Automatic Alert System for Red Light Violation Using Surveillance Cameras

P.Vimal Kumar#1, D.Vasanth Kumar#2, R.Muthu Krishnan#3

1,2,3,4 Department of Electronics and Communication Engineering
#JEPPIAAR SRR Engineering College, Old Mamallapuram road, I.T. Highway, Padur, Chennai -603103.

---***---

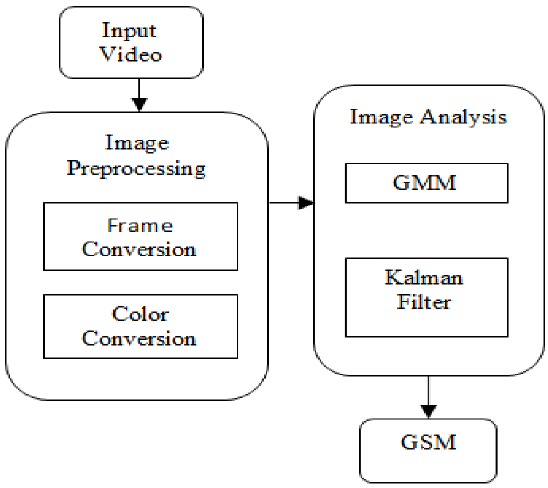
Abstract-*In the vehicle transportation domain to identify unusual patterns such as traffic violations, accidents, unsafe driver behavior, street crime, and other suspicious activities. Vast amounts of video footage are collected and analyzed for traffic violations, accidents, crime. The problem of finding patterns in data that do not conform to expected behavior violations are likely to happen before the stop line in the red-light violation detection region. We have developed the effective algorithms that can aid in the semi- automatic interpretation and analysis of video data for surveillance. First background subtraction is accomplished via the use of a Gaussian Mixture Model (GMM). Calculate the number of connected foreground pixels, and deem the connected segment to be a vehicle if this exceeds a threshold. Least-squares Cubic Spline Curves Approximation and mean square displacement (MSD) representation of trajectories used to track the centroid of the blob over time in order to obtain the object trajectory.*

Keywords: Red light violation, Gaussian Mixture Model, Least-squares Cubic Spline Curves Approximation, mean square displacement, object trajectory.

INTRODUCTION

With an increasing demand for security and safety, video based surveillance systems are being increasingly used in urban traffic locations. Vast amounts of video footage are collected and analyzed for traffic violations, accidents, crime. The problem of finding patterns in data that do not conform to expected behavior violations are likely to happen before the stop line in the red-light violation detection region. It is found that detecting the object from the video sequence and also track the object it is a really challenging task. Object tracking can be a time consuming process due to amount of data that is contained in the video. From the literature survey it is found that there are many background subtraction algorithm exits which work efficiently in both indoor and outdoor surveillance system. Background modeling technique and used another algorithm to detect shadowed region. But the shadow removal technique is an overhead for object tracking algorithm. It will be better if the shadow can be removed at the time of the foreground object detection algorithm by designing an efficient algorithm, which can properly classify the foreground object and background removing false foreground pixel from detection. Then there will no extra computation needed for shadow detection and removal. Video surveillance is the most active research topic in computer vision for humans and vehicles. Here the aim is to develop an intelligent visual surveillance system by re-placing the age old tradition method of monitoring by human operators. The motivation in doing is to design a video surveillance system for motion detection, and object tracking. The area of automated surveillance systems is currently of immense interest due to its implications in the field of security. Surveillance of vehicular traffic and human activities offers a context for the extraction of significant information such as scene motion and traffic statistics, object classification, human identification, anomaly detection, as well as the analysis of interactions between vehicles, between humans or between vehicles and humans. A wide range of research possibilities is open in relation to video surveillance and tracking.

BLOCK DIAGRAM



BLOCK DIAGRAM DESCRIPTION

A. Input Video-

Video acquisition is the first stage of the process. Video is obtained from the local surveillance cameras that are present in the traffic signals, these videos are collected and stored thus the processing can be done to the obtained videos. However if the videos are not obtained then the intended tasks cannot be performed.

B. Image Preprocessing-

To enhance the image features which are important for further processing preprocessing is been done.

Frame Conversion--Frame conversion is the process of converting the videos into frames as videos are collection of frames. Image processing is associated with images there is a necessity to convert the videos into images arises thus by means of frame conversion the video is converted to total number of frames present in the video. Thus the future processing can be done to the images.

Color Conversion--Color conversion is the process of conversion of color image into a gray scale image. That is the pixel value of color image(RGB) 24bit can be converted to gray scale which is of 8bit.

C. Image Analysis—

Image analysis method consists of following algorithm to detect the red light runners. At first Gaussian Mixture Model is used to subtract the background then kalman filtering is done to employ the relationship between the foreground objects in each frame and finally the Mean square displacement is calculated to object to check whether the object is moving or not.

Gaussian Mixture Model--Gaussian mixture models (GMM) is used to obtain the background subtraction. Background subtraction is process of separating the background and the desired object. The process is obtained by means of the GMM algorithm. GMM are composed of k multivariate normal density components, where k is a positive integer. Each component has a d-dimensional mean (d is a positive integer), d-by-d covariance matrix, and a mixing proportion. Mixing proportion j determines the proportion of the population composed by component j. Fit a GMM using the Statistics and Machine Learning Toolbox by specifying k and by supplying X, an n-by-d matrix of data. The columns of X correspond to predictors, features, or attributes, and the rows correspond to observations or examples. By default, fits full covariance matrices that are different among components (or unshared).GMMs to data using the iterative Expectation-Maximization (EM) algorithm. Using initial values for component means, covariance matrices, and mixing proportions, the EM algorithm proceeds using these steps. For each observation, the algorithm computes posterior probabilities of component memberships. Using the component-membership posterior probabilities as weights, the algorithm estimates the component means, covariance matrices, and mixing proportions by applying maximum likelihood. This is the M-step of the EM algorithm.
Kalman Filter--Kalman Filter is used to establish the relationship between They are based on Optimal Recursive Data Processing Algorithm. The Kalman Filter performs the restrictive probability density propagation. Kalman filter is a set of mathematical equations that provides an efficient computational (recursive) means to estimate the state of a process in several aspects: it supports estimations of past, present, and even future states, and it can do the same even when the precise nature of the modeled system is unknown. The Kalman filter estimates a process by using a form of feedback control. The filter estimates the process state at some time and then obtains feedback in the form of noisy measurements. The equations for Kalman filters fall in two groups: time update equations and measurement update equations. The time update equations are responsible for projecting forward (in time) the current state and error covariance estimates to obtain the priori estimate for the next time step. The measurement update equations are responsible for the feedback. Kalman filters always give optimal solutions.

Kalman filter algorithm:The Kalman filter estimates a process by using a form of feedback control: the filter estimates the process state at some time and then obtains feedback in the form of (noisy) measurements. As such, the equations for the Kalman filter fall into two groups: time update equations and measurement update equations.The time update equations are responsible for projecting forward (in time) the current state and error covariance estimates to obtain the a priori estimates for the next time step.

The Kalman filter addresses the general problem of trying to estimate the state $x \in \Re n$ of a discrete-time controlled process that is governed by the linear difference equation:

$$xk = Axk - 1 + Buk - 1 + wk - 1$$

with a measurement z that is

$$zk = Hxk + vk$$

The random variables wk and vk represent the process noise and measurement noise respectively.The nxn matrix A in the previous difference equation relates the state at the previous time step k-1 to the state at the current step k , in the absence of either a driving function or process noise.The nxl matrix B relates the optional control input u to the state x. The mxn matrix H in the measurement equation relates the state to the measurement zk.

Mean Square Displacement(MSD)-- Mean squared displacement (MSD, also mean square displacement, average squared displacement, or mean square fluctuation) is a measure of the deviation of the position of a particle with respect to a reference position over time. It is the most common measure of the spatial extent of random motion, and can be thought of as measuring the portion of the system "explored" by the random walker. In the realm of biophysics and environmental engineering, the Mean Squared Displacement is measured over time to determine if a particle is spreading solely due to diffusion, or if an advective force is also contributing.[1] Another relevant concept, the Variance-Related Diameter (VRD, which is twice the square root of MSD), is also used in studying the transportation and mixing phenomena in the realm of environmental engineering.[2] It prominently appears in the Debye–Waller factor (describing vibrations withinthe solid state) and in the Langevin equation (describing diffusion of a Brownian particle). Thus the mean square displacement of the required object can be found.

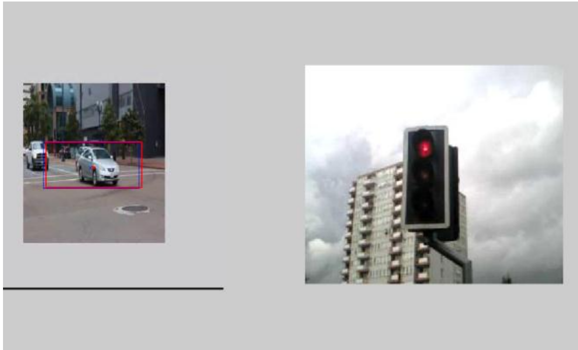


Fig.1 Detected moving object during red signal

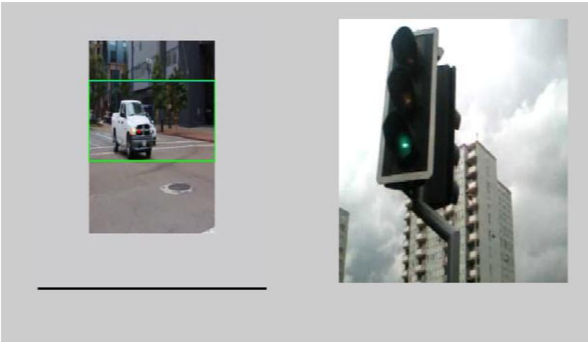


Fig.2 Detected moving object during green signal

GSM

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment.

Fig.3 GSM Kit Design

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

A GSM modem can also be a standard. GSM mobile phone with the appropriate cable and software driver to connect to a serial port or USB port on your computer. GSM modem is usually preferable to a GSM mobile phone. The GSM modem has wide range of applications in transaction terminals, supply chain management, security applications, weather stations and GPRS mode remote data logging

DATA FLOW

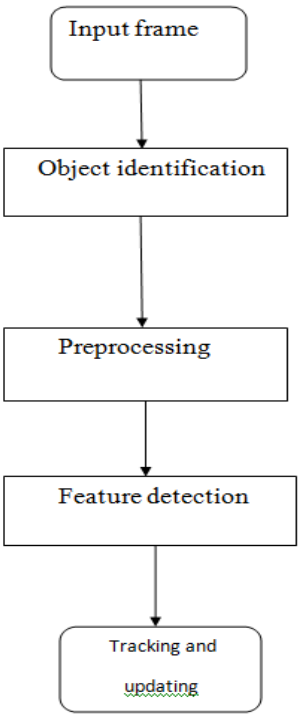


Fig.4 Data Flow Graph

CONCLUSION

Visual tracking plays a critical role in computer vision that finds many practical applications (e.g., motion analysis, video surveillance, vehicle navigation and human-computer interaction). Although significant progress has been made in the past decades, developing a robust tracking algorithm is still a challenging problem due to numerous factors such as partial occlusion, illumination variation, pose change, complex motion, and background clutter. In this paper, we propose a generative tracking method based on a novel robust linear regression algorithm. In contrast to existing methods, the proposed Least Soft-threshold Squares (LSS) algorithm models the error term with the Gaussian-Laplacian distribution, which can be solved efficiently. Thus it recognizes the object and successfully tracks the object by means of the algorithm.

REFERENCES

[1] R. H. Brasil and A. M. C. Machado "Automatic Detection of Red Light Running Using Vehicular Cameras ", 2017 IEEE Latin America transaction, vol 15,No.1,JAN.2017

[2] P. P´erez, C. Hue, J. Vermaak, and M. Gangnet, "Color-based probabilistic tracking,in Computer Vision and Pattern Recognition (CVPR)", 2012 IEEE Conference on, pp. 1838-1845, IEEE, 2012.

[3] W. Zhong, H. Lu, and M.-H. Yang, "Robust object tracking via sparsitybased collaborative model," in Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on, pp. 1838-1845, IEEE, 2012

[4] J. Kwon and K. Lee, "Visual tracking decomposition," in Computer Vision and Pattern Recognition (CVPR), 2010 IEEE Conference on, pp.1269-1276, IEEE, 2010.

[5] B. Babenko, M.-H. Yang, and S. Belongie, "Visual tracking with online multiple instance learning," in Computer Vision and Pattern Recognition, 2009. CVPR 2009. IEEE Conference on, pp. 983-990, IEEE, 2009

[6] D. A. Ross, J. Lim, R.-S. Lin and M.-H. Yang, "Incremental learning for robust visual tracking," International Journal of Computer Vision, vol.77, no. 1-3, pp.125-141, 2008.