

Intelligent Parking Management System

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Abstract: This paper presents an intelligent system for parking space detection based on image processing technique using color detection algorithm. The method uses a camera as the sensor which captures the image of the parking area and processes the image of the parking lot (green circular dots on the parking lot indicates vacant parking space) to produce the information of the empty car parking spaces. The nearest available vacant parking slot number is shown to the driver by using a LCD panel at the entrance of the parking area.

Keywords: Color detection, green circulars dots, image processing, intelligent system, space detection.

I. INTRODUCTION

Most of the car parking today are not run efficiently. This means that on busy days drivers may take a long time driving around the car park in order to find a free parking space.

Before the development of a camera based intelligent parking management system various methods were used to detect the vacant car parking slots. GPS based[1] system was proposed by S. Pullola in the year 2007 which used the poisson process, this method could not guarantee the vacant parking lot when the driver reaches the facility. Agent based parking system was proposed by Steenberghen in the year 2012 which used sustapark model, in this method the estimation of total demand for parking is very rough approach. Wireless sensor network technology was proposed by Nikos Larisis in 2012 which used event driven processing algorithm, this method detects the overlying automobiles and robustly distinguishes false positive indications.

Implementing a parking system based on image processing[2] [3] will help to resolve the growing problem of traffic congestion, wasting of time, wasting money and helps to provide better public service, reduces the car emissions and pollution and increases parking utilization.

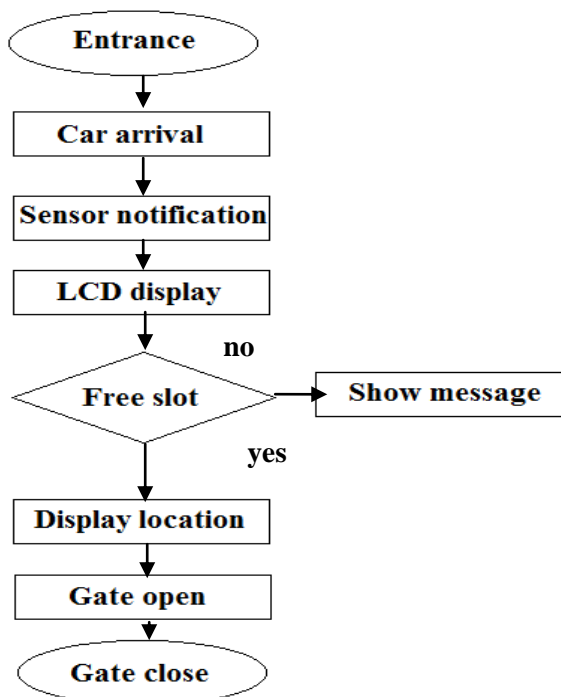


Fig.1 Flow chart of intelligent parking management system

The technique acquires the image of parking area, detects green color and identifies if the object detected is circular(object which is circular and green in color indicates availability of parking space). The location of the circular objects is found and the vacancy of parking space is displayed on the LCD. This helps

the driver to save his time in searching the vacant slot and also reduces traffic congestion inside the parking area.

The flow chart of the intelligent parking management system is shown in Fig 1. At the entrance of the parking area, the car encounters a IR sensor. The sensor notification indicates the arrival of a vehicle. The image of the parking area is captured and processed using image processing techniques and the vacant slot location is sent to a microcontroller which further drives the LCD. LCD display shows the location of vacant parking slot to the driver. If no slot is free it displays a message saying no free slots[4]. A stepper motor then opens the gate for the car to enter the parking area and then closes the gate after a suitable delay.

The motor and IR sensor pair can also be used at the exit of the parking area. The IR sensor to detect the vehicle which needs to leave the parking area and the motor to open and close the gate.

II. BLOCK DIAGRAM OF INTELLIGENT PARKING MANAGEMENT SYSTEM

Web Camera captures the entire parking area. The obtained image is processed using MATLAB R2013a software. The output of the processed image is the location of vacant car park. This output is sent serially to the microcontroller. The information about the car park vacancy is displayed on the LCD panel. IR sensors used at the entrance of the car park senses the arrival of the cars. ULN2803 drives the stepper motor to open and close the gates. All these devices are interfaced using a microcontroller (RenesasRL78). Fig.2 shows the block diagram of the intelligent parking system.

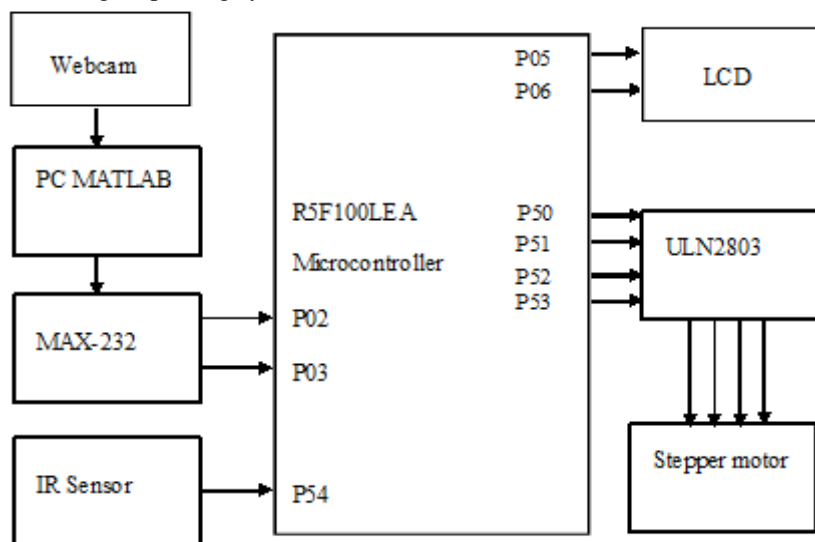


Fig.2 Block diagram of intelligent parking management system

III. SYSTEM MODULE

Image identification, Image acquisition, Image separation, Image development and Image determination are 5 steps involved in this process.

1. Image Identification: First an image of the car park is taken when there are no cars in the car park area. This would be used by the system to record the location of the parking area and divide the location into possible coordinates (i.e. possible number of parking slots). The RGB value can be used to find where green circles are, which represents the empty car spaces.

2. Image Acquisition: A high resolution camera is placed at a fixed position and at the suitable height, which captures the image of the parking area. The captured image is used to detect the vacant car parking slots. This camera should be in a position where it can clearly see all the car parks and not be obstructed by any other objects.

3. Image Separation: The green circles in the input image can be highlighted by subtracting the green frame of the input RGB image from the grayscale image (input RGB image is converted into grayscale image).

4. Image Development : After obtaining the grayscale image with the green part highlighted, the noise in the image needs to be removed. This can be done by using a median filter which operates on a 2 dimensional image. The median filter removes the salt and pepper noise present in the image. The filtered image is converted to binary image.

5. Image Determination: The green part highlighted in the image is due to the green objects present in the parking space, the highlighted part may be due to the presence of green cars, leaves etc. in the parking area. Therefore the roundness of the object is calculated and the object identified as round is kept as the area of

interest. By using the coordinates found in the initialization of the car park, each car park slot can be analyzed to determine whether a car is there or not. A car is absent and the parking slot is free, if the green dot is identified within the specific coordinate range..

IV. RESULTS

Various techniques were proposed in order to find vacant free spaces such as Expert Systems or Agent based technologies, which can solve the problems associated with distributed and complex traffic environment, but this process results in human error, therefore a system which supports the operator; safely and efficiently is presented. Fuzzy logic based systems, the method gives a car the capability to independently drive on different types of roads but the implementation of the Fuzzy rule-based system takes place upon the neural network architecture. A two-stage scenario called longitudinal and lateral movements is used for finding the proper parking lot. Then Wireless sensor based system in which each parking space has a sensor node for detecting and checking the occupation of the parking facility but these systems are difficult to implement, the process of finding free parking slots is easier and the human interference is reduced by implementing a parking system based on image processing technique using color detection method.

IR Sensor detects the vehicle arrival at the entrance of parking area. The LCD shows the message as "vehicle detected". An image of the parking area is obtained using a properly positioned webcam of resolution 320x240/30fps, which is then converted to RGB image. The image is as shown in Fig.3.



Fig.3 Input image

The green frame of the above image is extracted successfully. The input RGB image is converted into grayscale image. Subtracting the grayscale frame from the green frame gives the image with the green objects slightly highlighted. The previously obtained image is converted into binary image by fixing a suitable threshold. So that the green objects appears as white objects in the binary image. This image is shown in Fig.4. The objects in the above image which are identified as circles are counted and the centroids of this circular images are marked. This image is shown in Fig.5. The location of nearest available vacant slot is displayed on LCD.

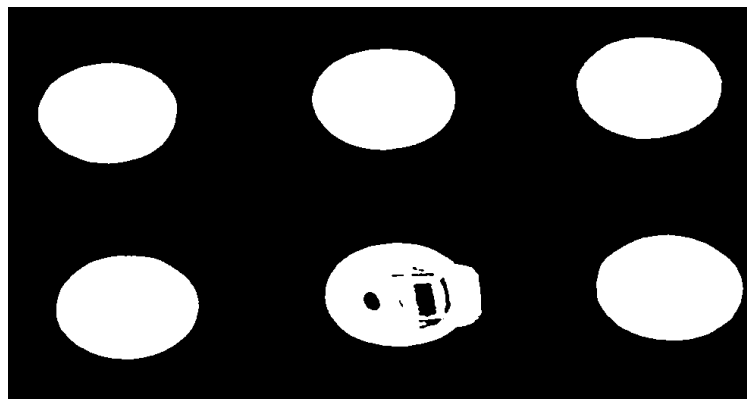


Fig.4 Binary image

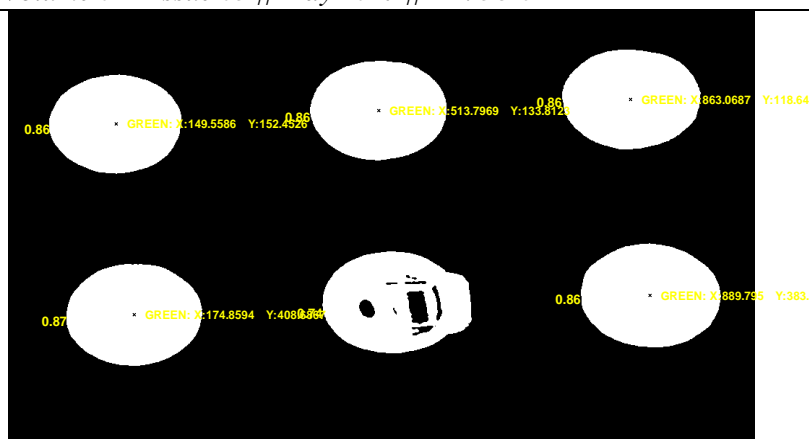


Fig.5 Objects identified as round with their centroids marked

V. CONCLUSION

The searching of vacant parking slots in the busy days is a time consuming task. To reduce this time consumption and make the parking easier, an intelligent parking management system is implemented using image processing techniques. In this method a green circle is drawn at the centre of each parking slot. In this method a IR sensor, LCD display, Renesas microcontroller, stepper motor and a web camera is used.

The IR sensor is used at the entrance of the parking area to sense the arrival of cars and the LCD shows the message as “vehicle detected”.

The web camera acquires the video of the parking area, the snapshot of this video is processed in the MATLAB tool. This processing includes getting the snapshot from the video, extracting the green frame, removing the noise, converting it into black and white image, labelling the green objects, finding the circular objects, getting the centroid of the circular objects and finding the location of these centroids by dividing the parking area into coordinates.

This centroid location is used to give the information about the vacant parking slot, a string corresponding to a particular vacancy is sent serially (using a USB to UART cable)[5] to the microcontroller from the PC. The nearest available vacant slot number is displayed on the LCD screen placed at the entrance of the parking area. If there are no vacant slots, the LCD message reads as “no free slots”.

If the slots are vacant the stepper motor opens the gate(anticlockwise rotation) for the car to enter the parking area, after a delay of 5 seconds the motor closes the gate(clockwise rotation). The LCD shows the message of opening and closing the gate.

Thus this system reduces human interference in searching for free parking slot and provides effective area utilization.

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