It is through this grace that we have been able to transcend mere technological advancements and develop a system that embodies "FaceGuardVMAPA."

Thank you all.

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