A Review on Different Techniques of Parking Automation

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ABSTRACT: In today's era, the problem of parking is also increasing due to the increase in the number of vehicles. For this, a reliable and accurate system is required which is able to manage parking by detecting the vacant slots and maintains the occupancy of slot. From the last decade, there are various researches took place with an objective to develop an ideal automatic parking slot system. The systems which have been designed so far having various flaws in different criteria. This paper has been designed for reviewing various techniques which have been used for automated parking slot detection till now. The existing systems lack somewhere to implement an effective system that would be cost effective. The proposed system is able to recognize free parking space as well as occupied parking using OpenCV. OpenCV is the latest computer vision technique or a library through which a system can be developed with high level of accuracy. Proposed system is based on Laplacian Edge Detection method which is able to recognize the occupied and free space for smart parking which may reduces the human efforts. This system is also useful for alarming if a vehicle is parked in no parking area and inform about the parking space availability at real time with high level of accuracy. In the field of intelligent vehicle and parking management system, accuracy is often important as human convenience required. It is required to get accurate outcomes at real time through which an intelligent parking slot or space detection can be implemented with newly introduced technique.

KEYWORDS: Automatic Parking, Smart Parking, OpenCV, Space Detection, Edge, Computer Vision

I. INTRODUCTION

There are several issues related to the parking area took place as no any ideal technique available to resolve it. There is no automated system installed practically where parking can be managed automatically with high level of accuracy. Drivers have to manually search for the slots and park their vehicle which sometimes create blockage. To manage parking areas, man power is required but they are not proficient enough as most of the time; slots does not occupy properly and remains vacant. Exploitation of an automatic and systematic parking system may reduce the human effort and able to work efficiently to avoid any obstruction and wastage of time. Different methods related to parking system have been proposed in the literature and many of them used hierarchical tree structure, AVM systems and various sensors. Human faults are the chief reason of accidents in traffic, so the techniques are building to check the available space in parking lots, dodging accidents and providing automatic guidance during parking of vehicle becoming an essential region of research. Hierarchical tree structure is used for the marking of parking slots of various types. AVM i.e. Around View Monitor system is used for the assistance to the driver while parking. System consists of four cameras which is capable to show the footage of all direction. Visual assistance on the monitor while parking helps the driver to

accurately park his vehicle. Ultrasonic sensors, Radio frequency Identification and some other sensing technique were also used to develop an automatic parking system.
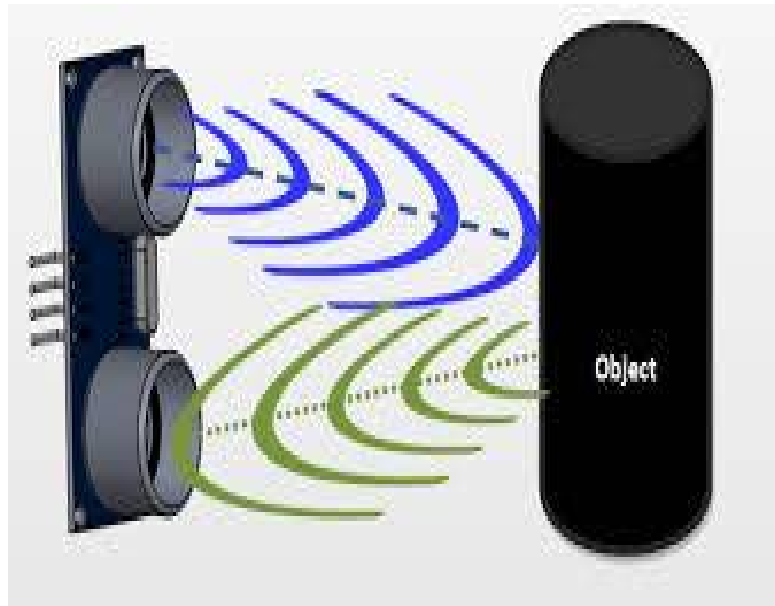

Fig 1. Ultrasonic Wave Transmission

Fig 2. Ultrasonic Sensor [10]
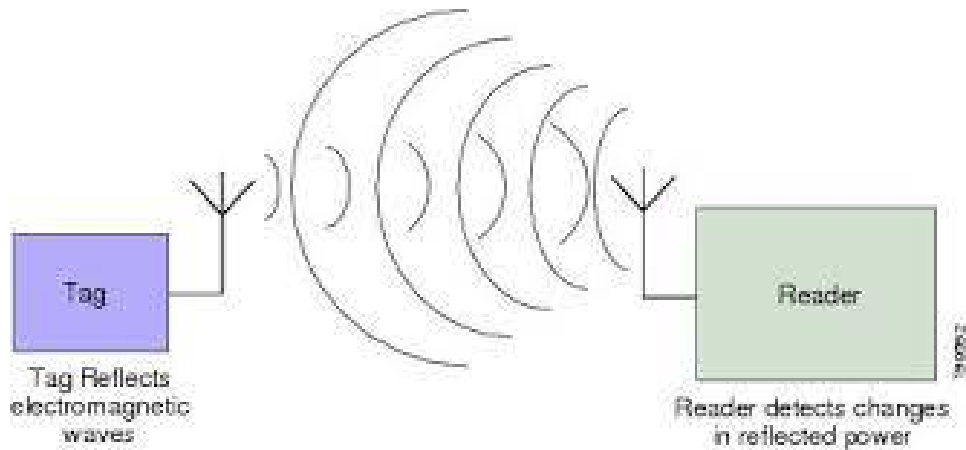
Fig 2. RFID System
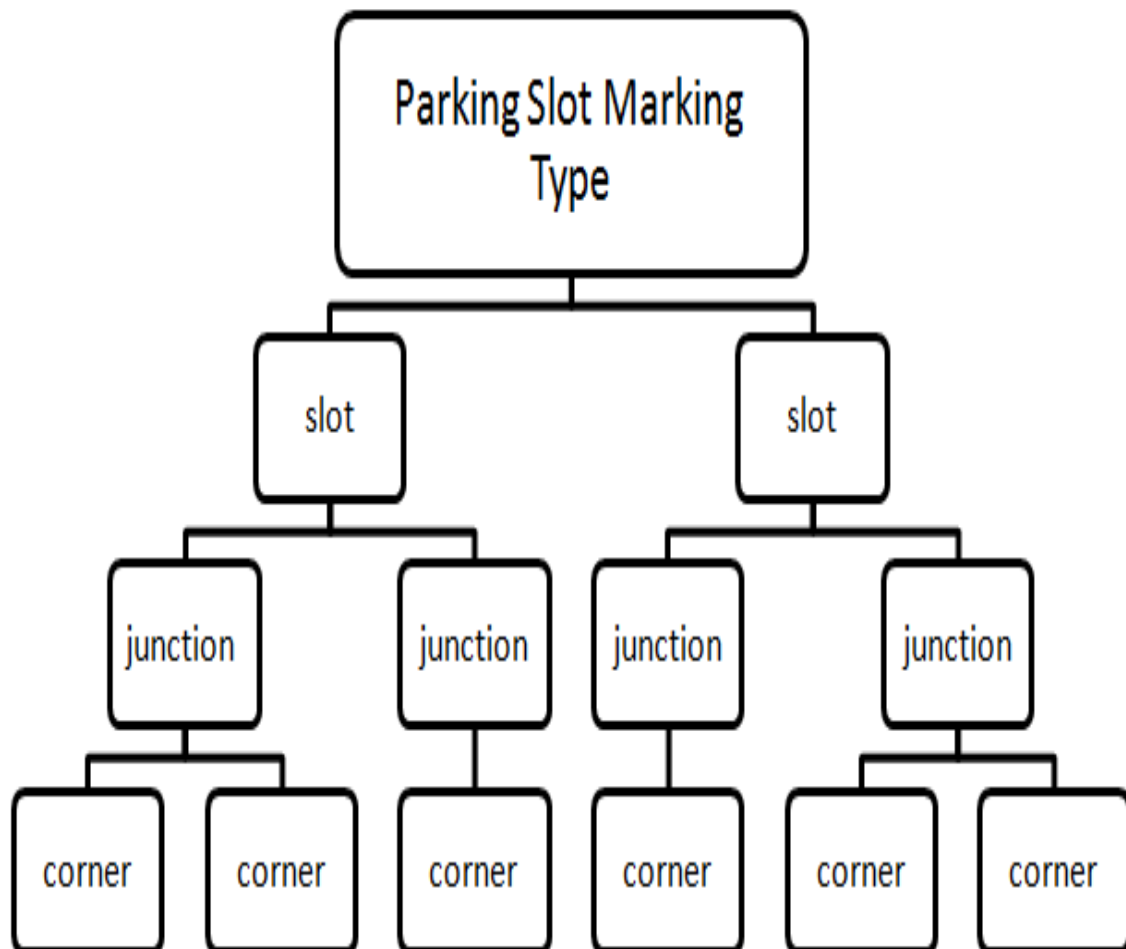
Fig 4. Hierarchical Tree Structure [11]

II. RELATED WORK

Jae Kyu Suhr et al. proposed a system which is based on Around View Monitor image sequences to recognize the marking of various parking slots. The method which has been used in this paper employs simple detector to find the slots and merges sequentially obtained slots. The technique applied in this paper uses four different types of parking slot marking which are rectangular, slanted rectangular, diamond, and open rectangular types shown in fig. 5 Transformation of current and previously detected images of parking slot took place to predict the current position of earlier detected slot. Thus, obtained outcomes of slots are clustered according to their assortment and orientation. A cluster which holds more than predetermined slots considered as final parking slots. Projected system does not display the cluster of single slot and wasted the occupancy of single slot as the system is waiting for more slots to display the whole cluster. As Hierarchical tree structure approach is used by utilizing single AVM image sequentially for the detection of parking slots fall short in situations where slot junctions are obstructed due to the adjacent vehicles. So the resultant system shows various missing and wrongly predicted slots [1].
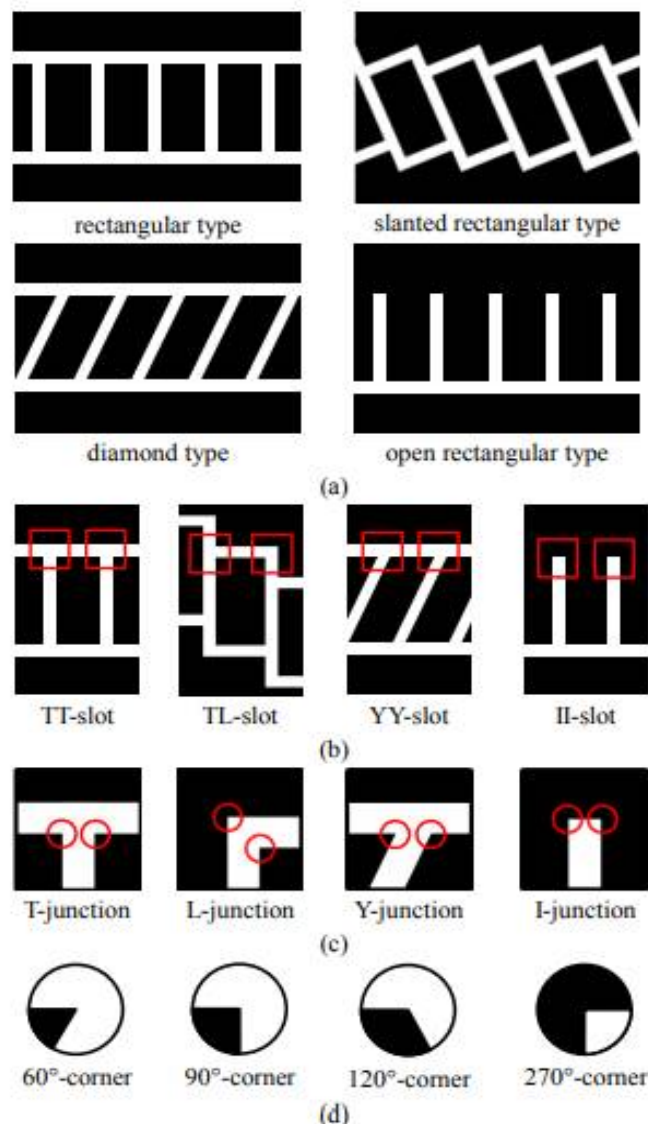

Fig. 5 Hierarchical tree structure of parking slot markings. (a) Parking slot markings. (b) Slots. (c) Junctions. (d) Corners [1]

Jae Kyu Suhr et al. developed a method by using Around View Monitor (AVM) system with ultra sonic sensors to detect and track the unoccupied parking slot. System works in three stages which includes detection of marked parking slots, assortment of slot occupancy, and tracking of marked parking slots. A format of Hierarchical tree structure has been exploited with AVM system to detect the marking of various slots. Sorting of parking slot occupancy recognizes the vacant slots among the detected parking slots using the data achieved by ultrasonic sensors. Third stage concludes the system which has been proposed, by continuously estimate the position of chosen slot during the moving of vehicle into it. Proposed system is semi- automated as the driver needs to select the available vacant slot of parking. Use of ultrasonic sensor reduces the reliability of the system as they are very sensitive to variation in nature whether it may be the temperature, weight, humidity, air turbulence, and airborne   particle. These variation influences the reaction of sensors which increases the rate of error in detection and tracking of slots. So, the proposed system is not ideal for practical implementation. In the figure 6, white arrow specifies the location and heading direction through the sensor, yellow dots are the information obtained by ultra sonic sensors, green portion indicates the parking slots and red line specifies the occupied slots [2].
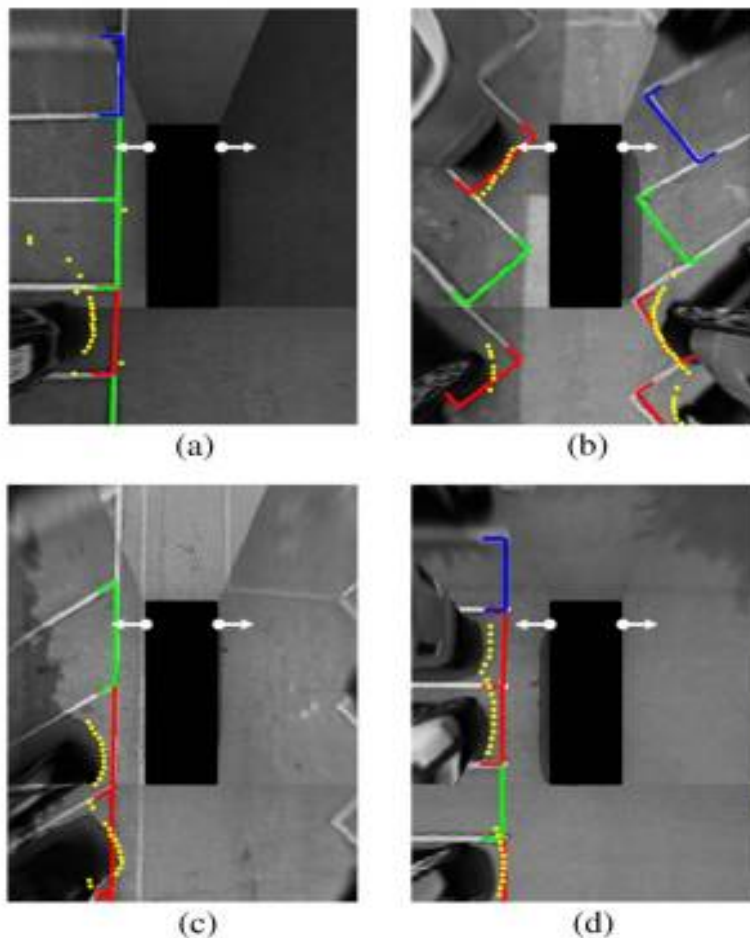

Fig. 6 Parking Slot Occupancy Classification in case of (a) TT-slots, (b) TL-slots, (c) YY-slots, and (d) II-slots [2]

Petar Solic, Ivan Marasovic et al. demonstrated vehicle detection system by using BAP (Battery Assisted Passive) RFID tags which are basically passive RFID tags containing internal battery and RFID readers. Use of RFID (radio frequency identification) technology is considered to detect the existence of car at the parking slot. In this technique, BAP tags are modified by replacing its battery from solar cell. BAP tags are centrally deployed on the ground of

parking area. Detection of occupied slot is obtained when the level of light goes lower than the preset threshold value of BAP tag due to which tag will not able to transmit information. Use of RFID is not a reliable option as the system is sensitive to the natural changes like temperature, dust, rain etc. Deployment of tags are not trained enough, as an obstacle may downs the level of light and barred the transmission of data through tag which shows a result of an occupied parking slot. Increase in simultaneous input information may let more than one tag to respond at the same time which can cause error in the system [3].
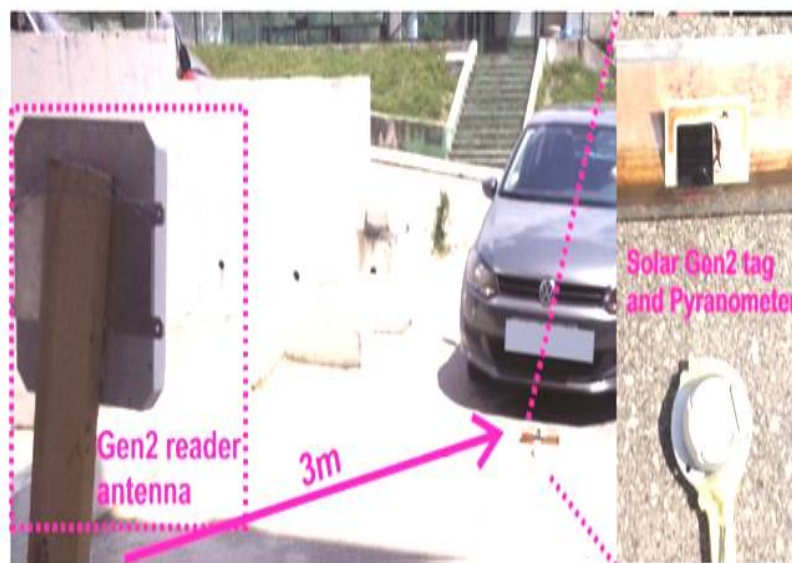

Fig. 7 RFID Setup [3]

Jae Kyu Suhr et al. proposed a system for the parking lot detection specifically for those parking spaces which are situated at the basement. The technique which has been proposed is the blend of two methods which are parking slot marking based approach and free space based approach. Identification of slots is done by estimating the pairs of parallel lines. For free space detection, position of parked vehicle and pillars at the space needs to be identified. The used approach detects the guide lines first and the separation of lines is identified. RANSAC which stands for RANdom SAmpling Consensus algorithm is used to detect the guide line and to detect the separation of lines, chamfer matching is used. Technique developed in this paper is usable to detect perpendicular parking slots only and not able to detect parallel slots. Used approach of free space based identification has a limitation, that it cannot detect free spaces if the alignment of vehicles are not adjacent and the precision of the system depends on the arrangement of adjacent vehicles [4].
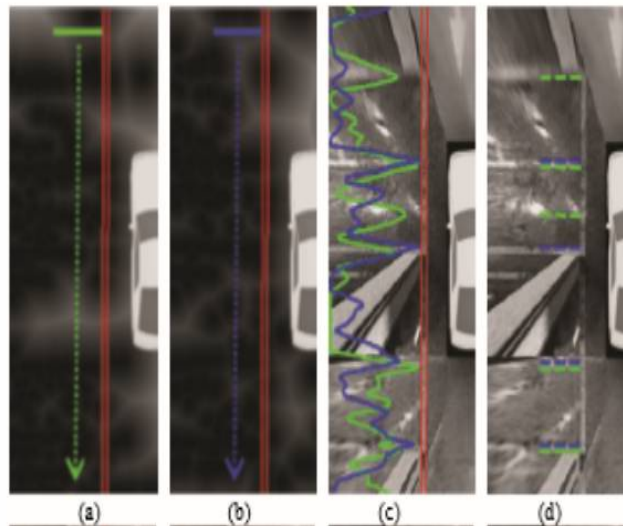
Fig. 8 Parking Slot Occupancy Detection   (a) Positive DT image. (b) Negative DT image. (c) Chamfer matching scores. (d) Positive and negative lines [4]
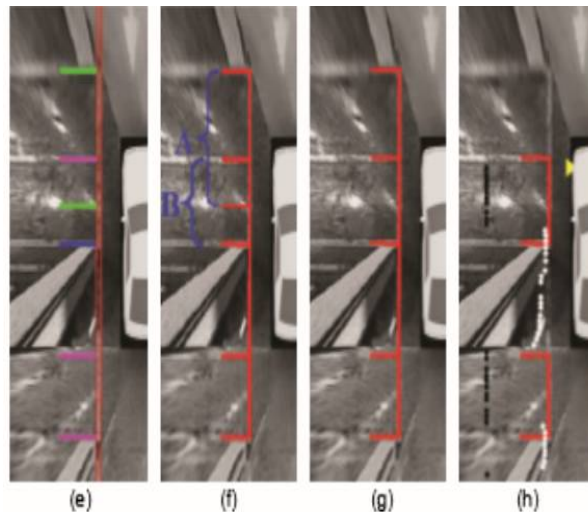

Fig. 9 Parking Slot Occupancy Detection (e) Separating lines. (f) Initial parking slots. (g) Non-overlapped parking slots. (h) Vacant parking slots [4]

K.Malarvizh et al. proposed a system for the detection of parking slot by using an approach of IOTs. Method developed in this system uses ultrasonic and proximity sensors for the detection and connects it with GSM network. The gathered information regarding vacant and occupied slots displayed in the LED screen. The execution of the system takes place in three stages: detection of slots, display of parking slots and reservation of vacant slot. Practical execution of the system which has been proposed in this paper is uncertain due to several reasons like the sensors used are sensitive to change in nature including temperature, dust, water etc and the facility of mobile reservation of parking slot may result in congestion at the parking area [5].

Sarthak Mendiratta et al. proposed a concept of car parking slot detection by using ultrasonic sensors with Internet of things. Sensors are used to detect the vacant slot for parking and send the status of slot through the internet to the system which will let the driver to know which slot is empty. The proposed system is not reliable for practical

execution as the sensors needs to install in every vehicle which is not cost effective. Meanwhile, sensors are able to detect the free space only. System is not trained in a way to detect the adjacent and slanted slots. Two sensors for every vehicle increase the cost of the system and limit the implementation at broad level [6].
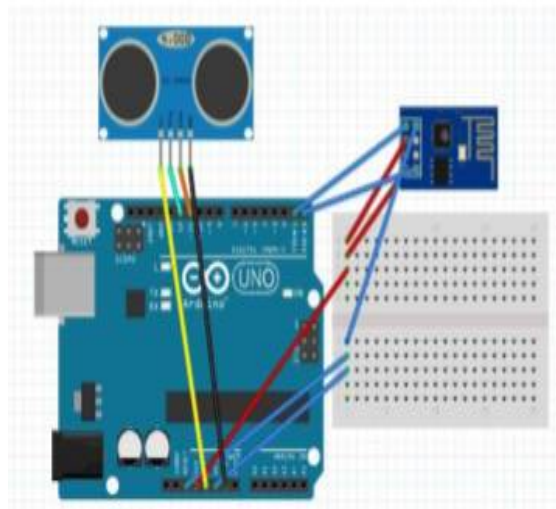

Fig. 10 Arduino Uno Board With Ultrasonic Sensors' Circuitry [6]

Nazia Bibi et al. proposed a method in which parking assistance system is developed to find the vacant slot for parking and reserve it. Fragmentation of parking area into blocks is done by using calibration process. Every block is organized in a manner through which vehicles can be identified and process the information with reference to the vacant and occupied slot to the driver. Entire system is executed in the platform of MATLAB and uses camera to capture and process the current image of the parking lot. Implementation of system took place for 14 slots in a parking area. If the reserved parking slot does not occupied, then the slot will go in vain and these existing vision-based methods doesn't acquire the expected result because of deviated intensity of light and the complex obstruction circumstances [7].
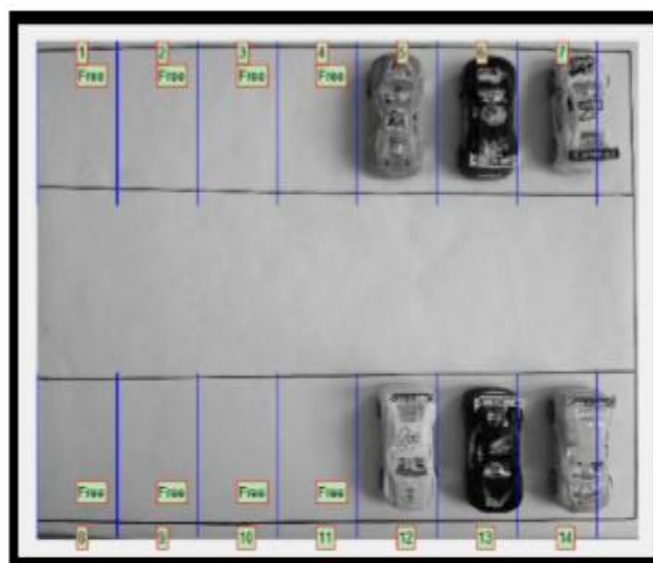

Fig. 11 Free Space Detection [7]

Lei Li, Changle Li et al. developed a method based on Around View Monitor (AVM) system encloses four Fish Eye Cameras around the vehicle. Depending on the extracted information of edges, Line Segment Detector is exploited to identify the marking of parking slots which contains couple of parallel lines with a certain distance in AVM image. Making use of four fish eye camera for every vehicle enhances the cost of whole setup which limits their use at expanded scale as the installed cameras are too expensive in itself [8].
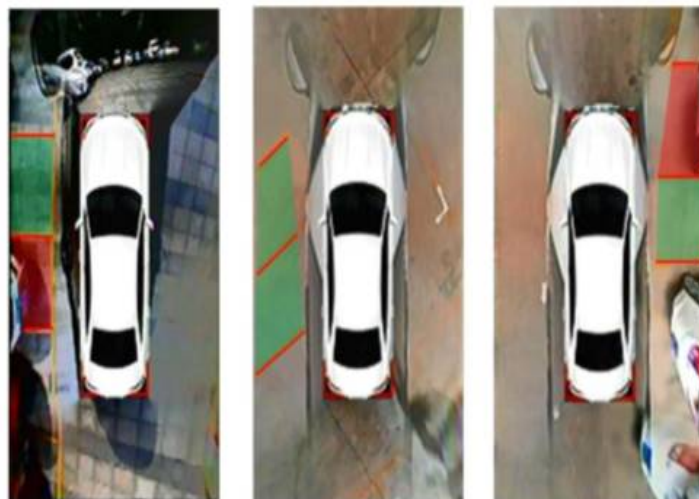

Fig. 12 Camera configurations of prototype vehicle. (a) Cameras calibration [8]

Fig. 13 (b) Location of cameras in the AVM system [8]

Fig. 14 Experiments Results of Typical Parking Slot. (A) Rectangular Type. (B) Slated Rectangular Type. (C) Open Rectangular Types [8]
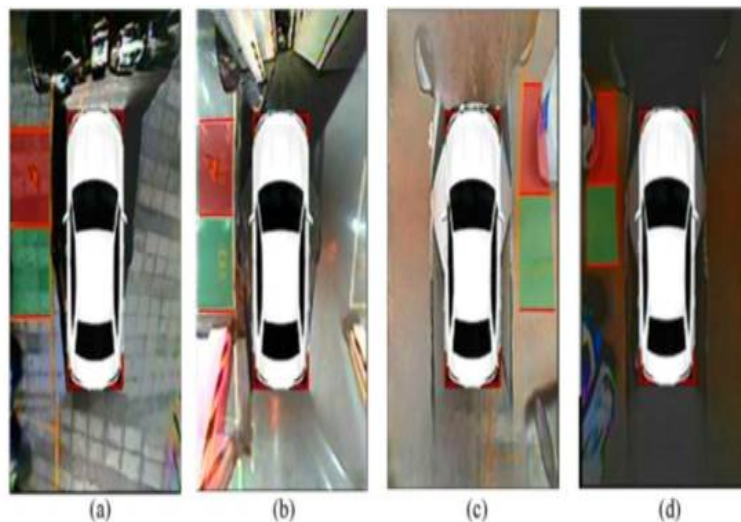
Fig. 15 Experiments Results In Diverse Special Situations. (A) Outdoor Scenes (B) Underground Parking Slots (C) Damaged Parking Slot Markings (D) Variation In Light Intensity [8]

III. CONCLUSION AND FUTURE WORK

The work which has been done till now in the area of parking slot detection does not have any ideal approach that can effectively implemented. Most of the systems are using sensors like ultra sonic, proximity and fish cameras which increase the cost of the system since these components needs to install in every vehicle to execute the system. There is more than one camera or sensors have been used for each vehicle which increases the cost of the system. The proposed system is capable enough to efficiently identify vacant and occupied parking slots by using OpenCV which enhances the accuracy and proficiency of the system up to a great extent. The real time parking slot detection can be used for automatic parking management. But accuracy is often important which requires to enhance for developing an ideal system that can be implemented practically. Edge detection technique can be enhanced in future where accuracy depends.

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