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Recognition Of Vehicle Number Plate Using MATLAB

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Abstract *–Automatic video analysis from traffic surveillance cameras is a fast-emerging field based on computer vision techniques. It is a key technology to public safety, intelligent transport system (ITS) and for efficient management of traffic. We define video analytics as computer-vision-based surveillance algorithms and systems to extract contextual information from video. Currently most reliable approach is through the recognition of number plates, i.e., automatic number plate recognition (ANPR), which is also known as automatic license plate recognition (ALPR), or radio frequency transponders.*
We are proposing two methods for extraction of license plates and comparing it with other existing methods. The Extracted license plates are segmented into individual characters by using a region-based method. The recognition scheme combines adaptive iterative thresholding with a template matching algorithm

1. INTRODUCTION

The escalating increase of contemporary urban and national road networks over the last three decades emerged the need of efficient monitoring and management of road traffic. Conventional techniques for traffic measurements, such as inductive loops, sensors or EM microwave detectors, suffer from serious shortcomings, expensive to install, they demand traffic disruption during installation or maintenance, they are bulky and they are unable to detect slow or temporary stop vehicles. On the contrary, systems that are based on video are easy to install, use the existing infrastructure of traffic surveillance. Furthermore, they can be easily upgraded and they offer the flexibility to redesign the system and its functionality by simply changing the system algorithms.

Those systems allow measurement of vehicle's speed, counting the number of vehicles, classification of vehicles, and the identification of traffic incidents (such as accidents or heavy congestion).There is a wide variety of systems based on video and image processing employing different methodologies to detect vehicles and objects.

1.1Traffic surveillance:

Traffic surveillance system is an active research topic in computer vision that tries to detect, recognize and track vehicles over a sequence of images and it also makes an attempt to understand and describe object behaviour, vehicle activity by replacing the aging old traditional method of monitoring cameras by human operators**.**

These systems are proving to be ineffective for busy large places as the number of cameras exceeds the capability of human experts. Such systems are in widespread across the world. Lower level of video processing is used in these systems

1.2 Overview of the proposed model

A typical surveillance system consists of a traffic camera network, which processes captured traffic video on-site and transmits the extracted parameters in real time. This system mainly having four modules:-

- ♣ Video Acquisition
- ♣ Vehicle detection and tracking
- ♣ License plate extraction
- ♣ Character recognition unit

1.3 Motivation

Traffic surveillance is the most active research topic in computer vision for humans and vehicles. Our aim is to develop an intelligent automatic License plate recognition in real time surveillance videos and replacing the age old traditional method of monitoring by human operators

1.4 Problem statement

To design and develop a real-time detection, tracking and license plate recognition system that will work efficiently under the conditions of slow moving objects and the objects that are merged into the background due to a temporary stop and becoming foreground again, adaptive to different traffic environment conditions, robustness against progressive or sudden illumination changes, Occlusions, identification time of the system should be as short as possible.

1.5 Factors influencing the performance of system.

Factors, which may have a negative influence on the results of this system, can be classified into a few groups: weather conditions, lighting, license plate placement in the picture, vehicle movement, mechanical plate damages, and other captions in the picture etc.

1.6 Organization of the Thesis

The remaining part of the thesis is organized as follows Chapter 2 presents a brief survey of vehicle detection in real time. Different methods are discussed in detail and their comparisons are shown. Chapter 3 describes the license plate extraction using different existing methods and proposing two methods and showing their comparisons with other existing methods. Chapter 4 character segmentation part is discussed. Chapter 5 concludes the thesis with the some suggestions for future research work.

2.Vehicle Detection

Traffic surveillance is used by private companies, governments and public organizations for efficient management of transport networks, road safety, public safety in highways and busy streets. A static camera observing a scene is a common case of a surveillance system

2.1 Categorization of motion detection

2.1.1 Frame differencing

Frame differencing [4] is a pixel-wise differencing between two or three consecutive frames in an image sequence to detect regions corresponding to moving object such as human and vehicles. The threshold function determines change and it depends on the speed of object motion.

2.1.2 Optical Flow

To detect moving regions in an image, optical flow uses flow vectors of the moving objects over time. It is used for motion-based segmentation and tracking applications. It is a dense field of displacement vectors which defines the translation of each pixel region.

2.1.3 Background subtraction

It is the most popular and common approach for motion detection. In this method the current image is subtracted from a reference background image, which is upgraded during a period of time.

2.2 Related Work

A large literature exists concerning moving object detection in video streams and to construct reliable background from incoming video frames.

2.2.1 Simple Background Subtraction

In simple background subtraction technique an absolute difference is taken between every current image lt (x,y) and the reference background imageB (x,y) to find out the

2.2.2 Running Average

Simple background subtraction cannot handle illumination variation and results in noise in the motion detection mask. The problem of noise can be overcome, if the background is made adaptive to temporal changes and updated in every frame.

$$B_t(x,y) = (1-\alpha)B_{t-1}(x,y) + \alpha\, I_t(x,y)$$

2.2.3 Simple Statistical Difference (SSD)

Simple Statistical Difference method (SSD) computes the mean Ux,y the standard deviation for each pixel (x, y) in the background image containing K images in the [t0,tk-1]

$$\mu_{x,y} = \frac{1}{K}\sum_{k=0}^{K-1} I_k(x,y)$$

$$\sigma_{x,y} = \left(\frac{1}{K}\sum_{k=0}^{K-1}(I_k(x,y) - \mu_{x,y})^2\right)^{1/2}$$

2.2.4 Motion Detection Based on Sigma – Delta Estimation (Σ -Δ)

At each frame, Σ – Δ (SDE) estimates the background by incrementing the value by one if it is smaller than sample, or decremented by one if it is greater than the sample [11]. This algorithm uses the sign function which is defined as

$$sgn(a) = \begin{cases} -1, & if\ a < 0 \\ 0, & if\ a = 0 \\ 1, & if\ a > 0 \end{cases}$$

2.2.5 Sigma-Delta Background Estimation with Confidence Measurement

The adaptation of the basic sigma-delta algorithm introduces a confidence measurement that is tied to each pixel and quantifies the trust the current value of that pixel deserves. This enables a mechanism that provides better balance between adaptation to illumination or background changes and prevention against undesirable background-model contamination.

2.2.6 Gaussian mixture model (GMM)

The GMM methodology models each pixel history as a cluster of Gaussian type distributions and uses an on-line approximation to update its parameters. As per this method, the background is found as the expected value of the distribution corresponding to the most populated cluster.

2.2.7 Algorithm for Background Estimation

Algorithm involves locating moving objects in complex road scenes by implementing an advanced background subtraction methodology; this model is a simple and effective method for segmentation of foreground objects.

2.3 Experimental Results

Performance evaluation of different background subtraction techniques have been tested for traffiv.avi video taken from data base. Specification of traffic.avi video is:
Bits per Pixel = 24
Frame Rate = 15
Height = 120
Number of Frames = 120

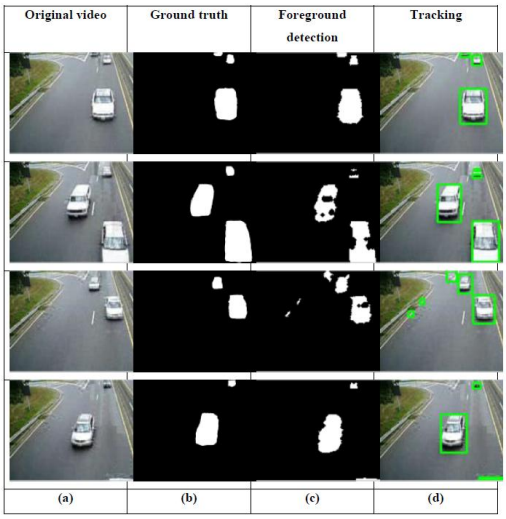
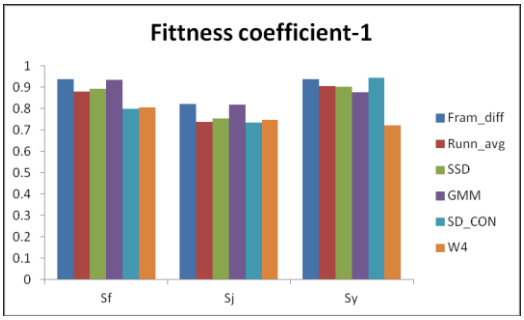


Figure 2. 2 Results of Frame Difference Algorithm

2.3.1 Accuracy Metrics

In this section, a more technically accurate performance study is conducted, making use of some segmentation quality metrics for quantifying the correctness of the foreground detection provided by algorithm in the traffic.avi standard video in sequence traffic.21, taffic.38, traffic.89 and traffic.98



2. 8: Traffic.21 sequence: Fitness coefficients

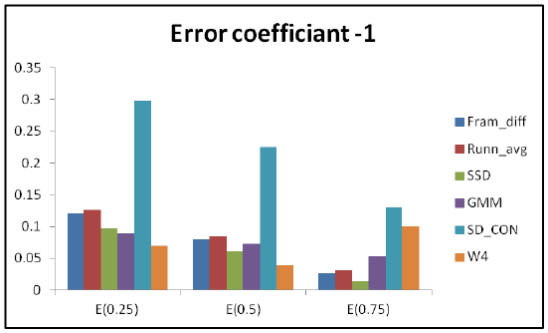


Figure 2. 9: Traffic.21 sequence: Error coefficient

3.LICENSE PLATE EXTRACTION

License plate recognition (LPR) is one form of ITS (Intelligent Transport System) technology that not only recognizes and counts the number of vehicles but also differentiates them. For some applications, such as electronic toll collection and red-light violation enforcement, LPR records license plates alphanumerically so the vehicle owner can be assessed the appropriate amount of fine. In others cases and is compared against a database of acceptable ones to determine whether a truck can bypass a weigh station or a car can enter a gated community or parking lot.

3.1 Pre Processing

Intensity transformations are applied to enhance the quality of the image for further processing. The following transformations are applied on the colour JPEG image
Digital images are composed of finite number of element which has a particular location value. Picture elements, image elements and pixels are used as elements for digital image processing.

3.1.1 Conversion of RGB image into a Gray-scale Intensity image

MATLAB built-in functions are used for the above transformations.
The image that is acquired from the camera can be an RGB colour image or a Grayscale Intensity image. The algorithm has to check for the RGB image and then has to convert it into a Grayscale image, because all the further processing is done in Grayscale format.

3.1.2 Conversion of Intensity image into a Binary image

This transformation, also known as *Image Quantization*, produces a binary image from the intensity image by comparing pixel intensities with a threshold.

3.2 License Plate Extraction

Once the Pre-processing is done there are many ways to extract the License plate. They are
HoughTransform Template matching Region growing Histogram Approach

3.2.1 Hough transform

In Hough transform approach, the first step is to threshold the Gray scale source image. Then the resulting image is passed through two parallel processes for the extraction of horizontal and vertical line segments respectively.

3.2.2 Template Matching

The main concept behind extraction through template matching is, that by comparing each portion of the investigated image to a template license plate, the actual license plate in the image is found as the region bearing the most resemblance to the template.

3.2.3 Region Growing

The basic idea behind region growing is to identify one or more criteria that are characteristic for the desired region. Once the criteria have been established, the image is searched for any pixels that fulfil the needs.

3.2.4 Histogram approach

For extracting the license plate, one approach is to take row wise histogram and using threshold we can detect the boundaries. And out of the extracted regions which will satisfy the dimensions of license plate.

3.3 Proposed Method I for license plate extraction

This Technique is based on observation that "The License plate is the noisiest part of the Car Image". It means that if the edges of the image are taken, then we get the most edges in the License Plate Area

3.3.1. Sobel edge detection

Therefore, the edge detector will detect much thinner edges in addition to the edges of the characters of the license plate.

3.3.2. Removal of unwanted small connected component .

As it can be observed in Figure 3.10, there will be many unwanted small connected component or we can say noise parts in the image such as screws and nuts and small dust particles, which may give the false alarm

3.4 Proposed Method- II for license plate extraction

Here we are proposing Block Variance Technique for license plate extraction. The plate having alphanumeric characters with high variance as compared to rest part of the image, so we are using this feature of license plate for extracting it from the image.

3.4.1 Pre-processing

In pre-processing stage some transformations are done. They are

- Conversion of RGB Image into a Gray-scale image.

3.4.2 Morphological Operation

Morphological operations are a collection of non-linear operations related to the shape or morphology of features in an image. Morphological operations rely only on the relative ordering of pixel values, and are especially suited to the processing of binary images.

3.4.3 Block Variance Algorithm

step 1: First an image is taken, then pre-processing is done to remove unwanted noise and to increase the image contrast.

step 2: Resizing of all input image in 300 x 400 pixels because we have to divide the whole image into the blocks so all the images should be of same pixel resolution.

step 3: Converting RGB image into Gray scale image because we only interested in intensity values.

step 4: The license plate of the car consists of several characters, so the plate area contains rich edge information. We used Sobel edge detection Technique to detect the edges of the image.

3.5 Results and Discussion

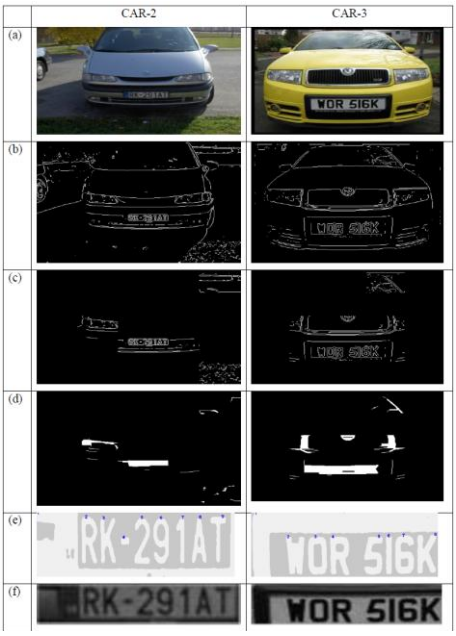


Figure 3. 17: Result of block variance technique for CAR-2 and CAR-

4.Character Extraction

Character Extraction or character segmentation is the important component of our recognition system. It takes a properly segmented license plate as an input. Some pre-processing (Morphological operators) is done on the license plate image for the removal of noise and the noise free output image is sent for character segmentation.

4.1. Character Extraction Methods There are two ways to extract the characters of License Plate. Histogram approach Connected pixels method

4.2 Character Recognition Using Template matching based OCR

The OCR technique is used in order to recognize different digits. This approach is based on pattern recognition principles. The system of OCR engine is based on a template-matching algorithm.

4.2.1. Pre-processing

Pre-processing is one of the preliminary steps in character recognition. Before the raw data is used for feature extraction it has to undergo certain preliminary processes so that we get accurate results.

5.Conclusion and Future work

Here in this thesis, the methods for traffic surveillance have been presented and the work on motion detection, license plate extraction and character recognition is carried out. In motion detection, a study on different background subtraction available in the literature has been studied and their performance tests on the different video test sequence are given. The fitness coefficient and error coefficient is also calculated for all the methods. It should be noted that robust motion detection is a critical task and its performance is affected by the presence of varying illumination, background motion, camouflage, shadow, and etc.

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