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Multiple License Plate Location Identification Using the Optical Flow Algorithm and Blob Analysis: A Review

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Abstract: **Now a day's object tracking is more difficult and tricky to surveillance in real time. This proposed work deals with the tracking of moving object in a sequence of frames and it also determines the velocity of the object. In this work algorithms are developed for improving the image quality, segmentation, feature extraction and for identifying the velocity. The algorithms developed are implemented and evaluated using MATLAB. The image quality of the video frame is obtained by applying certain noise removal filters. Next, identifying the moving objects from the portion of the video frame is performed using the background subtraction technique based on frame difference. However, there are usually more than one vehicle appear within an image frame simultaneously in practical cases. That is, They need to locate multiple license plates before identifying their license plate numbers. In this paper, They used the optical flow algorithm and Blob analysis to locate the multiple license plates in video Sequences. They use video data of surveillance systems from real cases to show the capability of the proposed method. From the experimental results, our method supplies exhilarating capability to locate multiple license plates.**

Keywords: **Surveillance, Experimental Results, Locate Multiple License Plates, Using MATLAB.**

I. INTRODUCTION

Content-based image retrieval (CBIR) techniques have shown their capability of searching data. They have been applied to forensic databases [1], such as fingerprints, bullets and cartridge cases of firearms, drug tablet, etc. Since many video processing techniques are extended from image processing techniques. Some commercial intelligent surveillance systems have been developed quickly and shown their capability of practical applications. In Taiwan, automatic license plate recognition

(ALPR) is one of the most important applications. ALPR has been applied in three main categories:

1. Road traffic management: improving the flow and safety of vehicle traffic; collecting electronic toll data on Pay- per-use roads and catalog the movement of Vehicle traffic [5].

2. Security management: recognizing and controlling the vehicles entire and exit from parking area, underground parking, and restrained region; managing the track of vehicles in the restrained region [3].

3. Crime prevention: reducing the criminal intention before crime incident happen; investigating the criminal vehicle after crime had occurred.

ALPR uses image processing and character recognizing technologies to identify vehicle numbers by automatically reading their license plates. ALPR algorithm can be separated into six main processing steps:

(1) Input images or video data with vehicles;

(2) Enhance and raise the image quality as the pre-process step;

(3) Detect and locate the license plate region on the images or video data;

(4) Segment the correct license plate(s) based upon characters features;

(5) recognize the numbers of the license plate(s);

(6) Display results.

The third and fourth steps play the important role for correct recognition. However, ALPR is quite challenging due to the diversity of plate formats and the non-uniform outdoor illumination conditions during image acquisition, such as background, illumination, vehicle motion, and the position of installed cameras. These factors make the detection and location of license plates difficult. Researchers have proposed many methods, such as edge detection methods , texture and color based methods , line sensitive filters to extract plate areas , sliding window methods , and the mathematical morphology method . Although these Algorithms can achieve license plate location, they are with formidable disadvantages such as sensitivity to the longer processing time and lock of versatility in adapting to varying environment. There are some research works for license plate localization and segmentation. However, they focus on detecting the accurate location of single license plate from a vehicle image or video.

In Taiwan, ALPR has been equipped to help police in suspected vehicles check if they are stolen from other people. They need to find and locate license plates in an image before identifying the plate numbers. Efficient plate location will help recognize license plate numbers correctly. However, there is usually more than one vehicle appearing within an image in practical cases. The current methods cannot capture multiple license plates in an image. The purpose of this paper is to locate multiple license plates before identifying license plate numbers.

In this paper, they propose a novel method to locate multiple license plates in video sequences. Our method can be applied to cars, motor cycles (the license plate size is smaller than that of a car), and transport vehicles. Our method is robust to detect vehicle license plates in both day and night conditions. It also works They for detecting and locating multiple license plates contained in an image or frame without setting interested regions. Automated license plate location is a particularly useful and practical approach.

II. PROPOSED METHODS

The proposed method uses the optical flow algorithm to calculate intensity changes of the region with objects in a video. With the calculated data, They can detect and locate license plates.

The Optical Flow Algorithm:

An image sequence (or video) is a series of 2-D images that are sequentially ordered with respect to time. An object in an image consists of brightness patterns. The optical flow is the distribution of apparent movement of brightness patterns in an image. As the object moves, the brightness patterns in the image move simultaneously. The optical flow can arise from relative motion of objects. Consequently, the optical flow can give important information about spatial arrangement of the objects. The computation of the differential optical flow can be summarized as a two-step procedure:

a) Measure spatio-temporal intensity derivatives (which is equivalent to measuring the velocities normal to the local intensity structures),

b) Integrate normal velocities into full velocities, for example, either locally via a least squares calculation or globally via regularization.

The concept of the optical flow method is if the motion is relatively small and the illumination of the scene maintains "uniform" in space and "steady" over time, it can be assumed that the brightness of a particular point remains relatively constant during the motion. In other words, the classical brightness constancy constraint equation can be established as [25]

$$E(x+\Delta x,y+\Delta y,t+\Delta t) = E(x,y,t)$$

where *E(x,y,t)* represents the brightness of a point *(x,y)* on the frame *E* at time *t*. The optical flow method calculates the motion ,the two image frames which are taken at times *t* and t+Δt at every pixel positions.

Expanding the left-hand side and ignoring high-order terms, the above equation is reduced to be,

$$E_t + E_x u + E_y v = 0$$

Where E_t, E_x, and E_y are the derivatives of the spatiotemporal frame brightness; *u* is the horizontal optical flow and *v* is the vertical optical flow, both are components of the optical flow along the *x* and *y* axes.

They use the Horn-Schunck algorithm to estimate the direction and position of the optical flow.

The Horn-Schunck Algorithm:

Assume that the optical flow is smooth over the entire image, the Horn-Schunck method computes the velocity field, $[u\ v]^T$ by minimizes this equation:

$$E=\iint(E_x u + E_y v + E_t)^2\, dxdy + \iint\{ (\partial u/\partial x)^2 + (\partial u/\partial y)^2 + (\partial v/\partial x)^2 + (\partial v/\partial y)^2\}\, dx\, dy$$

In this equation, $(\partial u/\partial x)$ and $(\partial u/\partial y)$ are the spatial derivatives of the optical velocity component *u*; $+(\partial v/\partial x)$ and $(\partial v/\partial y)$ are the spatial derivatives of the optical velocity component *v*; *a* is used to scale the global smoothness term. The equation (3) is minimized to obtain the velocity field by the Horm-Schunk method. For each pixel in the image, *[u v]* is given by the following equations:

$$U_{x,y}^{k+1} = U_{x,y}^{-k} + (E_x [E_x U_{x,y}^{-k} + E_y V_{x,y}^{-k} + E_t] / (\alpha^2 + E_x^2 + E_y^2))$$

$$V_{x,y}^{k+1} = V_{x,y}^{-k} + (E_x [E_x U_{x,y}^{-k} + E_y V_{x,y}^{-k} + E_t] / (\alpha^2 + E_x^2 + E_y^2))$$

Where $[U_{x,y}^{k+1}, V_{x,y}^{k+1}]$ s the velocity estimate for the pixel at *(x,y)*, and $[U_{x,y}^{-k}, V_{x,y}^{-k}]$ is the neighborhood average of $[U_{x,y}^{k}, V_{x,y}^{k}]$. For k=0,the initial velocity is 0 .The optical flow algorithm is sensitive to the apparent motion of brightness patterns in the image. The motion detector based upon the optical flow algorithm is the simplest one and the quickest one. The idea of this detector is to find the amount of difference in two consequent frames of a video stream. As illustrated in Fig.2, motorcycle is detected and located by the optical flow algorithm. Yellow vector signs are marked with regard to the motion direction that estimated by using the edge feature. According to the scope of signs, the motion object can be located by a green rectangle.

Blob analysis:

Blob analysis is a process of assigning a label to every pixel in an image, such that pixels with the same label share certain visual characteristics as using color, shape, texture, etc. . In our method, They use blob analysis to extract license plate regions using the color distribution from an image sequence. A Look-Up- Table (LUT) with three color components (red, green, and blue) is created based on the color distribution of a license plate. This three-color LUT is pre-built by using license plate color samples. After extracting the motion object from a sequence of frames, the system computes "blobs identifying candidates" for license plates. Although the three-color LUT may incorrectly identify candidate regions, which are similar to license plate color, as license plates, They can verify them through finer segmentation and check the rectangularity of the license plates. Thus, the license plates in a video sequence are identified.

The license color identification algorithm extracts hand and face regions using the color distribution from the image sequence. They prepare a three-color LUT which is used for setting the color distribution. They preset *M* or the background region *B*. According to the multidimensional color histogram of both regions, a combined histogram *C* is defined as,

$$C_j = \max (W_m M_j - W_b B / C_{max}, 0) \times D$$

Where *j* represents the index of each histogram bin, *Cmax* is the maximum value of the combined histogram, *D* is the range of the output image, e.g. 255 for an 8-bit image, *Wm* and $_{Wbare}$ weighted values representing the sensitivity for *C* in each histogram [26]. In our experiments, They set *Wm=1* and *Wb=0.7* to get the license plate that include edge feature. Identification of license plate color is made difficult due to diverse effects as fog, rain, shadows, irregular illumination conditions, partial occlusion, variable distances, vehicle's velocity, camera's angle on frame, plate rotation.

To remove these physical influences in the real world is impossible. However, research has shown the normalization of color is effective in alleviating these influences . In our system, prior to creating the color three-color LUT, They convert the original *(R,G,B)* to a normalized color space *(r,g,b)* as

$r = R/(R+G+B)$; $g=G/(R+G+B)$; $b=B/(R+G+B)$

The labeled region in the color image is then statistically analyzed. For each frame, They use blob analysis to calculate the statistics of blocks that are with connected regions on a color image. With color analysis, They can obtain the labeled region accurately. Fig.3 (a) shows a single video frame with a car and a motorcycle. Fig.3 (b) is the extracted motion region by using blob analysis. The blob analysis result is shown in Fig.3 (c).

Elongatedness:

After the candidate regions are obtained, each region is checked and extracted to correctly differentiate the license plate regions from others. Various features are utilized for this purpose. In our experiment, elongatedness is used to decide if a candidate region contains a license plate. Elongatedness is a ratio between the length and width of a region bounding a rectangle. This is the rectangle with the minimum area that bounds a shape, which is located by turning in discrete steps until a minimum is located, see as Fig.4 . In this paper, They use elongatedness to verify vehicles.

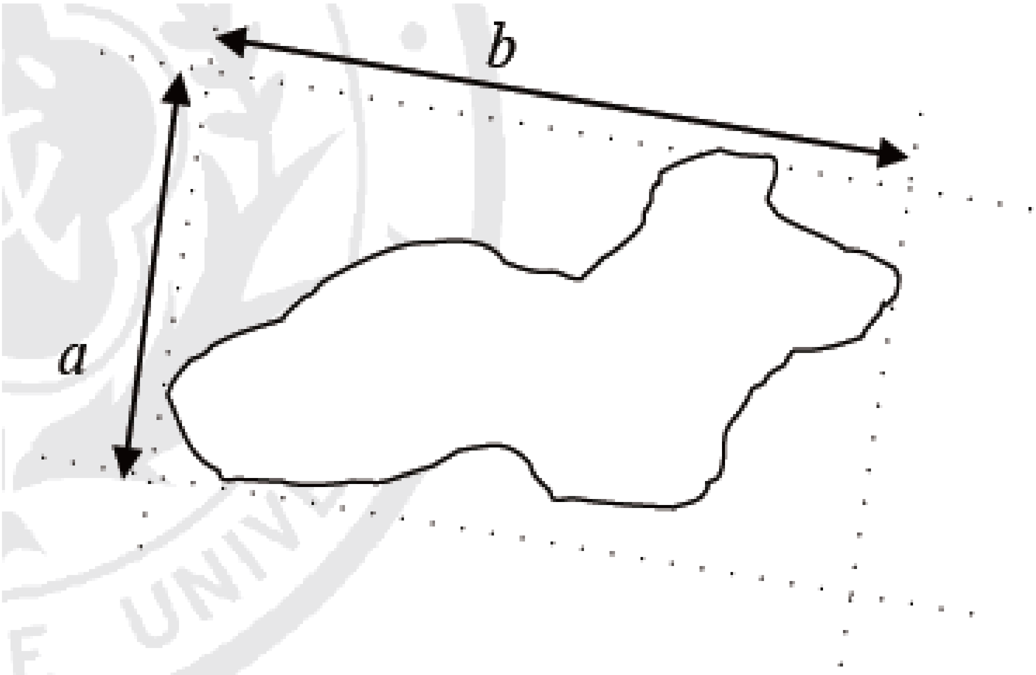


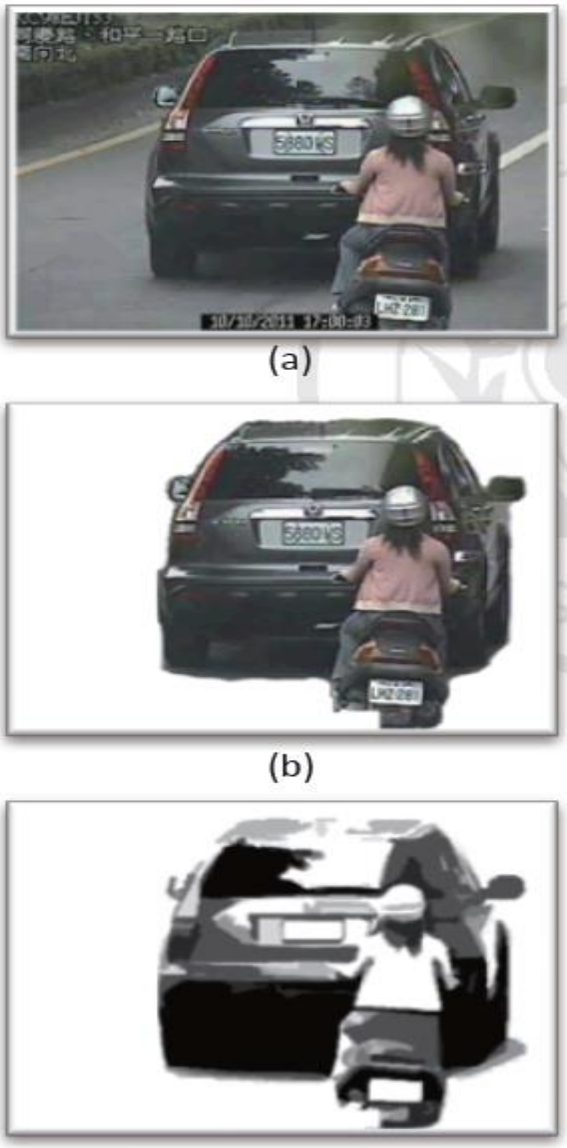
Figure: 1

A license plate takes a rectangle shape with a predetermined length to height ratio for each kind of vehicles. In practical cases, due to the imaging angle, a license plate is not usually with a rectangular on an image. Under limited distortion, however, license plates in vehicle images can still be view approximately as rectangle shape with a certain ratio. This is the most important shape feature of a license plates. Fig.5 illustrates the capability of elongatedness computation and ratio determination. To locate rectangle regions with green color blocks and remove the blocks with the ratio

< 1 condition, some regions are located as Fig.5 (a). The ratio of a license plate varies with different view angles; however, the ratio is always between 1.5 and 2. Two blocks with proper elongatedness and aspect ratio are shown in Fig.5 (b).

III. EXPERIMENTAL RESULTS

We use practical video data from surveillance systems to test our method. Two categories of videos (consist of single vehicle, and more than one vehicle) are used to examine the location ability of the proposed method.



(a)

(b)

(c)

Figure: 2

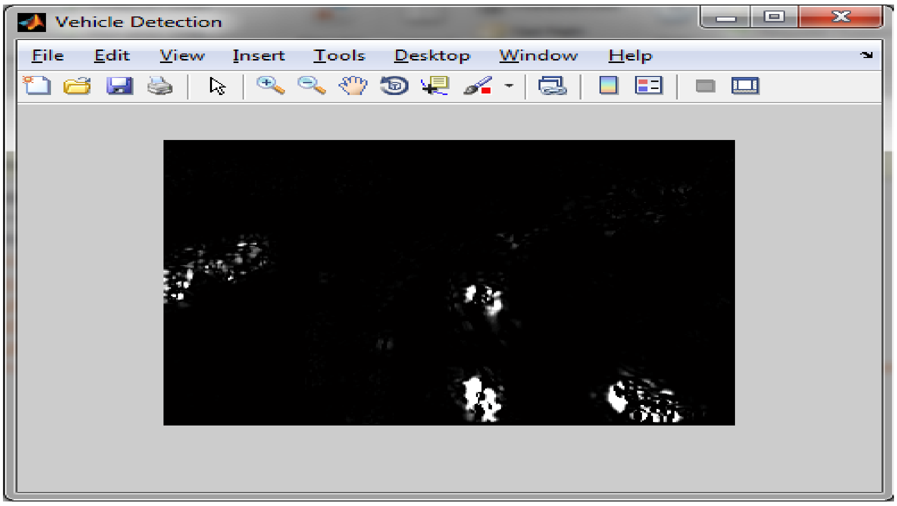


fig 3: Optical Flow Algorithm

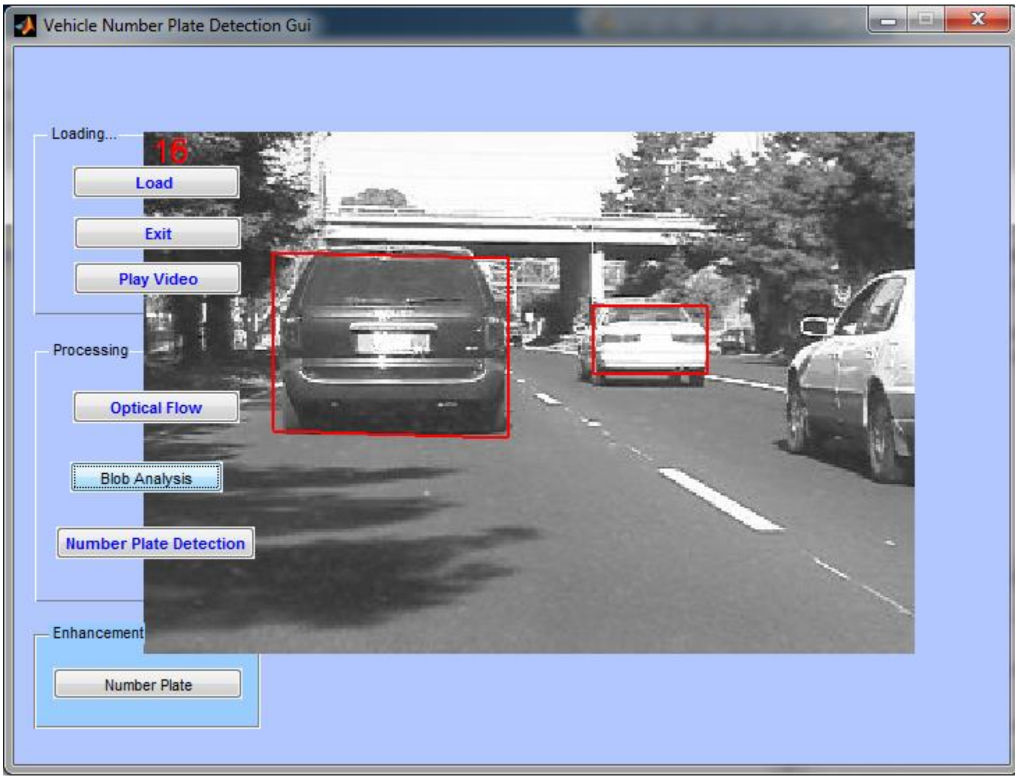


fig 4: Blob Analysis

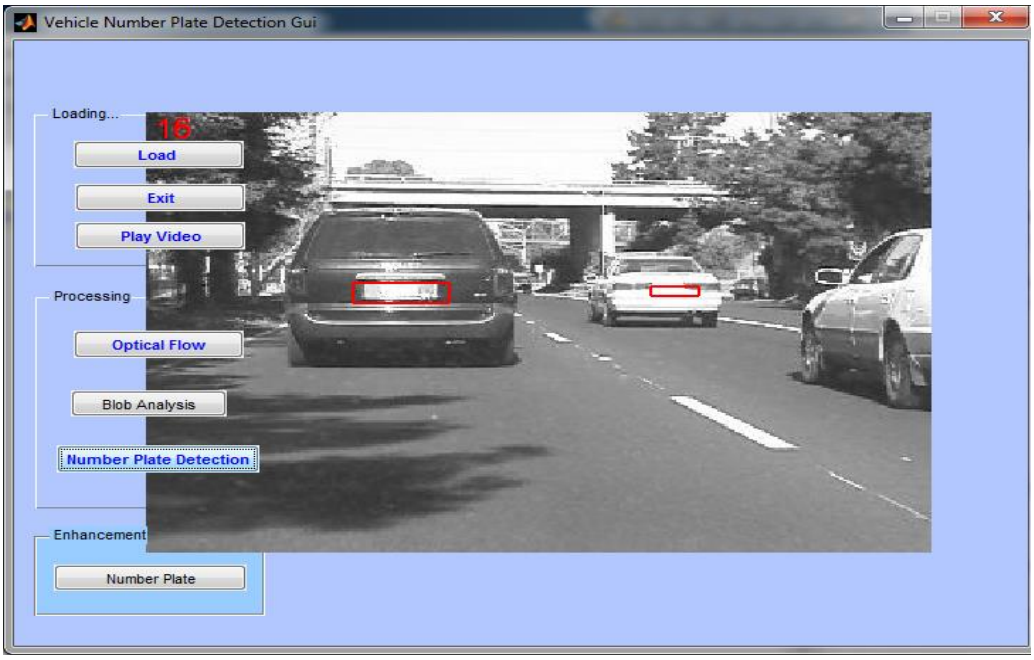


fig 5 : Number Plate Location Identification

IV. CONCLUSION

In this paper, a multiple license plate location method based upon the optical flow algorithm and blob analysis is proposed. Our method can locate multiple license plates when multiple vehicles co-exist in one frame. The advantage of the proposed algorithm is that it is able to extract the multiple license plates contained from video sequence without any human interface. As the next procedure, we expect to use more features to improve the correct rate of location and segmentation. this method is an efficient method for locating the license plate among a traffic management system.

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