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**Smart Vehicle Number Plate Recognition and Mobile-
Controlled Gate Access System**

Project Proposal 2025

Group Number 24

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Smart Vehicle Number Plate Recognition and Mobile-Controlled Gate Access System

1. Introduction

This project focuses on developing a smart vehicle access control system for institutional gate security. Using the ESP32-CAM module, real-time images of vehicle number plates will be captured when motion is detected. These images are sent to a local server for OCR (Optical Character Recognition) and database comparison. Based on the results, a custom-built mobile app allows security personnel to approve or deny gate access. The system is designed to operate day and night with integrated lighting, enhancing both automation and security.

2. Objectives

- Capture vehicle images in real-time using ESP32-CAM.
- Trigger image capture via motion sensors (PIR/Ultrasonic).
- Send captured images to a server over Wi-Fi.
- Perform AI-assisted number plate detection and OCR.
- Compare the plate with a database of registered vehicles.
- Send the verification result to a mobile app.
- Allow gate access control via the mobile app.
- Maintain a timestamped log of all detected vehicles.
- Ensure 24/7 operation using IR/LED lighting for night vision.

3. Methodology

The system involves setting up hardware like ESP32-CAM and motion sensors at the gate, with a relay module to control the gate motor. When motion is detected, ESP32-CAM captures an image and sends it to a local server. An AI model detects the number plate, followed by OCR for character extraction. The plate number is checked against a database. Based on the result, a mobile app interface enables the security to open the gate. Night vision is ensured using IR/LED lights

4. Time Plan (April - June)

Week	Tasks
Week 1	Research on similar systems and finalize project scope.
Week 2	Procure components and set up ESP32-CAM module.
Week 3	Integrate and test motion sensor with ESP32-CAM.
Week 4	Set up lighting system and test night vision capability.
Week 5	Develop AI model for number plate detection (YOLOv5 or MobileNet-SSD).
Week 6	Implement OCR and integrate it with AI detection pipeline.
Week 7	Set up server (Raspberry Pi/PC) and connect with ESP32-CAM.
Week 8	Start development of mobile application (UI design, basic control).
Week 9	Integrate database (SQLite/Firebase) and enable real-time data sync.
Week 10	Connect mobile app to database and gate control system via relay module.
Week 11	Perform full system integration and begin testing at installation site.
Week 12	Analyze performance, prepare final documentation, and deploy system.

5. Components Used

Component	Description
ESP32-CAM Module	Image capture and Wi-Fi transmission
PIR / Ultrasonic Sensor	Motion detection
IR / LED Light	Night vision support
Relay Module	Gate motor control
Raspberry Pi or PC	Local server for AI processing
Wi-Fi Router	Communication bridge
Mobile App (Flutter/Android)	Gate access control
Database (SQLite/Firebase)	Store plate numbers and timestamps

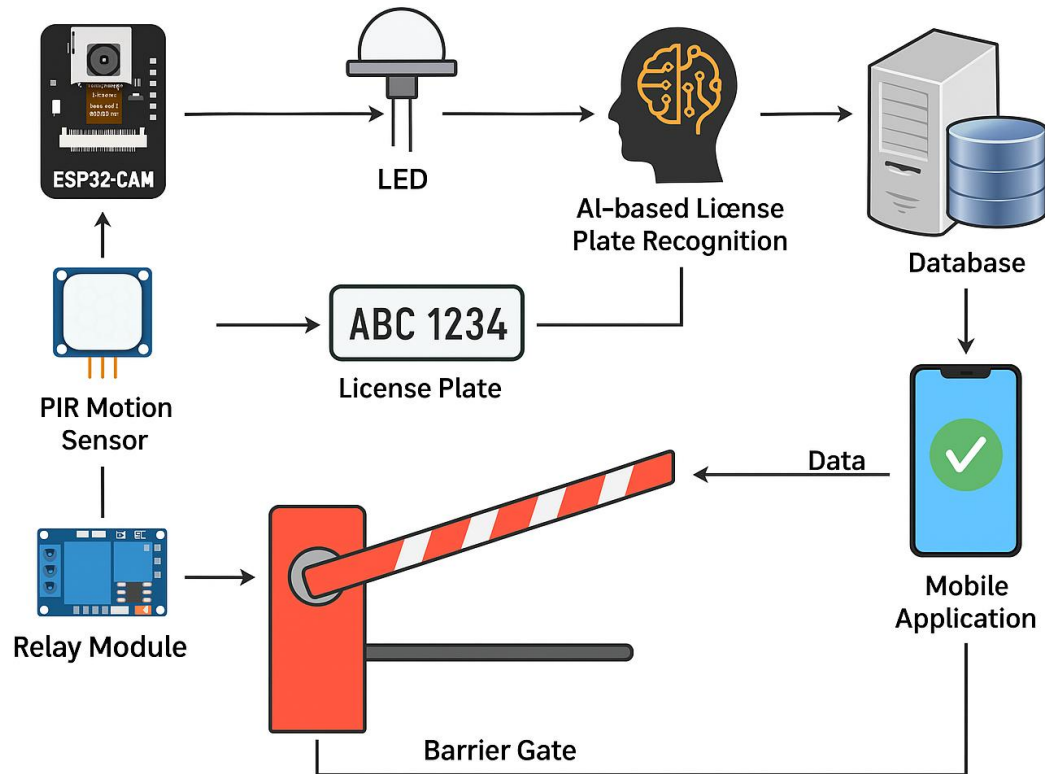
6. Estimated Budget (in LKR)

Item	Quantity	Unit Price (LKR)	Total (LKR)
ESP32-CAM	1	2,160	2,160
PIR Sensor	1	320	320
IR/LED Light	2	500	1,000
Relay Module	1	700	700
Wi-Fi Router	1	5,000	5,000
Misc. (Wires, Board)	1	-	2,000
Mobile App Dev Tools	-	-	Free/Open Source
Total Amount	7	-	11,180

7. Expected Project Outcomes

- A low-cost, scalable, and intelligent vehicle access system.
- AI-powered number plate recognition with high accuracy.
- User-friendly mobile app for real-time gate control.
- Secure, timestamped logging of all vehicle entries.
- Day and night functionality with integrated lighting.
- Enhanced security with human verification via mobile.
- Ready-to-deploy system for institutions and facilities.

Graphical Roadmap Diagram



Conclusion:

This enhanced vehicle access system leverages the ESP32-CAM module, mobile application control, and intelligent lighting to create a secure, efficient, and automated gate control setup. By integrating both edge computing and mobile-based approval, the system balances automation with security oversight — ideal for faculty or institutional gate access control.

