LICENSE PLATE RECOGNITION SYSTEM

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ABSTRACT

Automatic License Plate Recognition is an important problem in Computer Vision and Image processing. There are many applications ranging from complex security systems to common areas and from parking admission to traffic control. Automatic license plate recognition has complexity due to diverse effects such as of light and speed of the vehicle. In this project report we explore the methods to detect number plate in a frame using machine learning methods. We first use some basic image processing techniques (which uses some properties of number plate like white background etc.) to filter out possible objects for number plate and then use trained model to detect number plates among them.

Keyword: - *Image Processing, License Plates, OCR*

1. INTRODUCTION

The License plate recognition is a mass surveillance method that uses optical character recognition on images to read the license plates on vehicles. They can use existing closed-circuit television or road-rule enforcement cameras, or ones specifically designed for the task. They are used by various police forces and as a method of electronic toll collection on pay-per-use roads and monitoring traffic activity, such as red light adherence in an intersection. License Plate Recognition can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. A powerful flash is included in at least one version of the intersection monitoring cameras, serving both to illuminate the picture and to make the offender aware of his or her mistake. License Plate Recognition technology tends to be region-specific, owing to plate variation from place to place. License plate recognition (LPR) algorithms in images or video segments are generally composed of the following three steps: 1) extraction of a license plate region; 2) segmentation of the plate characters; and 3) recognition of each character. This task is quite challenging due to the diversity of plate formats and the non uniform outdoor illumination conditions during image acquisition. Therefore, most approaches work only under restricted conditions such as fixed illumination, limited vehicle speed, designated routes, and stationary backgrounds. The techniques based upon combinations of edge statistics and mathematical

morphology has been proven to give good results. Typically in these methods, gradient magnitude and their local variance in an image are computed. They are based on the property that the brightness change in the license plate region is more prominent and easily detectable than otherwise. Then, regions with a high edge magnitude and high edge variance are identified as possible license plate regions. A disadvantage is that edge-based methods alone can hardly be applied to complex images, since they are too sensitive to unwanted edges, which may also show high edge magnitude or variance. The license plate of a vehicle remains as the principal vehicle identifier. The video surveillance methods rely heavily on robust License Plate Recognition systems. The focus of this work is on detecting license plate on the given data and does it in an online manner.

1.1 The Proposed Solution

There are a number of possible difficulties that the software must be able to cope with. These Poor image resolution, usually because the plate is too far away but sometimes resulting from the use of a low-quality camera. Bad images particularly blur. Poor lighting and low contrast due to overexposure, reflection or shadows. An object obscuring (part of) the plate, quite often a tow bar, or dirt on the plate. A different font, popular for vanity plates (some countries do not allow such plates, eliminating the problem). Lack of coordination between countries or states. Two cars from different countries or states can have the same number but different design of the plate. While some of these problems can be corrected within the software, it is primarily left to the hardware side of the system to work out solutions to these difficulties. Increasing the height of the camera may avoid problems with objects (such as other vehicles) obscuring the plate, but introduces and increases other problems, such as the adjusting for the increased skew of the plate. On some cars, tow bars may obscure one or two characters of the license plate. Bikes on bike racks can also obscure the number plate, though in some countries and jurisdictions, such as Victoria, Australia, "bike plates" are supposed to be fitted. Some small-scale systems allow for some errors in the license plate. When used for giving specific vehicles access to a barricaded area, the decision may be made to have an acceptable error rate of one character. This is because the likelihood of an unauthorized car having such a similar license plate is seen as quite small. However, this level of inaccuracy would not be acceptable in most applications of a License Plate Recognition system.

1.2 Literature Survey

The techniques based upon combinations of edge statistics and mathematical morphology has been proven to give good results. Typically in these methods, gradient magnitude and their local variance in an image are computed. They are based on the property that the brightness change in the license plate region is more prominent and easily detectable than otherwise. Then, regions with a high edge magnitude and high edge variance are identified as possible license plate regions. A disadvantage is that edge-based methods alone can hardly be applied to complex images, since they are too sensitive to unwanted edges, which may also show high edge magnitude or variance. Various license plate detection algorithms have been developed in past few years. Each of these algorithms has their own advantages and disadvantages. Arth et al. described the method in which license plate is detected using confidence related predictions. As multiple detections are available for single license plate, post –processing methods are applied to merge all detected regions. In addition, trackers are used to limit the search region to certain areas in an image. Kwasnicka at el. suggests a different approach of detection using binarization and elimination of unnecessary regions from an image. In this approach, initial image processing and binarization of an image is carried out based on the contrast between characters and background in license plate. After binarizing the image, it is divided into different black and white regions. These regions are passed through elimination stage to get the final region having most probability of containing a number plate.

2. METHODOLOGY

An image is used to convey useful information in a visible format. An image is nothing but an arrangement of tiny elements in a two-dimensional plane. These tiny elements are called Pixels. A large number of pixels combine together to form an image, whether small or large. Each pixel represents certain information about the image, like color, light intensity and luminance. A large number of such pixels combine together to form an image. Pixel is the basic element used to describe an image. Mostly, each pixel in an image is represented in either RGB (Red Green Blue) format or YCbCr format. In case of an RGB image, all the three components, namely R, G and B combine together to convey information about the color and brightness of a single pixel. Each component consumes certain memory space during image processing. In case of a YCbCr image, each pixel in an image is represented as a combination of Y and Cb/Cr values. Here, Y stands for luminance, which describes light intensity, and Cb/Cr stands

for chroma component, which describes color information for an image. Over the time, it has been found that YCbCr components of an image convey sufficient amount of information compared to its counter parts RGB, with less amount of memory space. This is a major advantage nowadays, as most of the applications require sufficient Information at very high speed and less storage.

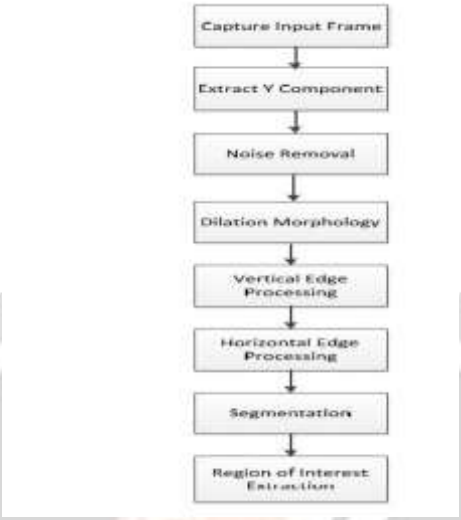

Fig -1: Flow chart for License Plate Recognition

2.1 Histogram of Gradient descriptors

The essential thought behind the Histogram of Oriented Gradient descriptors is that local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. The implementation of these descriptors can be achieved by dividing the image into small connected regions, called cells, and for each cell compiling a histogram of gradient directions or edge orientations for the pixels within the cell. The combination of these histograms then represents the descriptor. For improved performance, the local histograms can be contrast-normalized by calculating a measure of the intensity across a larger region of the image, called a block, and then using this value to normalize all cells within the block. This normalization results in better invariance to changes in illumination or shadowing. It is mainly used for object detection. The technique counts occurrences of gradient orientation in localized portions of an image. This method is similar to that of edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy. We have used HOG descriptors for converting image dataset into feature-space which can be easily used by various machine learning algorithms.

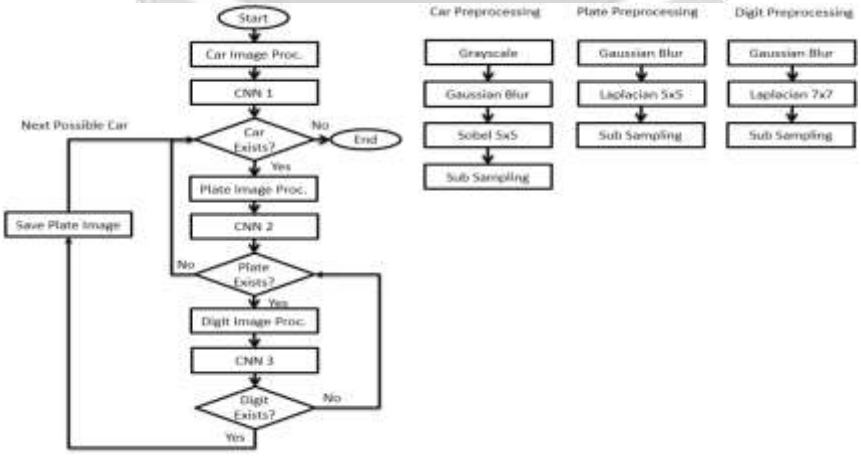

Fig -2: System Architecture

2.2 Core Technology

If you scan a document into your PC and then open it in a word processor you cannot edit or alter it in any way. This is because it is simply one bitmap made up of thousands of individual pixels. However there is software available, frequently a freebie with scanners that can convert these groups of pixels into characters. This is Optical Character Recognition (OCR), which scans each group of pixels and estimates whether or not it could be a letter and replaces the pixels with the ASCII code for the letter. For instance the ASCII code for the lower case 'a' is 01100001. So, the software scans the whole document and produces a page of letters exactly the same as though you had typed them in, which can be edited or manipulated in any way. OCR is the fundamental technology used in License Plate Recognition and provides the capability to store and sort data. The cameras need to be a special type and set up within certain important parameters as will be described later. As a vehicle approaches the camera the software takes a series of 'snapshots' and stores them in a file. When the number plate is of sufficient size for the OCR software the frame is scanned and the registration number is converted to ASCII code and held in a list. This continues for a series of images according to the speed and position of the vehicle. The list is scanned for similarities and a 'favourite' selected to retain. The system would typically scan and compare 10-15 images, with 5 being considered the minimum for high accuracy. Note that this is the principle of the software we are describing; some systems only take one image at a certain position. This then, is the start of the license plate capture and is totally dependent on the correct set up of camera, lens, illumination, angle of view and configuration. Get one wrong and you have a disappointed customer who won't pay the bill. At this stage we are concentrating on the number plate capture but there are many other aspects to be considered for a completely integrated system.

3. CAMERA POSITIONING

Where the camera is positioned other than directly in the line of the approaching vehicle the ANPR provider must be consulted. Many systems will not function with more than more 1 or 2 degrees of horizontal skew or vertical rotation. The positioning of the camera is a most important consideration for satisfactory operation of an ANPR system. This can vary the percentage of recognitions to number of vehicles from 30% or 40% to near on 100%. The camera location depends on several factors, such as:

Single camera covering a barrier entrance probably the best position is for a camera and illuminator in a 1M high bollard viewing directly at the approaching vehicle.

Single camera covering one lane could be a pole mounted unit about from 18M to 30M from the vehicle.

Single or multiple cameras covering multiple lanes is a special application requiring input from the License plate recognition provider.

Town centre cameras already installed are usually the cameras will not have been installed providers in mind and so the positioning will not be optimised, they will generally be colour with no infrared illumination and will operating with the shutter speed set to 1/50th. The first thing to address is the shutter speed if it is adjustable. The best would be if the speed can be set remotely, if not each camera needs to be visited and the speed set manually. The optimum setting is to 1/1000th. Alternative settings may be 1/250th for traffic up to 5 MPH and 1/500th for traffic up to 40 MPH. Note that all these settings will affect the low-light capability of the cameras and a compromise may be required. Another consideration is that the camera positions and heights would not be at the optimum for recognition. Particular attention must be paid to the angles of skew and rotation and a guaranty obtained that an acceptable percentage of recognitions will be achieved.

Cameras on motorway bridges Again a special application requiring input from the provider.

Congestion charging cameras, this application requires input from the license plate recognition provider and local authority before even starting to think of a specification.

Cameras in Police vehicles are normally colour cameras mounted on a swivel mount and can view images to the front or either side of the vehicle. This is another special application requiring input from the provider.

Overview cameras are often necessary to have a conventional colour image of the vehicle especially where prosecution or congestion charging is the application. This would be a separate colour camera mounted alongside or just below the ANPR camera. Saving the overview image is triggered by the ANPR camera registering a number plate. This then adds a colour image to the same file for future reference. It is generally a false economy to attempt to combine the number plate recognition and overview using a single camera for 24/7 operation.

4. EXPERIMENTAL SETUP

Number plate is a pattern with very high variations of contrast. If the number plate is very similar to background. It's difficult to identify the location. Brightness and contrast is changes as light fall changes to it. In this paper the morphological operations are used to extract the contrast feature within the plate.

4.1 Input Raw Image

Input the image that is taken from the car.

Fig -3: Input Raw Image

4.2 Gray scale conversion

From the input RGB image it has to be converted to gray scale and the 8-bit grey value calculated.

Fig -4: Gray sale car Image

4.3 License Plate Detection

The basic step in recognition of vehicle number plate is to detect the plate size. In general number plates are rectangular in shape. Hence we have to detect the edges of the rectangular plate. Mathematical morphology will be used to detect that region. Using Sobel edge detector we used to high light regions with a high edge magnitude and high edge variance are identified

Fig -5: Number Plate Detection

4.4 Segmentation of Characters

The next step is segmentation of the license plate area into smaller parts which represent each character of the license plate. This is done using the vertical projection.

Fig -5: Segmentation of Characters

4.5 Recognition

The process of character recognition is repeated for each character image obtained in the last step. This process could be carried out in several steps. The output of this Special Conference Issue: National Conference on Cloud Computing & Big Data 85 process should be a recognized character. The set of possible outputs are characters that appear on license plates, which are letters of the alphabet, numbers from 0 to 9 and special characters like a dash. In order to simplify recognition, the initial step is to separate possible outputs into smaller groups counting the character end points. For example, character 'C' has 2 end points, but on the other hand, character '9' has only 2 end points.

Fig -5: Possible plate found

5. CONCLUSIONS

In this research paper, we have discussed the image processing technique to implement the License Plate Recognition Signal in order to reduce congestion and misbehave at the Traffic Signal. This solution has been tested on static snapshots of vehicles, which has been divided into several sets according to difficultness. Sets of blurry and skewed snapshots give worse recognition rates than a set of snapshots which has been captured clearly. The future research of this project should concentrate on high definition plate image processing, and multi-plates processing at a time using temporal information and recognition of ambiguous characters and so on. The Future research can be concentrate on improving the recognition rate on ambiguous characters such as (O-0), (I-1), (A-4), (C-G) and broken characters.

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