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Traffic Analysis Based On Image Processing

Harsha H. Sanap[1], P. A. Ghonge[2]

[1]Department of Electronics & Telecommunication Engineering, YTIET, Bhivpuri Road, Mumbai University

[2]Professor, Department of Electronics Engineering, YTIET, Bhivpuri Road, Mumbai University

Abstract: ***Traffic information is an important tool in the planning, maintenance and control of any modern transport system. The Image Processing algorithm has been applied to measure basic traffic parameters such as traffic volume, timer to green signal for each path to reduce traffic at the junction side. In this paper we apply edge-detection techniques to the key regions or windows. Also, background subtraction algorithm is a very important part of Intelligent Traffic System (ITS) applications for successful segmentation of objects from video sequence to control the Traffic at heavy traffic junction. Automatic Number plate Recognition (ANPR) is an application of Traffic Analysis which use mainly for security purpose which identifies the character directly from the image of license plate.***

Keywords: Vehicle detection, Background Subtraction, Background Model, Segmentation

1. Introduction

1.1 Traffic Management

Traffic means the movement of vehicles along a route. Congestion may result due to heavy traffic at a junction. Traffic management is becoming important issue day by day due to rapid increase in number of vehicles. Lot of man-hours is being wasted in traveling due to bad traffic management. To avoid congestion there are so many traffic management techniques available. Even though many companies are working on traffic management over years, no technique is perfect by itself as the real time situations are generally continuously changing and the system has to adapt itself to change in the continuously changing circumstances.

1.2 Image Processing

Traffic density of lanes is calculated using image processing which is done of images of lanes that are captured using digital camera. We have chosen image processing for calculation of traffic density as cameras are very much cheaper than other devises such as sensors.

An Image is rectangular graphical object. Image processing involves issues related to image representation, compression techniques and various complex operations, which can be carried out on the image data. The operations that come under image processing are image enhancement operations such as sharpening, blurring, brightening, edge enhancement etc. Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video and the output of image processing can be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing.

2. Problem Definition

For Traffic analysis Frame subtraction Method is being used. This method is used to get the presence of moving objects through the difference between two consecutive images. In this method generally, it is difficult to obtain a complete outline of moving object and liable to appear the empty phenomenon so as a result detection of object is not accurate. In Frame Subtraction Method accuracy is less because Reference image is changing in each and every iteration so we do not get exact amount of traffic volume. Other Method to calculate traffic density is Optical flow Method is used to calculate the image optical flow field and do clustering processing according to the optical flow distribution characteristics of image. In this Method a large quantity of calculation is needed. It is also sensitive to noise, also the accuracy is less. It has poor anti-noise performance, makes it not suitable for real time demanding occasions.

3. Methodology

The background subtraction method is the common method of object detection. It is a technology that uses the difference of the current image and the background image to detect the motion region, and it is generally able to provide data included object information. The key of this method lies in the initialization and update of the background image. The effectiveness of both will affect the accuracy of test results. Therefore, we use an effective method to initialize the background, and update the background in real time. Input video is given as input which converted in to frame. From these frames images are separated. From these images initial background image is constructed. This image divided in to two images current frame image and background frame image. After separation background subtraction method applied to detect vehicle object for next frame background updated.

3.1 Preprocessing

As the complexity of the background, the difference image obtained contains the object region, additionally it also contains large number of noise. Therefore, noise needs to be

removed. To remove this noise we use median filter with the 3 X 3 window and filters out some noise. Preprocessing is necessary to improve the detection of object. After the median filter Morphological methods are used for further processing.

3.2 Background Subtraction Method

Phase 1: First images are captured by camera. The first images of highway when there is no traffic will be taken. The first image of highway has been considered as a reference file and stored in a specific location in the program. RGB to Gray scale Conversion in order to achieve image enhancement is done. Median Method is selected to initialize the background which can resolve the shadow problem. Expression is as follows.

$$B_{init}(x, y) = \text{median } f_k(x, y) \; k=1, 2,\ldots..n \quad (1)$$

Where B_{init} is the initial background is the total number of frame selected.

Phase 2: Secondly, images are captured from the highways indicating number of vehicles. RGB to Grayscale conversion has done on the hierarchy of images.

Phase 3: Apply Background subtraction on two images obtained in Phase 1 and Phase 2 respectively to obtain Background Subtraction image to extract the number of vehicles. This process includes area calculation of white object are nothing but the vehicles on the road in binary image with background of black color foreground as white color which is nothing but object in the form of vehicle. There are different approaches to the basic scheme of background subtraction in terms of foreground region detection, background maintenance and post processing. We uses the simple version of this scheme where a pixel at location (x, y) in the current image, it is marked as foreground if is satisfied.

$$|It(x, y) - Bt(x, y)| > \tau \quad (2)$$

Where, τ is a predefined threshold. The background image Bt is up- dated by the use of an Infinite Impulse Response (IIR) filter as follows:

$$Bt+1 = \alpha It + (1 - \alpha)\, Bt \quad (3)$$

The foreground pixel map creation is followed by morphological closing and the elimination of small-sized regions. Although background subtraction techniques perform well at extracting most of the relevant pixels of object even they stop, they are usually sensitive to dynamic changes when, for instance, stationary objects uncover the back- ground (e.g. a parked car moves out of the parking lot) or sudden illumination changes occur.

3.2.1 Background Modelling

In the background modelling process, the reference background image and some parameters associated with normalization are computed over a number of static background frames. The background is modeled statistically on a pixel by pixel basis. A pixel is modeled by a 4-finite sequence of pixels <Ei; si; ai; bi > where Ei is the expected color value, si is the standard deviation of color value which is defined in ai is the variation of the brightness distortion, and bi is the variation of the chromaticity distortion of the i^{th} pixel. The expected color value of pixel i is given by

$$E_i = [\mu_R(i), \mu_G(i), \mu_B(i)] \quad (4)$$

where $\mu_R(i), \mu_G(i)$ and $\mu_B(i)$ are the arithmetic means of the i^{th} pixel's red, green, blue values computed over N background frames.

3.2.2 Background Update

For accurately extracting the object the background needs to be updated in real time and the background model can better adapt to light changes. In the proposed method, the update algorithm is as follows: In the moving object detection, the pixels judged as belonging to the moving object maintain the original background gray values, not be updated. For the pixels which are judged to be the background, we update the background model according to following rules:

$$B_{k+1}(x, y) = \beta B_{k(x, y)} + (1 - \beta)\, F_k(x, y) \quad (5)$$

Where B(x, y) is background image, $F_k(x, y)$ is current image and F_3 E (0, 1) is update coefficient, in this paper f3 = 0.004. $F_k(x, y)$ is the pixel gray value in the current frame. $B_k(x, y)$ and $B_{k+1}(x, y)$ are respectively the Background value of the current frame and the next frame.

3.2.3 Object Extraction

When the background image B(x, y) is obtained, subtract the background Image B(x, y) from the current frame Fk (x, y). Set threshold as T. If the pixel difference is greater than threshold T, then determines that the pixels appear in the moving object, otherwise, as the background pixels. The moving object can be detected after threshold operation. Its expression is as follows:

$$D_k(x, y) = \{1 \; |F_k(x, y) - B_{k-1}(x, y)| > T \quad (6)$$

{0 others

Where, $D_k(x, y)$ is the binary image of differential results. T is gray-scale threshold. Its size determines the accuracy of object identification. As in the algorithm T is a fixed value, only for an ideal situation.

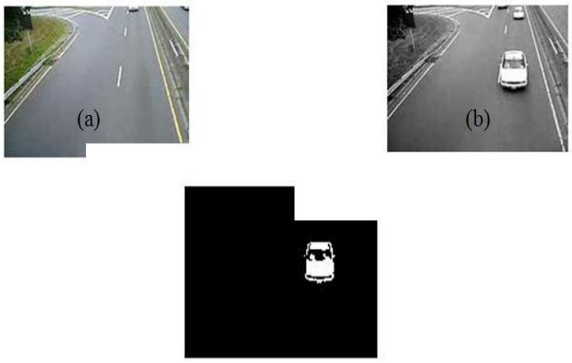

Figure1: Background Subtraction

4. Advantages of Proposed Method

- The key of this method lies in the initialization and update of the background image.

- The effectiveness of both will affect the accuracy of test results.
- Therefore, this paper uses an effective method to initialize the background, and update the background in real time.

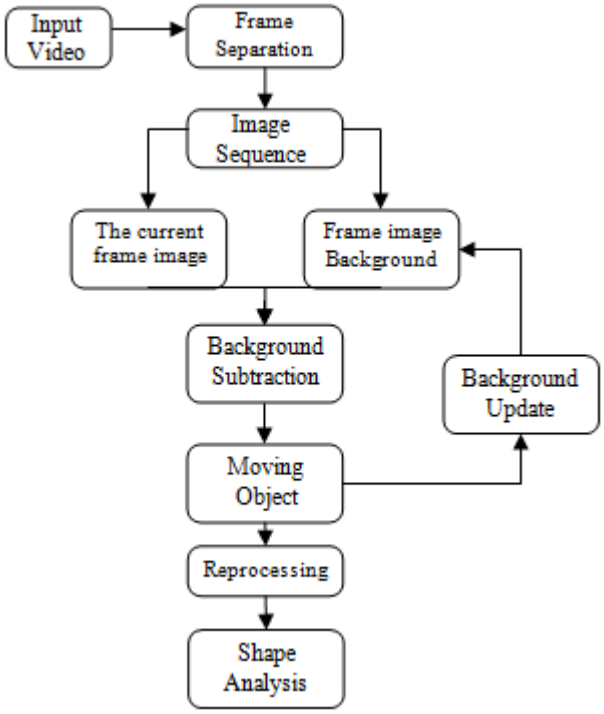

Figure 2: Flow Chart of Background Subtraction Method

5. Application of Traffic Analysis

- Video Surveillance
- Weapon Storage Area
- Toll Plaza Management
- Security system
- Traffic Control

Automatic Number Plate Recognition (ANPR) is also application of Traffic Analysis which identifies the characters directly from the image of the license plate. ANPR play a vital role at toll plaza, high alert areas, and high security places for recognition of unauthenticated and suspicious vehicle. In this paper we try to address this problem of ANPR by using a pixel based segmentation algorithm of the alphanumeric characters in the license plate.

6. Result

Graphical User Interface or GUI is a part of MATLAB, a type of display format that enables the user to choose commands, start programs, and see the result.

Step1: Background subtraction image obtained after Selecting 4 input image for path with different traffic volume on each path

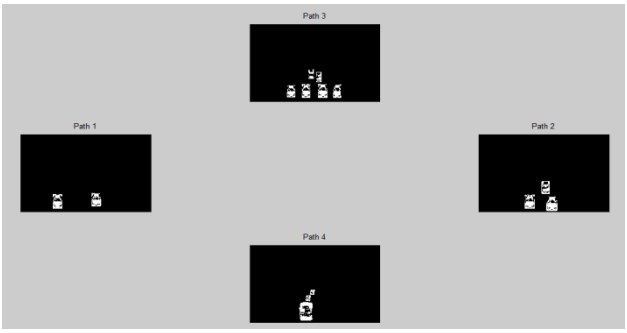

Figure 3: Snapshot of Background Subtraction

Step 2 : Result of traffic analysis with green signal displayed on Path 3 with highest traffic and timer is set for that path as shown in Figure 4.after some time green signal switches to second highest traffic volume Path and finally green signal switch to Path 1 with lowest traffic Path 1as shown in figure 5.

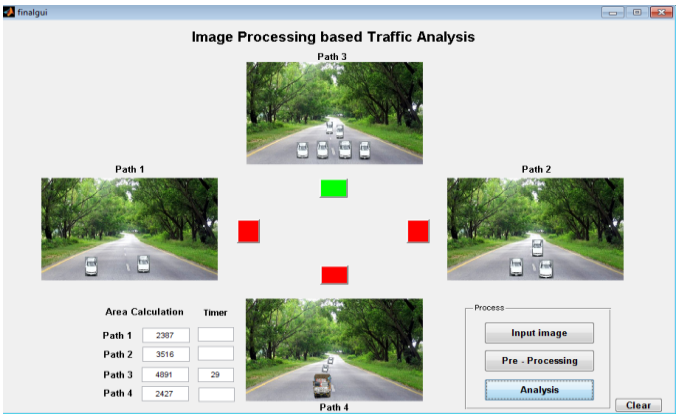

Figure 4: Snapshot of Traffic Analysis with signal on Path 3

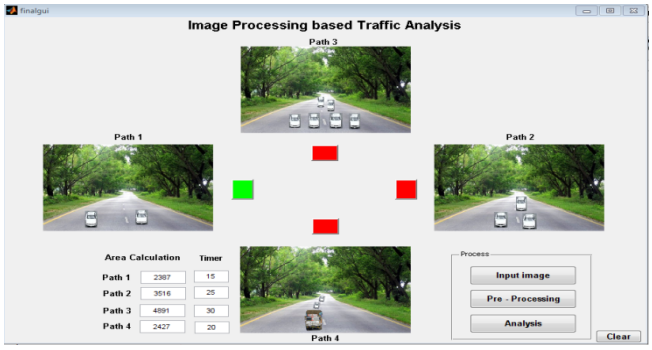

Figure 5: Snapshot of Traffic Analysis with signal on Path 1

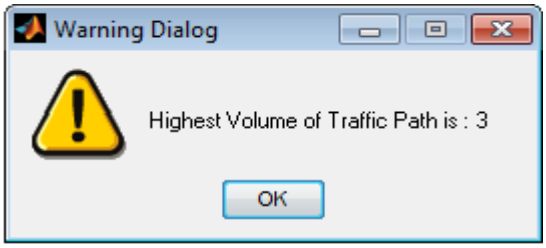

Figure 6: Snapshot of Heavy Traffic Warning Message

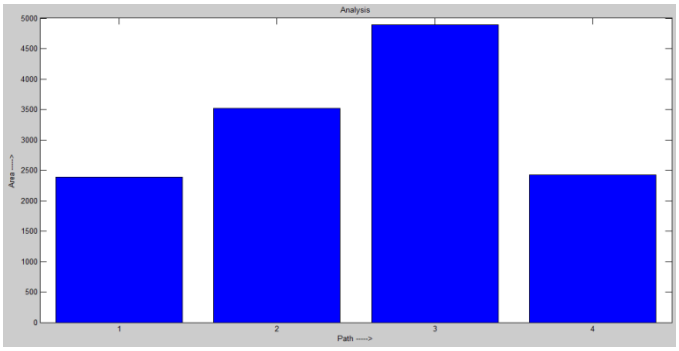

Figure 7: Graphical Representation of Traffic Volume against Path 1,2,3,4

Table 1: Result with Traffic area and Timer values

Traffic Path	Traffic Volume	Timer(insec)
1	2387	15
2	3516	25
3	4891	30
4	2427	20

7. Result of Number Plate Recognition

Step 1: For Number Plate Recognition following Number plate matched with the database number plate contains Stolen vehicle's Number plates thus it shows unauthenticated as below.

Figure 8: Snapshot of Unauthenticated License Number Plate

Step 1: For another Number Plate chosen as input following Number plate does not matched with the database number plate contains stolen vehicle's Number plates thus it shows Person is authorized.

Figure 9: Snapshot of Authenticated License Number Plate

8. Conclusion

In this paper, a method Background Subtraction for estimating the traffic using Image Processing is presented. In cognizance of the shortcomings and deficiencies in the traditional previous method of object (vehicle) detection, we establish reliable background model which use dynamic threshold method to detect moving object and update background. This is done by using the camera images captured from the highway and videos taken are converted to the image sequences. Each image is processed separately and the number of cars has been counted. If the number of cars exceeds a specific threshold, warning of heavy traffic will be shown automatically. Therefore green light signal will immediately display on high traffic road for specific time period after some time Green signal switches to other paths based on traffic area to overcome heavy traffic load till that Red light signal display on low traffic road. The advantages of this new method include such benefits as: 1) Non-use of sensors 2) Low cost and easy setup and relatively good accuracy and speed. Using Automatic Number Plate Recognition (ANPR) we can identify whether the vehicle and Person sitting in Vehicle is Authorized or not. Because this method has been implemented using Image Processing and MATLAB software, production costs are low while achieving high speed and accuracy.

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Author Profile

Ms. Harsha H. Sanap Completed B.E.(EXTC) and Perusing M.E.(EXTC) from Mumbai University.

Prof. P. A. Ghonge Completed M.E.(EXTC) and working as HOD of Electronics Dept. in Yadavrao Tasgaonkar Institute of Engineering & Technology. He has a 15 Years of Teaching Experience.