License Plate Recognition Technique (LPRT) in Smart LED Street Lighting

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Abstract

License plate recognition (LPRT) in Smart Street is one of the most important technique in our daily life due its highly security and economic efficiency system. This system is plays a vital role in security applications which include road traffic monitoring, street activity monitoring, identification of potential threats, and so on. Beside to the integrates system technologies which is to control energy efficient of the LED street lights to turn on only when needed and to remain in a dim state otherwise.

Paper targets is to detect and recognize license plates from image in a real time. This will help to identify and register vehicles and provide the reference for further vehicle tracking and activity analysis. license plate detection approach has two major steps. First, extract a certain features which encode by the image. Second, develop a matching network that decide wither the car should be pass or not. Another key requirement for the network is to have low set up and maintenance costs by using a smart LED street lighting which is a direct objective of this project.

This project mainly introduced by using IR sensors for turning the light on & off. Morphological operations, Edge detection techniques and numbers segmentation have been used for plate localization characters. This characters and numbers was extract and match with a stored data base in the recognition process. Experiment results was accomplished and reviewed using Matlab program, Arduino microprocessor and their connections tools.

Keyword: Car license recognition, Smart Street, IR sensor, Arduino, Servo motor, Arduino- Matalb tools optoelectronics.

1. Introduction

The use of car plate recognition can solved everyday problems, such as security, parking control, airport or harbor cargo control, road traffic control, speed control and so on. A number of commercial software is developed in this area. [1] However the license plate recognition is a very interesting but difficult one. It's recognition requires some complex tasks, such as license plate detection, segmentation and recognition. These tasks become more sophisticated when dealing with plate images taken in various inclined angles or plate images with noise. Because this problem is usually used in real-time systems, it requires not only accuracy but also fast processing. [2]

The use of image processing approach can solve these problems which its allows to remove these drawbacks by ensemble of two methods: (i) detection and extraction of image region included license plate from source images flow and (ii) recognition of character presented on the license plate. Once a license plate has been accurately identified, information about the vehicle can be obtained from various databases. Should the information suggest that there is anything suspicious about the vehicle, appropriate actions can be taken.[1]

In this paper Image processing techniques such as edge detection, thresholding and resampling have been used to locate and isolate the license plate and the characters. the recognitions in this paper depend on the following steps:

(i)Capture the car's images,
(ii) to extract image of license plate,
(iii) extract characters from license plate image,

(iv) recognize license plate characters and identify the vehicle.
Furthermore this paper is design aim to reduce the overall costs of street lighting by integrating dimmable light-emitting diodes (LEDs) and wireless technology. The principle of operation is to efficiently control the intensity of the streetlights to respond to the needs of road users.

2. Methodology

2.1 Smart LED Street lightening

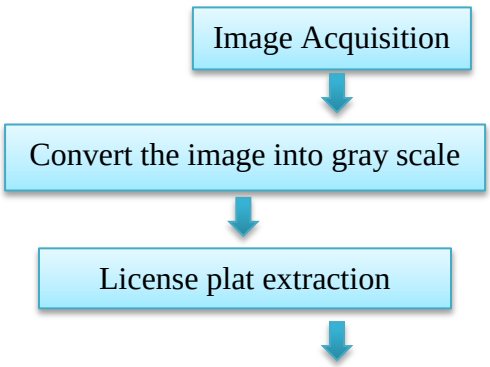
Conventional street lighting systems use constant illumination lighting which leads to high energy consumption accounting for up to 60% of a municipal government's total electricity expenditure. Furthermore, forecasts show that the energy spending for street lights is likely to increase over the next few years as the demand and price for electricity increase [3]. In this paper IR sensor was used for sensing the passing car for lighting the required region of the road that the car pass on. This technique has become increasingly important to develop a radically new system that is both environmentally friendly and cost effective.

2.2 License-Plate-Recognition Technique(LPRT)

In this technique Matlab program provides all image processing function and toolbox. MATLAB have large library functions and set of tools, which it provides advanced algorithm for high numerical computation. And the ability to define user define functions and large collection of mathematical functions[4].
This paper is carried over a number of car plats number expert ,a typical example of an Arizona license plate (for car) that we used as a recognize plate, shown in the figure 1.

Figure 1. Format of Arizona Car License plate

The steps for recognizing this number plate was as shown in the flowchart figure (2). Step by step process is followed for pre-processing of image.



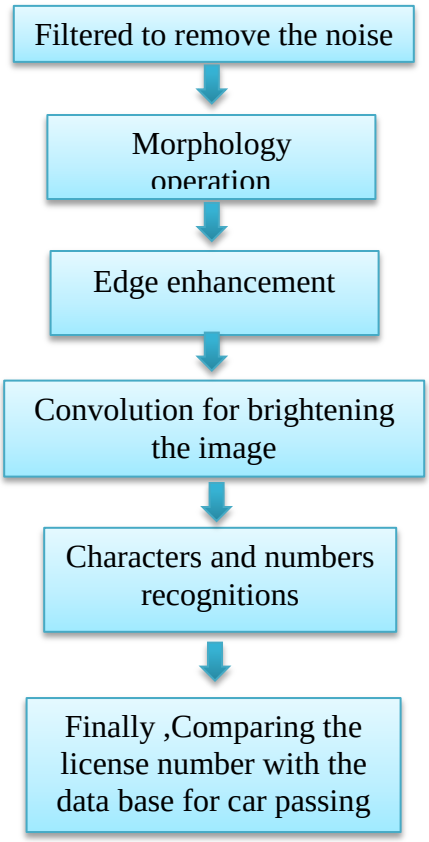


Figure (2): system flowchart

After image Acquisition or capturing by a digital camera. The image was cropped, convert in to a gray scale and filtered with median filter for noise removal. And for image filtering a median filter has been used which is a non-linear filtering technique used to remove noise from image under consideration. While it helps in removing the impulse noise it preserves the edges. As the impulse noise spikes are much brighter than their neighboring pixels, they are generally placed in the extreme top or bottom end of the brightness ranking while analyzing the neighborhood of input pixels[5].

For solved the problem of the preserving the edges a mathematical Morphology processing has been used which is a set-theoretic method for analyzing the image and extracting image components [6]. The following steps operations has been used to have the final result shown in figure (7):

- Dilation process was used to add pixels to the boundaries of objects in an image depend on the equation (1). The process may be repeated to create larger effects. The size and shape of the structuring element decides the number of elements to be added to the image under processing[6]. The Dilation of A by B translation of vector r [7].

$$(A \oplus B)(a) = \max\{A(r) \mid a - r \in B\} \ldots (1)$$

Where A is a set of function , B is the basic image and a is a scalar value.

- Erosion process which is works the same way except that it will cause objects to decrease as shown in equation (2). That is it removes pixels from the boundaries of objects in an image. The size and shape of the structuring element decides the number of elements to be removed from the image under processing[6]. The Erosion of A by B translation of vector r [7].

$$(A \ominus B)(a) = \min\{A(r) \mid r - a \in B\} .. (2)$$

Since texts are normally aligned in the horizontal direction a 2x4 rectangular structuring element was used. All Connected Components are then extracted.

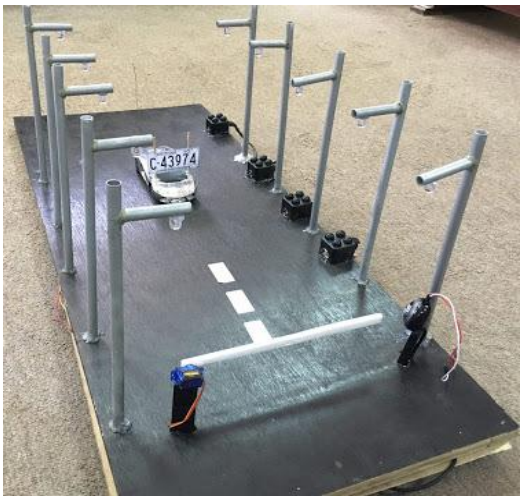
3. Design and Consideration

Several experiments have been a complied using the design shown in figure (3) , which it consist of LED light, IR sensors shown in figure (4) for ensuring that the lights only brighten when car is pass, web cam for capturing the license picture, Arduino microprocessor which was act as the processing unit, It will have the following functions:

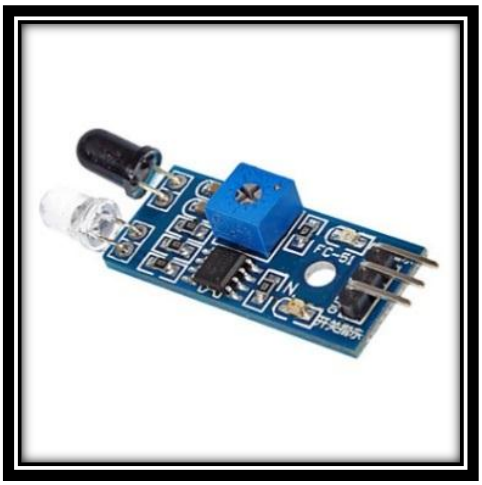
a. Process Data: It must process the data received from the sensor.

b. Control Output: This output controls the intensity of the light according to the results of data processing.

c. Communication with wireless interface: It must be able to receive and send control signals through the network. And servo motor for opening the door, and laptop to process the captured imaged by Matlab program.



Figure(3): System design



Figure(4): IR sensor

3.1 Smart LED Street lightening

This design consists of three main parts which are: IR sensors circuits, wireless communication and power control for the LEDs. In our design, we have included components with desirable features such as low cost, low power consumption and long lifespan. Using appropriate design techniques, we have integrated these components in a system that is reliable, fault tolerant and cost effective. The system was controlled the light lightening in the street using Arduino microprocessor by the following steps:

- When car pass on the smart street near one light, one of the IR circuit will be cut off.
- The sensor will send a control signal to the microcontroller.
- The microcontroller will process and forward this to the output the PWM signal for the LED driver to turn it on.
- The Power Circuit of the microprocessor provides the necessary voltage levels needed to power the modules and the rectifier converts the AC mains voltage to a DC voltage which will be used to power the LED driver.
- When the car is pass the light will turn off again because of the signal that received from the microprocessor and the IR sensor.

3.2 License-Plate-Recognition Technique (LPRT)

For recognizing car plate and controlling car traffic, following steps has been made:

- The last IR sensor was not only connect to LED light but also to a web cam to capture an image for the car plate, as shown in figure(5).

Figure (5): Webcam image

- This image will be analysis by MATLAB program, which it first will be crop and filtered by using Sobel mask filtered, as shown in figure (6)

Figure (6): the image after cropped and filtered

- Then a mathematical Morphology processing has been used analyzing the image, as shown in figure (7)

Figure (7): the image after morphology operations

- Characters and numbers recognitions and extraction for comparing with the saving data base, as shown in figure (8)

Figure (8): Characters and numbers recognitions

- Finally, if the car number is recognized, the MATLAB program will sent a signal to the Arduino using spatial MATLAB-Arduino tools, the Arduino will sent a signal to the servo motor for open the gate, otherwise the car was cannot pass on the controlled way.

4. Results And Conclusion

The experimental results, on 5 images taken with the help of 10mega pixels digital camera and MATLAB R2014a software, shows that:

- About 90% of the number plates were localized correctly and 10% images resulted in the localization of number plates along with unwanted non candidate regions, because of the damage in the number plates.
- Except for the unwanted regions, the algorithm works robust under different illumination and brightness.

5. Conclusion

This article proposes a text localization and extraction technique from vehicle number plates. The suggested method was tested with different weather and illumination, brightness conditions. Differentiation of characters from numbers had been done in our project. Some characters and numbers have similar shape and it becomes difficult to compare with template . In our project stolen cars can be identified by an array in database of Matlab. We have tested 5 number plates of different vehicles positions. Success rate of our project is about 70%.

Moreover this paper shows favorable options for saving the national economy ,by using Light Dimming with the wireless technology, in order to activate the street lighting in the required area only when car cutting the IR circuit.

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