

AUTOMATIC GATE CONTROL SYSTEM BASED ON VEHICLE LICENSE PLATE RECOGNITION USING OPENCV

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1. Introduction

1.1 Abstract

Gate entry and exit system for high rise residential societies like golf city, central park, golf estate, the grand arch and thousands of them across the metropolitan cities in the country face an issue of manual gate control security system where verification is required manually by the guards. The corporate offices mandate their employees to go through a security scan at the parking gate. The employees need to show their ID card for entering the premises every day. This leads to congestion and delay in time at the gate of the building. Nowadays there has been a problem during rush hours especially in the mornings, evenings and in public holidays of movement of vehicles passing the through the entry and exit points due to the time consumed on RFID manual scanning for each vehicle.

In this paper we have conducted a survey of most authentic techniques of license plate detection of a vehicle and an automatic gate control system that will increase convenience and security at entrance of all the important places that require protection and Security. Here the gate will work automatically without the need of human beings and also the system will be able to recognize license plates from vehicles at the entrance gate and decide whether to let vehicles inside or not.

1.2 Problem Statement

The manual gate monitoring system at residential societies and corporate offices has been a cause of congestion of vehicles at the entry point due to the time consumed during scanning and checking. The security guard has to verify using ID card/registration no of every person passing the security. This system is time consuming and is prone to human errors.

Every vehicle needs to halt at the gate and wait for completion of verification by the security guards. Manual facial recognition does not work when security guards are newly recruited often. This leads to time wastage of people. Criminals can use fake ID and fool the security guards easily without getting detected. Dishonesty among the guard employees also counts.

2.1 Literature Survey

A. Car Number Plate Monitoring Using Image Processing: - Chauhan proposed a system to identify the vehicle number plate known as Automatic Number Plate Recognition (ANPR). This system includes capturing of number plate, extraction of numbers from plate by utilizing the division procedure, MATLAB Software.

B. Scanning of Number Plate Using Image Processing: Santosh proposed a framework about how to detect the number plate of different vehicles and storing them in the database. This technique used-OpenCV, python Library for program, TensorFlow-KNN and CNN algorithms, MongoDB database for storing the vehicles information

C. Automatic Gate Control System Based on Vehicles License Plate Recognition Using OPENCV:

Previously more traditional means of license plate recognition, number plate recognition access control was used. Automatic number plate recognition ALPR system is a mass surveillance method that uses optical character recognition (OCR) on images to find vehicle registration plates. They also used at an existing closed-circuit or road rule for enforcement cameras, or ones specifically designed for the task of recognition and verification. They are used in police, Special Forces and as a method of electronic toll collection on pay-per-use roads and cataloguing the movements of traffic.

Automatic License Plate Recognition is a real time embedded system which automatically recognizes the license plate of vehicles. There are many applications ranging from complex security systems to common areas and road toll system, parking allotment to urban traffic control. Most of the ALPR systems are built with proprietary tools like Matlab software. Instead of MATLAB this paper gives alternative method of implementing ALPR systems using Software including Python language and the Open Computer Vision Library as open cv.

2. Methodology

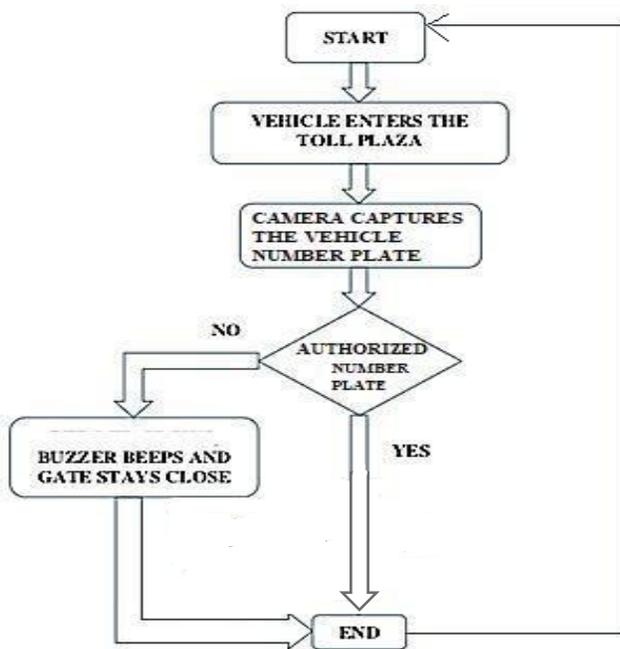


Fig 1: Flowchart of Gate Control Security System

2.1 Phases of the Proposed System –

1. Image Recognition Phase:

As the vehicle enters and settles in the field of the sensor (Camera). Through the infrared sensor (built-in camera) sense a vehicle and gives a signal to the PC through microcontroller to capture the number plate image of the vehicle and process it. It uses OpenCV library for image recognition. Cascade classifier are trained with samples of positive views of a particular object and an arbitrary negative image of the same size. The classifier can be applied to a particular part of the image and detect the object in the question. To search the object in the whole frame, we can move the window to be searched across the image and see if there is a classifier present at each location. This process is most commonly used in image processing for object detection and tracking, primarily facial detection and recognition.

The number plate validates against the authorized number in database to confirm its validity and finally signals the microcontroller to control the system hardware. Number plate identification on material and size required so as the sensor may detect and allow the processing of signals to perform functions as the automatic gate control system. After receiving and sending the digital image to the server system for preprocessing to improve the efficiency of character recognition and database interaction.

2. Processing Phase:

After digital image has been obtained and send to the server system for preprocessing to increase the efficiency of character recognition and interact with the database. The number plate is then compared to the authorized number in database to confirm its validity and finally open the plaza gate. The server is made using Java server pages. The frontend of the project comprises of user and admin portal for login and registration.

3. Image Analyzing Phase:

As the vehicle enters and settles in the field of the sensor (Camera). Through the infrared sensor (built-in camera) sense a vehicle and gives a signal to the PC through microcontroller to capture the number plate image of the vehicle and process it. The number plate is then compared to the authorized number in database to confirm its validity and finally provides signal to microcontroller to control the system hardware.

4. Vehicle Authentication Phase:

The characters are recognized from the number plate using Tesseract, the string output is extracted and is searched through the database to check its authorization. The database is created using SQLite, a table is created called Vehicle Details, the table has three columns: Name, Vehicle Number, Vehicle owner. All the three columns are of TEXT storage class. A representative of the organization has to update the database of registered vehicle details, this updated table is used by the system to authenticate the vehicle going to enter the parking space. If the vehicle number is found in the database, the vehicle is tagged authorized and a message is displayed on the LED screen as “Welcome, you may enter”. If the vehicle number is not found in the database the vehicle is tagged as unauthorized and the message displayed is “You are not allowed to enter”

1	owner_name	vehicle_no	owner_id
2	Rashmi Jain	MH12DE1433	6719
3	Jyoti Lohani	UP32FD6556	6789
4	Faruq Khan	DL7CQ1939	6897
5	Tanmay Jindal	DL3CAM0857	6578
6	Palak Mishra	UK14JK5665	6467
7	Kishore Kamal	HP23JM8787	6756
8	Tushar Verma	GJ16RM5555	6897

4. Data Storage Phase:

In this project, the database system holding all the necessary information related to the vehicles registered to use an entry/exit gate. This includes fields like its registration number, details of its registered vehicle and the details of its owner.

Vehicle record management in terms of registration needs to be stored and kept for verification because vehicles of different type may pass through and of different state with different guidelines and policies while neglecting the vehicles like the Military vehicles, Police and Ambulances which are important and require emergency level treatment are allowed to pass by.

To manage this variations and different records makes database to exist and support all the functions in record management.

2.2 System Functional Testing

Functional testing verified against the system functional requirements specifications. The following functionalities tested successfully on the system prototype.

- The system displays the unregistered status for unregistered vehicles on the UI.
- The system allows or denies the gateway if the registration verification either satisfies or not.
- The system captures and keeps the vehicle number plate and time of passing the lane in database.

2.2.1 Feasibility Study

Let's say, there are 100 manual security gate systems and each day

100 vehicles pass through each system, then

No of vehicle that pass through 1 system in one year = $100 \times 30 \times 12 = 36,000$.

No of vehicles that pass through 100 system in one year = $100 \times 36,000 = 36,00,000$.

Through the figure it indicates that in one year each of the 3600000 vehicles just stand there still for about 5.0 hours in the start condition of engine creating lots of pollution and fuel will be burnt. Suppose that in 5.0 hours a vehicle uses 1 liter fuel. So, Total fuel that is used by all the vehicles is $3600000 \times 1 = 3600000$ liter.

Table 2. Fuel Consumption and Amount

Vehicle	Fuel Consumed	Amount
1	1 lit.	75/- RS
3600000	3600000 lit.	270,000,000/- RS

Assuming cost of 1 liter fuel = Rs.75 Total cost of fuel consumed by 36, 00000 vehicles = $75 \times 36, 00,000 = Rs. 270,000,000/-$ The above is the money wastage under the consideration that the vehicle stops for 60 second at the entry point, and each day 100 vehicles will pass and there are 100 such cyber localities. 35% fuel consumption will be increased if the vehicle stops after every 10 km. If we consider 10 stops and accelerations per 10 km, then increase in fuel consumption is 130%.

Incidence and Percentage Distribution of IPC crimes in Metropolitan Cities During 1993 (Crime Head-wise)

Sl. No.	Crime Head	Incidence	Percentage to total
(1)	(2)	(3)	(4)
1.	Murder	2,854	1.2
2.	Attempt to Commit Murder	3,080	1.3
3.	C.H. not Amounting to Murder	188	0.1
4.	Rape	897	0.4
5.	Kidnapping & Abduction	2,383	1.0
	(i) Of Women & Girls	1,534	0.7
	(ii) Of Others	849	0.4
6.	Dacoity	393	0.2
7.	Preparation & Assembly for Dacoity	137	0.1
8.	Robbery	3,605	1.5
9.	Burglary	17,274	7.4
10.	Theft	76186	32.6
11.	Riots	5,861	2.5
12.	Criminal Breach of Trust	3,908	1.7
13.	Cheating	7,866	3.4
14.	Counterfeiting	2,017	0.9
15.	Other IPC Crimes	1,06,725	45.7
16.	Total Cognizable Crimes under IPC	2,33,374	100.0

2.3 System Security Testing

The security of people residing is at risk. Malicious people can gain access to the buildings by breaking the manual checking. The major motive to develop this project is the need to have an efficient automated gate control system that will maximize the security and authenticity as the system will record entry and exit

time stamp of every vehicle that visits the premises which in turn helps in crime solving.

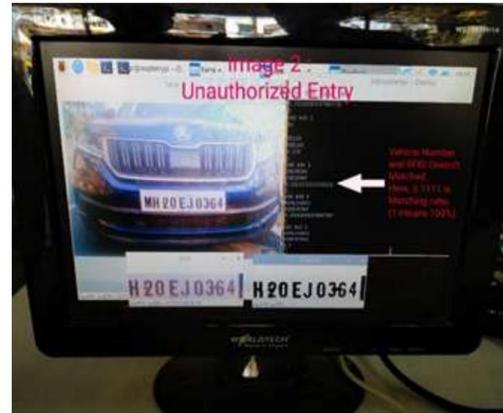
This system has been constructed that in such a way that only registered vehicles were tested by capturing and comparing the number plate with message invalid entry or successful login displayed on the visual studio code terminal and the Motor gate will Open/Close.

3. Result

The results of the system depend upon the input to the system. The desired output will be obtained when correct input is given into the system. The output will be displayed on the server as well as the visual studio code terminal and web browser where the vehicle passed near security area are displayed and the Motor gate will open. Also, the results of the program will be stored in a database created in MYSQL Server and could be seen through web browser local host in computer later.

It is not a replacement of Bar code as it is also a reliable method but it is a technology offering various other features. It provides highly reliable collection of data in harsh environments. The technology can provide new capabilities as well as an efficient method to collect, manage, disseminate, store, and also analyze the information. It eliminates manual data entry and also inspires new solutions of automation. It fundamentally changes how processes are managed and how businesses operate.

Its attributes provide greater automated tracking capability than existing technologies, and thus create the opportunity to reduce abhor, improve inventory management and it also generates the market intelligence, which leads to lower cost of operation and increase the assurance of security system.



An Unauthorised Entry



An Authorised Entry

4. Conclusion

Some of the particular challenges of this project are making the system work in malls and public buildings, each with its specified database for keeping records of the accounts for the respective vehicles. Also, the ability of the system to detect a vehicle is irrespective of the weather condition like rain in excessive mode or heat and the area of location within a distance of specified radius. The achievements of the system include successfully integrating the software and hardware modules. The Camera whenever detects a unique and registered vehicle number plate, the Arduino sends the signal to the motor and the motor opens the gate and then closes it. Also, the system database and the graphical user interface has been successfully designed. The Motor Gate lock circuit is also rotating in the specified degree to indicate the opening and closing of the gate after toll deduction The project has therefore been implemented only with minor problems in the controlling the database to microcontroller serial communication for data transmission data between them.

The system is low cost and eco-friendly with high security, and high efficiency. It reduces the cost of management and also increase the capacity of each premise/campus gate.

5. Recommendations

This project can act as a curtain raiser for others to see outside in a sense that, its solid foundation leaves a room for plenty of further developments in improving the system so as to make it serve the people better.

Some of the future scopes for improvements are like integrating it with network for quick response rather than keeping the whole program in a single computer also the use sensitive sensors and Camera since some plat manufacturers ignore the quality of number plate for an APR to function well.

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