

Design and Development of a Web-Based Campus Vehicle Gate Pass Management System with OCR Document Verification for Caraga State University

Elizabeth B. Palasan

Information Technology Department, College of Computing and Information Sciences, Caraga State University – Main

Harrold T. Chavit

Information Technology Department, College of Computing and Information Sciences, Caraga State University – Main

Elbert S. Moyon

Information System Department, College of Computing and Information Sciences, Caraga State University – Main

<https://doi.org/10.5109/7395576>

出版情報 : Proceedings of International Exchange and Innovation Conference on Engineering & Sciences (IEICES). 11, pp.602-608, 2025-10-30. International Exchange and Innovation Conference on Engineering & Sciences

バージョン :

権利関係 : Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International



Design and Development of a Web-Based Campus Vehicle Gate Pass Management System with OCR Document Verification for Caraga State University

Elizabeth B. Palasan¹, Harrold T. Chavit¹, Elbert S. Moyon²

¹Information Technology Department, ²Information System Department

College of Computing and Information Sciences, Caraga State University - Main

Corresponding author emails: elizabeth.palasan@gmail.com, harroldchavit@gmail.com, esmoyon@carsu.edu.ph

Abstract: *Handling vehicle gate pass applications at Caraga State University's Office of Campus Safety and Security Services (OCSSS) is difficult due to outdated manual processes, causing errors and delays. Relying on paper gate passes and manual verification slows approvals and increases staff burden. This study developed a web-based Vehicle Gate Pass Management System (VGPMs) that utilized Optical Character Recognition (OCR) for automated document validation and optimizing processing. OCR-based validation streamlines gate pass application approvals, lowers errors, and improves security and operational effectiveness. With an 81.18% system usability result, the system is user-friendly, intuitive, and effective in simplifying gate pass management. Overall, the system minimizes manual intervention, optimizing administrative functions, and builds a foundation for future security management control in educational institutions.*

Keywords: Optical Character Recognition; Gate Pass Management System; Document Validation; Automation

1. INTRODUCTION

Traditional manual gate pass systems (logbooks and paper-based gate passes) are prone to verification delays, misplaced records, and security risks, increasing unauthorized campus access [1]. Studies indicate that organizations managing material gate passes also encounter compliance and scalability issues, further diminishing security effectiveness [2]. Currently, the OCSSS, which is responsible for ensuring the safety and security of the campus community, faces challenges with an archaic paper-based gate pass system that impediment processing, leads to errors, and overwhelms staff with manual verification. At the Caraga State University-Main Campus, the usual gate pass approval is slow, leading to backlogs. Also, OCSSS staff must go through paper-based gate pass applications by hand to pull data and create reports, making the process slower and less efficient.[3], [4]

Various studies have explored automated solutions incorporating OCR technology[5]. Akiyama and Matsuhara [6]evaluated OCR's ability to improve text recognition in real-world applications. Paul et al.[7] demonstrated how OCR-based number plate recognition, when integrated with Radio-Frequency Identification (RFID) technology and real-time image processing, enhances secure vehicle entry. Similarly, SecurePass leverages OCR to extract text from license plates, supporting automated identification and verification while minimizing unauthorized access risks [8], [9]. OCR helps with text extraction from vehicle records, enhancing efficiency in toll collection, fleet management, and automotive security[8]. OCR helps extract text from vehicle documents and inspection reports, making processes smoother in toll collection, fleet management, and automotive security [8][6]. OCR accuracy was improved using inclination correction [5][7], while headline text extraction optimized data retrieval and security validation [8]. Hayasaka et al. [7] demonstrated that OCR based on deep learning increases character

recognition accuracy, thereby making it a reliable tool for structured text validation. Still, studies on vehicle gate pass systems mostly focus on license plate scanning, often ignoring complete document validation.

To bridge this gap, this study introduces the web-based Vehicle Gate Pass Management System (VGPMs), designed specifically for CSU's OCSSS.

This project aims to:

- Design and build a user-friendly web application, streamlining gate pass application submission.
- Integrate OCR technology to extract relevant information from submitted documents for credential validation.
- Evaluate the system's usability using the standard System Usability Scale (SUS).

Unlike prior solutions that emphasize license plate tracking, VGPMs integrates OCR-driven document validation to authenticate Official Receipt (OR), Certificate of Registration (CR), and Driver's Licenses (DL). OCR document validation reduces errors and improves the gate pass application process [10]. It also simplifies reporting and verification, lessening the burden on OCSSS staff while enabling effective application tracking and data-driven campus security management.

2. METHODOLOGY

This section outlines the development of the Vehicle Gate Pass Management System (VGPMs), covering the system architecture, OCR integration for automated document validation, technology stack, requirements analysis, validation procedures, system usability evaluation, considerations to enhance security and usability.

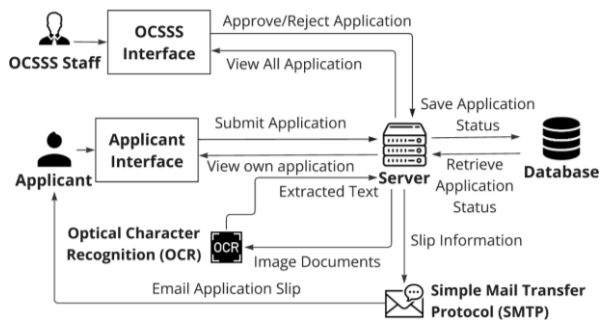


Fig. 1 Conceptual Framework

The diagram illustrates (Fig. 1) the streamlined vehicle access process through digital automation. Applicants submit requests online, where the server processes applications, extracts key details via OCR, and stores data in the database. OCSSS staff review and approve or reject applications, triggering the system to send a payment slip via email using Simple Mail Transfer Protocol (SMTP). This automation minimizes errors, accelerates approvals, and enhances security and efficiency.

3.1 Requirement Analysis

The systems' development follows the Waterfall Architecture Model. This approach divides the development process into distinct phases, enabling researchers to streamline tasks and minimize risks while building the system. The following sections describe each phase in detail.

The study employs a structured usability evaluation, gathering both quantitative and qualitative data to assess system efficiency. Using the System Usability Scale (SUS), users—including applicants, OCSSS staff, and administrators—rate various aspects of system performance on a scale from 1 to 5, with 5 being the highest. User experience feedback provides deeper insights into usability challenges, frustrations, and suggestions for improvement. Open-ended responses highlight specific difficulties, complementing numerical data with firsthand user perspectives. These findings are consolidated, ensuring a well-rounded assessment of the system's strengths and areas for refinement.

This study focuses on key areas:

- **Functional Requirements** - Streamlines online gate pass applications, ensures accurate credential validation through OCR, and integrates reporting and analytics to track application trends and financial transactions, supporting informed decision-making.

Table I. System Functionalities

Functionalities	Applicants	OCSSS Staff	Admin
Online application submission	✓	✓	✓
View & download application history logs	✓	✓	✓
Manage gate pass application (Approve/Reject)		✓	✓
View the approved gate pass application		✓	✓
Report generation (tabular format)		✓	✓

Functionalities	Applicants	OCSSS Staff	Admin
Create 'batch sticker'			✓
Create/Delete OCSSS staff account			✓

Applicants can submit gate pass applications online, as well as view and download their submissions. OCSSS staff review applications, approve or reject them, access and download approved gate pass records and history logs, and generate dashboards and reports in tabular PDF format. Meanwhile, admins create batch stickers for all application types, manage OCSSS staff accounts by adding or removing users, and oversee system operations. The admin maintains full control over the system, ensuring efficiency and security.

- **Non-Functional Requirements:** Ensures efficient processing, secure data encryption, and scalability while maintaining a user-friendly interface. Designed for easy maintenance, it integrates with web and mobile platforms to meet evolving OCSSS needs.

• Software and Hardware Requirements

The system's efficiency and usability rely on a well-balanced combination of software and hardware components. The software stack consists of PyTesseract (5.3.0.20) for Optical character recognition, ReactJS (19.0.0) for dynamic user interface development, Tailwind CSS (4.0.8) for streamlined styling and responsive design, FastAPI (0.115.8) for high-performance API functionality, PostgreSQL (8.10+) for reliable data storage and management, and Python (3.8+) as the core back-end programming language, ensuring flexibility and computational efficiency.

To support seamless execution of the software stack, the system adheres to recommended hardware benchmarks, utilizing 16 GB RAM for smooth multitasking and handling complex operations, and 475 GB SSD storage to ensure fast data access and optimal performance. These specifications prevent delays, crashes, and performance bottlenecks, maintaining the system's overall stability and responsiveness.

3.1.1 Application Image-Based Document Verification Using OCR Technology

The system was designed to meet OCSSS operational needs, ensuring secure data management for entry and exit security at Caraga State University - Main Campus. It follows a three-tier architecture, including a web-based interface for staff and applicants, an application layer handling verification and processing, and a centralized database securing credentials, records, and transactions.

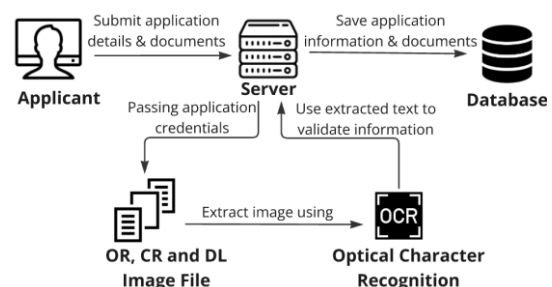


Fig. 2. OCR Document Validation.

The illustration (Fig. 2) presents the online application process, incorporating OCR via Tesseract 5.3.0.20. Applicants submit vehicle and personal credentials for validation. The OCR system ensures accuracy by verifying document formatting and readability, extracting key details: plate numbers, file number, expiration dates, and the driver's full name and birthdate. Additionally, it cross-checks file numbers from OR and CR for consistency.

3.1.2 Proposed Digital VGPMs Application Procedure

The proposed system enhances efficiency and accuracy, eliminating redundant steps while ensuring strict security compliance.

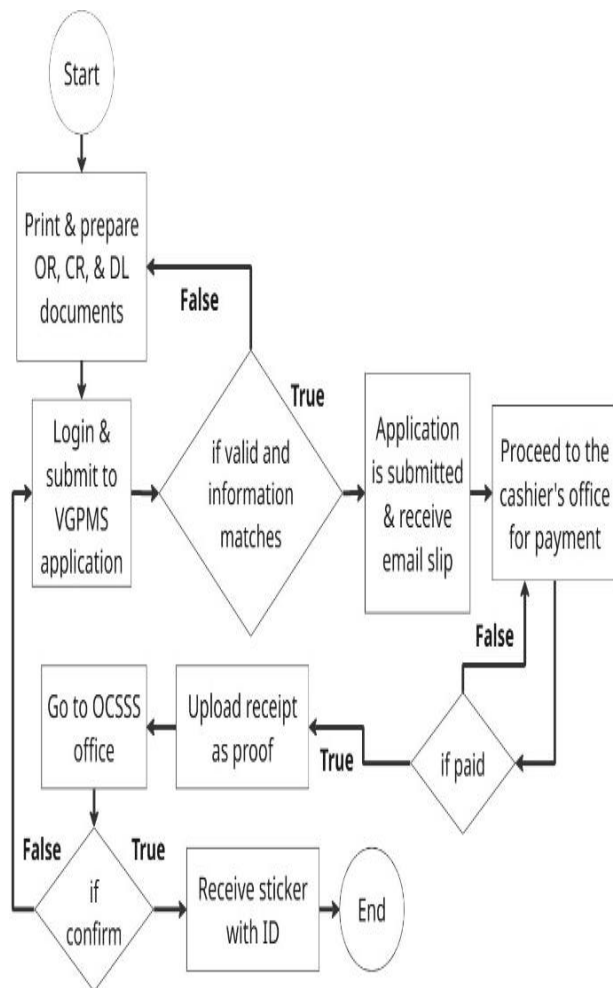


Fig. 3. VGPMs Application Process.

The flowchart (Fig. 3) enables online gate pass applications, reducing unnecessary travel between offices. This automation enhances efficiency, minimizes processing delays, and supports data-driven insights for report generation and forecasting. Applicants complete payments at the cashier and claim their gate pass at OCSSS, ensuring a seamless application process.

The system deletes incomplete gate pass applications after 5 days to prevent database congestion and maintain only active records. Once removed, applicants must resubmit their documents to restart the process. This cleanup optimizes operations, reduces storage load, and keeps records updated.

3.2 System Development

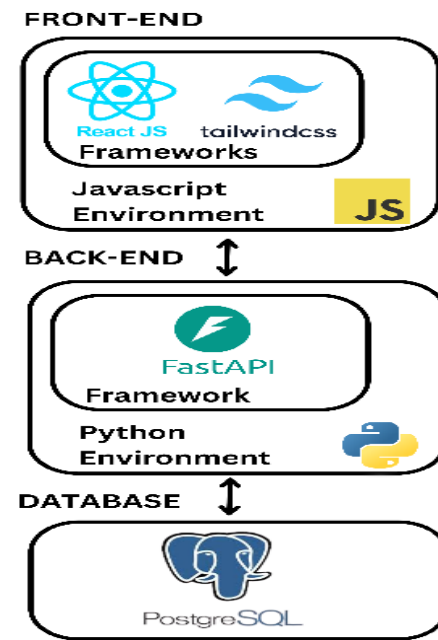


Fig. 4. System Architecture Diagram.

The system's front end was built using React.js, leveraging reusable components for a seamless and efficient user experience. Styling was enhanced with Tailwind CSS, which utilizes a utility-first approach and predefined classes to ensure a consistent, visually refined interface. For back-end operations, FastAPI facilitates asynchronous communication, optimizing task handling without interrupting system processes. To ensure scalability and reliability, PostgreSQL was selected for its robust relational structure, enabling efficient data management and future expansion (Fig. 4).

3.3 System Usability Evaluation

The researcher evaluated system usability using the System Usability Scale (SUS), gathering satisfaction ratings from OCSSS staff and applicants. The 10-question SUS assessment (scale: 1–5) provided quantitative insights into usability challenges, guiding design improvements for a more user-friendly experience. A study [10] highlights SUS as a reliable tool for collecting statistically valid data, helping applications determine precise usability scores.

4. RESULTS AND DISCUSSION

This section presents the system implementation results, assessing its alignment with research objectives. It highlights the automated credential verification process using OCR for gate pass validation and evaluates system performance, including processing speed and validation accuracy.

4.1 Application Submission Overview

The gate pass application process begins with an application pledge, ensuring compliance with campus regulations. Applicants then complete four essential phases, including document submission, & validation, streamlining authorization for secure campus access.

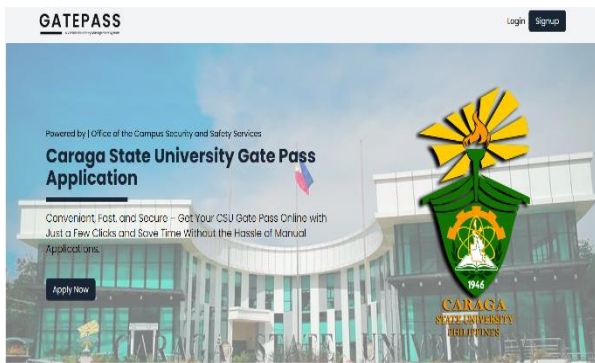


Fig. 5. VGPMs Home Page

This interface serves as an entry point for vehicle applicants, guiding them through the online gate pass application process at CSU-Main. It provides system navigation details and login access (Fig. 5), allowing users to submit applications online.

Fig. 6. Personal Information Entry Interface

This interface represents the first step in the gate pass application process, where applicants enter personal details such as name, email, phone number, and residential address (Fig. 6). A profile image upload is mandatory, along with a confirmation checkbox to ensure data accuracy before proceeding.

Fig. 7. Email Verification Interface

This interface represents Step 2 of the verification process, ensuring applicants provide a valid email before proceeding. The interface features input fields for the code and resend timer (Fig. 7), ensuring a smooth and secure verification process.

Fig. 8. OTP Verification

A six-digit OTP is sent to the registered email, which users must enter to confirm ownership and activity (Fig. 8).

Fig. 9. Vehicle Information & Driver Validation Interface

The third step of the application process ensures accurate vehicle registration and driver verification. Applicants input vehicle details, upload images, and assign a driver, whose license validity is checked using OCR technology to confirm authorization and compliance (Fig. 9).

Fig. 10. Document Submission for Identity Verification

GATEPASS

A Vehicle Gate Entry Management System

Payment Slip

Name:

Harrold Chavit

Nature of Payment:

New Parking Sticker Application
(Student)

Amount:

P50.00

Issued by:

GatePass CSU

Once applicants complete the four-step application, the system generates an email payment slip and sends it to their registered email (Fig. 11). This slip serves as proof of application and must be presented to the cashier's office for payment. The process ensures a smooth and verifiable transaction, reducing errors and streamlining fee collection for approved gate pass applications.

During the gate pass application submission, the OCR validator cross-checks key details across submitted documents. Applications must pass all three validation checks before being stored in the database.

A blank template was provided for the OR, CR, and DL to enhance OCR functionality, ensuring format verification beyond basic text extraction. Visible reference text facilitated accurate validation, while extracted content was compared against reference documents to ensure at least 70% similarity for reliability.

[illegible]

The Certificate of Registration Validation Reference displays an LTO-issued document with key fields enclosed in bounding boxes (Fig. 13) for format verification. Using PyTesseract 5.3.0.20, it ensures accurate data extraction by validating header details, field office, and office codes.



REPUBLIC OF THE PHILIPPINES
 DEPARTMENT OF TRANSPORTATION
 LAND TRANSPORTATION OFFICE
DRIVER'S LICENSE

Last Name First Name Middle Name
 (Last Name) First Name Middle Name

Nationality Sex Date of Birth Weight (kg) Height (m)
 Nationality Sex Date of Birth Weight (kg) Height (m)

Address
 Address

License No. Expiration Date Agency Code
 License No. Expiration Date Agency Code

Blood Type Eyes Color
 Blood Type Eyes Color

DL Codes Conditions
 DL Codes Conditions

Signature of Licensee
 Signature of Licensee

ATTY. WILSON D. MENDOZA
 Assistant Secretary

A sample driver's license with labeled bounding boxes, ensuring format consistency for accurate data extraction (Fig. 14). Key fields, including header details, personal details, physical attributes, and license data, provide a structured basis for verification.

4.4 Automated OCR Text Extraction Accuracy

The image comparison process evaluates uploaded images against a reference standard, enforcing a 70% similarity threshold for document verification. Text analysis applies a stricter 75% threshold, ensuring authenticity while enabling document classification. These controlled thresholds enhance accuracy in automated validation workflows.

4.5 Runtime Analysis of Document Validation

The validation runtime analysis assesses system efficiency by comparing successful and failed document validation attempts. Successful validations, averaging 59.6 seconds, effectively utilize OCR technology for precise authentication of structured submissions. Failed attempts, averaging 25 seconds, often result from unreadable, misformatted, or inconsistent documents, leading to early termination. These runtime variations offer insights into system performance and user interaction challenges.

4.6 System Usability Scale Result

Table III. Summary of SUS Result

Role	Sum / Number of Counts	Average
Employees	550.0 / 6	91.67
Students	725.0 / 8	90.63
Concessionaire	367.5 / 6	61.25

VGPMS demonstrates strong usability potential, despite a 61.52% average score from the concessionaire role. Its excellent usability is reflected in 91.67% and 90.63% average scores from Employees and Students, resulting in an overall usability rating of 81.18%, indicating a generally high usability experience for users.

4.7 Automated Analytics and Downloadable Reports

The system streamlines report generation by automating data summaries within the dashboard and report interfaces. A downloadable button enables OCSSS staff to export reports in PDF format, ensuring efficient access to analytics for monitoring and decision-making analytics for monitoring and decision-making.

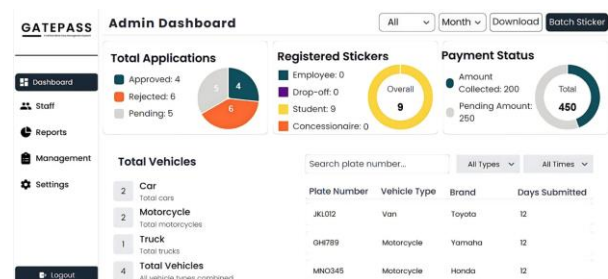


Fig. 15. Admin Dashboard

This interface streamlines vehicle gate pass management, providing real-time application status, registered stickers, payment summaries, and vehicle records. Admin can review, approve, or reject requests while tracking vehicle

details using search and filter options (Fig. 15). Also, download dashboard analytics in tabular format and create batch sticker.

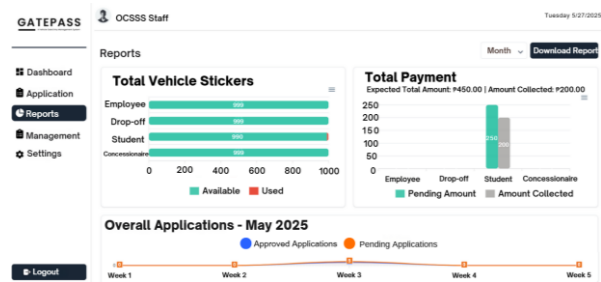


Fig. 16. Staff Report

This interface displays the summaries of the total distributed vehicle gate pass stickers, total payment, and total gate pass application filtered by month and year. The staff can also download this report in PDF format via clicking the download report button (Fig. 16).

4.8 Gate Pass Application Transaction History

Applicants can view and download their Gate Pass Application in PDF format via the Applicant History Interface for reference. The document contains vehicle details, uploaded images, and key supporting documents, helping users track submissions and resolve potential issues efficiently.

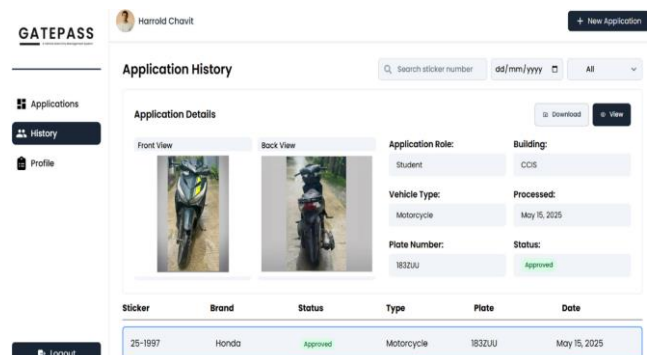


Fig. 17. Application History

This interface ensures transparency between the applicant and OCSSS staff regarding gate pass applications. It provides access to the applicant's data history and current status, allowing them to track, view, and download their application as needed (Fig. 17).

5. SUMMARY

The Vehicle Gate Pass Management System (VGPMS) digitizes the manual application process using OCR technology for document validation, enabling applicants to submit their gate pass requests online. This transition minimizes wait times, eliminates repetitive office visits, and streamlines processing for both applicants and the OCSSS staff, enhancing productivity.

VGPMS ensures accurate document matching and validation, optimizing data management and improving verification reliability. Additionally, its database-driven

reporting supports forecasting, analytics, and strategic decision-making, giving OCSSS valuable insights.

Applicants can conveniently view and download their application records for reference, aiding issue resolution and ensuring transparency. System Usability Scale (SUS) scores indicate high usability among Employees (91.67%) and Students (90.63%), while Concessionaires scored lower (61.25%), highlighting areas for future improvement.

6. CONCLUSION AND RECOMMENDATION

VGPMS replaced the manual application process at OCSSS, improving efficiency and accessibility. OCR technology played a key role in document validation but faced challenges with older Official Receipts documents, image noise, and format inconsistencies. Despite filtering key details and using similarity thresholds for verification, OCR occasionally failed to extract text accurately, requiring resubmissions.

While the system enhances security operations, it has limitations. It depends on internet connectivity and requires well-formatted documents for accurate validation. PyTesseract 5.3.0.20, the system's OCR engine, has difficulty with low-resolution images, complex fonts, and lacks built-in post-processing tools.

To improve GPMS, future upgrades should consider integrating computer vision for document structure validation, adopting advanced OCR models like Google Cloud Vision, and implementing alignment and skew correction techniques. Adding static bounding boxes, a remarks section for document discrepancies, and a hybrid manual submission option would also enhance usability. Lastly, automating sticker printing would streamline processing and improve tracking accuracy. These refinements will make GPMS more efficient, reliable, and user-friendly.

7. REFERENCES

- [1] (22) Eliminating Delays and Costs with Automated Material Gate Pass Management | LinkedIn." Accessed: May 30, 2025. [Online]. Available: <https://www.linkedin.com/pulse/eliminating-delays-costs-automated-material-gate-pass-mahesh-kotgire/>
- [2] R. T. Payongayong and T. D. Palaoag, "Building A Smart Campus: Designing An Architectural Framework For Campus Security Gates And Vehicle Asset Management With GPS Tracking Technology," *J. Electrical Systems*, vol. 20, no. 3, pp. 1373–1381, 2024.
- [3] M. Amirul, A. Roslan, and H. Haron, "Smart Shopping Cart Mobile Application (SmartCart): A Collaborative Shopping Cart System Across Multiple Devices," *International Exchange and Innovation Conference on Engineering and Sciences*, vol. 10, pp. 1–10, 2024, doi: 10.5109/7323235.
- [4] S. A. Ismail, Z. A. Zakaria, and A. Jantan, "Promoting Accountability in Green Technology and Sustainability: Insights from Perpustakaan Tun Abdul Razak (PTAR), Universiti Teknologi MARA in Community Welfare through Islamic Principles," *International Exchange and Innovation Conference on Engineering and Sciences*, vol. 10, pp. 977–985, 2024, doi: 10.5109/7323378.
- [5] J. M. Jayoma, E. S. Moyon, and E. M. O. Morales, "OCR Based Document Archiving and Indexing Using PyTesseract: A Record Management System for DSWD Caraga, Philippines," *2020 IEEE 12th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management, HNICEM 2020*, Dec. 2020, doi: 10.1109/HNICEM51456.2020.9400000.
- [6] A. DAIGORO and M. MASAFUMI, "Performance Evaluation of Automatic Correction Method for Informal Words using OCR," *情報科学技術フォーラム講演論文集*, vol. 21st, pp. 307–308, 2022, Accessed: May 30, 2025. [Online]. Available: https://jglobal.jst.go.jp/en/detail?JGLOBAL_ID=202202229763829337
- [7] S. Paul, S. M. R. Alam, M. O. Sunny, S. Rahman, and A. Al Omar, "Image Analysis using Deep Learning for a Smart Traffic Control System," *ACM International Conference Proceeding Series*, pp. 126–132, Mar. 2022, doi: 10.1145/3542954.3542973;PAGE:STRING:ARTICLE/CHAPTER.
- [8] "Key Presence of Optical Character Recognition (OCR) in Automotive Applications - MosChip®." Accessed: May 30, 2025. [Online]. Available: <https://moschip.com/blog/key-presence-of-optical-character-recognition-ocr-in-automotive-applications/>
- [9] R. D. -, P. B. -, S. D. -, D. R. -, S. B. -, and V. C. -, "SecurePass: Intelligent Vehicle Access Management System," *IJFMR - International Journal For Multidisciplinary Research*, vol. 6, no. 5, Oct. 2024, doi: 10.36948/IJFMR.2024.V06I05.29723.
- [10] "(PDF) SUS: A quick and dirty usability scale." Accessed: May 29, 2025. [Online]. Available: https://www.researchgate.net/publication/228593520_SUS_A_quick_and_dirty_usability_scale