Design and Implementation of an Intelligent Parking Management System using Image Processing

B.Karunamoorthy[1], R.SureshKumar[2], N.JayaSudha[3]

Department of Electrical & Electronics Engineering, Kumaraguru College of Technology,Tamil Nadu, India

***Abstract*- Parking is an ever-growing challenge in any city around the world as the number of travellers/ passers is continuously increasing. Parking availability is one of the most significant challenges that traffic/ private officials are trying to address. The biggest issue in the parking area is to find the empty parking lot to park the vehicle. Intelligent Parking has found a broad audience from airports, shopping malls, convention centres, and universities. Intelligent Parking is a revolutionary new system that turns the existing parking applications into a world class facility. This paper proposes an intelligent parking system to solve the problem of unnecessary time consumption in finding the parking spot in commercial car park areas by using image processing techniques. A parking management system is designed in such a way that it provides the information about the available parking lots and also it involves the automated payment system for the registered users. Thus the designed system will completely eliminate the hassle in searching the available parking lots and it could be applied everywhere due to its ease of usage and effectiveness.**

***Key words*— Image Processing, Automated parking system, Secured payment, Efficient parking.**

I. INTRODUCTION

Currently, most of the existing parking areas do not have a systematic system. Most of them are manually managed and are not much efficient. The main problem that occurs at the parking area is the time being wasted in searching for the available parking spaces. Users will keep on rounding the parking area until they find an empty parking lot. This problem usually occurs in the areas, where the number of vehicles is higher as compared to the availability of parking spaces.

There are many methods that are employed in the design of smart parking system. Few such methods are listed in the references as follows. In [1], an automatic method for estimating the traffic using image processing technique is carried out. This method uses Gamma Correction as a method for estimating the traffic by using a threshold value. In [2], a system that involves the detection of UAV images has been proposed. This method uses a catalogue based approach by storing different kinds of car images in a database and then the obtained image is compared with the images stored in the database and the vehicles are detected. In [3], an automatic method for traffic surveillance has been carried out. In this system, moving vehicles are automatically separated from the image sequences by a moving object segmentation method. In [4], a system for locating vehicles in a parking lot by using image processing technique has been proposed. In this method, the gray levels of the input image are processed by using log-transform. This extracts edges and counts the number in each parking division and then decides if each division is occupied or not. In [5], an automatic method for counting of vehicles captured by unmanned aerial vehicle has been performed. This method involves the use of SVM Classifier for detecting the car vehicles and counting them. In [6], the detection of parking space by drawing reference dots in the parking lots has been proposed. The area of the reference dots are calculated in order to find whether the area is occupied or not. In [7], a system is designed to capture the rounded images drawn at the parking lots and processes the image to produce the information about the empty parking spaces.

One way to solve the problem in the parking area is by displaying the status of the parking area using the LCD display fixed at the entrance of the parking area. If the status of the parking area is displayed at the entrance, the drivers can easily know the availability of the parking lots and can park their vehicles accordingly. In case if there is no availability of parking space, the drivers can move away without any delay in searching unnecessarily. The proposed work aims to cater for a larger number of prospective users. Hence, a system is designed in such a way that based on processing the image of the parking lot, the status of the parking area is displayed at the entrance of the parking area and automated payment is made by registering the users account in the frequently used commercial car park buildings with their vehicle numbers.

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Whenever a user approaches the parking entrance, the user can know the status of the parking area through the display provided at the entrance and also after parking the vehicle, the parking amount is automatically deducted.

For this designed system, MATLAB is used as a software platform. In part II, the detailed description of the modules used in the designed system is explained. Part III presents the results of the simulation obtained from Matlab for the counting process used for the counting of the number of vehicles present in the parking area. Part IV deals with the conclusion and the suggestion for future works to make this system more efficient.

II. SYSTEM MODULE

The proposed system involves 2 modules: Vehicle counting module and Automatic payment module. The Vehicle counting module is used for counting the number of vehicles in the parking area. This involves the Feature extraction, Classification using ANN and the Output. Automatic payment module involves the use of RFID Transmitter and the Receiver section. The overall module is illustrated in fig.1

VEHICLE COUNTING MODULE

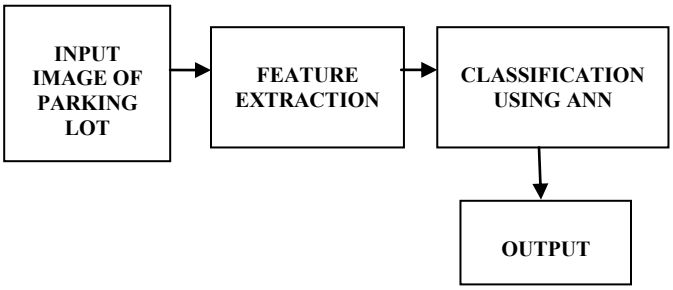

Fig.1 Block diagram for Vehicle Counting Module

AUTOMATIC PAYMENT MODULE

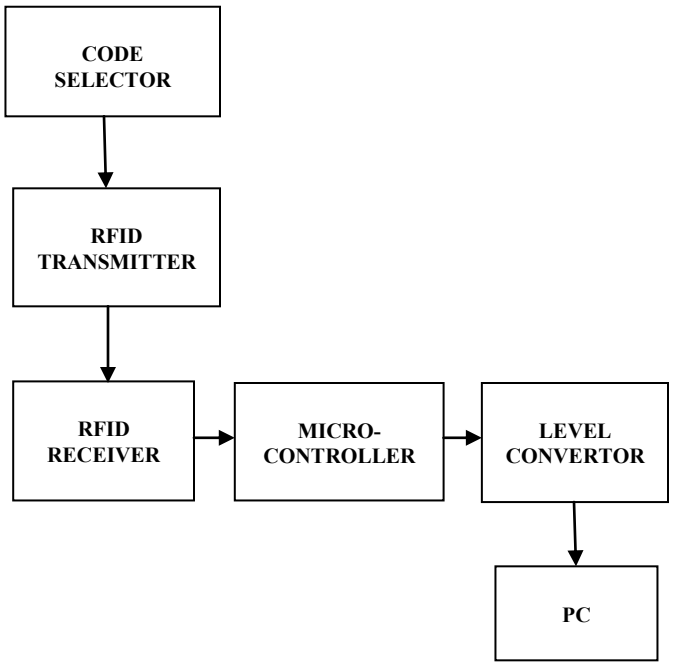

Fig.2 Block diagram for Automatic payment module

Various blocks that are involved in the vehicle counting module is shown in the fig.1 and the blocks that are involved in the automatic payment module is shown in fig.2

A. Vehicle Counting Module

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

1) Parking Lot Image Input

A prototype model of the parking area has been designed to develop this system. This model consists of 4 parking lots to park the vehicles. The sample images of the designed parking lots are shown in fig.3 and fig.4. The images for various combinations that are possible for the vehicles to be parked in the designed prototype model are stored in the database. Whenever, an input image is fed as an input to the system, the system compares it with the images in the database. Fig.2 shows the image of the empty parking lots when no vehicle is parked and fig.3 shows the image of the parking lots when it is filled with 4 parking lots.

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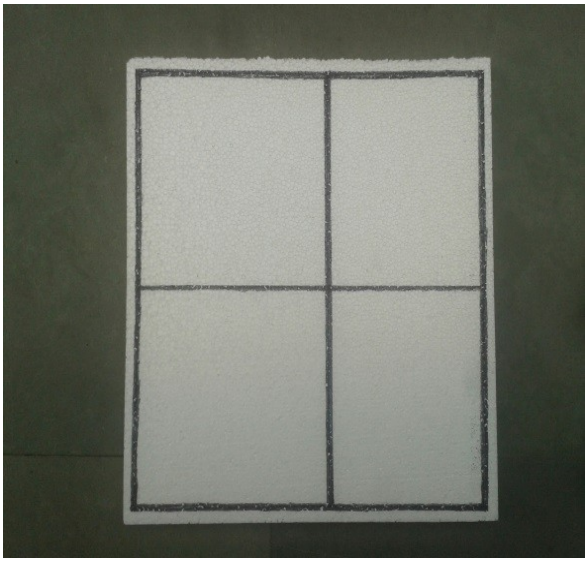

Fig.3 Empty parking lot

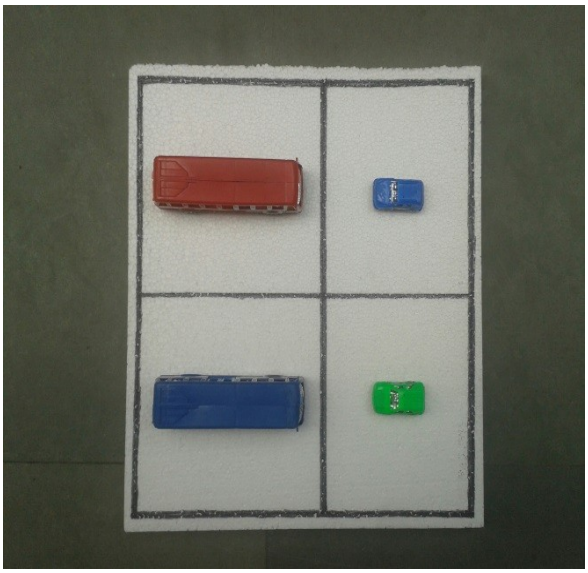

Fig.4 Filled Parking lots

2) Feature Extraction

Feature extraction is one of the most important process that is carried out by image processing. The accuracy of the output depends on the quality of the features extracted from the image. Feature extraction involves transforming the input data into the set of features. This deals with the extraction of the required details of the images that are fed into the system. The input images are carefully processed by the system and the required features are extracted from it for further processing.

3) Classification Using ANN

Neural networks are good when dealing with the features and patterns. ANN stands for the Artificial Neural Network. ANN involves the detection of the features by classifying an unknown input pattern by comparison to previously learned patterns. The reference images are stored in the database and the network is trained to run based on the stored images. Hence, the ANN classifier compares the input images with that of the images stored in the database and produces the required output.

4) Output

The vehicle counting process is carried out and the output is simulated in the Matlab platform. Desired simulated outputs are obtained for the process of vehicle counting. The output for the designed system proves good for all the possible combinations in the designed parking module.

B. Automatic Payment Module

1) Transmitter Section

The transmitter section of the designed system includes the step down transformer, power supply, encoder, switch selector, micro-controller board and LCD display. In the designed system, in order to show that the registered user is entering, the user number (say 1, 2 or 3) is set by using the switch selector. The switch 1 corresponds to the registered user 1, the switch 2 corresponds to the registered user 2 and switch 3 corresponds to the registered user 3. The user number will be displayed in the LCD fixed in the transmitter module whenever the corresponding switch is selected. Thus when switch 1 is selected, the details of registered user 1 is displayed in the LCD.

The input that has been chosen by the code selector is encoded by the encoder and is transmitted by using RF 433 MHz transmitter. The PIC 16F877A micro-controller has the entire control over it. To implement in real time, the details of the registered users are stored in the database and a unique RFID tag is provided to each registered user. The transmitter section that has been designed for this system is shown in the fig.5

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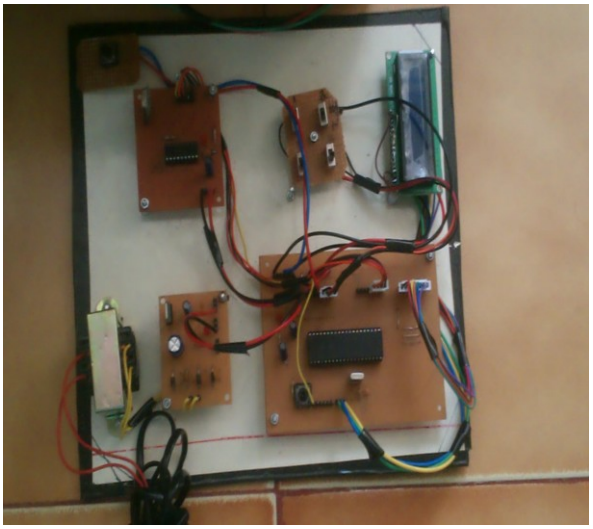

Fig.5 Transmitter Section

D. Receiver Section

The receiver section of the proposed system involves the step down transformer, power supply, micro-controller board, decoder, relay, driver circuit and the gate model. The transmitted data from the RF transmitter is received by the RF 433 MHz receiver and is decoded using the decoder. This data is processed by the PIC micro-controller and the automatic detection of parking charge for registered users is performed. Along with this, an automatic gate model is set up. Whenever a registered user enters the parking area, the gate gets automatically opened up with the help of relay and driver circuit. The receiver section of the designed system is shown in the fig.6

Fig.6 Receiver Section

III. SIMULATION RESULTS

Thus the working of the designed system that uses image processing technique for counting the vehicles in the parking lots and the automatic payment process has been carried out. The simulation for the vehicle counting process is done in the Matlab and the simulation results are obtained for the designed parking module. The automatic process is carries out by the usage of RF transmitter and Receiver. In real time, the automatic payment can be performed by fixing RFID tag in the car's number plate. The simulated results are shown as follows. Fig.7 shows the simulated output when the parking lots are empty and the Fig.8 shows the simulated output when the parking lots are filled.

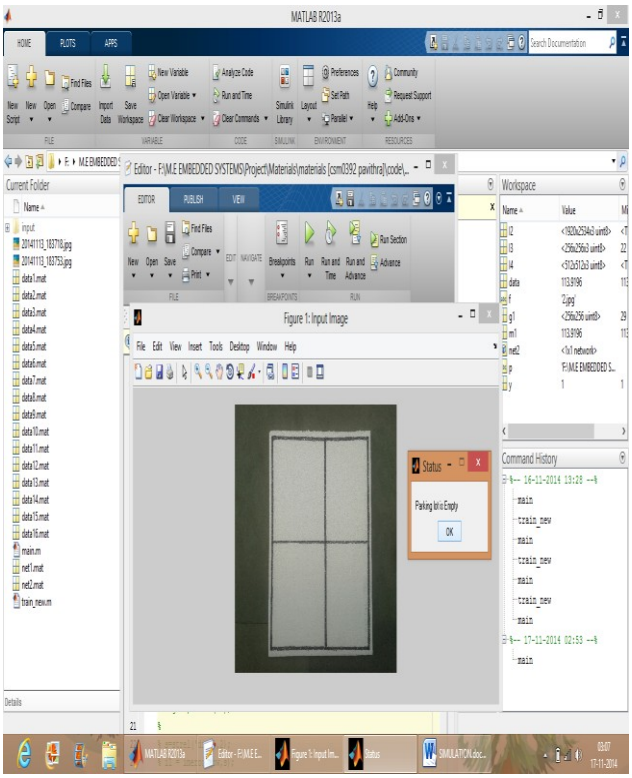

Fig.7 Simulated output when parking area is empty

The simulated output that is obtained when the parking area is empty is clearly shown in the simulated output shown in fig.8.

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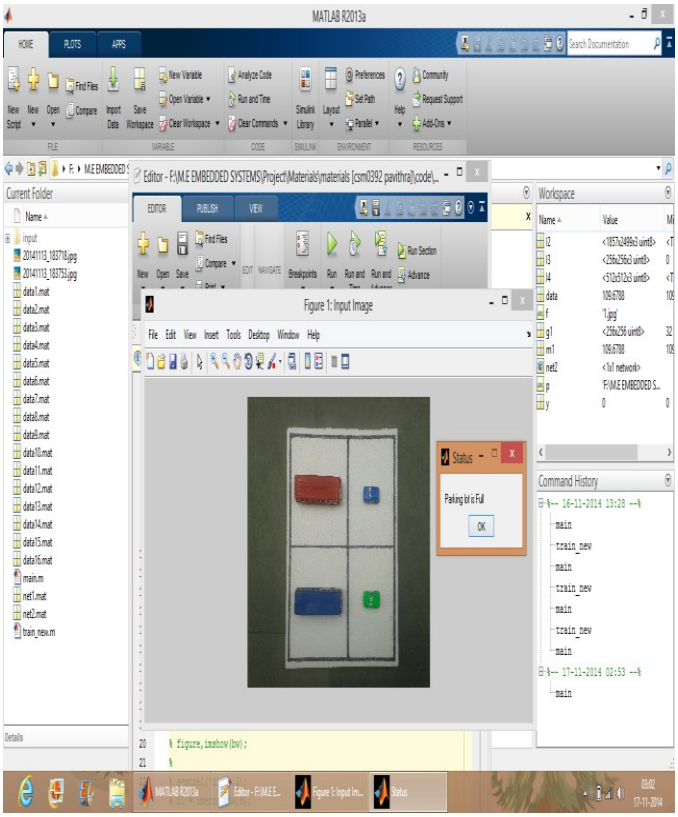

Fig. 8 Simulated output when parking area is full

IV. Conclusion and Future Work

Thus the objective of the proposed system has been achieved. The time for searching the availability of parking lots has been eliminated by displaying the status of the parking lots at the entrance of the parking area. The integration of image processing and the use of RFID have made it a smart system. The simulated results are obtained in the Matlab and the number of vehicles is displayed in the LCD. The future work for this system can be made by enhancing the security feature.

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B.Karunamoorthy received his B.E degree in Electrical and Electronics Engineering from Madras University, Chennai, Tamil Nadu in 2001, M.E degree in Power Electronics and Drives from Anna University, Tamil Nadu in 2005 and PG Diploma in VLSI in 2006. He is currently working as an Assistant Professor in the Department of Electrical and Electronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu.

R.SureshKumar received his B.E degree in Electrical and Electronics Engineering from Government College of Technology, Coimbatore, Tamil Nadu in 2004 and M.E degree in Applied Electronics from P.S.G College of Technology, Coimbatore, Tamil Nadu in 2009. He is currently working as an Assistant Professor in the Department of Electrical and Electronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu.

N.JayaSudha received her B.E degree in Electronics and Communication Engineering from Anna University, Tamil Nadu in 2012. She is currently pursuing M.E Embedded Systems in Kumaraguru College of Technology, Coimbatore, Tamil Nadu.

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