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Parking Space Detection

Pratiksha R. Jagtap
Department of Computer Engineering
Brahma Valley College of Engineering and Research Institute, Nashik, MH
impratiksha29@gmail.com

Adarsh S. Ripote
Department of Computer Engineering
Brahma Valley College of Engineering and Research Institute, Nashik, MH
imadarsh28@gmail.com

Jayesh D. Pawar
Department of Computer Engineering
Brahma Valley College of Engineering and Research Institute, Nashik, MH
jayeshdpawar1999@gmail.com

Aadesh R. More
Department of Computer Engineering
Brahma Valley College of Engineering and Research Institute, Nashik, MH
moreaadesh125@gmail.com

Abstract

Successful implementation of Parking Space Detection can effectively reduce a lot of problems related to traffic congestion in urban areas. Wastage of fuel and time in search of a vacant parking space will be significantly reduced and the complete utilization of the available parking areas canmake our cities really smart. Parking slot detection and user notification are the two major sections of a smart parkingsystem. The empty parking space detection was initially done by deploying a number of sensors in the parking lot. It is highly expensive and complicated to install. But the advancement of image processing has enabled us to use images of the parking area to find out empty spaces. In this paper a comparative study of the various parking space identification techniques has been done. Also the image processing based system models has been presented as a replacement for sensor based systems. A very efficient and simple technique for parking slot identification based on optical character recognition (OCR)has been introduced in this paper. The camera installed in the parking lot captures the image of the parking area with specially numbered parking spaces. The OCR system recognizes the numbers which are not hidden by a vehicleparked over it and this information is used for identifying the empty spaces.

Keywords: -Parking space detection, Image Processing, Optical Character Recognition

INTRODUCTION:

So many researches on traffic congestion analysis reveal that an estimated 70 per cent of all drivers currently on the road are searching for effective parking. This will intensify traffic congestion as the vehicles spend more time on the road. Drivers may also tend to drive at low speed when they are searching for a parking space. Researches in this area have found out that vehicles spend an average of 15 minuteslooking for a parking space, travelling at an average of 10 mph and covers only half a mile in the meantime. The result is frequent traffic congestion. When the drivers are in search of a parking space, the possibility for accidents increases as they give less attention to the road [1]. A sophisticated car parking system can only solve these problems. That is why numerous research works are taking place in this area all around the world. Empty parking slot detection is the first phase of any smart parking system. The second phase is sharing this information to the drivers who are in search of parking lots. There are many methods used for detecting empty parking slots [2].

RELATED WORK:

Smart solutions for car parking in urban areas and the related technologies have been improved tremendously over the past few decades. Wherever there is a significant amountof traffic some form of car parking system is also needed. Rapid rise of urban population and the increase in traffic congestion has escalated the demand for the researches in the smart parking system domain during the past two decades. By taking the advantage of some modern tools in information and communication engineering, the parkingspace information can be shared effectively in real time.

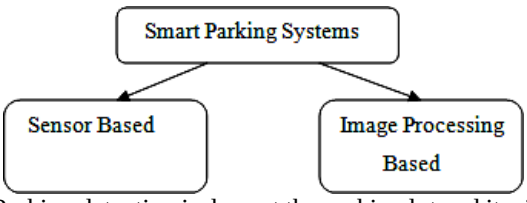
For example, Parking Guidance and Information (PGI) systems [3]-[5] through variable message signs provide real time parking information to the drivers who are in search of a parking lot. In order to gather information about occupancy of parking spaces the system uses special sensorswhich are deployed mainly at the entry gates and exit gates of the parking lot. These types of systems can be deployedin the car parking lot of commercial shopping malls and trade centers and can be installed easily

The remaining portion of this paper is organized as follows: Section III explains the overall system model of a typical smart parking system. A study of different sensors detecting the empty parking spaces is done in this section. InSection IV, our proposed OCR based system is introduced as an efficient alternative for existing algorithms. Results and conclusions are given in the last two sections.

SYSTEM MODEL:

A modern Parking Space Detection will have two fundamental sections such as (A) Empty Parking Spot Detection section and (B) User notification section. In the typical system model (shown in Fig.1) we can see that the parking lot is divided into separate parking spaces [6]. The empty parking space is to be identified and the information about that particular parking area and the available empty parking spaces is to be passed on to the driver who is in search of a parking lot. This is done in the user notification stage. The parking detection system of the parking lot is connected to a web server through a gateway. The database stores the parking space information of the entire city.

This data is given to the driver simply by the help of a mobile application. The application will guide the driver towardsthe available parking spaces in the nearby localities



B. Parking detection is done at the parking lot and it will find out the occupancy of a vehicle in a parking space. The presence of a vehicle in the parking space is identified with the help of a variety of techniques using some type of sensors [6]. Even though the techniques and sensors are different the output of this section will be always the same.It will be a binary value whose states indicate the presence and the absence of a vehicle in that particular spot. Performance of different sensors used for the detection ofthe presence of a vehicle will depend on various factors. In the following subsections we will examine the role of some sensors for occupancy detection.

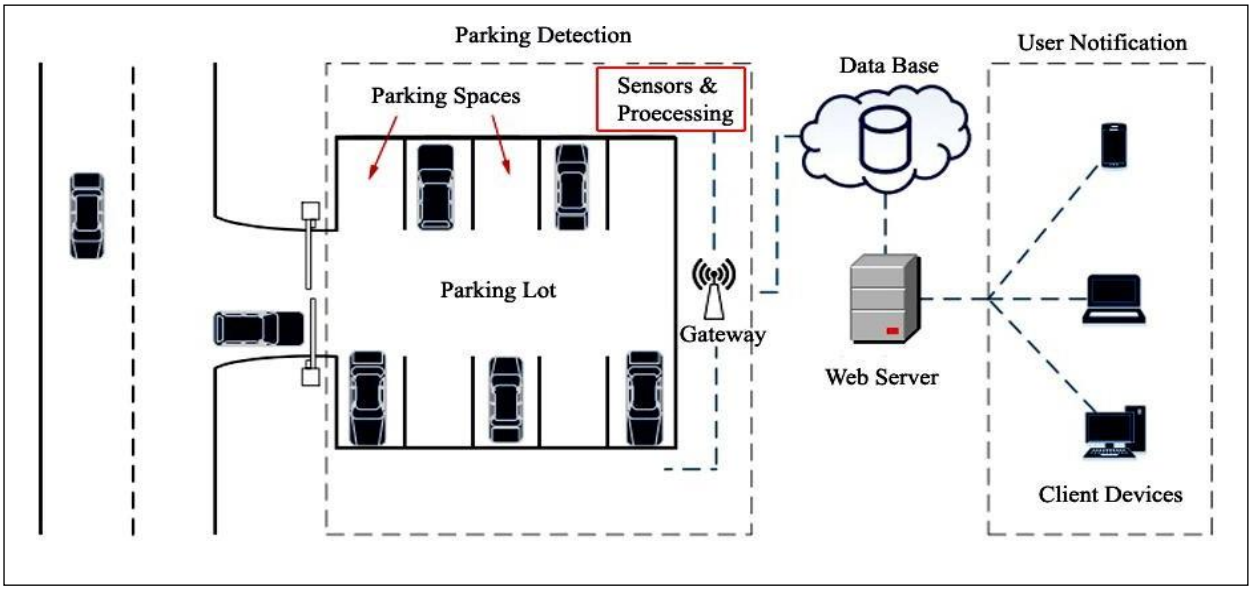


Fig. 1. Schematic Model of a Parking Space Detection

Modern Parking Space Detectioncan be broadly divided into two based on the technology used for identifying the empty parking spaces in a parking lot; (1) Sensor based methods and (2) Image processing based methods. Here in this paper we make a comparative study about different parking spot detection techniques and we also propose an advanced parking spot identification technique using OCR algorithm of image processing.

A. Sensor Based Methods

Inductive Proximity sensor:

An inductive proximity sensor can detect metal objects approaching it by using the principle of mutual induction. It can be deployed at the entrance and exit of the parking lot for identifying the entry and exit of vehicles in the parking area. This sensor is usually buried underground at the entrance as well as the parking space. Most of the Inductive Proximity Sensors usea coil and an oscillator for producing an electromagnetic field in the close surroundings. The vehicle which is a metal body can cause a change in the magnetic field which will in fact cause a damping of oscillation amplitude. The rise or fall of such oscillation beyond a given threshold value changes the output of the sensor. This sensor will only detect the presence of metal bodies such as vehicles and will be

inactive if some living or nonmetal objects enter its proximity. The main demerit is the complexity in the installation and maintenance of the sensors in the parking lot.

Active Ultrasonic Sensor:

a) A special sensor that can be used for detecting the presence of a vehicle is an ultrasonic sensor. These sensors will generate ultrasonic pulse waves which are used in them for measuring the distance between the object and the sensor. The sensor transmitter sends ultrasonic pulses and the reflected pulses are received by it for measuring the time delay. By using this time delay between the emission and reception, the distance betweenthe sensor and the target will be calculated. The ultrasonic sensor can accurately detect the presence of objects in the parking spaces but it has no provision to distinguish between the occupancy of a vehicle and some other objects. That is, even the presence of an animal or a person will be treated as a vehicle occupying the space. Also, the system is very costly as we need sensors for each and every parking spot. The installation and maintenance of the system is complex.

RFID Sensor:

Radio Frequency Identification (RFID)) isused for automatic identification of objects with the help of radio waves. RFID uses a tag or a chip which will be installed in the vehicle and will send a code which will be received by an RFID reader present in the parking area and the data can be used for accurately identifying the arrival of a vehicle. When the vehicle enters the parking area, the data stored in the RFID chip will be received by the RFID reader.Only vehicles with correct RFID tag will be identified. Vehicles without the RFID tag will be blocked from entering the parking area. Although this a very simple and effective technique, the installation of RFID tags in each andevery vehicle is a highly complex process.

LIDAR Sensor:

a) LIDAR (Light Detection and Ranging) is similar to that of ultrasonic sensors but uses light pulses instead of RF pulses. Although this sensor is more accurate even at longer distances it is highly expensive.

Sensor based methods have many disadvantages such as high installation cost per parking area, complexity of the system causes confusion for customers and there may be a chance of breakdown which requires a maintenance contractwith the supplier.

Image Processing Based Methods:

Image processing based parking space detection proposed by Yusnita and Norbaya and so many other similar papers introduce algorithms using imagesegmentation and detection techniques. Here a round white image will be drawn on each parking slot manually. This will enable the system to automatically identify the location of every parking slot in the image. The absence of the white circle in the image will be considered as the occupancy of a vehicle in the parking space.

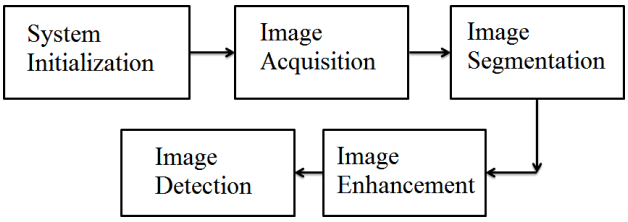


Fig. 3. Schematic of Image Processing Based Parking Space Detection.

The first module is system initialization which will automatically set up the boundaries of every parking space in the entire parking area. A camera is used for capturing the image of the parking area and then it is stored in the memory. It is taking place in the image acquisition section. The acquisition unit is connected to an image processing unit that runs a MATLAB program. The third module is image segmentation, which uses thresholding technique. Then the image is enhanced by using morphological functions which will remove pixels that does not belong to the selected object. Image detection is the last module, which identifies the round brown image on each and every parking space. Based on the output of image detection section the empty parking lots can be identified. Fixing of the camera at a proper location is very critical in this method. Any variation in the orientation of the camera will cause errors in the output.

PROPOSED SYSTEM:

System Initialization

A one-time manual drawing of slot numbers is done in the parking area as shown in figure 4. In order to identify the location of each parking space a unique number is assigned to each and every parking slot. A camera is set up in a position to capture the entire slot numbers in a single frame. Unlike the earlier systems, there is no need to give extra care for fixing the camera. The only one thing here we need to ensure is that the captured image should contain all the slot numbers clearly (as shown in Fig.4).

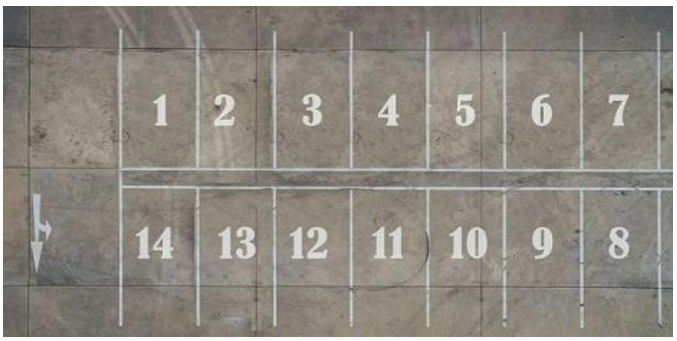
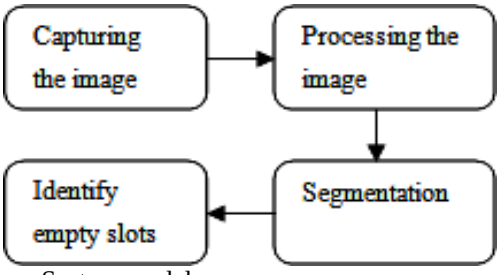


Fig. 4. Image of the empty parking lot with individual numbers for eachslot.

Fig. 5. Image of the parking lot with cars parked. Slot numbers are onlyvisible in the empty slots.

When cars are parked in the lots the corresponding slot number will be hidden in the image. Now the only one thingwe need to do is to identify the available slot numbers. This can be done by using Optical Character Recognition (OCR) techniques of digital image processing. A typical OCR based number recognition model is shown in Fig. 6.



System model

a) ***Capturing the image of the parking area****:* The camera is used to captures the image of the parking area. It is placed ata particular angle to monitor the entire parking area and the slots numbers in a single frame. There is a five second delay to take images by camera. Then the image is stored for further processing.

b) ***Processing the image****:* The captured image is processed for improving the quality of the image. Basically it involves RGB to gray scale conversion and contrast enhancement. The image processing done in this stage will also eliminate unwanted noises present in the captured image. This will create an enhanced image for further processing.

c) ***Image Segmentation and Recognition****:* The image segmentation is the key technique used in optical character recognition based system. This section focuses on identification of the slot numbers. A MATLAB based OCR algorithm is used for the recognition of the numbers in the image. These numbers are stored as a vector.

d) ***Identifying the empty slots****:* If a vehicle is parked in a slot then its slot number will be hidden. So the slot number will not be present in the output vector. The missing number is identified as an occupied slot. The available slot numbers in the output vector represents the empty slots and it will be transferred to the user notification stage. These numbers can be displayed as vacant spaces in the parking area.

RESULTS:

The image of the parking area is processed to obtain the gray scale image and then it is converted into the corresponding binary image. After proper filtering, the image will show only the slot numbers as shown in Fig. 7.

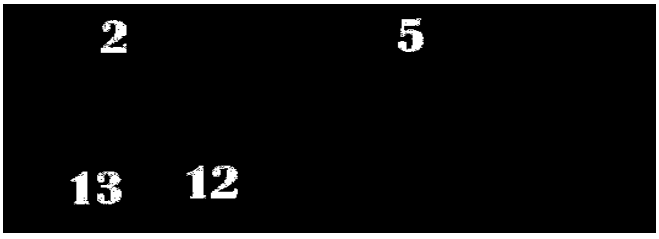


Fig.7. Binary image of the parking area contains only empty parking slotnumbers

This image is processed by using OCR function of the MATLAB which will result the characters present in the image. The characters are converted into integer numbers for further processing and passed on to the user notification section. The accuracy of the empty parking slot detection is very high when we use this method. It is seen that by using proper filtering before and after banalization the number detection accuracy can be further increased.

A GUI window has been created in MATLAB for displaying the status of each and every parking slot in the

parking area. A typical output GUI window is shown in Fig.8.When we give the image of the parking lot as the input of the MATLAB code, the GUI window will display the status of all the slots in the parking area. It will be either 'occupied' or 'empty'.

CONCLUSION:

The first section of the Parking Space Detection is the parking slot detection. This can be done using sensors placed at different locations of the parking lot. But this is a very costly system with a lot of drawbacks. The image processing based empty parking lot identification has made the system simple as well as cheap. Here we need only to use images captured by the surveillance camera in the parking lot for empty slot detection. OCR based solution will be an integral part of future smart parking systems. Using suitable image processing algorithms, the accuracy of detection can be improved.

REFERENCES:

[1] T. Lin, H. Rivano and F. Le Mouël, "A Survey of Smart Parking Solutions," in IEEE Transactions on Intelligent Transportation Systems, vol. 18, no. 12, pp. 3229-3253, Dec. 2017.

[2] N. Bibi, M. N. Majid, H. Dawood and P. Guo, "Automatic Parking Space Detection System," *2017 2nd International Conference on Multimedia and Image Processing (ICMIP)*, Wuhan, 2017, pp. 11-15.

[3] Y. Ji, W. Guo, P. Blythe, D. Tang, and W. Wang, "Understanding drivers' perspective on parking guidance information," IET Intell. Transport Syst., vol. 8, no. 4, pp. 398–406, June 2014.

[4] H. Guan, L. Liu, and M. Liao, "Approach for planning of parking guidance and information system," J. Highway Transport. Res. Develop., vol. 1, pp. 034, 2003.

[5] F. Caicedo, "Real-time parking information management to reduce search time, vehicle displacement and emissions," Transport. Res. D, vol. 15, no. 4, pp. 228–234, 2010.

[6] R. Grodi, D. B. Rawat and F. Rios-Gutierrez, "Smart parking: Parking occupancy monitoring and visualization system for smart cities," SoutheastCon 2016, Norfolk, VA, 2016, pp. 1-5.