Estimation of Momentum for Moving Object using Image Morphology

Supriya Bagoji[1] R.R.Maggavi[2]
[1]PG Student [2]Professor
[1,2]Department of Electronics and Communication
[1,2]MMEC, Belgaum, India

Abstract— The main aim of the paper is to count the number of moving vehicles and to estimate the speed of each moving vehicle in a traffic video. In recent years moving vehicle detection, tracking, counting number of vehicles and speed estimation of each moving vehicle has become very important to monitor and control the increasing traffic congestion. Increasing traffic causes traffic jam , this can be controlled by counting the number of vehicles in a particular area and allowing limited number of vehicles at a time in that area. By estimating speed of each moving vehicle, the number of accidents can be reduced by detecting the vehicle moving with high speed. Background subtraction and frame differencing algorithms are used to detect and track the moving vehicles. Further estimating the displacement of vehicle from one frame to next frame in a video sequence and the time taken in accordance with the frame rate, the speed of each moving vehicle in the video can be calculated and the number of moving vehicles is counted.

Key words: Background subtraction, image morphology, frame differencing

I. INTRODUCTION

In recent years there is increasing demand for traffic surveillance system. The increasing number of vehicles day-by- day is causing traffic congestion in urban areas due to which there is increasing need of traffic surveillance system, which provides required information about the number of vehicles and also the speed of each vehicle. High speed of the vehicles is the main reason of increasing accident rate now-a-days. By detecting the speed of each moving vehicle in the traffic, accidents can be controlled to a great extent. Here we count the number of moving vehicles and also detect the speed of each moving vehicle in a traffic video. Real time vehicle tracking is a challenging task due to light intensity variations and background complexions. This application is mainly used in intelligent transportation system.

Traditionally, speed of a vehicle was detected by Radar technology in which a Radar gun was used. Doppler shift phenomenon is the principle of this technique. However this technology has a number of drawbacks such as high cost of the Radar systems and also the accuracy of the output.

Video processing technology is software based technology where, the hardware cost is very low. A low quality video recording camera is the only hardware required for video processing.

In this paper a stationary camera is situated at a high elevation on a road side and the video of the traffic is captured. In order to reduce the hardware cost and to increase the computational efficiency, a low quality camera is used. In this case moving vehicle is detected by background subtraction algorithm and the speed is detected by frame differencing algorithm considering the frame rate. Static background is initially captured through a camera and then the traffic flow is captured so that it will be helpful in background subtraction algorithm. Along with background subtraction algorithm, few morphological operations are used such as, image dilation, image segmentation, measurement operations etc.

There are several methods to detect a moving object in video surveillance systems. Errors occur due to dynamic background, light intensity variation, illumination, reflection, shadow of the object and change in weather conditions. Hence it is important to choose an efficient method to track the exact moving target.

RADAR systems [1] were used traditionally in traffic surveillance systems in which line of sight connection was required between vehicle and radar equipment but they could not become popular due their high installation and maintenance cost and less accurate results. To overcome the drawbacks and limitations of the traditional methods, several new algorithms are developed; few of those are discussed in this section.

Blob detection algorithm [2],[3] was developed to detect the moving object in different video frames by dynamic template matching method but detecting cluster of moving objects in a video sequence was difficult. All the algorithms developed for the detecting of moving object are actually combination of several other methods such as; Background subtraction, optical flow, template matching and space time continuity methods.

Optical flow algorithm [4] is one of the popular methods in detecting moving vehicles. This method makes use of motion flow vectors to track the moving vehicle but real time implementation is expensive and the computational process is very difficult and requires high-end processing capabilities.

Counter based object [5], detection algorithm is another method in object tracking which also combines the use of optical flow method with edge detection. It is more efficient as compared to the previous methods.

Spatio-temporal method [6] represents a Bayesian formulation using temporal coherence to combine both background and foreground models. In statistical model, moving vehicles do not possess uniform features hence, it is difficult to detect them in varying periods of time.

Gaussian mixture algorithm [7] is kind of a background subtraction method in which a sing moving vehicle can be detected but detection of multi vehicles is erroneous.

Portable magnetic sensor system [8] in this system an algorithm based on magnetic model is developed. Portable magnetic sensors are placed at the road side to count the number of vehicles and also to detect the speed. The speed is determined by measuring the passing vehicle's length and the time of detection of the vehicle between two magnetic sensors on the road side. Installation of this system

is expensive and hardware is required which in turn contributes to the overall cost.

Moving vehicle tracking by background subtraction and frame differencing method is a novel and cost effective approach [9]. Centroid of each moving vehicle is detected and speed is determined by measuring the distance travelled and frame rate.

II. PROPOSED METHODOLOGY

In order to give a better perception of the implemented architecture for air quality monitoring, in Figure 1 are presented the main hardware and software element.

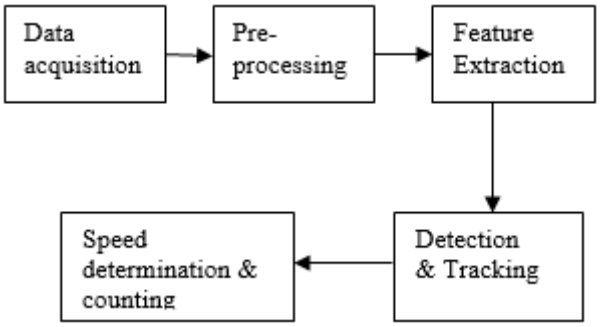


Fig. 1: Basic block diagram of proposed methodology

First step of the proposed system is data acquisition. Video is converted into frame sequence which serves as input for the system and these frames are stored in a buffer. Pre-processing consists of background registration, comparing RGB values of each pixel, gray scale and binary conversion which are necessary for motion detection. Few morphological operations are carried out such as image dilation and erosion. Dilation adds pixel on the object and erosion removes pixel from the object which contributes for feature extraction. Speed of each vehicle in the video is estimated by considering the position of the vehicle in a frame and its displacement. Position is calculated by the rows and columns of the matrix and further displacement of the vehicle from one frame to next is calculated. Speed is then estimated by considering the displacement and the time taken (frame rate). Finally the number of vehicles is counted by incrementing the counter as the vehicle passes the defined line in the video.

A. Data acquisition

The first component is image acquisition. The processes in this component are “video stream” which is an input from the video camera “single-sequence image” which comes from capturing the video stream to single sequence image in one frame, “store image in buffer” which is used to store the images in the buffer, and “display captured image” which will show the image in picture box.

When we subtract two subsequent frames clicked by our cam, the part of image which does not change (background) get subtracted to give zero intensity (black). Only the part of the image moved (moving object) don't get reduced to zero as intensity of pixels of two consecutive frames are different. So we get non zero intensity of pixels corresponding moved objects. Rest is simple. Just convert the image into binary and obtain the centroid of largest area of connected pixels.

Convert color image into binary image. For that step, the method was the conversion with binary value (black & white) function.

In this system for optimum detail of the image, images are converted into black and white images by using MTLAB function im2bw.

In photography and computing, a greyscale or greyscale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of grey, varying from black at the weakest intensity to white at the strongest. So, the processing becomes easier.

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision.

Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries.

The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image.

B. Background subtraction

Background subtraction, also known as Foreground Detection, is a technique in the fields of image processing and computer vision wherein an image's foreground is extracted for further processing (object recognition etc.). Generally an image's regions of interest are objects (humans, cars, text etc.) in its foreground. A motion detection algorithm begins with the segmentation part where foreground or moving objects are segmented from the background.

The simplest way to implement this is to take an image as background and take the frames obtained at the time t, denoted by I(t) to compare with the background image denoted by B. Here using simple arithmetic calculations, we can segment out the objects simply by using image subtraction technique of computer vision meaning for each pixels in I(t), take the pixel value denoted by P[I(t)] and subtract it with the corresponding pixels at the same position on the background image denoted as P[B].

Mathematical expression for Background Subtraction:

$$P[F(t)] = P[I(t)] - P[B]$$

C. Preprocessing & feature extraction

The processes in this component are “consecutive image” which will traverse the whole pixels of background image and it has to compare the RGB value of each pixel at the same time during traversal in the consecutive image process, “store the different RGB value” which is a process that stores the values that come from consecutive image process and it will store value as binary number and, “display binary image” which is used to show the image after previous processes are done, and the image is displayed in black and white. The brightness of surrounding environment is one of the factor that can affect the result because the brightness of environment affects the color value of the road.

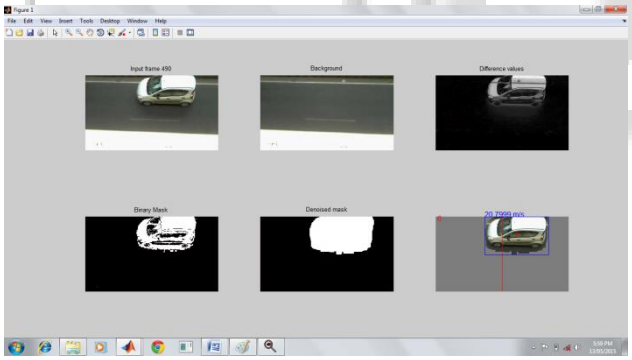
D. Vehicle detection, tracking and counting

In this project we make a program possible to detect multi vehicles on the road which are recorded in video file. Moreover the program can detect the cars. The program contains picture of the road that have no cars. As a background picture and then the program can differentiate the cars from the road and make car detection with a captured image. After the car detection process is done, the program will give a unique number to car and show the number of cars in the program. To provide a better understanding and more details for each operation of vehicle detection and counting. In order to distinguish moving pixels from stationary pixels, first we apply a frame wise analysis on video. The intensity of the objects (in motion) increases or decreases sharply. This gives us the background image without any objects in motion. After the training phase, initial background model for each pixel is obtained. The resulting background image is then used in the background subtraction process. Background subtraction results in an image containing only the moving objects for every frame in that scene. After subtraction we convert the resulting image to a binary image.

E. Estimation of speed

The velocity of vehicle in each frame is calculated using the position of the vehicle in each frame, we can calculate the position by rows and columns, we give the unique id for each vehicle, this information is used the video to calculate velocity(speed).

F. Experimental results



In the above screen shot of an experimental result, the count of number of vehicles in a video sequence can be observed and also a rectangular box on the vehicle displays the speed of that vehicle.

III. SOFTWARE TOOL USED

MATLAB which stands for MATrix LABoratory, is the coding language used here. The version is R2012a

- It is a high level language for technical computing
- Everything is a matrix - easy to do linear algebra
- Very user friendly interface
- Easy and fast to write code
- Supports developing applications with GUI-includes GUIDE

IV. CONCLUSION

The proposed method gives better results as compared to previous techniques. Background subtraction is robust against illumination changes in real world. Also by extracting ROI the noise immunity is improved. As the distance is mapped on the image by calculating it from real world. So the calculated speed is approximated to actual speed.

REFERENCES

[1] Karishma Malhotra1 and Mr. G.S. Sekhon2"Consecutive Frame Scanning Algorithm For Multi Vehicle Velocity Detection", IJCSC Transactions, Vol. 3, No. 1, January-June 2012, pp. 207-210

[2] Jianqiang Ren, Student Member, IEEE, Le Xin, Yangzhou Chen, and Deliang Yang, "High-efficient Detection of Traffic Parameters by Using Two Foreground Temporal-Spatial Images" Proceedings of the 16th International IEEE Annual Conference on Intelligent Transportation Systems (ITSC 2013), The Hague, TheNetherlands, October 6-9, 2013

[3] Prabhakar Telagarapu Department of ECE GMR Institute of Technology RAJAM-532 127, "A Novel Traffic-Tracking System Using Morphological and Blob Analysis", AP, INDIA e-mail:prabhakar.t@gmrit.org

[4] Dolley Shukla, "Speed Determination of Moving Vehicles using Lucas- Kanade Algorithm" International Journal of Computer Applications Technology and Research Volume 2– Issue 1, 32-36, 2013, ISSN: 2319–8656

[5] Masayuki Yokoyama, "A Contour- Based Moving Object Detection and Advanced LSI Design & Development Divisio SoC Business Center Sony Corporatio Tokyo, Japan.

[6] GJiuYue Hao, Chao Li, Zuwhan Kim, and Zhang Xiong, "Spatio-Temporal Traffic Scene Modeling for Object Motion Detection", IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 14, NO. 1, MARCH 2013

[7] Yang Wang, Member, IEEE "Real-Time Moving Vehicle Detection With Cast Shadow Removal in Video Based on Conditional Random Field", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 19, NO. 3, MARCH 2009

[8] Daniel J. Dailey, Member, IEEE, F. W. Cathey, and Suree Pumrin "An Algorithm to Estimate Mean Traffic Speed Using Uncalibrated CamerasIEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 1, NO. 2, JUNE 2000and Mobile Computing (WiCOM), 2011 , pp 1-4.

[9] Shweta Joshi. "Vehicle Speed Determination Using Image ProcessingInternational Journal of Research in Management, Science & Technology (E-ISSN: 2321-3264) Vol. 2, No. 1, April 2014 Available at www.ijrmst.

