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Automatic Unauthorized Parking Detector with SMS Notification

Madhurima Chakrabarti[1], Sandip Karmakar[2], Sumit Singh[3], Madhura Sur[4], Dipankar Kundu[5]

UG Student, ECE Dept., St. Thomas' College of Engineering and Technology, Kolkata, India[1,2,3,4]

Assistant Professor, ECE Dept., St. Thomas' College of Engineering and Technology, Kolkata, India[5]

Abstract: Due to high population growth, car demand has increased at an alarming rate. This leads to increase in demand for more parking slots, which poses an acute problem, especially, when we are concerned with metro and fairly large cities. A solution to this problem on priority basis is necessary. People should have to cater to the illegal parking aspect as well. This paper deals with the detection of illegal parking and it also helps to identify the vehicles, which are parked in non-parking areas and send information regarding those vehicles to the control office. Thus it is meant for decreasing the number of illegal parking. A Raspberry Pi processor is the main device, which is able to manage the whole task. Advanced techniques of image processing, using Support Vector Machine (SVM) algorithm and Optical Character Recognition (OCR), have been used in the model.

Keywords: Parking Detection, Image Processing, Raspberry Pi, SVM, OCR

I.INTRODUCTION

In recent years, the transportation complexity has increased dramatically with the increase in population throughout the world. Consequently, the amount of works related to traffic control, which is needed to be carried out by different agencies, have increased much more due to the hike in vehicular movements. These organizations, for example, law enforcement agencies, who are responsible for monitoring each vehicle and arresting the persons with illegal vehicles, need to do the job of checking the license plate, whether it is registered, or not. A huge number of vehicles in the streets make the job harder. Therefore, it would be helpful to recognize the vehicles using machine learning techniques, and automatic vehicle identification has become an essential part in modern traffic control systems. For this automatic vehicle identification, one can take the help of Raspberry Pi 3 module, Support Vector Machine (SVM) algorithm, Image Processing, Optical Character Recognition (OCR) and Cloud Communication using Application Program Interfaces (APIs). The proposed model helps in detecting unauthorized parking. When any vehicle comes in front of the system, the image of the vehicle can be captured by using a Pi camera, and the system will try to identify whether it is a vehicle, or not. Then, if it is a vehicle, its number will be extracted from the picture containing the number plate of the vehicle. This will be fed as input to the Raspberry Pi processor. With the processor, there will be a database, storing the numbers and associated details of all authorized or registered vehicles. When a matching is found, the person driving the vehicle will be allowed to park that in an available zone. If no matching is found, then a warning message will be sent to the intruder, as well as the authority of the area, via cloud using APIs. Thus, the Raspberry Pi processor takes the responsibility of checking the authentication of the vehicles. To perform this task, Raspberry Pi is programmed using python. This design will offer an automatic unauthorized car parking detector with SMS notification to the owner as well as the authority. In this paper, the design and construction of such an automatic unauthorized car parking detector with SMS notification to the owners and the authorities have been proposed, which will overcome the problems of existing parking detectors. The proposed model will provide a solution to parking space problems and will be able to decrease the number of parking violations. Also, it will render convenient and secured parking places to the car owners, since it is user-friendly, convenient and secured. This can be used for building a smart city, and to reduce traffic congestions in large cities. It can stop illegal parking. The automatic unauthorized car parking detector can also be used in private parking lots, housings, apartments, hospitals, municipalities, etc. to provide secured as well as legitimate parking places.

II. LITERATURE SURVEY

Various methods are prevalent for development of autonomous or intelligent parking systems as well as illegal parking detectors. One intelligent system for car parking has been proposed by making use of image processing in parking space detection system [1]. In this system, an image of the parking slot is captured and processed to detect whether the slots are free or not. The seven segment displays show the number of currently available parking lots in the parking

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area. The limitations in the system are the type of camera used, the coordinate system used, and camera needs to be placed at a fixed location.

Another automatic parking system and electronic parking fee collection system has been developed and implemented, which is based on vehicle number plate recognition [2]. This system has less human interactions with no use of magnetic card and its devices. In addition, it has parking guidance system to guide users towards parking spaces. The system recognizes number plates for parking and billing by using image processing. The license plates are extracted from car images, which are followed by segmentation of characters and reorganization. Electronics for parking fee collection has been developed based on the number plate information. Limitations with this system include background colour, which is compulsorily black and character colour is white. Also, analysis is limited to the number plates in only one row.

A smart car parking system has been proposed, which is commanded by an Android application to regulate the number of cars to be parked in the parking area [3]. This is done by automating the parking and un-parking of the car by commands from an Android application. This reduces the time required for search of free parking space by manually driving through multiple slots. The automation in the car is achieved by path tracing, using sensors. The car is parked at multiple levels by using lift and image processing is used to capture the number plate, which is compared with that stored in a database to avoid illegal entry of cars.

A prototype system of smart parking services based on Wireless Sensor Networks (WSNs) has been developed and implemented, which allows drivers to efficiently find the free parking spaces [4]. The system consists of wireless sensor networks, embedded web-server, central web-server and mobile phone application. In each parking slot, low cost WSN modules are used. The state of the parking slot is detected by sensor node, which is reported periodically to embedded web-server by WSN. Wi-Fi networks send this information to central web-server and the driver finds free parking slots by standard mobile devices.

Another RFID and OCR enabled automated system for parking management, which can work efficiently for small to large organizations, has been elucidated in [5]. Here, access control is provided by use of boom barriers and both time and human efforts are saved. At first, the identification of the vehicle is done. If the vehicle is registered in the database, then the corresponding RFID tag is read and the database entry is updated. Vehicles cannot access parking area without being identified and runtime updating of parking places allotment makes it easy to manage parking. After the identification phase, an Optical Character Recognition (OCR) is used to read the number plate of the vehicle. This is done by using image processing algorithms. A similar record is made, when a vehicle leaves the parking slot.

In [6], a car is detected by Support-Vector Machines (SVM) and Histogram Oriented Gradient (HOG) algorithms. An SVM performs classification by finding the hyperplane that maximizes the margin between the two classes. The first step is to identify the image. Then, in the next step, zero order and second order gradient are included to increase accuracy of feature extraction.

A new vehicle identification system that provides high degree of accuracy and success rates is proposed in [7]. This consists of four stages: license plate detection, license plate recognition, license plate province detection and vehicle shape detection. In this system, the features are converted into local binary pattern (LBP) and HOG as training dataset. For high accuracy in real-time, a novel method is used to update the system. In this system, the vehicles' features and information are stored in the database. In addition, the procedure is able to detect any discrepancy between license plate and vehicles automatically.

III. SYSTEM DESIGN

The hardware consists of a Raspberry Pi processor, a Pi camera, a 16×2 LCD module and power supply. The Raspberry Pi is programmed using python. Twilio network cloud server has been used for IoT connectivity. A Support-Vector Machine (SVM) classifier, a Histogram Oriented Gradient (HOG), an Optical Character Recognition (OCR) and Cloud Communication with Application Program Interfaces (APIs) have been used. The SVM training algorithm builds a model, making it a non-probabilistic binary linear classifier. When a set of training examples is given, each one is marked as belonging to one or the other of two categories. The SVM constructs a hyperplane in multidimensional space to separate different classes and generates an optimal hyperplane in an iterative manner to minimize errors. Histogram of oriented gradients (HOG) is a feature descriptor used to detect objects in computer vision and image processing. The HOG descriptor technique counts occurrences of gradient orientation in localized portions of an image-detection window, or region of interest. The OCR is a common method to recognize text inside images, such as scanned

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documents and photos. OCR technology is used to convert virtually any kind of images containing written text (typed, handwritten or printed) into machine-readable text data.

The block diagram of the system is given below:

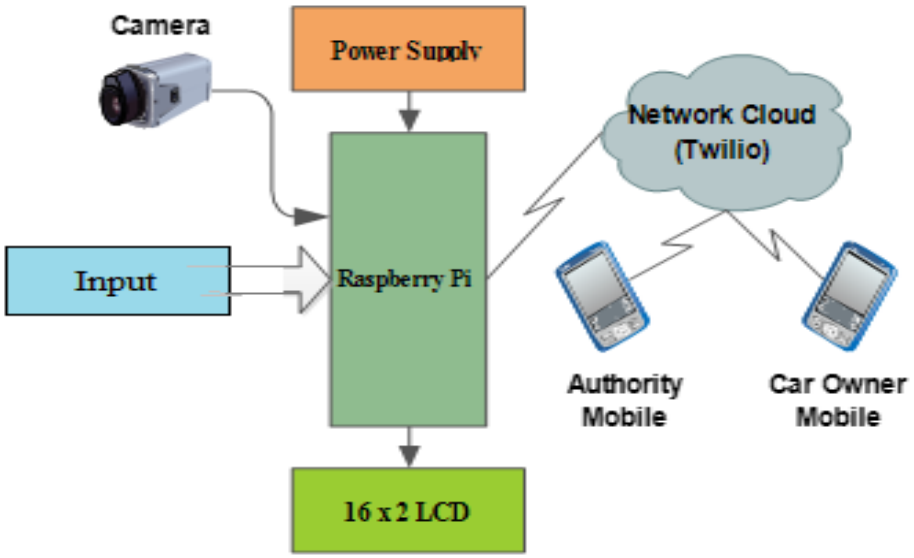

Fig.1 Block diagram of the system

A website is created, where users can allot their preferred parking areas by logging into their accounts. They can choose the slots for their cars. There is a database to store the necessary details, such as Name, Contact No., Email Address, Car plate number, Car License number, etc. of the users. The system has been trained with several pictures and extracted features from them to detect cars using SVM classifier and HOG. In the parking zone, a camera module along with Raspberry Pi is placed at the entrance side. The Pi camera is used to take streaming videos. When a car tries to enter into the parking area, first it is detected. Once the car is detected, the car number is extracted from the current video frame. That information is compared with the data stored in the database. If no matching is found, then a warning message is sent to the intruder as well as the authority via cloud. In this way, the authority can become aware of the unauthorized parking and be able to take proper action against it. The basic steps of Unauthorized Parking Detector are shown in Fig. 2.

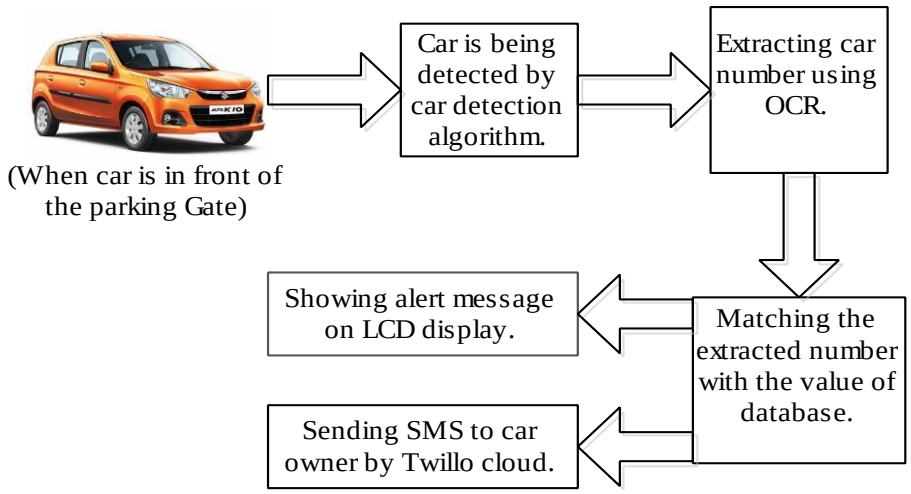

Fig.2 Basic steps of Unauthorized Parking Detector

Several images of cars of different sizes, colors, and brands and some non-car images as well, like wall, lamp posts, roads, trees, lanes, sky, etc. from different angles (front, back, middle close, left, right) are taken. From those pictures, feature components, such as ‘spatial features’, ‘color histogram features’ and ‘HOG features’ are extracted. Those features are fed back to the SVM classifier. The flow chart is shown in Fig. 3.

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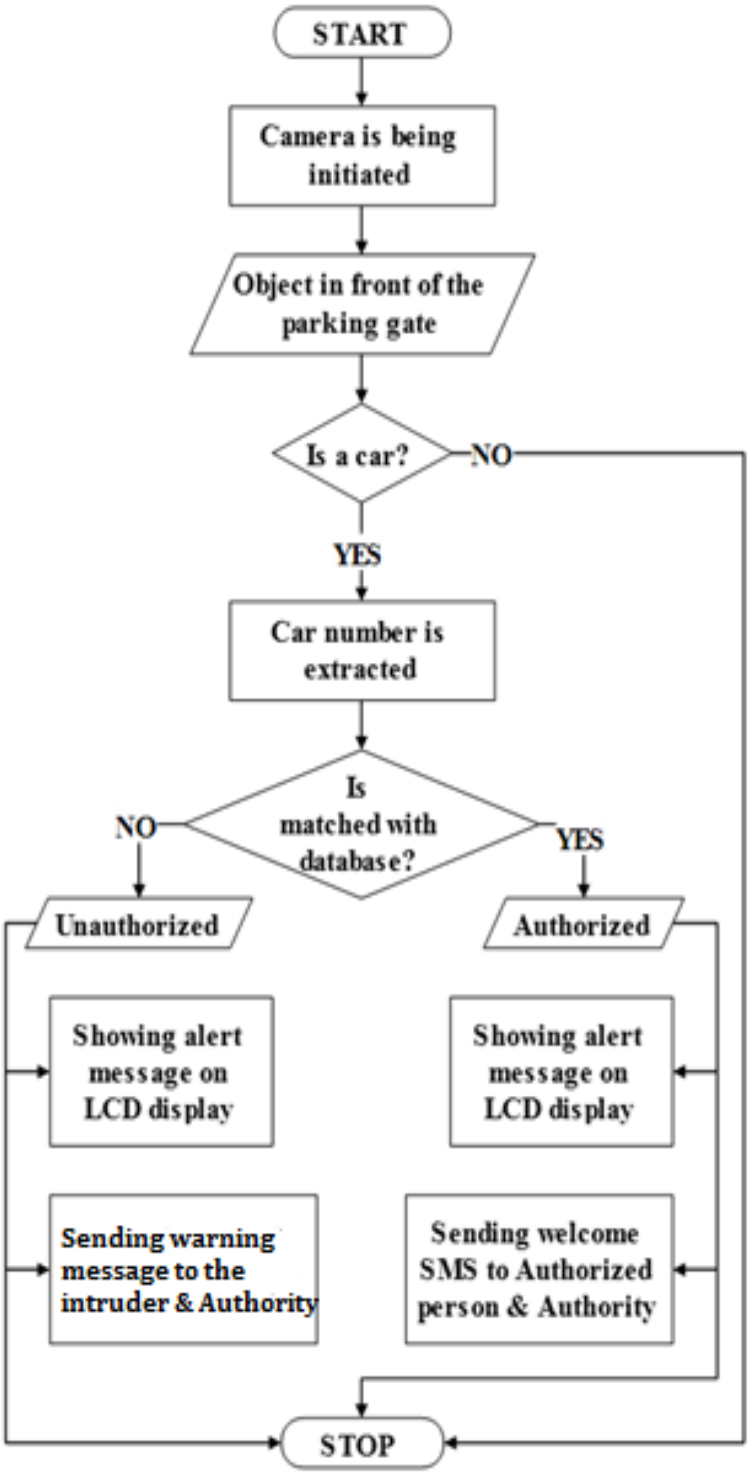

Fig. 3 Flow Diagram of the system

IV. RESULTS

The home page of the website is shown in Fig. 4. The sign up page, where name, E-mail id, Contact Number of the car owner, license number and plate number of the car, username and password can easily be entered to test the authorization, is shown in Fig. 5.

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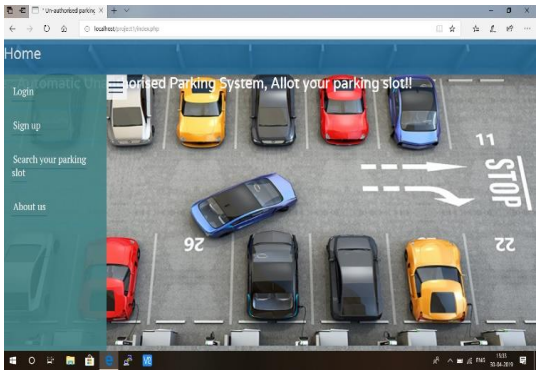

Fig. 4 Home page of Website

Fig. 5 Sign up page

Fig. 6 shows the HOG image. The colour histogram features are shown in Fig. 7.

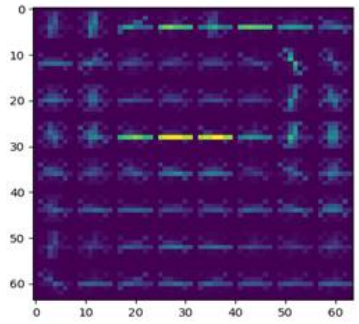

Fig. 6 Hog Image

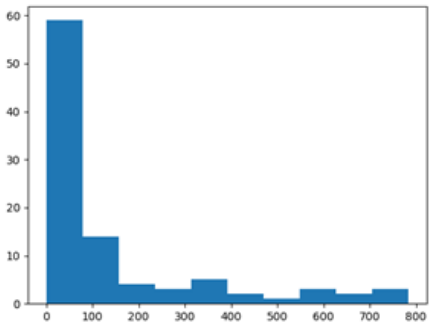

Fig. 7 Spatially Binned Feature

The detection of a real time car is shown in Fig. 8. The car objects are identified from the current video frame by car detection algorithm (bounded by the blue windows in Fig. 8) and the accuracy of SVM classifier is 98%, approximately. The output on the LCD screen for an authorized parking is depicted in Fig. 9.

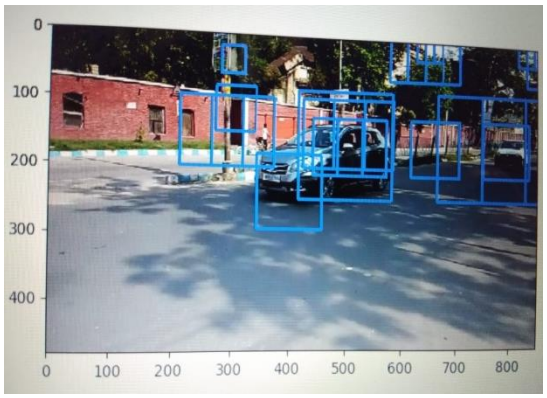

Fig. 8 Detection of Real time car

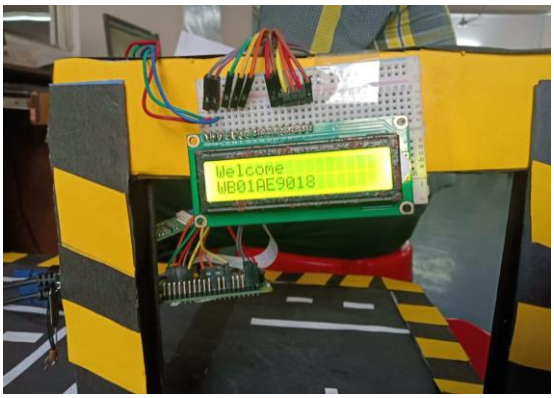

Fig. 9 Output for Authorized parking

V. CONCLUSION

A solution to the problem of identifying unauthorized car parking, working on priority basis, is presented in this paper. The model can not only be used to detect illegal parking, but also to reduce traffic congestion in various places by sending information about unauthorized parking to the control office with the help of Raspberry Pi processor and advanced techniques of image processing. It will decrease the number of illegal parking. The system is taking little time for processing and identification. To improve the system performance, it is needed to improve the accuracy of the SVM classifier, reduce the total time of operation, and identify the cars perfectly by discarding other objects in the searching window. The system can be upgraded by ensuring vehicle registration via any smart card, fine and parking charge collection via online payment and parking slot booking in advance via SMS.

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