

# Smart Parking Bay Based on Image processing and Internet of Things

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## Abstract

In Urban areas, it is estimated that up to 35% of traffic is due to drivers searching for nearby available parking slot. Research also propose that drivers invest an average of 3-6 minutes searching for an available space. Thereby it increases individual stress levels as well as pollution and congestion. Smart Parking Systems afford an impressive way to reduce parking search time by providing drivers with dynamic information on parking premises. This paper intends to present an automated system for parking space detection based on image processing technique. The monitor shows the number of current available parking lots in the parking area. Authorization card will be given to each user, which carries the vehicle number and user details. Thus the proposed system will entirely eliminate the commotion in searching for available parking lots and it could be practiced everywhere due to its ease of management and efficacy.

**Keywords:** Raspberry Pi, Image processing, Automated parking system, RFID, Motor, Web Camera, Parking space detection, Car detection, Secured parking.

## INTRODUCTION

At present, most of the car parks does not have an automated system. They are not efficient and managed manually. The time has been wasted by searching for the available parking vacancy in Parking area. Users will keep on circling the parking area until they found a vacant parking slot. This problem mostly occurs in most crowded areas, where number of vehicles is higher than the parking spaces. The lack of implementation of technologies which are available in the market today is a main reason for these problems.

A web camera is used for taking live video feed and image detection in [1]. This is due to its effectiveness and inexpensive cost. In [2], the authors employ the edge detection by sobel method for vehicle detection. Papers [3-5] used the RFID technology to identify the vehicle's information and hence doesn't require any manual record to monitor and maintain the details. In [6], the authors proposed the canny operator method to extract car movements from the noisy images.

OpenCV is used as software platform for image processing in this project. In Image processing module, the system initialization, image acquisition, image segmentation, image enhancement and image detection will be described and

presented. Monitor is used to show the number of available free slots. RFID authorize the user by RFID tag and number of slot available. Servo Motor is used to opens the parking gate when authorized user enters. The check-in, check-out timing and user id are stored in database. The Raspberry Pi is programmed in such a way that concurrently vacancy of parking slot and authorization of user has been checked for better efficiency. Hence vehicles that are about to check-in will not be allowed, so there will not be any time loss to look for parking space.

## SYSTEM MODULE

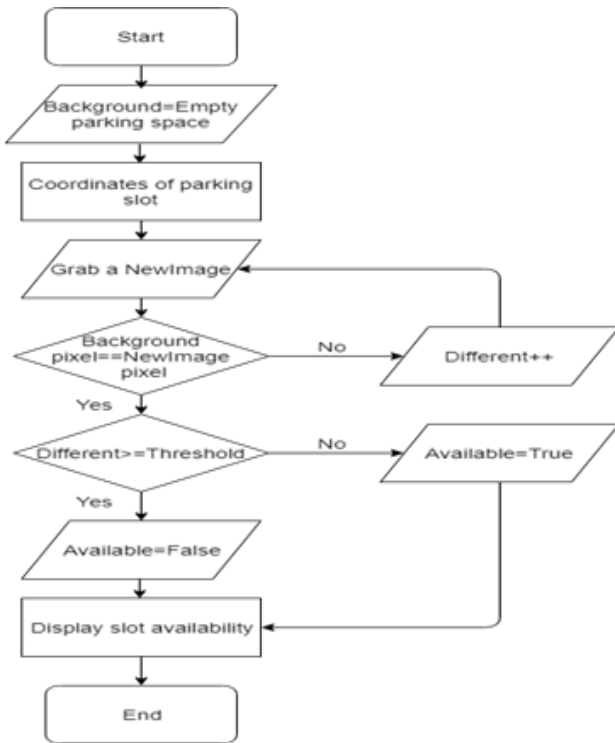
The proposed system involves 2 modules: Detection module and Security module. The Detection module is used for counting the number of vacancy and vehicles in the parking area. This involves the Image acquisition, Feature extraction, Image classification and the Output. Security module involves the use of RFID reader and storing details of incoming users.

### A. Detection module

The processes that are involved in the detection module designed in the proposed system are explained briefly as follows.

*Image Acquisition.* A standard model of the parking area has been developed which consists of 2-4 parking lots to park the vehicles. The images for various solutions that are possible for the vehicles to be parked in the designed model are stored as base in the database. When, an input image is given as an input to the system, the system correlates it with the base images in the database.

*Feature Extraction.* The accuracy of the output based on the quality of the features extracted from the image. It involves transforming the given input data into the set of features to be evaluated with the base images. This accords with the extraction of the necessary details of the images that are fed into the system. The input images are safely refined by the system and the needed features are extracted from it for further processing as shown in Figure 1.



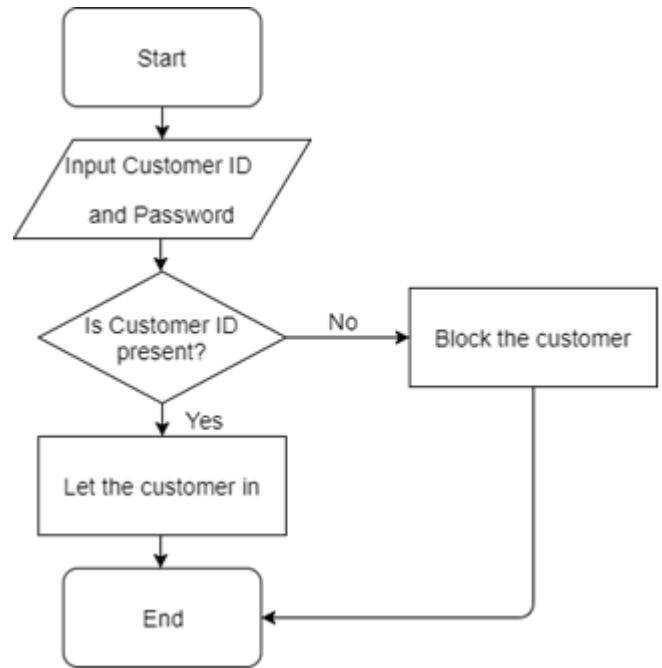
**Figure 1.** Image Processing to detect Parking space availability

*Image Classification.* Neural networks are used to deal with the features and patterns. ANN stands for the Artificial Neural Network. ANN involves the detection of object(vehicles) through the classification of features from an unknown input pattern by comparing it to already provided learned patterns. It detects Vehicle and vacancy space by comparing the reference images. The reference images are stored in the database and the network is trained to run with the help of the stored images. Therefore, the ANN classifier compares and evaluate the input images with that of the reference images in the database and determine the desired output.

*Output.* The detection process is carried out and the output is simulated in the OpenCV platform. Desired outputs are obtained for the process of vehicle detection and vacancy in parking area. The output for the designed system proves good for all the possible combinations in the parking model.

**B. Security module**

In Security module, Entry and Exit gate will be opened only if authorized RFID is punched. Unauthorized person will not be allowed to park in parking space. If free parking space will not be available, then gate will not be opened even if authorized card is shown. Database is maintained to check who is entering and leaving the parking area and check-in and check-out timings of them. Overall system will allow to track the user’s details and has improvised security system by not allowing unauthorized persons to enter into parking premises.



**Figure 2.** RFID Reader evaluates the user

*Entry.* When the user reaches parking gate, he will show the RFID card on RFID reader. Reader will read the tag and sends its information to Raspberry Pi and check whether ID is authorized or not. If it is authorized, then signal will be send to servo motor to open gate and check-in time has been stored in the database. Once the car gets entry, gate will be closed. If the user is authorized and free parking space is not available, then Raspberry Pi will send signal to display that parking is not free and hence gate will not be opened. If the user is unauthorized then again Raspberry Pi will send it to display unit to show the UNAUTHORIZED message and will not allow to open the gate.

*Exit.* User punch its card to RFID reader, if he is authorized the Raspberry Pi will send signal to servo motor to open the gate and stores the current time as check-out time in database. If he is not authorized, then gate will not be opened and he will not be allowed to go out and considered as theft.

**DESIGN**

*A. Requirements*

*Raspberry Pi 3 Model B*



internet.

The Raspberry Pi is a low cost and small sized computer that plugs into a computer monitor or TV, and can be used to communicate with other devices through

*USB Camera*



A USB camera is a video camera that feeds live video and streams its image in real time through a computer network.

*RFID Reader RC522*



A Radio Frequency Identification (RFID) is a device used to gather information from an RFID tag, which is used to track individual objects..

*LED display 16\*2*



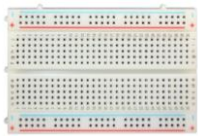
An LED display (16\*2) is a flat panel display that uses light emitting diodes to show characters or digits.

*Servo Motor*



A Servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.

*Bread Board*



A breadboard is a construction base for prototyping the electronic components. The solderless breadboard does not require soldering, it is reusable.

*Jumper Wires*

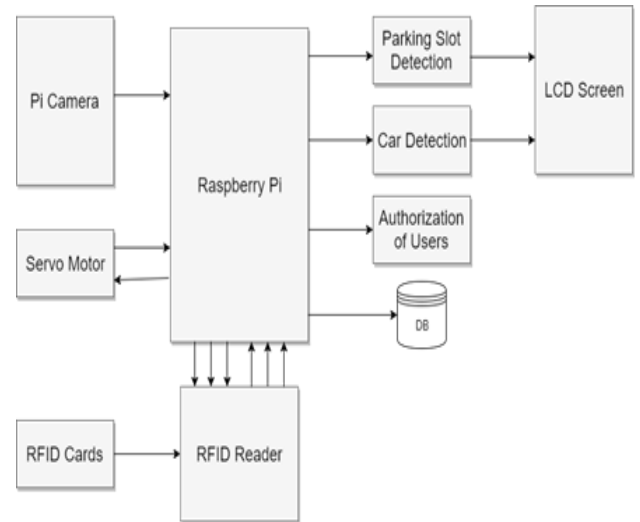


Jumper wire is an electrical wire in a cable with a connector or pin at each end, which is normally used to interconnect the components in a breadboard.

*B. System Architecture*

Raspberry Pi, USB camera, 16\*2 Display, Servo motor, RFID Tag and RFID Reader are used in designing the automated car parking system. All the components are connected to the Raspberry Pi as shown in Figure 3.

The first step to be taken to check for vacancy in the Parking space, hence the image is taken by the USB camera. This image is then processed through the OpenCV library in Python. In this library, the main function of interest is the Canny Algorithm, which uses Gaussian Curves to determine the edges of objects in an image and provides an image of only the edges in the form of a white line. The code then checks for the presence of edges in the coordinates of each parking slot. Absence of edges indicates vacancy of Parking slots, while their presence indicates that it is occupied.



**Figure 3.** System Architecture

RFID tags do not have a battery and powered by a separate source typically the reader. RFID Tag is a microchip, which has compact package antenna, antenna is used to pick signal from RFID reader and then return with data. In datasheet, serial number is used as a primary key to differentiate between the other users. Additional information is stored with the serial key. We have stored vehicle number and user name with a primary key. When the reader reads the card and finds serial number in datasheet then it sends output to display board as “AUTHORIZED”. At the same time, Raspberry Pi board receives the image processed values to check whether slot is free or not. If the slots are free then it sends an analog signal to servo motor to open the gate. If the slot is not free then “NOT AVAILABLE” message will be sent to display board to display and no signal will be given to relay board. If the serial number is not present, then “UNAUTHORIZED” will be displayed on the led display board.

**RESULTS**

The detection of vehicle has been determined by Canny Edge detection which extracts moving object from the video as shown in figure 4 and blob detection is used to find the vacant parking spaces.

When the user reaches the parking gate and shows the RFID card. RFID reader reads the card and authorize the user. Then,

the message has been displayed as shown in figure 5. The parking gate is opened for authorized user.

After punching the RFID card, the details of vehicle, user, check-in time are stored in the database as shown in figure 6.

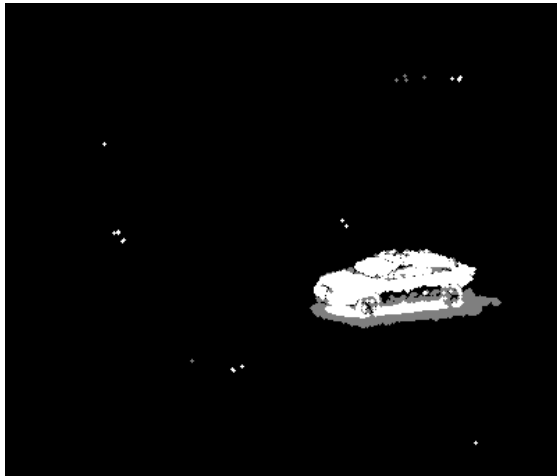


Figure 4. Background Subtraction

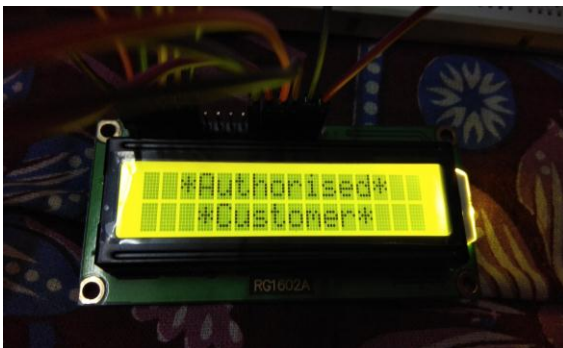


Figure 5. LED display unit shows the message

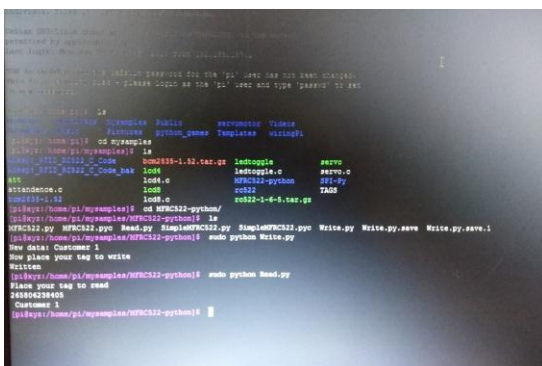


Figure 6. Database storing users' details

## CONCLUSION

Thus, the objective of the proposed system has been achieved. The vision of this project is to discover the parking system by using image processing instead of using sensors. Smart parking

system is developed using an image processing approach to reduce cost of sensor and wiring convenience. The time for searching the availability of parking lots has been removed by displaying the status of the parking lots at the entrance of the parking premises. The integration of image processing and the use of RFID have made it a efficient and secured system.

## FUTURE WORK

Future research will be focused on additional guidance devices such as voice guidance to the drivers and light guidance for available parking by placing LED at each parking lot is also considered. Android application can be developed to provide the status of every nearby parking lot to the user.

## REFERENCES

- [1] Mr. Basavaraju S R, "Automatic Smart Parking System using Internet of Things(IOT)", International Journal of Scientific and Research Publications, vol. 5,no. 12, December 2015
- [2] Amit U.Godge, Vijay D. Chuadhari, Kantilal P. Rane, "Automatic Car Parking Using Image Processing", IPASJ International Journal of Electronics & Communication (IJEC), vol. 2, no. 8, August 2014
- [3] J. K. Suhr, H. G. Jung, "Sensor fusion-based vacant parking slot detection and tracking", IEEE Trans. on Intell. Transp. Syst., vol. 15, no. 1, pp. 21-36, 2014.
- [4] P. Xu, "Ultrasonic-based detection system design for intelligent parking spaces", Inform. & Commun. vol. 143, pp. 76-77, 2014.
- [5] S. Bitam, A. Mellouk, "ITS-cloud: Cloud computing for intelligent transportation system", Proc. IEEE Global Commun. Conf., pp. 2054- 2059, 2012.
- [6] Atmadja Wiedjaja, "Parking guidance system based on real time operating system [J]", International Conference on Industrial Automation Information and Communications Technology, pp. 5-8, 2014.
- [7] R. Yusnita, Fariza Norbaya, and Norazwinawati Basharuddin, "Intelligent Parking Space Detection System Based on Image Processing", International Journal of Innovation, Management and Technology, vol. 3, no. 3, June 2012
- [8] Pejman Niksaz, "Automatic Traffic Estimation Using Image Processing", International Journal of Signal Processing, Image Processing and Pattern Recognition Vol. 5, No. 4, December, 2012, pp.167-174
- [9] Thomas Moranduzzo, Student Member, IEEE, and Farid Melgani, Senior Member, IEEE, "Detecting Cars in UAV Images With a Catalog-Based Approach", IEEE Transactions on Geoscience and Remote Sensing, vol. 52, no. 10, October 2014, pp.6356-6367

- [10] Jian-Min Wang, Sen-Tung Wu, Chao-Wei Ke and BoKai Tzeng, "Parking Path Programming Strategy for Automatic Parking System" *Vehicle Engineering (VE)* Vol. 1. (2013) 57-63
- [11] Sumathi, V., N.V. Pradeep Varma and M. Sasank, "Energy Efficient Automated Car Parking System". Paper published in *International Journal of Engineering and Technology (IJET)*. ISSN: 0975-4024 Vol. 5. (2013) 2848-2852.
- [12] D.J. Bonde, R. Shende, K. Gaikwad, A. Kedari and A. Bhokre, "Automated car parking system commanded by android application", *International Conference on Computer Communication and Informatics*, (2014) 4
- [13] E. Soni, K. Kaur and A. Kumar, "Design And Development Of RFID Based Automated Car Parking System", *The International Journal of Mathematics, Science, Technology and Management*, Vol. 2. (2016)