RESEARCH ARTICLE OPEN ACCESS

Comparative Analysis of Vehicle Detection and Counting Algorithms for Traffic systems.

Sowmya Kini M, Rekha Bhandarkar
Department of Electronics and Communication, NMAMIT NITTE Karkala Taluk,Udupi Post
Corresponding author; Sowmya Kini M

ABSTRACT— Traffic congestion is a serious issue in the present scenario which needs to be resolved using appropriate and accurate systems. As we know the population in a city is increasing day by day. With this increase in population there is also an increase in the number of vehicles. Major traffic congestion leads to wastage of man-hours and creates havoc in the roadway system. It is necessary to have a system that estimates the size of the traffic using Image processing. An efficient system if developed can reduce this problem to a greater extent. This paper focuses on algorithms for resolving traffic congestion. The paper is also focussed on analysing algorithms to select the best method for real time implementation. A self adaptive system can be developed using Image processing techniques to calculate the traffic density. These systems are cheaper and cost effective as they eliminate the usage of cameras being installed to perform the same task. The paper focuses on a method wherein all the relevant information from the roadway is obtained and then the algorithms are applied on the same to test for efficient results. The result thus obtained is then interfaced with and android application which helps the user get a clear idea of the traffic condition at any given point of time.
Keywords- Image Processing, Matlab, Android Application, Sensors.

Date of Submission: 25-02-2020 Date Of Acceptance: 08-03-2020

I. INTRODUCTION

Traffic congestion is a major problem in and an obstacle in the development of cities and how to rectify the problem in the existing traffic condition is of high practical significance. The two major drawbacks that lead to traffic congestion are the limitation of carrying capacity of the road and inadequate or lack of guiding information. Without accurate information the drivers can select only roads according to experiments and intuition but optimal routines.

It is important to select those routes where the traffic density is lesser to avoid jamming conditions. This can be done with the help of image processing algorithms to generate accurate results.

The system proposed in the paper helps in classifying roadways into lightly, moderately and heavily populated traffic regions using the algorithms and an android application. This helps the driver to identify lightly populated roadways during a traffic jam and thus reducing the number of man hours.

II. LITERATURE SURVEY

[1] Georgios Vigos proposed a system that makes use of an Infrared sensor, AVR-32 microcontroller with programmable flash memory and built in 8 channels Analog to Digital Converter. Infrared sensor is programmed to spot emergency vehicle and microcontroller is deliberated in such a way to give red signal to all the lanes except for the lane consisting of the emergency vehicle. The main disadvantage or a limitation of this system is that it makes use of infrared sensors which needs to be kept in a safe place as it is affected by the varying weather and climatic conditions. Due to the limitation of this system it makes it a slightly lesser reliable technique to achieve the desired results.

[2] Ahmed S presented a new model that makes use of a Wireless sensor system which is used as a communication substructure in the suggested traffic light controller. This structure makes use of Fuzzy Logic techniques to describe the path of the emergency automobiles. Main observing system accumulates all the required statistics and gives the required reaction. A limitation of this system is that communication using wireless sensor network system is still in the area of research. Data exchanges between sensors are not a reliable technique. And sensors need to be robust to respond to all the varying climatic conditions.

[3] Celil Ozkurt provided a method that makes use of active radio frequency identification and global system for mobile communications technology. System includes radio frequency identification tag, Wireless router Wireless Coordinator, Modems using global systems for mobile communication and observing station software. Wireless devices collect the data from Radio frequency identification tags which are attached at the wayside. Observing station collects all the facts from GSM and retorts to

corresponding roadwaysignal. The main limitation of this system is that it involves many communication systems makes the device very costly. Wireless communication systems have their own drawbacks and this also requires a monitoring station to be set up.
[4] Zhou J presented an Optical flow approach method which is quite good because it can find out the moving objects independently and it works very well in varying environmental conditions even when there is no previous information of the background data. However, the computational cost is very high which makes it very difficult to be applied in real time situations. This system is also quite changing to disturbances like the headlights of the vehicles. Due to which it makes it not suitable for traffic control system.

[5] S.Zeadally suggested the progress of (Vehicular Ad Hoc Networks), which are quite significant and interesting amongst the new systems of networks that are coming up in the field of wireless network systems. They provide a medium for communication between the automobiles themselves and between the automobiles and roadway jams. VANET also plays a significant role in concepts such as emerging smart cities. The work done in this paper is based on the outline of a smart city that send facts and figures about the conditions of the traffic and thus helps the vehicle drivers to take immediate and smarter decisions to avoid their vehicles from getting stuck in vehicular jams. This finally helps in reduction of traffic jams. Limitations include direction-finding procedures being highly dependent on global positioning systems. Also the location servers are not always in the range. It is also a very unsuccessful system in low vehicle mass conditions.

[6]Ye Li proposed another method which makes use of AND OR graph synonymously called as the AOG method. This method makes use of constructing an AND OR graph, complicated vehicle feature detection by taking into account the most easily and flexibly visible feature and eliminating the smaller features of the vehicle. A breakdown of the automobile depiction is shown and presented using the AOG method which further helps in the reduction of traffic occlusions and jams on highways. A calculable trial was also conducted under various traffic conditions especially during the peak and heavily crowded conditions. This method was used to effectively deal with automobile profile, automobile gesture, automobile stance and the climatic or weather conditions over the time of day. A limitation of this method was it was restricted only to cars and a method had to be developed for vehicles like a bus. Also this method cannot be applied to actual time automobile video processing and reconnaissance. Also in case of a red car the system fails to identify if it is a rear sight or front sight vehicle which disturbs the accuracy of the system making the system not a reliable one for real time applications.

[7]Jie Xia, the study of this paper revealed the tracking target to be calibrated manually and can track single target at a time. This paper proposes a vehicle tracking is based on double difference method and CAMShift (continuously adaptive mean-shift) algorithm. By using a multi-tracker CAMShift algorithm moving vehicles in traffic video can automatically improve and achieve multi-target tracking. Effectively tracking interested target in video sequences is an important problem in computer vision area it can contain more information as compared static single frame images. The real time detection and multi-moving vehicle tracking is the base of intelligent monitoring system, It is use to detect and track moving vehicles in traffic video surveillance and mark it for different operations such as classification and identification. Real-time detection and tracking of moving vehicles locate vehicle quickly and accurate without subtraction foreground by background image from current video frame, because the.

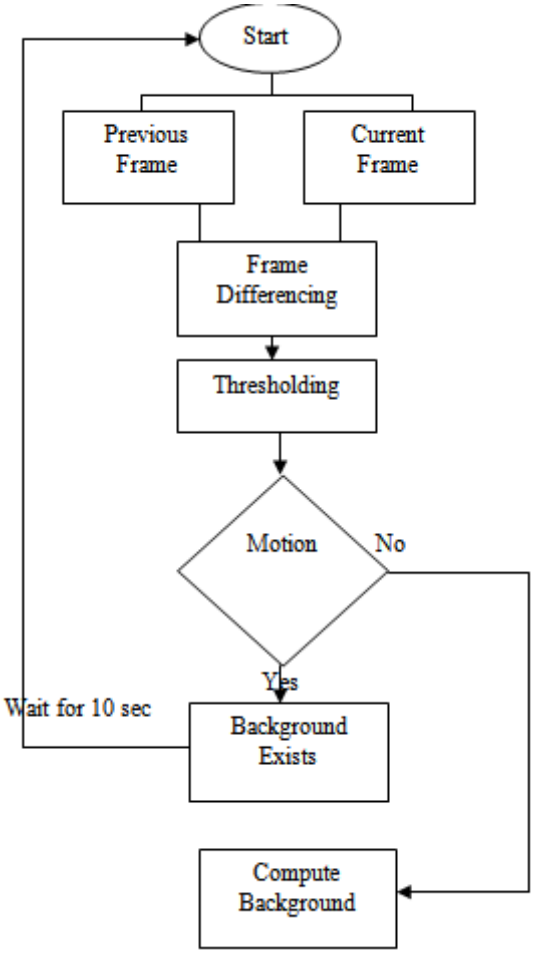
III. METHODOLOGY

Cameras placed at lanes or several nodes continuously monitor the traffic. The recorded video is extracted into frames; these frames are then sent into the server. At the server the frames are processed further for brightening, blurring, sharpening etc. Algorithms are used based on which the count of vehicles in each frame is estimated to decide about lightly, moderately and heavily populated roadways. The server then updates its status as low traffic, high traffic and medium traffic.

The picture of a road is represented as a digital data which has to be processed before use to extract all the relevant information from it. This has to be mandatorily done because the image captured from a natural environment is raw and not in the form of a formatted data. Hence it includes several operations such as Image enhancement, Image Brightening, Image Blurring, Image sharpening etc. Methods used to detect and count vehicles include Frame Differencing, GMM and Optical Flow Methods.

A. Frame Differencing method

It is a method where the computer checks the difference between two video frames. There is apparently some motion if the pixels have changed. The flow chart of frame differencing method is depicted below.



Most techniques work with some blur and threshold to detect real movement, because frames could differ when lighting conditions change. This method is also popularly known as temporal difference method as it subtracts the video frame at time t-1 with the background model for the frame at time t. It basically computes the absolute difference between the pervious and current frames.

In two frame differencing method two frames are taken into consideration and then subtracted in terms of intensities at each pixel resulting in an image giving brief idea about the moving object region. In this method pixel wise difference current frame and previous frame of the video are used to extract the moving object. It is a type of background subtraction method in which the last frame becomes the background for the current frame and difference is calculated.

This method has some limitations such as: Important pixels are not extracted properly leaving holes in the moving entity, in slow moving objects the difference is almost zero resulting in no moving objects, unable to detect objects in case they stop moving, sensitive to noise and changes in illumination.

B. Gaussian Mixture Model (GMM) method

It is used to capture the background using the Gaussian mixture model both in colour, its depth and amplitude modulation. Then a new function known as matching function is used which allows better noise treatment and shadow treatment. This helps in overcoming the problem of fusing high resolution colour information. To overcome the problem of fusing high resolution colour information with low resolution depth, this approach is tested with GMM method with different factors. GMM method works on the following principles:

- There should be no changes in the results when the ordinary background subtraction based on colour works.
- If the foreground classification is not done properly with respect to its colour then this should be compensated with its depth.
- If the noise and shadow treatments of the colour based background subtraction is far from accurate then it should be improved through depth information.

C. Optical Flow Method

Optical Flow is estimated through two consecutive frames, image pyramids. Images are segmented into binary images after which through morphological operations and rectangular splitting algorithms on images moving vehicles will be extracted from the background. The detection accuracy of optical flow method is higher than the temporal difference method hence this method is most suitable for multi object moving analysis. Through optical flow estimation techniques motion parameters of the moving objects can be obtained. Also at the same time phenomenon of Image blocking and overlapping can be avoided as far as possible. Due to these advantages optical flow method is used for vehicle detection.

Steps involved in vehicle detection and tracking are as below:

Step 1: Computing Optical Flow.
Step 2: Computing Threshold of Optical Flow Image.
Step 3: Threshold Segmentation.
Step 4: Morphological Transformation Filter on Image.
Step 5: Extracting Vehicle Images with Rectangle.

Optical Flow method has several advantages over the other two methods and hence it is preferred for vehicle tracking and counting.

IV. RESULTS

The methodologies listed above were simulated using Matlab and the results obtained are as depicted below

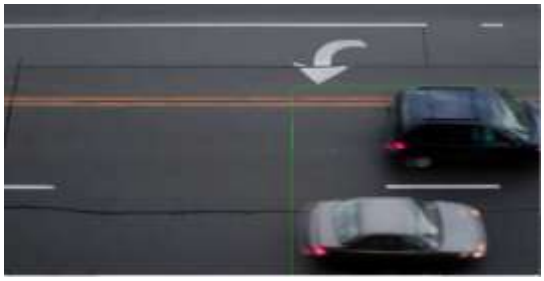


Fig. 1 Output using Frame Differencing Method

Fig. 2 Output based on GMM Method

Fig. 3 Output based on Optical Flow Method

From the simulations it is clear that frame differencing has certain disadvantages such as when there is a moving background tracking becomes difficult while in GMM based method accuracy is not up to the mark. Comparatively in optical flow method the results are efficient except for the method being slightly iterative and time consuming. Hence we conclude that optical flow method is one of the best methods out of the existing technologies for vehicle detection.

V. CONCLUSION AND FUTURE SCOPE

By conducting experiments and simulations on these three methods it is found that Optical Flow method gives almost efficient results if the time required for each iteration is reduced. Future work also includes simulations using AOG method and fuzzy logic methods for the same to derive better and efficient results.

REFERENCES

[1] Georgios Vigos "Real-time estimation of vehicle-count within signalized links", Journal of Transportation Research Part C: Emerging Technologies, Volume 16, Issue 1, pp.18–35, February 2008.

[2] Ahmed S,"Intelligent Cross Road Traffic Management System (ICRTMS),"Proceedings of 2nd International Conference on Computer Technology and Development, pp. 27-31, Nov 2010.

[3] Celil Ozkurt "Automatic Traffic Density Estimation and Vehicle Classification for Traffic Survillance Systems Using Neural Networks", Journal of Mathematical and Computational Applications, Vol. 14, No. 3, pp. 187-196, May 2009.

[4] Zhou J "Moving Vehicle Detection for Automatic Traffic Monitoring," Vehicular Technology, pp.51-59, Jan 2007.

[5] S.Zeadally "Vehicular Ad Hoc Networks:status,results,and challenges" Telecommunication Systems Volume 50,Issue 4,pp 217-241.

[6] Ye LiVehicle detection based on AND OR Graph for congested traffic condition, Volume 14, Isuue 2, June 2013.

[7] Salama A.S,Intelligent cross roadtraffic management systems,Computer Technology and Development, 2010 First International Conference,pp.119,123,5-7 August 2010.

[8] R PorterWide Area Motion Imagery,"Volume 27, Ahmed Elliethy,Automatic registration of wide area motion imagery to vector road maps by exploiting vehicle detections, Volume 25, Isuue 11,November 2016.

[9] P.M.Daigavane "Real Time Vehicle Detection and Counting method for unsupervised traffic video on Highways" IJCSNS, International Journal of Computer Science and Network Security,Vol 10, No 8, August 2010.

[10] Badura.S:Lieskovsky,A.,"Intelligent Traffic System Cooperation of MANET and Image Processing" ,2010 First International Conference, Volume 22,pp.27.31,2-4 November 2010.

[11] Chandrasekhar. M, Saikrishna. C, Chakradhar. B, Phaneendra Kumar. P & Sasanka. C, "Traffic Control using Digital Image Processing",International Journal of Advanced Electrical and Electronics Engineering, ISSN (Print): 2278-8948, Volume-2, Issue-5, 2013.

[12] Jialue Fan, Xiaohui Shen and Ying Wu, " What are we Tracking: A Unified Approach of Tracking and Recognition", IEEE Transactions on Image Processing, Vol.22, No.2, pp. 549-560, 2013.

[13] Karan Gupta, Anjali V. Kulkarni, "Implementation of an Automated Single Camera Object Tracking System using Frame differencing and Dynamic Template Matching", International Joint Conferences on Advances in Computer, Information, System Sciences and Engg. Sponsored by IEEE, Bridgeport, pp. 245-250, 2007.

[14] Yilmaz, O. Javed and M. Shah, "Object Tracking: A Survey", ACM Comput. Surv. Vol.38, No.4, pp.1-13, 2006

[15] Ismail Haritaoglu, David Harwood and Larry S. Davis, "W 4: Who? When? Where? What? A Real Time System for Detecting and Tracking People", IEEE Transaction on Patt. Analy. Mach. Intell, Vol. 22, No. 8, pp. 809-830, 1998

[16] G. Mallikarjuna Rao and Dr.Ch.Satyanarayana, "Object Tracking System Using Approximate Median Filter, Kalman Filter and Dynamic Template Matching", I.J. Intelligent Systems and Applications,Vol.6, No.5, pp. 83-89, 2014.

[17] Prerna Rajput and Vikas Tripathi, "New Trends in Object Motion Analysis", International Journal of Advanced Research in Computer Science and Software Engineering, Vol.4, No.4, 2014.

[18] N. Prabhakar, V. Vaithiyanathan and Akshaya Prakash Sharma, "Object Tracking Using Frame Differencing and Template Matching", Research Journal of Applied Sciences, Engineering and Technology, Vol.4, No.24, pp. 5497-5501, 2012.

[19] Rahul Mishra, Mahesh K. Chouhan, Dr. Dhiiraj Nitnawwre, "Multiple Object Tracking by Kernel Based Centroid Method for Improve Localization", I.J of Advanced Research in Computer Science and Software Engineering, Vol.2, No.7, pp. 137-140, 2012.

[20] R. Venkatesh Babu , Patrick Perez and Patrick Bouthemy ," Robust tracking with motion estimation and local Kernel-based color modeling", Elsevier, Vol. 25, No. 8, pp. 1205-1216, 2007.

[21] Sowjanya kotte & Hima Bindhu Yanamadala ―Advanced Vehicle Tracking System on Google Earth Using GPS and GSM‖, International Journal of Computer Trends and Technology (IJCTT)‖ – volume 6 number 3– Dec 2013.

[22] Abid Khan & Ravi Mishra ―GPS – GSM Based Tracking System‖ International Journal of Engineering Trends and Technology- Volume 3 Issue 2- 2012 ISSN: 2231-5381.

[23] Hsu-Yung Cheng, Po-Yi Liu, Yen-Ju Lai, "Vehicle Tracking in Daytime and Nighttime Traffic Surveillance Videos", 2nd International Conference on Education Technology and Computer (ICETC), 978-1-4244-6370-1/$26.00 © 2010 IEEE.

[24] Amirali Jazayeri, Hongyuan Cai, Member, IEEE, Jiang Yu Zheng, Senior Member, IEEE, and Mihran Tuceryan,Senior Member, IEEE, "Vehicle Detection and Tracking in Car Video Based on Motion Model", Transactions On Intelligent Transportation Systems, VOL. 12, NO. 2, 1524- 9050/$26.00 © 2011 IEEE.

[25] Lei Xie, Guangxi Zhu*, Miao Tang, Haixiang Xu, Zhenming Zhang, "Vehicles Tracking Based on Corner Feature in Video-based ITS", 6th International Conference on ITS Telecommunications Proceedings, 0-7803-9586- 7/06/$20.00 © 2006 IEEE.

[26] R. Ramani, S. Valarmathy, Dr. N. Suthanthira Vanitha, S. Selvaraju, M. Thruppathi, R. Thangam, "Vehicle Tracking and Locking System Based on GSM and GPS", I.J. Intelligent Systems and Applications, 2013, 09, 86-93 © MECS.

[27] Raad Ahmed Hadi, Ghazali Sulong and Loay Edwar George, "Vehicle Detection and Tracking Techniques: A Concise Review", An International Journal (SIPIJ), Vol.5, No.1, February 2014.

[28] Jie Xia, Jian Wu, Haitao Zhai, and Zhiming Cui, "Moving Vehicle Tracking Based on Double Difference and CAMShift",International Symposium on Information Processing (ISIP'09), Huangshan, P.R. China, August 21- 23, 2009, pp. 029-032.

Sowmya Kini M, "Comparative Analysis of Vehicle Detection and Counting Algorithms for Traffic systems." *International Journal of Engineering Research and Applications (IJERA*), vol.10 (03), 2020, pp 50-54.