

Intelligent Vehicle Parking System Using Automatic Number Plate Recognition

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Abstract— By the increase in the number of vehicles, parking of the vehicles has become a serious problem in day to day life. This paper presents an intelligent vehicle parking system using Automatic Number Plate Recognition. The aim of this system is to develop and implement a parking system that will increase convenience and security of the public parking lot. This parking system will be able to have less interaction of humans. It has a parking guidance system that can show and guide user towards nearest vacant parking slot. This system uses image processing for recognizing number plates for operation of parking. IPS has the facility for locating the car if a person forgets its exact parking location. Also this system can find the liable person for blocking some ones car while wrong car parking in the parking lot. System consists of Raspberry Pi 3, Webcam, ATMEGA2560 microcontroller, LCD, PC/Laptop, etc.

Keywords— *Smart Parking System (SPS); Global Positioning System (GPS); Radio Frequency Identification (RFID); License Plate Recognition (LPR)*

I. INTRODUCTION

Due to the increase in population which results in the increase in number of vehicles, it becomes very difficult to manage the parking system, especially in offices, institutes and other public places [1]. Parking causes traffic congestion in various cities, results in pollution, and causes frustration among drivers in the most of the cities around the world [2].

Today in parking lots, there is no standard system to find the space for parking. The system mostly depends on human interaction. This leads to wastage of human manpower and makes the parking system inefficient [3]. It also weakens the security of such areas. The main parking lot problems are difficulty in finding the vacant space, improper parking and parking fee payment.

To overcome these problems we propose an intelligent vehicle parking system using automatic number plate recognition. In the recent years, Number Plate Recognition has

a wide impact in people's life as their scope is to improve transportation safety [4]. Vehicle number is extracted from the car plate images. Before extracting the number, the captured vehicle image should have been converted into binary format. Optical Character Recognition (OCR) algorithm is used to recognize the vehicle number [5].

This system mainly aims to manage the entry of the vehicles inside a parking area effectively and efficiently. This proposed system can work accurately with less man power. Proposed system has both hardware and software components. The automated control of all operations of the parking system is achieved with the help of Raspberry Pi 3 and ATMEGA2560 controller.

The rest of the paper is organized as follows: Section II describes the existing systems that have been developed to manage the parking areas. Section III presents the design and working of the proposed system. Section IV describes the Optical Character Recognition algorithm used for number plate recognition. Section V presents the result and discussion of proposed system. Finally, Section VI concludes the paper by describing the future scope of the proposed system.

II. RELATED WORKS

Many systems were developed using the techniques like Induction loop sensors, RFID, Ultrasonic Sensor, Image Processing etc. by the researcher to implement an intelligent parking system.

Ming-Yee Chiu et al. proposed a method for counting the number of vehicles at the checkpoint and thereby the number of vacant space for parking can be counted [6]. The counting is done by installing induction loop sensors under the road surface. Although the usage of sensors is less costly, it is not easily affected by environmental conditions and it detects accurately.

R. Yusnita et al. presented a method in which a brown color round patch was drawn in each space for parking

manually [7]. When the system is on it looks for the rounded shape in each parking space, if patch is detected that particular slot is considered as free and this will be displayed to the driver. When the patches are blocked by objects such as vehicles then the system consider that the slot is not vacant. This system was good enough for managing the space for parking.

Amin Kianpisheh et al. proposed a smart parking system (SPS) to help drivers to find free spaces in a parking area within less time. This system uses ultrasonic detectors to detect the occupancy of parking space and improper parking [8]. For each individual car park, it needs one detector placed on the ceiling above each parking space. Ultrasonic detector is working based on echo-location. The sensor transmits a sound and hits a solid object such as car or ground and then reflected back to the sensor. The time between the transmitted pulse and the reflected echo is used to calculate distance. In a free space, that time will be more than in an occupied space, hence the sensor can detect when a space is occupied. LED lights are attached to the sensor or mounted separately. If the space is vacant, the led indicator displays green. When the indicator displays red, it means the space is not vacant. In case of a handicapped parking space, a blue LED indicates free space and red indicates that the space is occupied. Reserved spaces are indicated using yellow LED.

S. C. Hanche et al. aims at implementing an automated vehicle management system using radio frequency identification (RFID) technology [9]. This automated vehicle management system includes the stage consists of embedding the code into a RFID tag and assigning the same to each vehicle. The second stage is reading the data from the RFID tag by the RFID reader. In the third stage, the data from RFID reader is stored in the database. This is done using RS232. The final stage is to keep a record about the vacancies in the parking spaces. To properly utilize the parking lot, the number of the cars in the parking lot needs to be tracked. In this the number of cars in the parking lot is incremented for every car entering the parking lot and is decremented for every car leaving the parking lot.

Anees Abu Sneineh, Wael A. Salah presents the system based on image recognition technology that can be used to effectively control various parts of a parking system [10]. This automotive parking system is effectively developed by using image processing technologies and an Arduino controller. In this system, the vehicle number is captured from the image using license plate recognition and compared with the vehicle numbers which is stored in the database. If the captured number already present in the database, the system sends a command to the Arduino controller to open the parking gate. A sensor and two led placed in each parking space, namely, red and green and they are located inside the parking area. The sensor will sense the presence of the car in each position. If a vehicle is present, the red light is illuminated. A green light is illuminated if vehicle is not present. Meanwhile, an LCD

located outside the parking area will be showing the number of the vacant spaces present in the parking area.

III. PROPOSED SYSTEM DESIGN

This section describes the design and working of the proposed system. Fig 1 presents the system overview. This system contains both hardware and software components. Camera is connected to the Raspberry Pi which is placed at the entrance of the parking area. Fig 2 shows the block diagram of the proposed system. Firstly, whenever a vehicle enters the parking area the data is acquired from the IR sensor which is placed at the parking gate, and then the image of the number plate is taken using camera and processed using Raspberry pi. This is done with the help of python programming. Optical Character Recognition (OCR) algorithm is used for number plate recognition.

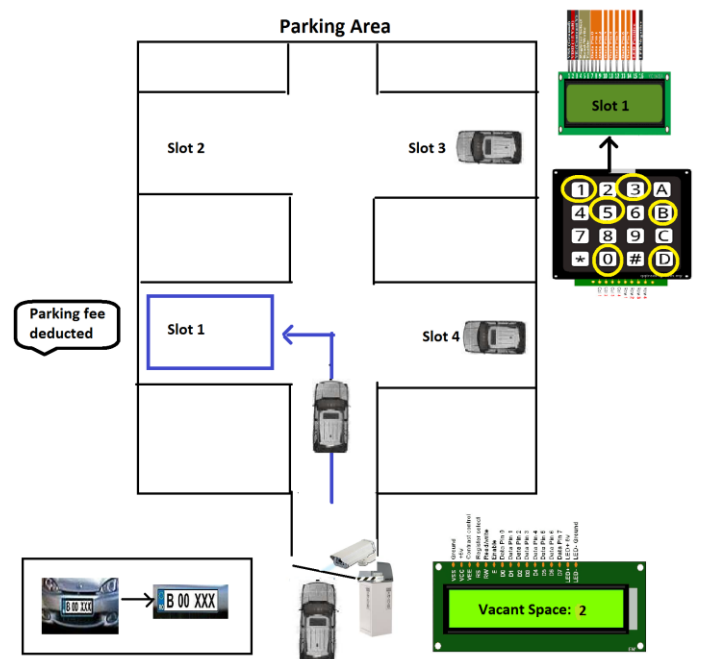


Fig. 1. System Overview

The processed output will be compared with all the number in database and generate an order to open the parking gate, if the user is an authorized person. The opening of the gate is indicated using motor. If not, a buzzer is sounded to indicate the unauthorized entry. When the parking gate opens, the no of vacant space is identified using the data from the IR sensors which is placed in each parking slot. Then it will be displayed in a LCD. Once the number of vacant space is identified, the vehicle will be directed to the nearest vacant space which is highlighted using LED strips. When the vehicle reaches the parking slot a parking fee deduction message is sent to the owner using GSM. Also this system can locate the place where our car is parked by entering the vehicle number in keypad and the slot will be displayed in LCD by slot number along with the owner information. In the same way, we can

obtain the details of the owner of the car which has been blocked by wrong car parking. All the displayed are the output from C programming.

strips, GSM, LCD, buzzer are connected as the output from the Controller. 5V power supply is provided to ATMEGA2560 and Raspberrypi 3. An LCD is interfaced with the Mega2560 for displaying the status of the parking area.

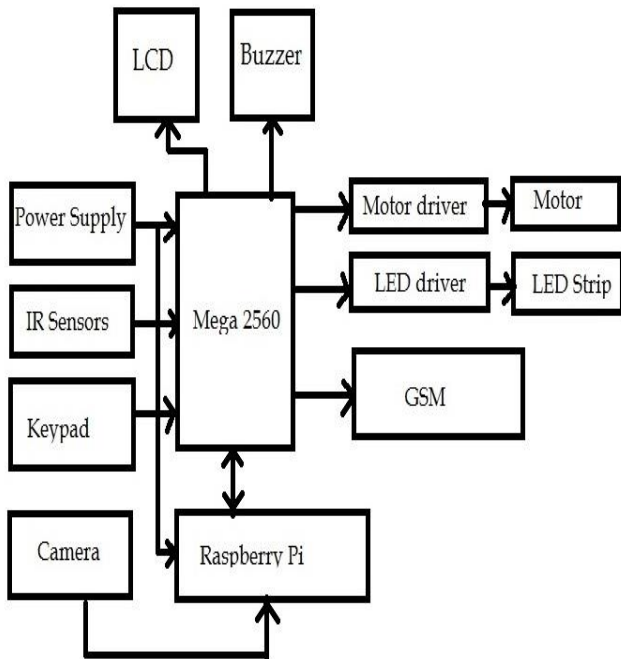


Fig. 2. Block Diagram

IV. OPTICAL CHARACTER RECOGNITION

This section describes Optical Character Recognition algorithm that is used for automatic number plate recognition. A tesseract python binding is used here to apply OCR to the image. PyTesseract is an OCR tool for python. It is actually a wrapper for Tesseract OCR engine. It can recognize and read the text embedded in the images. By using this tool we can convert the content of image into desired string. Optical character recognition process is shown in fig 3.



Fig. 3. Optical Character Recognition

V. RESULT AND DISCUSSION

Hardware setup for the proposed system is shown in fig 4. Six IR sensors, Keypad, Raspberrypi 3 with Webcam are connected as the input to ATMEGA2560 and Motor, LED

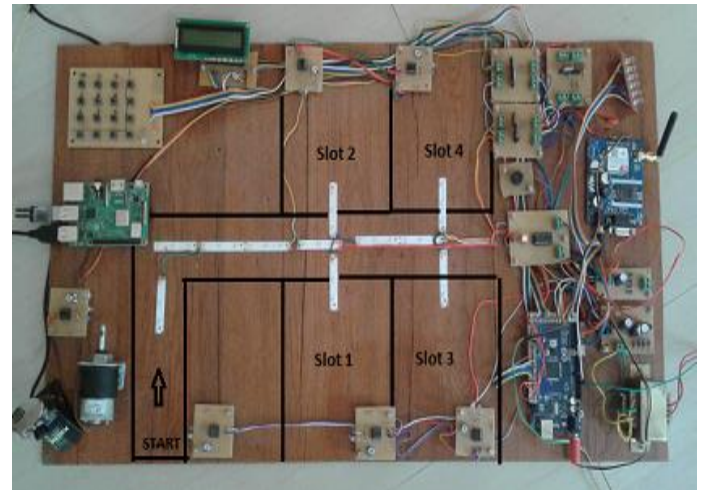


Fig. 4. Hardware Setup for Proposed System

This system begins whenever a vehicle arrives at entry of a parking area. The presence of the vehicle is identified using the data from the IR sensor. Fig 5 shows the Number plate recognition.



Fig. 5. Number Plate recognition

Then image of the vehicle number is taken using the web camera as shown in fig 6. Firstly, the image is converted to grayscale image and the grayscale image is preprocessed using thresholding as shown in fig 7. Here binary thresholding is used which creates a binary image. After preprocessing the image, derive a temporary file. Then write the preprocessed image and grayscale image into disk and save it with a filename. Then apply OCR to the image using Tesseract python bindings. PyTesseract is an OCR tool for python. It can recognize and read the text embedded in the images. By using this tool we can convert the content of image into desired string. Fig 8 shows the detected vehicle number using OCR algorithm. Finally, the input image and preprocessed

image will be displayed in separate windows and the recognized text is also displayed in the screen.

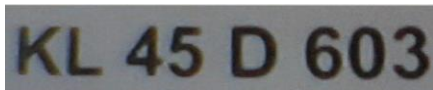


Fig. 6. Input Image



Fig. 7. Preprocessed Image

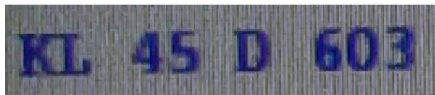


Fig. 8. Detected Vehicle Number

Once the vehicle number is detected it will be compared with the vehicle numbers in the database. If the vehicle is authorized that is if vehicle number is already present in the database the gate will be opened for the user to park the vehicle inside the parking area. When the vehicle enters inside the parking area the gate will be closed. Then vehicle will be directed towards the nearest vacant slot which will be highlighted using LED strips as shown in fig. 9.

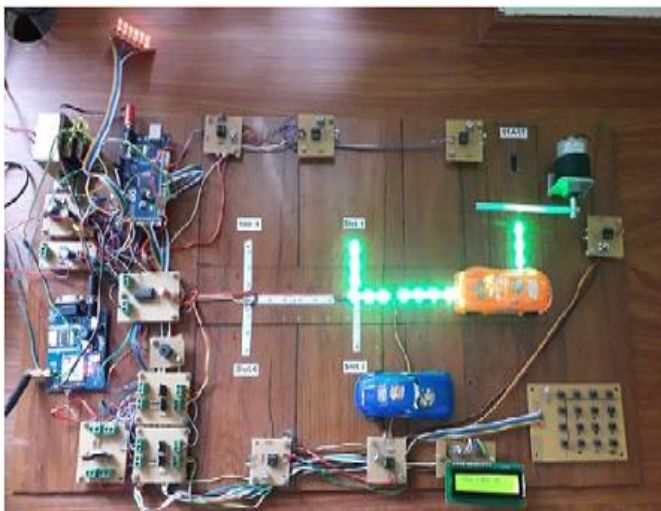


Fig. 9. Directing vehicle to nearest vacant slot

VI. CONCLUSION AND FUTURE SCOPE

In this paper we have introduced Intelligent Vehicle Parking System using Automatic Number Plate Recognition. The main aim of the proposed system is to automate the existing systems with efficient and effective use of parking lots. By integrating image processing technologies and ATMEGA2560 controller, various parts of the parking system is effectively implemented. The result shows the successful implementation of the Intelligent parking system by detecting the vehicle number and thereby managing the entire parking

area efficiently. As a future work, this system can be extended by using a Mobile application for reserving the slot for parking. We can also add a module so that the user can pay the parking cost using his/her mobile.

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