

Modified Number Plate Localization Algorithm and its Implementation Using FPGA

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Abstract-This paper represents implementation of number plate localization for automatic toll collection using FPGA. Number plate localization plays a key role in various applications. Number of techniques has been proposed for number plate localization. Number plate recognition is the process of extraction of any vehicle number plate information from an image which is taken from a video. Since it is easier and faster than the normal token based ticket system, it has all the capability to interchange the usual system. Hence it avoids the user to wait in long queue on the counter of toll. It saves the valuable time of the users. It accustomed pay the bill automatically and does the opening and closing of the gate automatically. A detection device is placed at the gate which reads the information from the coming moving vehicle and compares it with stored database. After that it gives permission to access consequently to move through the gate. This information is used to print a daily or monthly basis bill for toll collection from the vehicles. This system has low complexity and it takes less time to localise and recognise the characters on number plate. This system helps to assist RTO, local department to trace the vehicle, if it was actually stolen or used for any illegal activities. In this paper, FPGA implementation is done using VHDL language.

Index Terms: Number plate localisation, character segmentation, character recognition, binarization.

1 INTRODUCTION

Number plate localisation systems are used for various applications such as track the vehicle if it is stolen, unbilled parking heaps, access control, and toll collection and identify the vehicle which is used in illegal activities.

Number plate recognition techniques vary from application to application. The cameras mounted on toll or anywhere, capture an image as they move. This image could have contained different number plates or no number plate. After detecting the plate from an image, number plate has different characteristics such as various sizes and shapes of characters, orientations & positions.

In first stage of process position of number plate present on vehicle is determined by adjusting the resolution, height & width of the image using MATLAB. Character segmentation is used to extract number plate. There are number of segmentation techniques, from which many of the techniques uses binarization. After that character recognition is done by comparing the types of characters which are various in sizes and shapes stored in database.

In this paper, the algorithm proposed is

applicable for FPGA implementation using VHDL. A MATLAB implementation used in this algorithm is as proof of idea prior to hardware implementation.

2 PROPOSED TECHNIQUE

2.1 Number plate recognition

In many of the plate detection algorithms has more than class which supports different techniques. To identify the variety of plates. Below points should be considered.

1) Size of plate: Plate can be of any size depending on the choice of the user.

2) Location of plate on vehicle: Plate can be placed at any place which varies on the type of vehicle.

3) Background of the plate: colour of the plate can vary. In India 3 types of coloured plates are used.

A) White Background: white background with black letters used only for private use. It can't be used for commercial purpose.

B) Black: These vehicles have black plate with yellow letters can be used for any commercial use without limitations of driver having to have commercial driving license.

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C) Yellow: Yellow plate with black letters used for any commercial purpose. Driver should have commercial driving license.

There are number of techniques used for segmenting the image. In most of the techniques binarization is utilized. In following section plate recognition is explained.

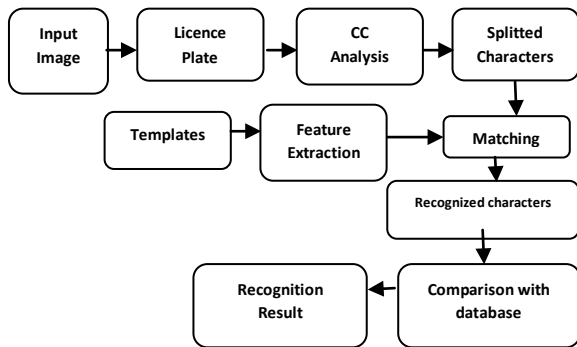


Fig 1 Number Plate Recognition

Above system involves following steps:

- 1)Input Image 2) Binarized gray scale image
- 3)Locating plate 4)Black and white filling in image
- 5) Denoising 6) Character segmentation
- 7)Character recognition.

First input image is converted from RGB to gray using `rgb2gray()` function and gray value is calculated using $gray(i,j) = 0.59 * R(i,j) + 0.30 * G(i,j) + 0.11 * B(i,j)$.



Fig2 Input Images

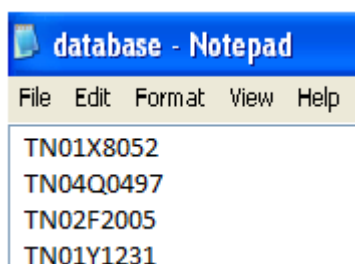


Fig 3.Database Image

Exact location of plate can be determined by size of plate. To achieve these values of number of bands of rows and columns has to be calculated with plate's properties such as height & width. To do so `[r c p]=size()` function is used. So that we can find exact location of the plate.

Binarization is done by converting a gray image into black & white. This by choosing certain threshold value to classify some pixels as black & white. After binarization to fill complete black & white colour in an image `bwfill` function is used.

After filling black & white colour into an image denoising process is carried out using median filter. Median filtering is applied for both rows & columns values so that we can get denoised image.

Character segmentation includes MATLAB function named as `regionprops()` which measures set of properties of image region boundingbox is used. At the end after labelling the components, region will be extracted from input image.

After segmenting characters & numbers, the final process is recognition of characters. This can be done by matching or comparing the extracted characters or elements with stored database numbers and finally exact characters are carried out.

The proposed system makes sure that the load of traffic at toll is handy & security is good. The toll tax is collected depend. On the carried load of the vehicle. Readings taken from the information of vehicle's plate recognition system, computer system compares the information with database & gives permission to access by opening or closing the gate. This information is used to print daily or monthly bill for toll from vehicles.

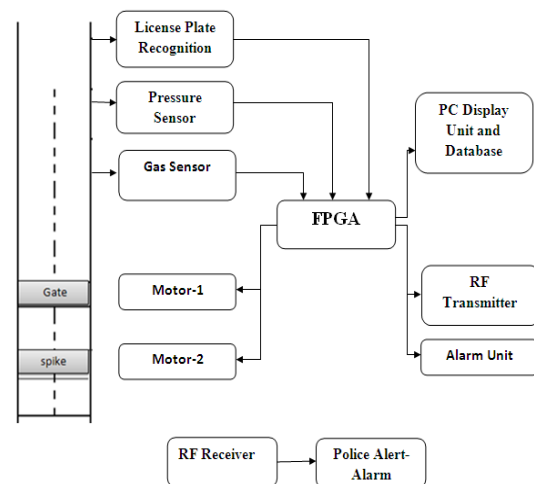


Fig.4 Block Diagram for Toll Gate System

2.2 Pressure Sensor

To count number of vehicles passed by the gate, pressure sensing element is used. These counted numbers are displayed on screen. This pressure sensing element also measures the weight of vehicles, depend on weight measured, predefined amount i.e. tax will be taken. This is also displayed on screen. For this purpose we are using piezo pressure sensor.



Fig5 Piezo electric sensor

The amount to be paid is deducted from user's checking account. These sensors are used to measure the electric effect caused by applying force to piezoelectric material. It converts energy into mechanical & electrical energy forms. These sensors are used to measure pressure, acceleration, strain or force.

2.3 Gas Sensor

Gas sensing element is used when a vehicle carries any flammable gas that shouldn't be carried. If flammable gas is detected, RF transmitter is used to alert nearby police station associated. Buzzer is activated to alert nearby area. After ringing the buzzer, motor 1 is used to shut down the gate & simultaneously motor 2 opens up spikes to puncture that vehicle.



Fig6 Gas Sensor (type-MQ2)

To sense flammable gas or any kind of smoke present at the vehicle. Gas sensor MQ2 is used. It is analog type of sensor. This sensor detects pressure of smoke & sends an analog image to FPGA. It is also used as gas leakage detecting device. It detects H₂, LPG, Alcohol, smoke or propane. It is high sensitive & fast so smoke detection is done as soon as possible.

2.4 Wireless Communication Module using RF transmitter & receiver.

If any sensor detects any illegal gas or any kind of dangerous gas illegally, the buzzer gets activated & alert signal is sent to nearby police station through RF transmitter through antenna & then this police station will receive this alert signal via RF receiver through antenna. This is done by RF communication strategy as shown in fig.

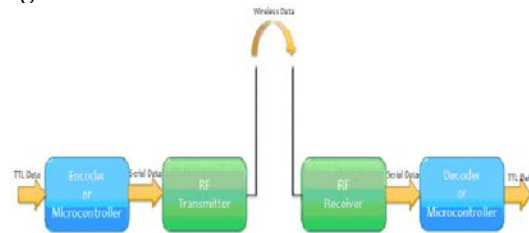


Fig7 RF communication block diagram

RF transmitter & buzzer is connected to FPGA which takes corresponding decisions. Most of RF communication modules are TTL compatible & input can be given in TTL level logic. This TTL input is converted into serial data input & read by RF transmitter transmit through antenna at receiver end, it receives modulated signal & performs processing, filtering, demodulation & give serial data out. This output is converted back to TTL logic level which is same as input signal. After that action will be taken accordingly.

3. RESULTS

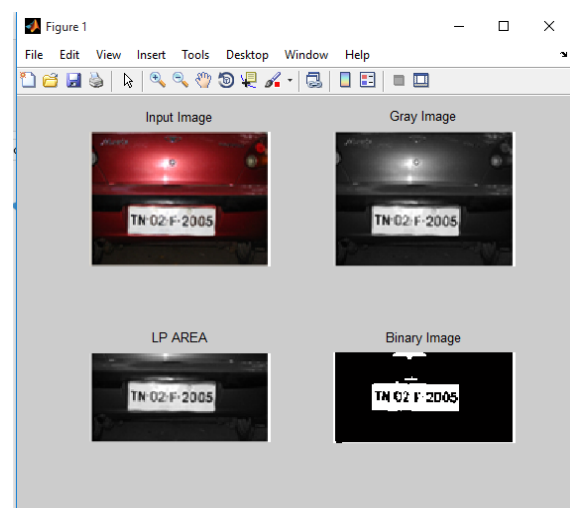


Fig8 Input image is converted into Gray & Binary Image

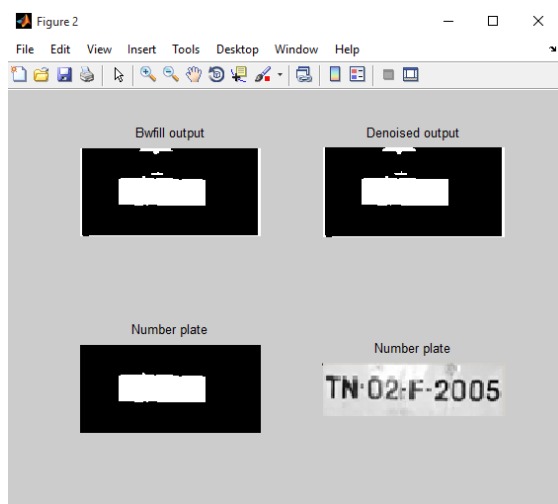


Fig 9 Denoised Number Plate



Fig10 Before Segmentation Number Plate



Fig11 After Segmentation Number Plate



Fig12 After Matching

4 CONCLUSION

Main aim of this system is to recognize the images of number plates. This system is implemented to provide exact identity of vehicles, captured images from camera. This system has been concentrated to detect lightning variations, dim headlights, obscuration's of vehicles. This system also helps in collecting toll tax of the user. The next step involves increasing protection from illegal activities happening nowadays on road every day.

5 FUTURE WORK

In future, this system will be concerned about to focusing on different styles of plate recognition. Video based high definition number plate image process, multi-plates process. The important points were planned to detect different varieties of alphanumeric characters, rotational angle & character formats.

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