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Automatic License Plate Recognition Using OpenCV and Neural Network

Sweta Kumari,   Leeza Gupta, Prena Gupta
Department of Computer Science and Engineering
Dr. A.P.J Abdul Kalam Technical University, Lucknow
Uttar Pradesh – India

ABSTRACT

Automatic license plate recognition is a Computer Vision technique which is able to recognize a license plate number. This system is useful in many field likes parking lots, private and public entrances, theft control. In this paper we designed such a system. First we capture the image from camera then load into system after that we used OpenCV library tools. Then we make the training set of different characters of different sizes. On the basis of these training set we extracted the character from images. When the license plate is detected, its digits are recognized and displayed in the GUI. In this mainly focuses on Neural Network and proprietary tools OpenCV in which ALPR systems implementing using Free Software Open Computer Vision Library including Java.

Keywords:- License plate, Computer Vision, Neural Network, Java

I.   INTRODUCTION

Automatic License Plate Recognition (ALPR) is a computer vision technology to extract the license number of vehicles from images. It is an embedded system which has numerous applications and challenges. One of the notable contributions of the open source community to the scientific world is Java. Intel's researches in Computer Vision bore the fruit called Open Computer Vision (OpenCV) library, which can support computer vision development.

II.   PROPOSED SYSTEM

In India, basically there are two kinds of license plates, black characters in white plate and black characters in yellow plate. The block diagram of the proposed system is shown in Fig. 1.
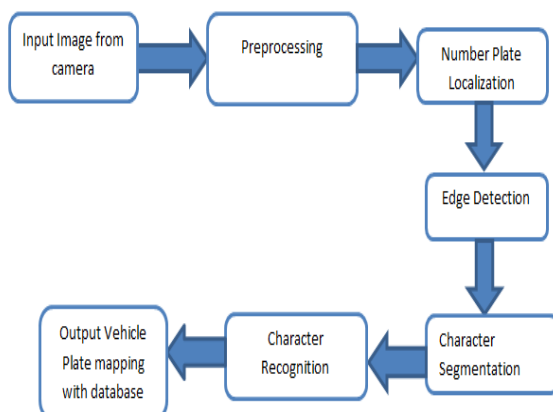

Fig.1. Proposed System

1.   Capture

The given image of the vehicle is captured by camera which is high resolution quality. We save this image in the system.

Fig.2. Captured Image (Original image)

2.   Pre-processing

Pre-processing is the technique in which background illumination conditions and the number plate localization algorithms is used. In this phase mainly focuses on reduce background noise, enhancing of contrast. The system preprocessing uses two processes: **Resize** – In this section we have to change the size of object according to requirement. **Convert Color Space** – Images captured by cameras will be either in raw format or encoded into some multimedia standards. These images will be in RGB mode basically i.e. red, green and blue. There should be using OpenCV function in pre-processing phase.

Fig.3. Localization (Threshold image)

3. Number Plate Localization

The number plate localization is the phase in which mainly focuses on ROI (Region of Interest) where we find the contour region.

3.1 Contour Tracing

Contours can be explained simply as a   curve joining all the continuous points (along the boundary), having same color or intensity. The contours are a useful tool for shape analysis and object detection and recognition. Here we use contours in rectangle shape.

Fig. 4. Contour Image

- Since For better accuracy, use binary images. So before finding contours, apply threshold.
- In OpenCV, finding contours is like finding white object from black background.

4. Edge Detection

The edge detection helps us to detect the edges present in an image.

4.1 Morphological Operations

Morphological operations apply on a structuring element to an input image and generate an output image. This is the Non-linear filters, with the function of restraining noises, extracting features and segmenting images etc.

4.2 Identifying the License Plate

To identify the region containing the license plate, two features are defined

1. **Aspect ratio**
2. **Edge Density**

Aspect ratio

The aspect ratio is defined as the ratio of the width to the height of the region.

Aspect Ratio = width/height

In this phase we have to assume the width and height of an image. In this we assume width and height is 16/9.

Edge density

The edge density is the process in which we mainly determine the pixel of a square image of vehicle. Here also assume the area covered in whole image. We assume the 6.25 square of area of vehicles.

5. Character Segmentation

Character segmentation is the technique in which individual character present in the image is separated out. Here all character is checked out individually.

6. Character Recognition

An automatic license plate recognition system must recognize alphanumeric characters. The character image is compared with the training set and the best similarity is measured and according to this recognized character is displayed..
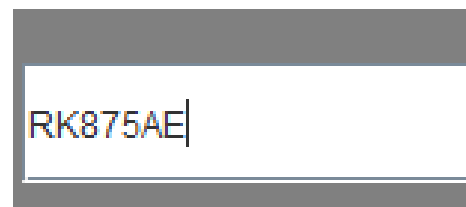

Fig.5. Recognized Vehicle plate

7. Output Vehicle Plate mapping with Database

The character obtained by training set is further mapped by database which we already made in MySQL tools.

Fig. 6. Registered Info. (From Database)

III.   TOOLS

1.   NetBeans

Netbeans is a software development platform written in Java. The NetBeans IDE is primarily intended for development in Java, but also supports other languages, in particular PHP, C/C++ and HTML5. Netbeans is a cross-platform and runs on Microsoft Windows, Mac OS X, Linux, Solaris and other platforms supporting a compatible JVM. The following are some features of Netbeans:

- User interface management (e.g. menus and toolbars)
- Storage management (saving and loading any kind of data)
- Window management
- Wizard framework (supports step-by-step dialogs)
- NetBeans Visual Library
- Integrated development tools

2.   OpenCV

OpenCV is a library of programming functions for real time computer vision originally and developed by Intel and now supported by Willogarage. It is free for use under the open source BSD license. The library has more than five hundred optimized algorithms. It is used around the world, with forty thousand people in the user group. The library is mainly written in C, which makes it portable to some specific platforms such as Digital Signal Processor. Wrappers for languages such as C, Python, Ruby and Java (using JavaCV) have been developed to encourage adoption by a wider audience. The recent releases have interfaces for C++. OpenCV is a cross-platform library, which

can run on Linux, Mac OS and Windows. To date, OpenCV is the best open source computer vision library that developers and researchers can think of.

3.   MySQL

The MySQL tools is used to fill the information of Owner of the vehicle plate which is registered. Here we make Tables.

IV.   LITERATURE REVIEW

This section involves survey on various techniques of automatic license plate recognition.

Kaushik Deba, Md. Ibrahim Khana, Anik Sahaa, and KangHyun Job, (2012) [1]

There is segmentation technique used to sliding concentric windows (scw). In this we extract license plate from natural properties by finding vertical and horizontal edges from vehicle region. On the Basis of a novel adaptive image segmentation technique is for detecting candidate region and Color verification for candidate region by using HSI color model on the basis of using hue and intensity in HSI colour model verifying green and yellow LP and white LP, respectively. Basically they focus on artificial neural network (AAN) new algorithm which is based on Korean number plate system.

M.I.Khalil, (2010), [2]

This LPR system consists of 4 modules: Image acquisition, licensed plate extraction, segmentation & recognition of individual character. After the license plate extraction phase, INFORMATION RECOGNITION PHASE (IPR) is applied. For this phase "moving window technique" is used. For recognizing the image license plate, country name is load as source image. Then the first image entry of country image set is loaded as an object. The moving window technique is applied to detect that object within the image.

Kumar Parasuraman, (2010), [3]

There is SVM i.e. Supervised Learning Technique is used which takes Statistical Learning Theory and for best the structural risk minimization as its optimal object to realize. Two main approaches

have been suggested for applying SVMs for multiclass classification. They are "one against all" and "one against one". A number plate region is located by using mean shift method and extracted; the histogram projection method in horizontal direction is applied for a simple segmentation only.

V. IMPLEMENTATION

OpenCV, neural network and Java are the deadly combination for computer vision.

1. Capture

Load an image using imread. The following code snippet explains how to capture the image from camera and load   source image into the system.

```
Mat img = new Mat();
img = Imgcodecs.imread(picPath);
```

2. Pre-processing

As seen before, preprocessing involves changing color spaces of the source image. Transform an image from BGR to Grayscale format by using cvColor.

```
CvtColor(original,gray,CV_RGB2GRAY);
```

3. Localization

Threshold operation is performed in this phase. To retain the image quality, adaptive threshold algorithms are to be used. OpenCV provides complex and efficient adaptive thresholding algorithms including Sobel method and Ostu method.

```
cvThreshold(imgSobel, imgThreshold, 0, 255,
        CV_THRESH_OTSU    +
CV_THRESH_BINARY);
```

4. Edge detection

Neural neworks are typically organized in layers. Layers are made up of a number of interconnected 'nodes'. Patterns are presented to the network via the 'input layer', which communicates to one or more 'hidden layers' where the actual processing is done via a system of weighted 'connections'.
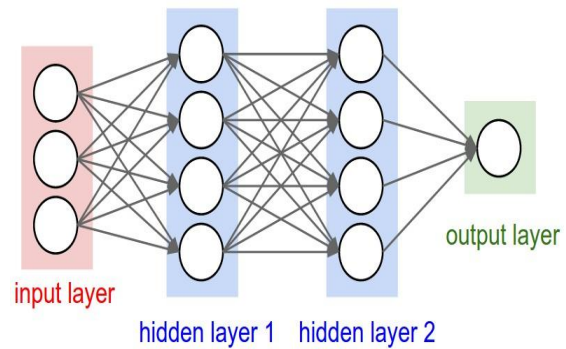

Fig. 7. Neural Network Layers

Here we also make training sets of different sizes i.e., 6*8, 8*13, 10*15 and so on. According to input of that training set output is also define to make system predictable and intelligent.
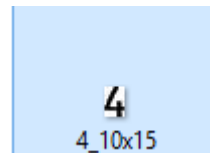

Fig. 8. Training Set

The snippet of coding is following:-

```
Mat element=
getStructuringElement(MORPH_RECT, new
Size(17, 3));

morphologyEx(imgAdaptiveThreshold,
imgMoprhological, CV_MOP_CLOSE, element);

imgContours = imgMoprhological.clone();
```

5. Segmentation

Segmentation phase also involves classification of the individual character which is written alphanumeric form. In this phase neural network is used and segmentation is done in hidden layer. So no output of this phase shown.

6. Recogniton

Character is recognized by using training set. Individual character is checked by training set of different sizes and according this whether it is checked similar to which character.

7. Output Vehicle Plate mapping with Database

In this phase recognized license plate is matched with database and according this information

regarding that plate is displayed that means which person is registered to that vehicle number plate.

VI.   CONCLUSION

We were able to solve a subset of a very difficult and complex problem that continues to be pursued by researchers today. Finally, the characters are recognized in the character recognition stage by using OpenCV. The message of this research is to show that free and open source technologies are matured enough for scientific computing domains. OpenCV is good points of start for researchers and students of computer vision.

VII. FUTURE WORK

The automatic license plate recognition system proposed in this research has several limitations. Most major being that the state information position is assumed to be at top part of license plate. Though most of the plates consists of state information at the upper part of license plate, the proposed system will not be able to recognize the state information if the position of state information is changed.

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