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Computer Vision based Automated Underground Parking System

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Abstract:- **Finding a parking spot is becoming increasingly difficult with the increase in the amount of cars and it becomes an even more difficult task when you have to look for a parking spot in an almost packed basement or multi-level parking. The proposed method looks to identify the lanes in a parking where there are empty spaces available using computer vision and the prior information about the number of parking spots available in the lane.**

Keywords:- Frame differencing, Raspberry Pi, Dilation, Contour.

I. INTRODUCTION

Whenever a parking lot is packed and an empty spot cannot be seen with our naked eye people have to drive around to look for a parking spot, but in recent years certain sensor based parking systems have been implemented but these systems are very costly. The use of image processing has increased very much in the recent years because of the increase in the processing power available, it is used in Autonomous driving, emotion recognition and at many more places. Then why not use the power of image processing and computer vision to create an affordable automated car parking system. A car parking system can save people a lot of time in their everyday lives and solve a problem that's quite simple but experienced frequently by each and every person.The current systems use sensors or computer vision techniques[3] to detect empty parking spots. The sensor based technique has very high accuracy as compared to the other systems but is very costly as compared to the others the reason being that sensors are deployed at each and every parking spot to mark whether the spot is occupied or empty. Certain computer vision techniques try to find empty spots in the parking directly and then notify about these empty spaces[2] .The system being proposed uses computer vision techniques to detect moving cars and the information about the number of available parking spots to identify the number of unoccupied parking spots.

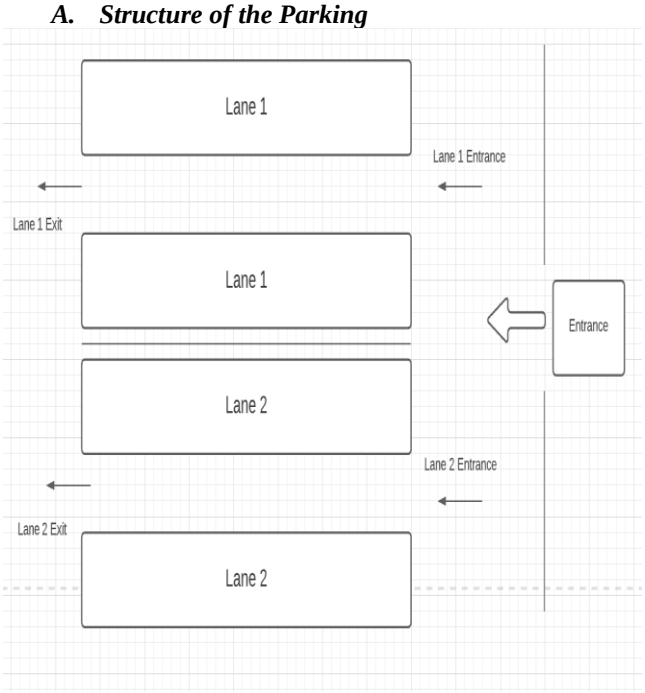
II. HARDWARE COMPONENTS

A. Raspberry Pi High Quality Camera
It is used to get the Video Feed from the parking. A standard 12 Mega Pixel camera is enough for our purpose.
B. Raspberry Pi
The Raspberry Pi is used for performing the computer vision operations on the video Feed obtained through the Raspberry Pi HQ camera.

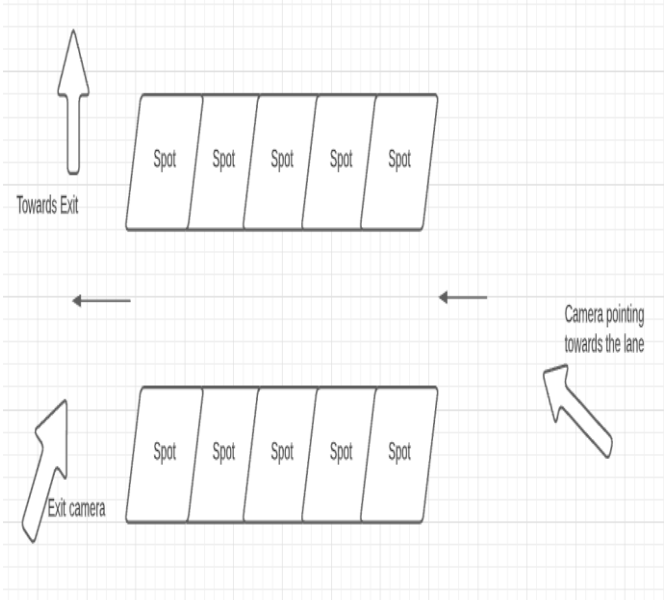
III. OVERVIEW

The structure of the parking consists of numerous different lanes where the parking spots are located. In these lanes there are certain spots for parking.

A. Structure of the Parking



B. Structure of Individual Lane



The Raspberry Pi Camera and the Pi will be placed in the position as shown in the second figure i.e. facing towards

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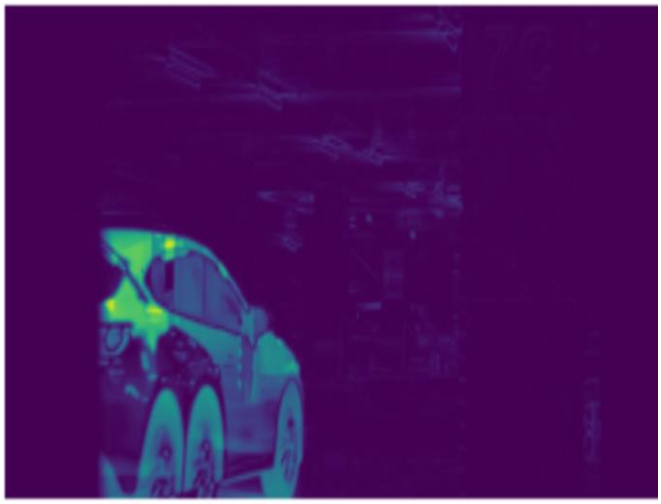
the entrance and exit of the lane so that all cars entering and leaving are visible in the video feed. So whenever a car enters or leaves a lane it will be identified. Hence the cars leaving and entering the lane in real time can be calculated and as the number of parking spots in the lane are already available it can be identified whether the lane has space to accommodate another car. The methodology to identify a car leaving or entering is being discussed below.

IV. METHODOLOGY

A. Frame differencing

The first objective is to capture the coordinates of the moving object in the video feed i.e. the car. The frame differencing method is used on consecutive frames of the video feed. Using this method the pixels that have changed in the image can be found.

$$I_{d(K+1,k)} = | I_{k+1} - I_k |$$



B. Thresholding

Then the process of Image thresholding is done on the frame differenced image where all pixels below a particular brightness threshold are made completely dark and those above are made completely bright. A threshold of 30 has been set to obtain the below image.

$I_{thresh} = 255 \quad I_{d(K+1,K)} >$ threshold

$I_{thresh} = 0 \quad I_{d(K+1,K)} <$ threshold

C. Dilation

The problem faced here is that a lot of fragmented contours close to each other are formed and could be a problem in detecting the car and hence Image dilation is performed to merge these smaller contours.

D. Finding Contour

Then we find the contours in the dilated image to find the borders of the moving object in the image. We only find contours that have an area larger than threshold, so that only the movement of a car is detected and not that of a person or anything else. Also, the camera has been intentionally placed at an angle so that once a car has been detected it move from the left half of the picture to the right half so that a car that has already been counted does not get counted once again and also a one second delay is provided after every car that is detected so that the car has enough time to move outside the frame of reference.

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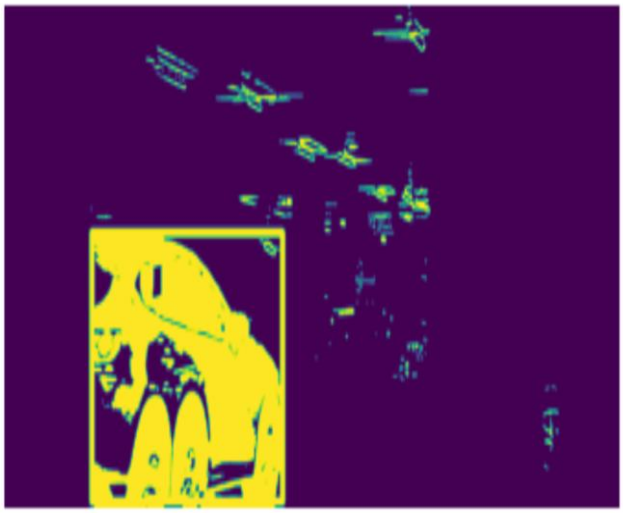

The threshold for the area of the contour has been set to one lakh so that unnecessary small contours and the frames containing small partial images of the car are not counted.

V. CONCLUSION

The system being implemented above is much cheaper than those based on sensors as the hardware required decreases by a drastic amount. The system works on the concept of computer vision and helps the user identify the lane where a parking spot is empty which is all a user needs as whenever the user enters the lane the empty space is clearly visible.

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