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Smart License Plate Recognition Using Optical Character Recognition Based on the Multicopter

Sanjaa Bold
Department of Computer Hardware and Networking
University of the humanities
Ulaanbaatar, Mongolia
Snj_goopy@yahoo.com

Batchimeg Sosorbaram
Department of Computer Hardware and Networking
University of the humanities
Ulaanbaatar, Mongolia
Snj_goopy@yahoo.com

***Abstract*—**In recent years Unmanned Aerial Vehicle (UAV) is major focused of active research, since they can extend our capabilities in a variety of areas, especially for application like research detection, tracking and recognition. For our project goals is vehicle tracking and plate recognition. In addition, we have to combine some intelligence algorithms. In this project to define the number and type of vehicles, using our nation's roadways is becoming more and more important. This project used for Multicopter. The multicopter to flying around of the roadway. Because it is to collect roadway's data. That means, to send a picture of a vehicle violating the law. Then our algorithm is recognizing to the number plate. In addition, this algorithm saving the vehicle number plate. We are great database in this algorithm.

In this paper, template matching algorithm for character recognition is used. The developed system first detects the vehicle and capture the image. Then vehicle number plate region is extracted using the image segmentation in an image. Character recognition algorithm working on the OCR algorithm. We are detection accuracy to increase by using some algorithms. We combined these different algorithms using a modified version of PCA and OCR recognizer, we designed the proposed an architecture using OpenCV and we used to implement the design in the Multicopter.

Keywords*-*Automatic Number Plate Recognition (ANPR), Optical Character Recognition (OCR), OpenCV, VisualStudio 2015, Multicopter, HD camera.

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I. INTRODUCTION

This project was talked about vehicle plate number recognition system. That means, we are improving some tracking and recognition system. These vehicle plate number recognition system was combined some different recognition and detection algorithms. Those systems allow recognize the number of the vehicle, classification of the vehicle. It is based on computer vision on license plate for a specific target, special of the important research session of the computer vision and pattern recognition technology in the field of intelligence transportation application [1]. In this recognition, system can be used in highway monitoring, bridges, some tunnels, city transport vehicle management also intelligent parking system and other fields.

In this system work based on two main algorithms and using the four steps. First step multicopter capture image to the vehicle and it was sent to the image, (2) number plate detection (3) OCR algorithm is working on computer (4) looking at the result from the computer. So the first step to capture images of vehicle looks very easy, but it is a quite exigent task as it is very difficult to capture an image of moving vehicle in real time in such an unmannered that none of the component of the vehicle especially the vehicle number plate should be missed. The success of final steps depends on how before steps are able to locate the vehicle number plate and separate each character. [2]

The implementation of the system for license plate recognition must consider regulations for license plate design in Mongolia. We have to need fonts in Mongolia. See the below Fig 1.1. In this figure upper strip represents the vehicle's plate origin and the pattern of 3 letters, 4 numbers, and 2 logo represent the vehicle identification.

Figure 1.1. The Mongolian fonts

In this paper, we introduce some of different algorithms. These plate detection systems follow different algorithms to

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locate vehicle number plate from the vehicle and then to extract vehicle number from that image. See fig 1.2.

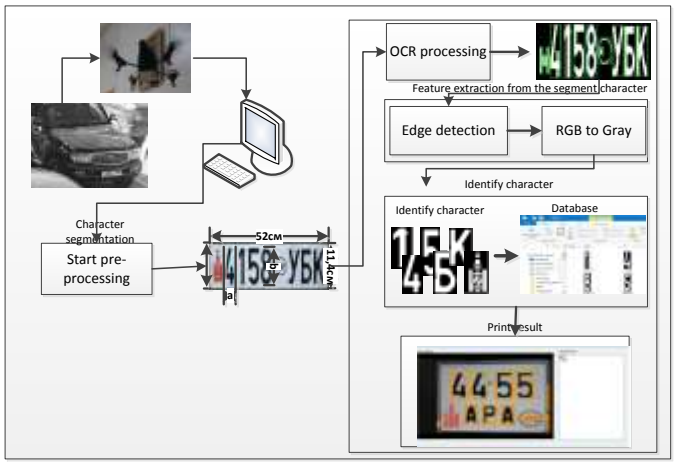

Figure 1.2. The general algorithm of the Vehilce number plate recognition

This vehicle plate recognition system is based on some algorithms like Automatic Plate Number Recognition (APNR), Vehicle Plate Number Recognition (VPNR), Optical Character Recognition (OCR), Principal Component Analysis (PCA), Edge detection algorithm, color segmentation, scale invariant feature transform. All of the detect steps depends on image quality. In addition, we are improving image quality. Each component and algorithms are explained inthe next section.[3]

In this project using multicopter. Because multicopter to fly around on the highway, then it will check on road stuff, accident and detect in vehicle plate number. The capture all of the images from the multicopter and our algorithm image extracting based on OCR. We are includinga high definition camera on the multicopter. In this recognition and detection algorithm can be controlled to the drone.

II. NUMBER PLATE RECOGNITION AND CHARACTER RECOGNITION

A. Optical character recognition.

Character recognition in vehicle license plate detection and recognition is reading of the single character and numbers. This step is very important. The single elements on license plate must be segmented and analyzed. The analysis is called as Optical Character recognition using artificial neural network. [5] The character recognition of the number plate is fairly well developed field in computer vision in which matching and neural network are often used and can produce satisfactory results. The template matching has its drawbacks in some aspects comparing with neural networks.

This algorithm for a vehicle plate number based on optical character recognition. In this algorithm, the first step is capturing the image approximately about 3meter, 4 meter and 5 meters from the number plate with a camera. This camera included on the muticopter. All of the images from the multicopter come to recognition algorithm. The purpose is to get a clear image distortion. The next step is cropping the vehicle plate number of captured images. The cropped image is the input to the character recognition. Also next step is character recognition. Then OCR technique is used to recognize an optically processed printed character number plate that is based on template matching. The OCR algorithms in an extracted plate number separate section. The separate individual character is then stored in separate variables.[6] The OCR used to compare the each individual character against the complete database.[5] See the fig 2.1.

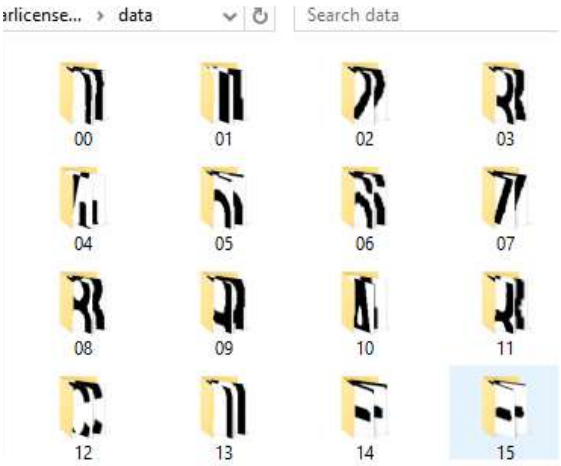

Fig 2.1. All template database.

The OCR actually uses correlation method to match individual character and finally the number is identified hand stored in string format variable. The string is then compared with the stored database for the vehicle authorization. Algorithm of the software model.

B. Algorithm of the Number Plate recognition.

Character recognition was great to some converting process. That means, we are talking about converting process of the Grayscale and binary image. Actually the gray color is one in which the green, blue and red components all have equal intensity in RGB. (A component of the Red, Green and Blue) It carries only intensity information for each pixel. See the fig 2.2.

Figure 2.2. The inverting RGB to binary image.

Binary image is digital image whose pixels have only two possible values. This value is black and white. After we are called 1 (white) and 0 (black).[6] Now we convert to the grayscale image to a binary image. The output image replaces

all pixels in the input image with luminance greater that a threshold value with the white and all pixels with the black. Also, we used the function to compute the threshold value argument.

In image to optimize the image, we should apply some morphological operators to the binary image. This is a very difficult task. Because there are, no efficient ways to find objects based on the intensity values of the pixels. However, if recognize the object different features, we cloud uses the information about the shape of the object. The shape recognition is not based on the intensities, but preformed on binary images. Also, simply to change gray to binary image. For a binary image, there are four fundamental operators, dilation, erosion, opening and closing**.**

C. Segmentation the characters out from the plate number

First, weintroduce plate recognition in the computer application. This application is working on the visual studio. Now see the figure 3.1. We compute a function to segment the character. Now we are talking about how to implement the algorithm of character segmentation Mongolian plate number. See fig 2.3.

Figure 2.3. Segmentation the character select form the Mongolian plate number

We improve this binary image as a matrix. First, we calculate this matrix oppositely. We use the same function which is to return the row vector of the sums of each column. We should research matrix along the horizontal direction by loop. [7] also we are creating the limited condition. The condition is limited when the sum of some column is less than 1 and the sum of the next column is greater than 1, then I will be segmented from the column before. This process dependent to the Mongolian plate platform. It need segments 9 blocks in total. In the processing of segmentation, we set a counter to calculate how much segmentation the programming need to segment. See fig 2.4.

Figure2.4. The blocks in Mongolian plate number platform

D. Character segmentation module.

The character template should be used in the first operation of the characters matching. The way used is to cut out the related character of the license plate. See the template fig 2.5.

Fig 2.5. the cropped character of the license plate

Before start beginning of model matching, the sizes of the original plates image and template image shoul be adjusted to obtain same size. That is sould be judged if the black point is in same position between original plate image and the templates. We need to calculate the similarity rate of those two images according to the equation of similarity function. [5]Seeeq .(1)

$$S(i,j) = \sum_{m=1}^{M}\sum_{n=1}^{N} f_{ij}^{2}(m,n) - 2m{=}1Mn{=}1Nfijm,ntm,n{+}m{=}1Mn{=}1Nfij2m,n\ldots \quad (1)$$

The similarity value S is calculate each time to figure out the maximum value of the S as similarity function. To find out the templates which are corresponding to the maximum of S one by one. The value of S in this template is filtered whether large that the threshold T (Threshold Value). If S is large than T, the matching is successful and this templates character is the characters plate. If S is smaller than T, the matching is not successful and we are repeat to this processing.[5][6][7]

III. EXPERIMENT RESULT

A. Interface of the plate recognition system

In this section, we present the programming interface of the vehicle plate recognition testing system. See the fig 3.1.

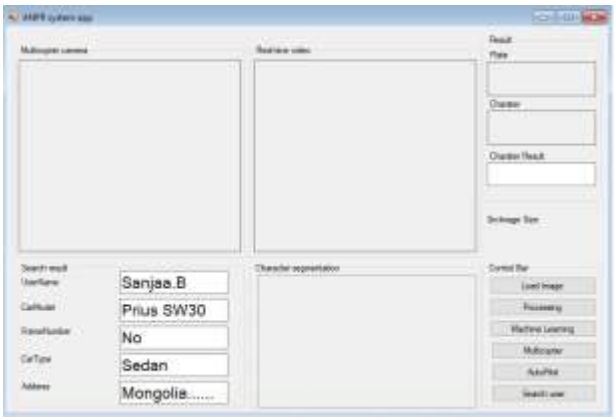

Figure 3.1. Vehicle number plate recognition on the Visual studion form.

Firstly, the camera is interfaced using Visual Studio and multicopter and PC. The multicopter camera sent to all of the video in real time. The camera connected using wireless port. The real time video received on the plate recognition algorithm. At this time, we capture the any images. Different images of cars having different colors and structure types are taken and stored in the image database. The images are in RGB format and the resolution is 1280x720 pixels. Some of the process, we are explain before section.

The algorithm used next to extract the vehicle number plate. However, this image chooses from the database. The vehicle number plate is extracted, it is converted into the binary format. The fig 3.2. and fig 3.3.shows the binary and the inverted format respectively.

Figure3.2. Binary images

Figure3.3. The inverted binary images

The Individual characters on the plate recognition segments. The result of the segmentation isshow below picture. See fig 3.4.

Figure 3.4. The vehicle number plate segmentation

The plate number recognition and detection systems, statistical result of our testing. The some of the result is low. Because this recognition and detection system is depend to the Mongolian fonts.

Experiment conditions	Total images	Success	Error	Accuracy
Matching of character	200	185	15	92.5%
License plate location	200	183	17	91.5%
Recognition and detection result	200	184	16	92%

Table .1. The statistical result of the plate number.

Automatic plate number recognition and detection process depend on the distance. Let me show the testing result.

Experiment conditions	3m	4m	5m
Distance between multicopter camera and vehicle (4 meter)	99 %	97.5 %	94. 5%

Table .2. The recognition and detection result of the distance

Now we are talking about another situation. How plate recognition and detection system depends on the weather. This distance is 5 meters. Show the table 3.

Experiment conditions	Foggy	Snowy	Sunny
Detected accuracy	68 %	72,3 %	94. 5%

Table .3. The recognition system result on the weather

IV. CONCLUSIONS

In this project focuses to detect Mongolian plate number. The developed automatic number plate recognition algorithms successfully detect the Mongolian standard vehicle number plate in various day condition and show the higher detection and recognition rate. It can recognize vehicle number plate from many distances and angles. The vehicle number plate recognition algorithm using OCR algorithms. In addition, we are included OCR Mongolian font's template on this algorithm. The algorithm uses image processing and identifying the vehicle number plate from the database stored on this PC. This plate number recognition is implemented in Visual Studio 2015 and its performance is testedin real time. The detection result show that tables.

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