

SMART CAR PARKING SYSTEM USING FPGA AND E-APPLICATION

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Abstract - This smart car parking system using FPGA and e-application paper proposes an advanced software application for parking services and the hardware module for the showing actual interfacing between software and hardware. Smart car parking system is the embedded system which allows user to reserve or book the parking slot in advance from home itself and hardware module shows the real time processing at the parking area. For security purpose an image processing technology for Number Plate Recognition is used which identify the vehicle from number (license) plate and compare it with the previously saved data if match found then only allow driver to park their car so that security will be maintain.

Key Words: android application, number plate detection, FPGA based Parking slot detection.

1. INTRODUCTION

Finding empty parking spaces is a common problem in densely populated areas. Drivers individually find empty parking spaces, searching without information of the parking status. These drivers take an unnecessarily long time to find the parking spot.[1] Due to the technological innovations man is leading a comfortable life. But at the same moment these advancements have at times become troublesome. The number of people using their own cars has increased exponentially in the past ten or fifteen years. The car parking has become an immense issue especially in big cities. Two main reasons can be cited for this. One reason is the growth in population and the other is the security. Car theft has become an evil art nowadays. Now the question arises, is it possible to introduce such a system that would solve all these issues and will be intelligent too.[2] The number of parking spaces is limited in almost every city in the world, a problem that leads to congestion,

air pollution and to driver frustration due to wasted time searching for a parking space and / or penalties paid for illegal parking and to recover cars from companies specializing in seizing vehicles that are not parked legally. However, parking spaces are often wasted. In large parking a driver can exit the parking lot without knowing about new spaces that just became vacant. This is a worldwide problem and different solutions were proposed throughout the world [3]

To avoid these problems, a design of an intelligent parking system is proposed, which will be implemented on FPGA to check its functionality. Recently, a reconfigurable FPGA is efficient method to implement a design, because FPGA provides a compromise between general-purpose processors and ASIC. The FPGA based design is also more flexible, programmable and can be re-programmed. FPGA based design can easily be modified by modifying design's software part.[4] proposed system is basically divided into three parts that is e-parking, number plate recognition, parking area

2. SYSTEM DISCRPTION

We have divided the proposed smart car parking system into following different modules.

- A. e-parking
- B. number plate recognition
- C. parking area

2.1 e-parking

Through the communication system the parking reservation database can be allocated directly by the user or by the parking administrator.

First, the data being communicated will be the car type (TM). Type selection is made so that the car can be charged according to the space occupied by the vehicle. We considered three types: cars or motorcycles, small commercial vehicles (vans) and trucks. Second, the information will be the name and surname of driver (NP). In this field it will be introduced first and last name of the

vehicle's driver. The third data is the registration number of the car (NI). The registration number is the most important criteria, based on which the driver will be allowed access into the parking lot.[3] To use this e-parking application we can use login id and password so that it will be easy to keep record for the users those are doing reservation frequently.

Reservation will be set by three parameters:

1) Date (D), day of the desired reservation. This will appear as a calendar, the user will select first the month of the year and then the day. Date can also be entered directly from the keyboard as "dd/mm /yyyy";

2) Initial time (TI), represents the time at which the reservation begins

3) Parking time (TP) or stationary time. Reservations can be made for at least one hour and only a number of hours (hours are not divisible). If the driver leaves the parking lot early, it will be charged for the entire period that the reservation was made. [3]. This total data will be sent to the client computer through internet and that computer will check whether there parking slot is available or not, If slot is available then that slot number will be sent to the respective account from where reservation will be made with one time password. Which password will be used at the time of parking in the parking area.

2.2 Number plate recognition

The main and the most important portion of this system is the software model. The software model use series of image processing techniques which are implemented in MATLAB 7.0.1. The automatic number plate recognition (ANPR) algorithm is broadly divided into three parts:

1. Capture image
2. Extract the plate from the image
3. Recognize the numbers from the extracted plate

The first step is the capturing of an image using the USB camera connected to the PC. The images are captured in RGB format so it can be further process for the number plate extraction.

The second step of the ANPR algorithm is the extraction of the number plate in an image. A yellow / white search algorithm is used to extract the likelihood ROI in an image. As the official number plate of Sindh has yellow background with alphanumeric character written in black,

it is easy to detect the plate area by searching for yellow pixels. The image is search for the yellow color pixels or some which are closer to yellow in value. If pixel value is of yellow color the pixel is set to 1, otherwise the pixel value is set to 0. The image obtained after the search algorithm is in black and white format. After identify the ROI, image is then filtered using two different filtering techniques. The first technique involves removing of all white patches that are connected to any border and set their pixel value to 0.

The second filtering technique use pixel count method to remove the small regions in an image other than the plate region. The number of consecutive white pixels is inspected and regions that contain number of white pixels less than the predefined threshold are set to 0. At this stage the image contains only the vehicle number plate. Smearing algorithm [7] is used next to extract the number plate in an image. The smearing algorithm is search for the first and last white pixels starting from top left corner of an image. The image is then cropped that only contain the vehicle number plate.

The third step of the developed ANRP algorithm uses Optical Character Recognition (OCR) algorithm to recognize the vehicle number. The resultant cropped image obtained after the second step is inverted i.e. all white pixels are converted to black and black pixels to white. Now the text is in white and the plate background is black. Before applying the OCR the individual lines in the text are separated using line separation process. The line separation adds the each pixels value in a row. If the resultant sum of row is zero that means no text pixel is present in a row and if the resultant sum of row is greater than zero that means the text is present in row. The first resultant sum greater than zero represents the start of the line and after this the first resultant sum equal to zero represents the end of the line. The start and end values of the line is used to crop the first line in the text. The same process continues to separate the second line in the text. Once the lines in an extracted vehicle number plate are separated, the line separation process is now applied column wise so that individual character can be separated. The separated individual characters are then stored in separate variables. The OCR is now used to compare the each individual character against the complete alphanumeric database. The OCR actually uses correlation method to match individual character and finally the number is identified and stored in string format in a variable. The string is then compared with the stored

database for the vehicle authorization. The resultant signals are given according to the result of comparison. The complete detail of the software model is shown in figure 1. From this camera will capture the image of car from the front side. and number will be recognized from that and displayed on the LCD board.[5]

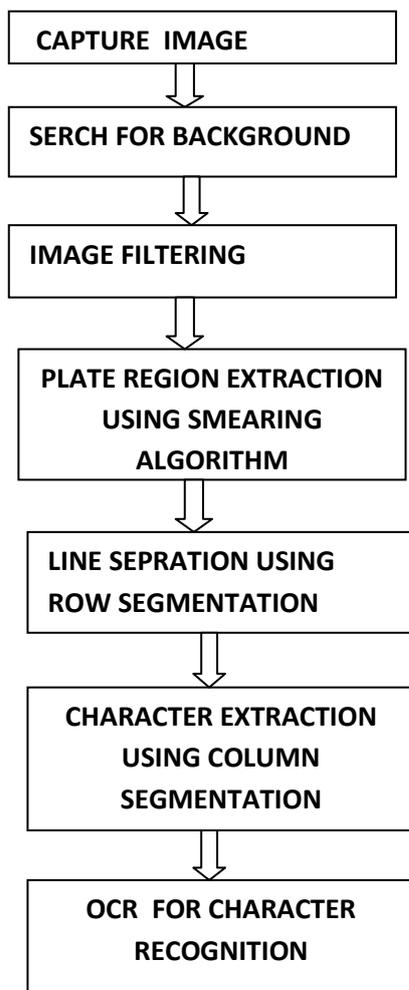


Fig 1. Steps for number plate recognition

2.3 PARKING AREA

At the parking area when vehicle will entered in the parking area then it will be sensed by the sensor after number plate recognition system will check for the is reservation is already done or not if not then simply shows message that “invalid reservation number” and if number will get match then ask to user to enter password given at the time of reservation . if that matches then open the gate and allow vehicle to park at the given slot.

Parking area is divided into two module:

1. Entering Module
2. Exiting Module

2.3.1 Entering Module

In Entering Module, as the car enters the lot, it is detected by the IR Sensors. The IR Sensors provide the pulse to the FPGA which assumes that an input is detected and thus the vehicle is entered into the parking lot. Now as the car enters the lot, the car is directed to park in the slot which is allotted. This is an important feature because the user doesn't need to search for the empty slot rather it is directed to park in the allotted slot number. Thus our parking system's approach is to provide ease to the users[2].

2.3.2 Exiting Module

In Exiting Module, as the vehicle leaves the lot, it is detected by the IR Sensors. The IR Sensors provide the pulse to the FPGA which assumes that an input is detected and thus the car is exited out of the parking lot. A significant task here is to keep track of the slot number from which the car leaves. This slot number should be tracked so that at exit we can display the right invoice [2]. Here at the exit system again ask for the enter password if the password is correct it will note the current time and from that it will give invoice from the time utilized by that car in the parking area after payment simply open the gate and allow user to go .

3. BLOCK DIAGRAM FOR PROPOSED SYSTEM

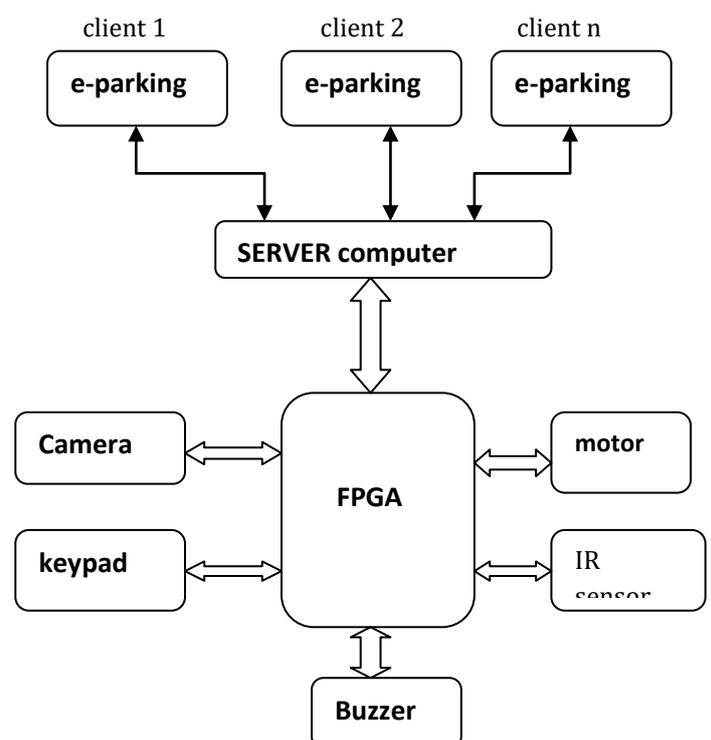


Fig2. Overview of proposed system

In the proposed system we will be based as shown in the fig 2 .server 1 , server2 to server n will be the n numbers of server which will be control from one client computer . which is at the parking side . Here we will use FPGA for all processing part which is TKB3S of daughter board XC3S200. A reconfigurable FPGA is efficient method to implement a design, because FPGA provides a compromise between general-purpose processors and ASIC. The FPGA based design is also more flexible, programmable and can be re-programmed. FPGA based design can easily be modified by modifying design's software part

4. CONCLUSION:

Our approach for finding the free parking slots is simpler The optimal management of parking services is made up of two complex sub-systems: hardware and software. We have used IR sensors for the detection of car's arrival and for the car's departure avoiding the expensive wireless sensors. From the user point of view, the application significantly reduces the search time of a parking . This leads to improved quality of life on the road, reduced urban congestion and pollutant emissions released into the atmosphere. On the other hand, the software application can easily be integrated into a complex management System for all the parking's in a city or region. The idea was to keep it simple and innovative so that the parking system is cheap and at the same time provides the functionalities as per the constraints set at the time of designing.

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