POLITEKNIK MALAYSIA
Sultan Idris Shah

KEMENTERIAN PENGAJIAN TINGGI

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COMMUNICATION TECHNOLOGY

DIPLOMA IN INFORMATION TECHNOLOGY
(DIGITAL TECHNOLOGY)

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INTERGRATED PROJECT(NETWORK)

STUDENT VEHICLE AUTHORIZATION / STAFF BASED ON PLATE LICENSE DETECTION(RASPBERRY PI)

SUPERVISOR: ENCIK MOHD FAIZAL BIN YAHAYA

SESSION : 2 2022/2023

NAMA	MATRICS NO
YAMUNA DEVI A/P DAVANDRA	17DDT21F1071
SRI SANGGARY A/P GUNASEGARAN	17DDT21F1055
JIVITHA A/P BRAGASAM	17DDT21F1043

Declaration

We, the undersigned members of the project group, hereby declare that this technical report, titled "**STUDENT VEHICLE AUTHORIZATION / STAFF BASED ON PLATE LICENSE DETECTION(RASPBERRY PI)**," represents our collective and original work produced under direction and supervision of **Sir Mohd Faizal Bin Yahaya** .All information and data presented in this report are the result of our joint research and analysis. Any external sources used have been appropriately acknowledged and cited.

We confirm that this report has not been submitted elsewhere for academic credit or evaluation.

1.Signature : *Yamuna Devi*

Name : YAMUNA DEVI A/P DAVANDRA

Registration No : 17DDT21F1071

Date :

2.Signature : *Sri Sanggary*

Name : SRI SANGGARY A/P GUNASEGARAN

Registration No: 17DDT21F1055

Date:

3. Signature : *Jivitha*

Name : JIVITHA A/P BRAGASAM

Registration No: 17DDT21F1071

Date :

APPROVAL FOR SUBMISSION

Project Title : STUDENT VEHICLE AUTHORIZATION / STAFF BASED ON PLATE LICENSE DETECTION(RASPBERRY PI)

Session : 2 2022/2023

Submitted by : 1.YAMUNA DEVI A/P DAVANDRA(17DDT21F1071)
2.SRI SANGGARY A/P GUNASEGARAN (17DDT21F1055)
3. JIVITHA A/P BRAGASAM (17DDT21F1043)

"This technical report has been read, checked and approved in term of scope and quality for the award of Diploma in Information Technology (Digital Technology)."

Checked by

Supervisor's Signature :

Supervisor' Name :

Date :

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1.0 ABSTRACT

In this project, a Raspberry Pi-based system for student vehicle authorization and staff based plate licence detection is developed. The current issue is the ineffective control of vehicle access on college campuses, which creates security risks and allows unauthorised entry. The growing campus safety concerns and the absence of a practical automated solution have necessitated this project. The main goal is to develop a smart system that can recognise and authorise vehicles based on their licence plates. The objectives of the project is Scalability and Performance to ensure accurate authorisation even during busy times, Real-Time Authorization and Database management. In the prototype method, a Raspberry Pi is combined with a camera to capture licence plate information, which is then processed using machine learning algorithms. The project's goal is to improve campus security by implementing an automated vehicle authorization system.

2.0 Project Plan

2.1 Problem Statement

Manual approaches to car permission and access control in educational institutions are inefficient, risky, and have a little degree of scalability. Due of these difficulties, a Raspberry Pi-based automated solution for staff and student car permission based on licence plate detection is needed. The following issues must be resolved:

a) Ineffective and Time-consuming Authorization Procedure:

-The current manual vehicle authorization procedure in educational institutions necessitates that security staff manually verify and log the information on each vehicle's licence plate. During peak hours, long lines, delays, and traffic congestion result from this lengthy process.

b) Lack of Real-Time Monitoring and Control:

- Real-Time Monitoring and Control is frequently missing from traditional methods of vehicle authorization. This restriction makes it more difficult to identify and respond to unauthorised vehicles trying to enter the property right away, which raises the risk of security breaches.

c) Inconvenience for Vehicle Owners:

- Presenting physical documents or identification cards for authorization can be inconvenient and time-consuming for vehicle owners. The manual approach may cause authorization paperwork to disappear or be misplaced.

To increase the overall security, effectiveness, and convenience of vehicle authorization at educational institutions, these issues must be fixed.

2.2 Objective

The "Student Vehicle Authorization/Staff Based on Plate Licence Detection (Raspberry Pi)" project aims to create an automated system that makes use of the capabilities of the Raspberry Pi to address the issues related to vehicle authorization in educational institutions. The project wants to accomplish the following goals:

a) Scalability and Performance:

-Create a scalable system that can effectively handle a lot of automobiles. To ensure prompt and accurate authorisation even during busy times, optimise algorithms and system settings.

b)Real-Time Authorization:

- Create a real-time authorization system that compares observed licence plates to the registered vehicle database. Quickly allow authorised cars entrance, while preventing unauthorised or unidentified vehicles from entering.

c) Database Management:

-Create and deploy a central database to record and manage the data on vehicles driven by students and staff that have registered licence plates. Create systems that make it simple to register, update, and retrieve licence plate information. Maintain data privacy and security in compliance with applicable laws.

The system will ensure a safer and more effective environment within the educational institution by enhancing security, enhancing traffic management, and providing a faster and convenient vehicle access process.

2.3 Project Scope

2.3.1 User's Scope:

User Scope for the "Student Vehicle Authorization/Staff Based on Plate License Detection (Raspberry Pi)" project:

a) Owners of Vehicles:

During the initial registration procedure, system users—including students and staff—will be vehicle owners. They will give the specifics of their car's licence plate and update it as necessary. They will gain from the enhanced ease and security that the automated authorization system offers as well.

b) Administrators of the educational institution:

The system for running the database of licence plates will be accessible to administrators of the educational institution. They can keep an eye on the permission process and add, amend, or remove registered automobiles from the database. They will also be able to create reports and examine information on vehicle access.

c) Security staff:

Security staff will use the system to control vehicle entry at the educational institution's entrance points. They will supervise the system's operation and respond to any alarms or messages the system may send forth. In unusual circumstances, they might even be involved in manually inspecting specific cars

2.3.2 System Scope

System Scope for the "Student Vehicle Authorization/Staff Based on Plate License Detection (Raspberry Pi)" project:

a) Centralised Database Management:

To store and manage the registered licence plate information of staff and student vehicles, the system will have a centralised database. It will offer tools for putting new automobiles in the database, upgrading existing ones, and taking them out entirely. During the authorization procedure, the database will ensure safe and effective retrieval of licence plate information.

b)Vehicle Image or Captured by Cameras Connected to Raspberry Pi:

The system will incorporate algorithms and processes for precisely detecting and recognising licence plates from vehicle photos or video streams. To reliably recognise licence plates and recognise characters, it will use computer vision techniques and machine learning models.

c) Integration with Raspberry Pi Hardware:

The system will link to cameras or other image-capture devices and combine with Raspberry Pi hardware to detect licence plates. It will provide smooth data flow and communication between Raspberry Pi and the associated hardware elements. To ensure effective functioning, proper setup and integration will be put into place.

d)Feedback Mechanism:

When the system have recognize the legit staff or student’s vehicle licence plate in order to get pass the security entrance and enter the institute compound, the gate automatically open for the authorised user. The system does not respond to unauthorised user. The gate will remain close.

2.4 LITERATURE REVIEW

INTRODUCTION -With the increasing number of vehicles in today's world it may not be possible to keep a record of the entire vehicle manually. It requires manpower to note down the number and hence it is time consuming. Furthermore the data stored manually cannot be accessible after a long time. So in order to overcome all these problems we have developed a system which would automatically detect the number plate and store it in its database. Later on the information can be accessed when required. This process gives the correct result compared to manually one. The process of working involves that as soon as the vehicle enters the specific area the system automatically captures the images and stores it. The processing of the image is done through the number plate recognition (NPR) software which is stored in the system. If the vehicle matches the stored data then it allows to pass through the gate. And if the vehicle is not matched or if its marked in the blocked list then it do not allow to cross the gate and further checking process are followed[1]

OpenCV OpenCV is an image processing library for real time computer vision applications using python, C and C++. Open Source and free and may have some commercial packages . It is easy to use and install. OpenCV provides a simple window manager with sliders, mouse, call backs etc, and uses Intel Integrated performance primitives to enhance image and video applications in computer vision .[1]

In recent years, demands for intelligent transportation system based on images such as vehicle surveillance, traffic surveillance, etc. are on the rise. Hence, many new algorithms have been produced, especially to detect the car number plate automatically. Despite these many algorithms, differences in rules, shape, font and format for the number plate in a certain country lead to miss detection for some algorithms. As an example, in Malaysia, the number plate can be in two different types; white numbers and letters with black background or vice versa. There are many methods on car number plate detection have been done proposed such as colour features , template matching , edge information , morphological operators , Hough transform , neural network . Hough transform needs considerable amount of computing time and a large memory space. An edge-based approach is simple and fast, but it is sensitive to complex background,
which sometime caused an increment in false alarm. In this paper, a method based on a combination of template matching and colour information is presented, which combines

the colour information method with the output from the template matching algorithm. Malaysian car number plate that contains only two colours makes this algorithm suitable to be applied[3]

1.2 License Plate Extractor This is most critical process in License Plate Recognition System. In this process we apply different techniques on image to detect and extract license plate. This process is divided in two parts.[2]

1.2.1 License Plate Detection through Haar-like features In image processing techniques, Haar-like features are used to recognize objects from image . If our proposed system is selected to detect only license plates then the Haar-like features are used for this purpose and no further processing is done. This technique is old and laborious and more over needs a large database to store the collected samples nearly about 10000 images of the plates and characters [2]

1.2.2 License Plate Detection through Edge Detection In the other case, if our proposed system has to recognize license plates, then the binary image is created from the image. After that following steps are performed to extract license plate from binary image:
1. Four Connected Points are searched from binary image.

2. Width/Height ratio is matched against those connected points.

3. License Plate region is extracted from image.

4. Transformation of extracted license plate is performed. Then the extracted license plate is passed to next component for further processing. This approach is quick and takes less execution time and memory with high a efficiency ratio. That's why we have adopted this technique in our project[2]

AUTOMATIC NUMBER PLATE RECOGNITION SYSTEM -In this section, we have described the proposed Automatic number plate recognition system in detail. The working of Automatic number plate recognition (ANPR) system can be classified into two sections namely software and hardware. The software model utilizes image processing concepts and OpenCV Python for

implementation. The flow diagram implements in five stages: Capturing an image, preprocessing, edge detection, contour finding and number plate display in the image and is shown in Fig. 2. [1]

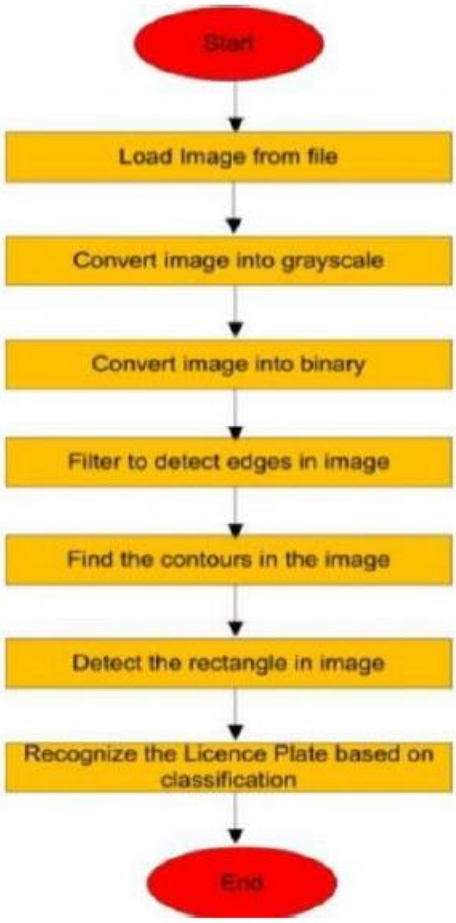


Figure. 1 Flow diagram of ANPR system

Raspberry pi and noir camera are hardware part of this implementation.

1. Capture an image : The first step is to capture an image. A raspberry pi noir camera captures the image in RGB and is stored in JPEG format. Later on it is converted into the gray scale image from RGB.

2. Preprocessing : The next stage performs pre-processing. Every image will have useful and useless information, in this case for us only the license plate is the useful information and the rest are pretty much useless for our program. This redundant or unwanted information is removed by a bilateral filter (Blurring). Later, for edge detection, the gray-scale image is converted into binary.

3. Filter to detect edges : The next step is interesting where we perform edge detection. The main objective of edge detection is to decrease the sum of information in the image and to maintain the structural features for the additional image processing. To detect the image discontinuities many techniques of edge detection are used. The edge is the extremity
between two regions with comparatively distinct gray level characteristics. There are various ways to do it, in our proposed system, we have used canny edge method from OpenCV [6].

4. To Find the contours : This can be described merely as a line linking all points along the border of an image with the same colour or intensity.

5. To display the region of the number plate in the image

[1] International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278- 3075, Volume-9 Issue-2, December 2019. Automatic Number Plate Recognition System using
Raspberry Pi Naveena Budda, K. Meenakshi, Padmavathi Kora, K. Swaraja, G.V.Subba Reddy

[2] International Journal of Computer Applications Technology and Research Volume 3–Issue 12, 756 - 761, 2014, ISSN:- 2319–8656 Automatic License Plate Recognition using OpenCV Pratiksha Jain Department of CSE IGIT, GGSIPU New Delhi, India Neha Chopra Department of ECE IGIT,
GGSIPU New Delhi, India Vaishali Gupta Department of CSE IGIT, GGSIPU New Delhi, India

[3] Malaysian Car Number Plate Detection System Based on Template Matching and Colour Information Mohd Firdaus Zakaria, Shahrel A. Suandi Intelligent Biometric Group, School of
Electrical and Electronics Engineering, Engineering Campus, University Sains Malaysia, 14300 Nibong Tebal, Penang, Malaysia. firdauszakaria@gmail.com, shahrel@eng.usm.my

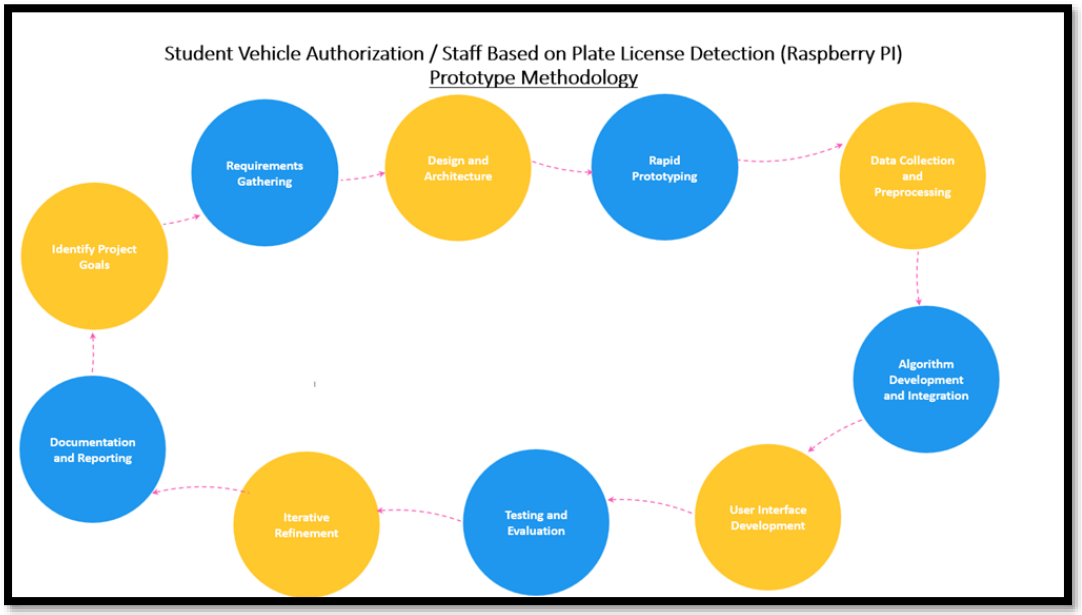
STUDENT VEHICLE AUTORIZATION / STAFF BASED ON PLATE LICENSE DETECTION (RASBERRY PI)	Malaysian Car Number Plate Detection System Based on Template Matching and Colour Information (2010) Mohd Firdaus Zakaria et. al. / (IJCSE) International Journal on Computer Science and Engineering[3]
✓ Uses opencv which is helps computers to understand images and videos.It offers function for loading and saving images and vidoes adjusting colors and contrast ✓ Advantages of opencv ✓ Open source and free • Opencv is an open source library,which means its freely available to use,modify and distribute ✓ Database included • We can add or remove car number plate in database	✓ The input image is first converted to greyscale image, in order to find its intensity information. In order to minimize the processing time, the input image has been cropped, only fifty percent of the lower part of the input image will be processed. ✓ Template Matching is a technique that compares portions of images against one another. It can be used in manufacturing as a part of quality control , a way to navigate a mobile robot

2.5 METHODOLOGY

The Prototype Methodology offers a structured way to quickly create and test a working prototype of the system for the student vehicle authorization and staff based on plate licence detection project using Raspberry Pi. This methodology places a strong emphasis on quick development, iterative improvement, and gathering user feedback to confirm key features and improve the system's efficiency.

The prototype methodology's goal is to create an initial version of the system that highlights the core features, with a focus on licence plate detection, recognition, and staff authorization. The project team can effectively show the concept's viability and gain insightful feedback from stakeholders by using this methodology.

The student vehicle authorization and staff based on plate licence detection project using a Raspberry Pi can effectively advance from the conceptual stage to a tangible and validated prototype by adhering to the prototype methodology. Rapid system development, validation of key functionalities, and stakeholder feedback gathering are all made possible by the methodology, which ultimately results in a better and more efficient system.



1) Identify Project Goals: Clearly define the project's parameters and objectives. Determine the precise features and functionalities needed for the staff and student vehicle access control system. Specify the requirements for staff access control and student vehicle authorization.Establish the project schedule and the resources that are available.

2) Requirements Gathering: Engage stakeholders, such as administrators, employees, and IT professionals, to gather requirements. Determine the features required for staff access control based on licence plate recognition and student vehicle authorization. Record the specifications and rank them in order of importance and prototype viability.

3) Design and Architecture: Create the prototype's high-level architecture and design. Plan the integration of the necessary hardware elements, such as the Raspberry Pi and camera module. Find the software components and algorithms required for detecting and recognising licence plates.

4) Rapid Prototyping: To create a working prototype quickly, use rapid prototyping techniques. Put your efforts into implementing the essential staff authorization and licence plate detection functionalities. To quickly iterate and improve the prototype, employ lightweight and agile development methodologies.

5) Data Collection and Preprocessing: Assemble a representative licence plate image dataset for the prototype's training and testing. To increase accuracy and robustness, preprocess the data by applying the necessary filtering, normalisation, and augmentation techniques.

6) Algorithm Development and Integration: The prototype should incorporate the licence plate detection and recognition algorithms. To identify licence plates and extract pertinent data, this involves using computer vision techniques, pattern recognition, and machine learning models.

7) User Interface Development: Create and implement a user interface for administrators to control staff and vehicle access. To ensure a positive user experience, put an emphasis on usability and simplicity.

8) Testing and Evaluation: Extensive testing to confirm the prototype's performance and functionality. Analyse the dataset to determine the precision of licence plate detection and recognition algorithms. To assess the prototype's success in achieving the set objectives, collect user and stakeholder feedback

9) Iterative Refinement: Iterate and improve the prototype based on user feedback and evaluation findings. Address any problems that have been found, improve the features, the user interface, and the system's overall performance. Up until the prototype reaches the required standards, repeat the testing and improvement process.

10) Documentation and Reporting: Record the design choices made, the difficulties encountered, and the lessons learned during the development process. Create a thorough report outlining the functionalities, restrictions, and future suggestions for improvement of the prototype.

2.6 GANTT CHART

TASKS	WEEKS							
	1	2	3	4	5	6	7	8
1.0 PROJECT PROPOSAL **1.1** Prepare project plan and project design								
Proposal Demonstration								
2.0 PROJECT DEVELOPMENT **2.1** Plan requirement and design specification **2.2** Manage the hardware and software configuration **2.3** Develop problem specification and design								
Project Demonstration 1								
2.0 PROJECT DEVELOPMENT **2.1** Plan requirement and design specification **2.2** Manage the hardware and software configuration **2.3** Develop problem specification and design								
Project Demonstration 2								
3.0 DELIVERABLES **3.1** Present deliverables **3.2** Prepare project documentation **3.3** Present final project								
Project Demonstration 3								
Final Presentation								

3.0 REQUIREMENT SPECIFICATION

3.1 Functional Requirement

a) License Plate Detection and Recognition:

The system able to detect license plate and recognize license plates from inserted data in database. The system also able to distinguish between authorized and unauthorized vehicles based on the recognized license plates.

b) Authorization Status Check:

The system able to perform a real-time or near real-time check against the license plate database to verify the vehicle's authorization status.It should immediately raise an alert if an unauthorized vehicle is detected.

c) User Interface:

This system include a friendly interface and simple interface to easily understand by novice user for add details of license plate into database.

d) Gate Operation:

Gate automatically open or close upon successfully authentication of the car license plate. This mechanism operate smoothly and securely

3.2 Non-Functional Requirement

a) Security:

Only those who are authorised to enter through the gate have access to the system.

b) Performance :

The processing time of this system for detecting and recognizing license plates should be efficient, ensuring that authentication and gate operation happen swiftly, so users experience minimal waiting times.

c)Maintainability:

The system's codebase and architecture are well-structured and documented to make maintenance easier.

d)Capacity:

In the database, we can store and manage an abundance of license plates for registration.

3.3 HARDWARE AND SOFTWARE REQUIREMENT

3.3.1 Hardware Requirement

1.Raspberry pi

Figure 3.3.1.1

The Raspberry Pi 4 is a small yet capable single-board computer with improved performance and memory options over prior generations. It's a wonderful platform for a variety of projects, including instructional, hobbyist, and DIY projects. Because of its small size, low cost, and low power consumption, the Raspberry Pi 4 has garnered popularity among enthusiasts and developers for a variety of projects including home automation, gaming consoles, and programming education. Its adaptability and user-friendly design make it an excellent choice for both novice and experienced users looking to explore and experiment with cutting-edge computing applications.

2.Servo Motor

Figure 3.3.1.2

A Servo Motor is a small device that has an output shaft. This shaft can be positioned to specific angular positions by sending the servo a coded signal. As long as the coded signal exists on the input line, the servo will maintain the angular position of the shaft.

3.Jumpire wire

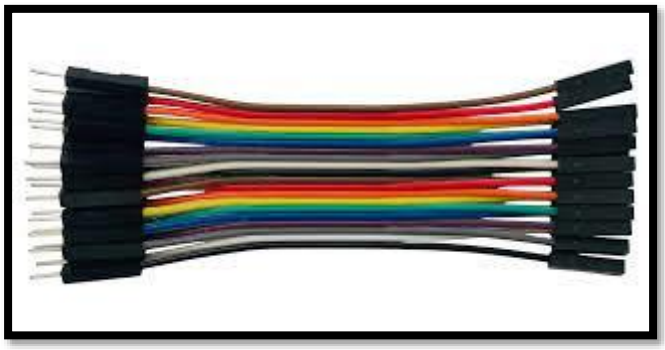


Figure 3.3.1.3

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

Bil	Hardware	Price(RM)
1.	Raspberry pi 4 Model B with 8GB Ram	RM369.00
2.	Servo motor	RM9.00
3.	Jumper wire	RM3.00
	Total	RM381.00

3.3.2 Software Requirement

Bil	Software	Price(RM)
1.	Open Source Computer Vision Library(OpenCV)	Free
2.	Python	Free
3.	HTML	Free
4.	Raspberry Pi OS	With Model
	Total	RM 0

3.4 SYSTEM CONFIGURATION

3.4.1 Interface

```
<!DOCTYPE html>
<html>
<head>
   <title>Number Plate Detection Registration</title>
   <style>
      body {
         background-image: url('image/nature.jpg');
         background-size: cover;
         background-position: center;
         text-align: center;
      }

      form {
         display: inline-block;
         margin-top: 50px;
         background-color: rgba(255, 255, 255, 0.8);
         padding: 20px;
         border-radius: 10px;
      }

      label {
         display: block;
```

```
            margin-bottom: 10px;
        }

        input[type="text"] {
            width: 200px;
            padding: 5px;
            border-radius: 5px;
            border: 1px solid #ccc;
        }

        input[type="submit"] {
            padding: 10px 20px;
            background-color: #4CAF50;
            color: white;
            border-radius: 5px;
            border: none;
            cursor: pointer;
        }
    </style>
</head>
<body>
    <h1>Number Plate Detection Registration</h1>

    <form action="index.php" method="POST">
```

```
        <label for="name">Name:</label>
        <input type="text" id="name" name="name" required><br><br>

        <label for="no_plate">Number Plate:</label>
        <input type="text" id="no_plate" name="no_plate" required><br><br>

        <label for="car_brand">Car Brand:</label>
        <input type="text" id="car_brand" name="car_brand" required><br><br>

        <label for="car_colour">Car Colour:</label>
        <input type="text" id="car_colour" name="car_colour" required><br><br>

        <label for="phone">Phone:</label>
        <input type="text" id="phone" name="phone" required><br><br>

        <label for="department">Department:</label>
        <input type="text" id="department" name="department" required><br><br>

        <input type="submit" value="Submit">
    </form>
</body>
<?php
if ($_SERVER["REQUEST_METHOD"] === "POST") {
    // Retrieve the form data
```

```
$name = $_POST['name'];
$no_plate = $_POST['no_plate'];
$car_brand = $_POST['car_brand'];
$car_color = $_POST['car_colour'];
$phone = $_POST['phone'];
$department = $_POST['department'];

// Create a new database connection
$conn = new mysqli("localhost", "root", "", "staff_info");

// Check the connection
if ($conn->connect_error) {
    die("Connection failed: " . $conn->connect_error);
}

// Prepare the SQL statement to insert the form data into the table
$sql = "INSERT INTO details (name, no_plate, car_brand, car_color, no_phone, dept)
        VALUES ('$name', '$no_plate', '$car_brand', '$car_color', '$phone', '$department')";

// Execute the SQL statement
if ($conn->query($sql) === TRUE) {
    echo '<script>alert("Data inserted successfully.");</script>';
} else {
    echo "Error: " . $sql . "<br>" . $conn->error;
```

```
    }


    // Close the database connection
    $conn->close();
}
?>
</html>
```

3.4.2 Python in Raspberry PI

```
import cv2

import pytesseract

import mysql.connector

import RPi.GPIO as GPIO

import time


# Replace the placeholders with your MySQL database credentials

db_host = '192.168.50.205'

db_user = 'fyp'

db_password = '123'

db_name = 'staff_info'


# Establish connection

db = mysql.connector.connect(host=db_host, user=db_user, password=db_password,
database=db_name)

cursor = db.cursor()


# Set up camera

camera = cv2.VideoCapture(0)  # Use 0 for the first USB camera


# Load the machine learning or deep learning model for character recognition

# Replace 'model' with your actual character recognition model

model = None
```

```
# Set up the GPIO pin connected to the servo motor
servo_pin = 18

# Set up the GPIO mode to BCM and the servo motor pin as an output
GPIO.setmode(GPIO.BCM)
GPIO.setup(servo_pin, GPIO.OUT)

# Function to move the servo motor to a specified angle
def move_servo(angle):
    pwm = GPIO.PWM(servo_pin, 50)  # 50 Hz (20 ms period)
    pwm.start(0)
    duty_cycle = angle / 18 + 2  # Convert angle to duty cycle (2 to 12%)
    GPIO.output(servo_pin, True)
    pwm.ChangeDutyCycle(duty_cycle)
    time.sleep(1)  # Wait for the servo to reach the desired angle
    GPIO.output(servo_pin, False)
    pwm.ChangeDutyCycle(0)
    pwm.stop()

# Function to perform OCR on the detected number plate
def perform_ocr(image):
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    ocr_result = pytesseract.image_to_string(gray, config='--psm 6')
    return ocr_result.strip()
```

```
# Function to compare the extracted number plate with the data in the MySQL database
def compare_license_plate(no_plate):
    query = "SELECT * FROM details WHERE no_plate = %s"
    extracted_text = (no_plate,)
    cursor.execute(query, extracted_text)
    result = cursor.fetchone()

   # Check if the number plate is authorized or unauthorized
    if result:
        print("License plate found in the database. It is authorized.")
        # Move the servo motor to 90 degrees (upward position)
        move_servo(90)
        time.sleep(3)  # Wait for 3 seconds with the gate open
        # Move the servo motor back to its original position (0 degrees)
        move_servo(0)
        time.sleep(1)  # Wait for 1 second to settle in the closed position
        return True
    else:
        print("License plate not found in the database. It is unauthorized.")
        return False

# Function to detect potential license plate regions in the frame
def detect_number_plate(image):
```

```
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    # Applying image preprocessing for accurate contour detection
    _, thresholded = cv2.threshold(gray, 0, 255, cv2.THRESH_BINARY + cv2.THRESH_OTSU)
    blurred = cv2.GaussianBlur(thresholded, (5, 5), 0)
    edges = cv2.Canny(blurred, 50, 150)
    contours, _ = cv2.findContours(edges.copy(), cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

    min_area = 300
    max_area = 5000
    min_aspect_ratio = 2
    max_aspect_ratio = 6
    detected_plates = []

    for contour in contours:
        (x, y, w, h) = cv2.boundingRect(contour)
        aspect_ratio = w / float(h)

        if min_area < cv2.contourArea(contour) < max_area and min_aspect_ratio < aspect_ratio < max_aspect_ratio:
            detected_plates.append((x, y, w, h))

    return detected_plates
```

```
while True:
    ret, frame = camera.read()

    if not ret:
        print("Error: Unable to capture frame from the camera.")
        break

    # Display the frame with number plate overlay
    cv2.imshow("Number Plate", frame)

    # Process the image to detect the number plate when 's' is pressed
    if cv2.waitKey(1) == ord('s'):
        # Detect and extract number plate
        detected_plates = detect_number_plate(frame.copy())

        # Process detected license plates
        for (x, y, w, h) in detected_plates:
            plate_roi = frame[y:y + h, x:x + w]
            plate_text = perform_ocr(plate_roi)
            is_authorized = compare_license_plate(plate_text)
            cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 255, 0), 2)
            cv2.putText(frame, plate_text, (x, y - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.7,
(0, 255, 0), 2)
```

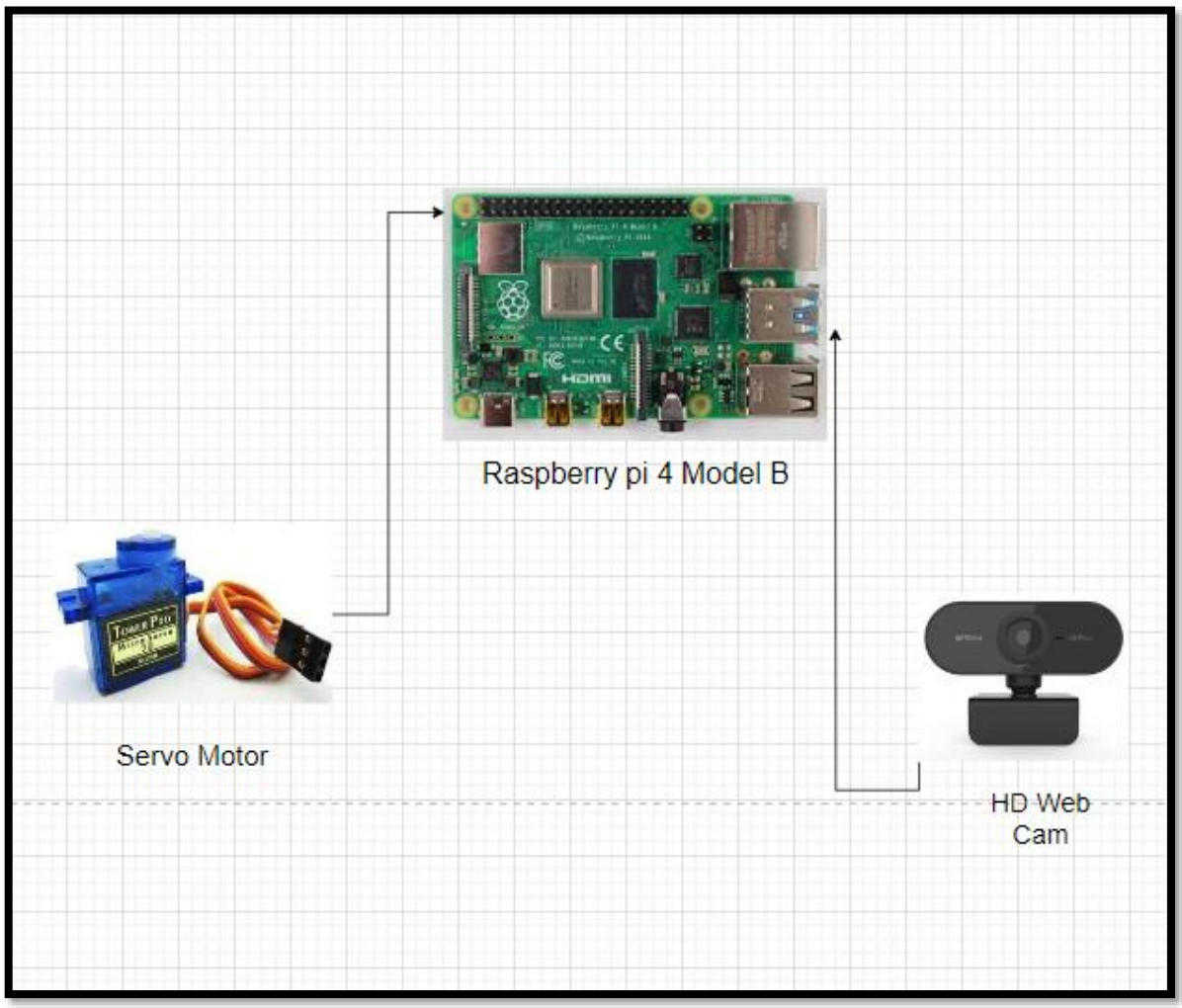
```
        cv2.imshow("Detected Number Plate", frame)

    # Exit loop when 'q' is pressed
    if cv2.waitKey(1) == ord('q'):
        break

# Release the camera and close all windows
camera.release()
cv2.destroyAllWindows()

# Cleanup GPIO and close the database connection
servo.stop()
GPIO.cleanup()
db.close()
```

3.5 SECURITY REQUIREMENT

This license plate detection system project's security needs include integrating authentication measures to ensure that only authorised persons may administer and use the system. This could include securely confirming the identification of users like system administrators or authorised workers using the website only. Furthermore, the project intends to impose tight access control measures to prevent unauthorised access to the control interface of the license plate detection system. Only authorised administrators should be able to access system configuration and administration functions, ensuring that sensitive settings are not changed and stolen. Using the interface, the system will securely store licence plate data in a database, following to data privacy guidelines to protect sensitive information such as no.tel. To avoid unauthorised access and protect data confidentiality, any acquired licence plate data should be maintained securely.

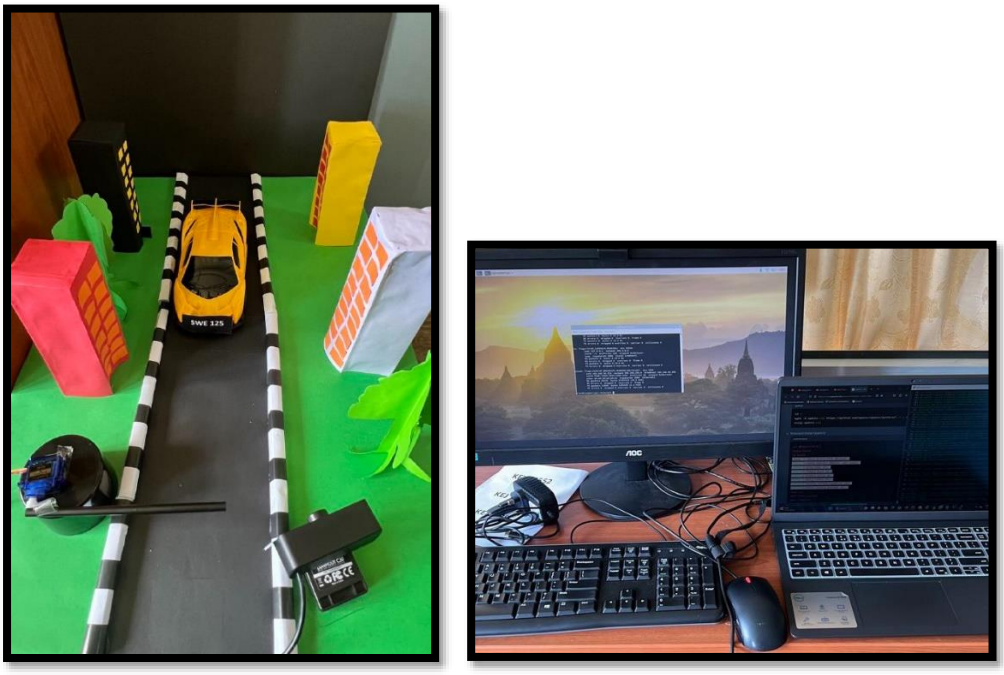
4.0 FINAL DESIGN

4.1 Logical Design



4.2 Physical Design

The Prototype methodology for student vehicle authorization or staff-based license plate detection with Raspberry Pi involves creating an initial working model of the access control system. This model, or prototype, is a basic version of the final system that demonstrates the core functionalities, such as capturing and processing vehicle license plates and granting access to authorized vehicles. During this stage, the focus is on rapid development and testing to validate the system's feasibility and efficiency. The prototype provides valuable insights into potential challenges, technical feasibility, and user experience, helping to identify necessary improvements and adjustments before proceeding to full-scale development and implementation.



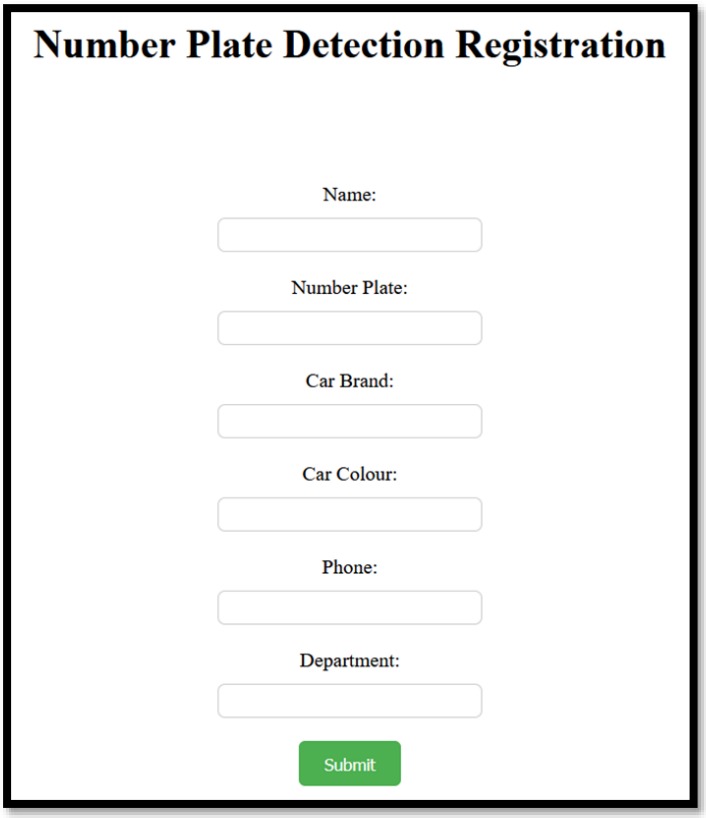
4.2.1 Project Prototype

The camera captures an image of the vehicle's number plate, and then the system compares it with the entries in the MySQL database. If the number plate is found in the database, the vehicle is considered authorized, and if not, the system displays the vehicle as unauthorized.

Figure 4.2.2 Project prototype

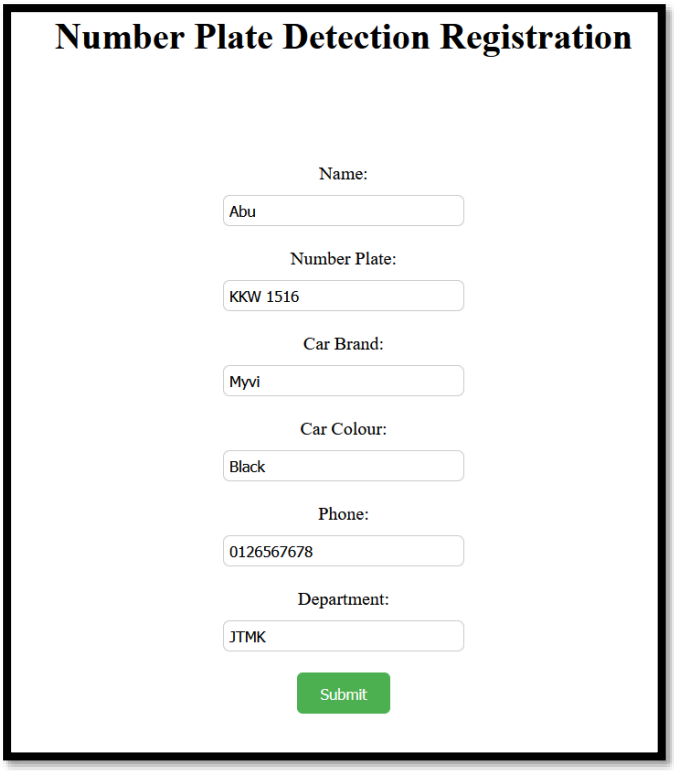
i. If the vehicle number plate is validated as authorized, the gate bar, represented by the servo motor, will execute a 90-degree movement.

4..2.3 Project Prototype



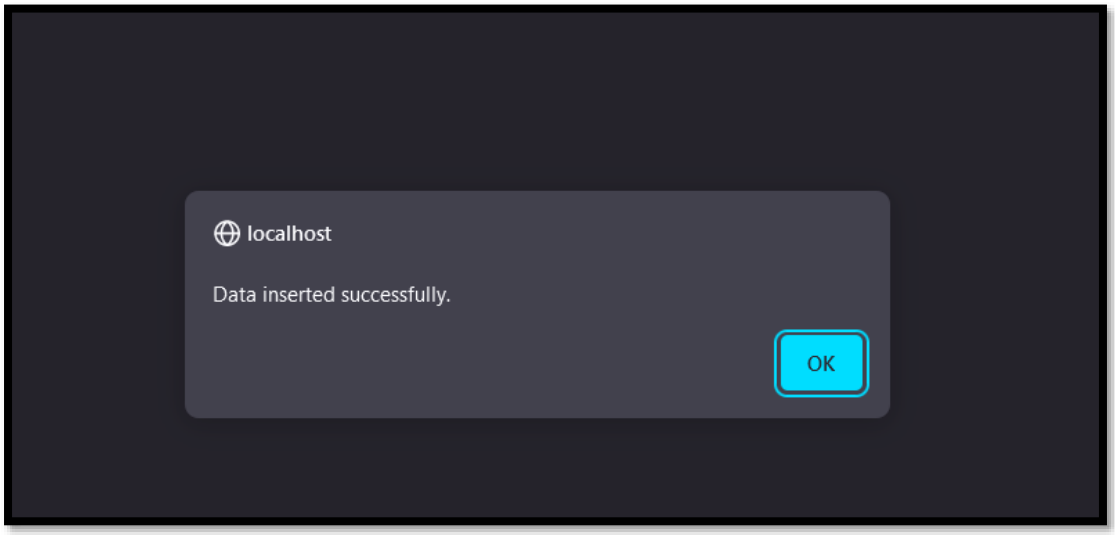
4.3.4 User Interface

This interface is designed for new staff/students to gain authorization by registering their vehicle's license plate. During the registration process, they must provide their name, number plate, car brand, car color, phone number, and department information.



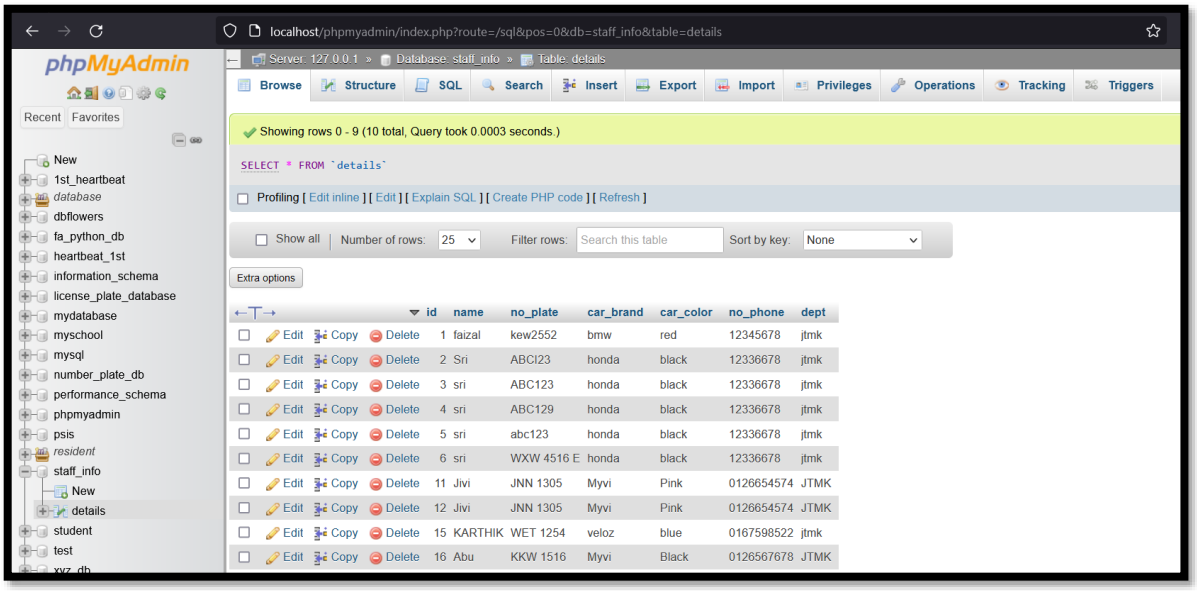
4.3.5 Example of User Entering Data

This example involves Abu, who is a new staff member, and he is using the interface to input his information for registration purposes.



4.3.6 This Message will display once User's details added to Database

After completing the registration process, a message indicating "Data inserted successfully" will be displayed.



4.3.7 Example Database

This is the PHPMyAdmin website, where all the inserted data will be visible and displayed.

5.0 TEST DESCRIPTION AND RESULT

5.1 Unit Testing

UNIT TESTING PLAN (UTP)						
No.	**Test Case Name**	**Test Procedure**	**Pre-Condition**	**Expected Result**	**Tester**	**Result (Pass / Failure)**
1.	Raspberry PI	Required to setting up the hardware, installing the required software, capturing test images, implementing the detection algorithm.	Check if the necessary peripherals, such as a camera module and power supply, properly set up and connected for image processing.	Able to capture images, accurately detect and recognize number plates from vehicles.	“Yamuna”	PASS
2.	Test the servo motor	Required to move at 90 degrees.	Connect the gate’s bar to the servo motor to enable vertical movement	Able to move 90 degrees when the vehicles number plate is authorized.	“Sri”	PASS

Continue of **Unit Testing Table…..**						
3.	Test the LED light	Requited to turn on if the vehicles number plate is authorized.	Check and connect to the right pin.	Light able to turn on.	“Jivitha”	PASS
4.	Test the camera	Required to capture images of vehicles with visible number plates under various lighting conditions and angles to ensure the camera can produce clear and accurate images for processing.	Check if the camera is capable of capturing clear and high-quality images of vehicles with visible number plates.	Able to capture authorized and authorized vehicles number plate.	“Jivitha”	PASS

5.2 Integration Testing Plan

INTEGRATION TESTING PLAN (ITP)						
No.	**Test case name**	**Test Procedure**	**Pre-condition**	**Expected result**	**Tester**	**Result (Pass/Failure)**
1.	Capture the image.	Capture the images of vehicles number plate, evaluate quality, assess recognition.	Capture high-quality images of vehicles' number plates for accurate processing and recognition.	Capture authorized and unauthorized vehicles number plate.	“Jivitha”	PASS
2.	Move at 90 degrees.	The servo motor need to move when vehicle number plate is authorized.	Connect the gate's bar to the servo motor to enable vertical movement	Move 90 degrees if the vehicles number plate is authorized.	“Yamuna”	PASS
3.	Turn on the lights	The light need to on automatically.	The light will automatically on if the vehicles number plate is authorized.	Turn the light on if the vehicles number plate is authorized.	“Sri”	PASS

6.0 MAJOR FINDINGS AND DISCUSSION

6.1 Advantages of Project

a)Automated and Efficient Access Control

By automatically recognizing and validating license plates, the system allows authorized vehicles to enter or exit premises without the need for manual intervention. This automation leads to increased efficiency and reduced wait times for staff, students, and visitors, as they no longer have to wait in long queues for manual inspection or clearance. Moreover, the system operates 24/7, ensuring access control is always available, even outside regular working hours.

b)Enhanced Security and Unauthorized Vehicle Prevention

Utilising a Raspberry Pi for licence plate detection greatly improves security measures. This is especially important for educational institutions concerned with safety and safeguarding priceless assets because it helps prevent unauthorised vehicles from entering restricted areas. Real-time licence plate recognition enables the system to quickly identify vehicles that are not listed in the authorised database and to prevent access for those vehicles. In the event of unauthorised entry attempts, it can also notify security personnel, enabling quick responses and investigations.

c)Real-Time Monitoring and Reporting

Raspberry Pi-based license plate detection systems can provide real-time monitoring of vehicle movements. This feature allows security personnel or administrators to track the entry and exit of vehicles, ensuring better control and situational awareness. Additionally, the system can generate detailed reports on vehicle access patterns and usage, offering valuable insights for administrative purposes, security audits, or future planning.

6.2 Disadvantages of Project

a)Cost and Initial Setup

Setting up a license plate detection system with Raspberry Pi involves costs associated with hardware, camera modules, and software development. Additionally, integrating the system with existing databases and infrastructure may require further investments. The initial setup costs could be a significant factor for institutions with budget constraints, and ongoing maintenance expenses might also be necessary for optimal system performance.

b)Maintenance and Calibration

For accurate and dependable performance, Raspberry Pi-based licence plate detection systems may need routine calibration and maintenance. The accuracy of the system can be impacted over time by environmental factors like alterations in lighting conditions, the weather, or camera alignment. For the system to remain effective and prevent false positives or negatives, regular maintenance and periodic calibration are necessary. Lack of proper maintenance could lead to decreased security measures and hampered access control.

c)Data Privacy and Legal Compliance

Capturing and archiving vehicle information, such as licence plate numbers and timestamps, is required for licence plate detection. This information may be sensitive and cause staff, visitors, or students to express privacy concerns. To properly protect the information collected, educational institutions must address data privacy issues and adhere to applicable data protection laws. To maintain compliance and make sure the system operates morally and legally, adequate security measures, data retention policies, and user consent mechanisms should be in place.

7.0 RECOMMENDATION AND CONCLUSION

7.1 Recommendations

The student vehicle authorization / staff-based license plate detection (using Raspberry Pi) is currently operating smoothly and in line with the planned objectives. However, there are some recommendations we can offer to enhance the project further, including:

a)Data Privacy and Security Measures

Give data security and privacy top priority. For the information about the captured licence plates, use encryption and secure storage techniques. Establish appropriate access controls to grant only authorised personnel access to data. Ensure user consent for data collection and processing, and abide by applicable data protection laws.

b)Monitor System Performance

Continuously monitor the system's performance and gather feedback from users. Analyze access logs and user experience to identify areas for improvement and optimize the system's efficiency.

c)Integration with Existing Systems

Integrate the license plate detection system with other existing systems, such as parking management or security cameras, to create a cohesive and comprehensive access control solution. Data exchange between systems can improve overall security and operational efficiency.

7.2 Conclusion

In conclusion, implementing student vehicle authorization or staff-based license plate detection with Raspberry Pi offers a host of advantages for educational institutions and organizations seeking to enhance access control measures. The automation of access procedures streamlines vehicle entry and exit, reducing wait times and congestion at entry points. Enhanced security measures through real-time license plate recognition help prevent unauthorized vehicles from gaining access to restricted areas, ensuring the safety of students, staff, and valuable assets. Moreover, the cost-effectiveness and scalability of Raspberry Pi-based systems make them a viable option for institutions of varying sizes, allowing seamless expansion to accommodate a growing number of authorized vehicles and users.

Despite these benefits, careful consideration must be given to potential challenges associated with the setup and maintenance of the system. Technical expertise is required for the initial configuration and integration of hardware and software components. Regular maintenance and calibration are essential to ensure the system's accuracy and reliability over time. Additionally, data privacy and legal compliance must be diligently addressed to safeguard sensitive information collected through license plate detection.

Overall, educational institutions and organisations can leverage the power of Raspberry Pi-based licence plate detection to build a sophisticated and effective access control system by striking a balance between the benefits and drawbacks. This technology can significantly contribute to a safer, smarter, and more secure environment for all stakeholders if proper planning, implementation, and adherence to best practises are followed.

8.0 REFERENCES

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1)Real Time Car Number Plates Extraction in 30 Minutes 🔥 | OpenCV Python | Computer Vision | EasyOCR

https://www.youtube.com/watch?v=ltpnWBBT7NI

2) License Plate Detection Demo Using Raspberry Pi Camera

https://www.youtube.com/watch?v=qRFR0_FvkSs

3) Setup USB/External Webcam in Raspberry Pi with OpenCV 4.5

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