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MOVING VEHICLE DETECTION FROM VIDEO SEQUENCES FOR TRAFFIC SURVEILLANCE SYSTEM

Jency Rubia J*[1], Babitha Lincy R[2] and Ahmed Thair Al-Heety[3]

[1] Assistant Professor, M.A.M. College of Engineering and Technology. Tiruchirappalli, India.
[2] Department of Electronics and Communication Engineering, Sri Venkateshwara College of Engineering. Bengaluru, India.
[3] Department of Electrical, Electronic and Systems Engineering, Universiti Kebangsaan Malaysia. Bangi, Selangor, Malaysia.

[1] http://orcid.org/0000-0002-0088-3611, [2] http://orcid.org/0000-0003-2520-2410, [3] http://orcid.org/0000-0002-1863-9318

Email: *jencyrubia@gmail.com, rblincy@gmail.com, ahmedth162@gmail.com

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ABSTRACT

In the current scenario, Intelligent Transportation Systems play a significant role in smart city platform. Automatic moving vehicle detection from video sequences is the core component of the automated traffic management system. Humans can easily detect and recognize objects from complex scenes in a flash. Translating that thought process to a machine, however, requires us to learn the art of object detection using computer vision algorithms. This paper solves the traffic issues of the urban areas with an intelligent automatic transportation system. This paper includes automatic vehicle counting with the help of blob analysis, background subtraction with the use of a dynamic autoregressive moving average model, identify the moving objects with the help of a Boundary block detection algorithm, and tracking the vehicle. This paper analyses the procedure of a video-based traffic congestion system and divides it into greying, binarisation, de-nosing, and moving target detection. The investigational results show that the planned system can provide useful information for traffic surveillance.

I. INTRODUCTION

Computer vision is a widely exploiting research area in the applications like automation system, robotics, Optical Character Recognition, human-machine interface, Natural Language Processing, and video analysis [1]. Moving item tracking is an important research area in the computer vision applications. The finding and tracking of the moving target is essential in several applications, particularly in video surveillance system. This research has made an experiment on tracking and finding moving vehicles at the video surveillance scenario. The video surveillance system usually contains both static and moving objects. The main task is to identify the physical movement of a moving object in a particular area. The objects that are present in the video system can be determined by moving object techniques. This design supports the automatic finding and tracking of the moving vehicles from the video. The automatic finding of the moving vehicles is used to found a connection between targets or object parts in following frames and to extract temporal details about the target like trajectory, speed direction, and posture [2]. Tracking of the moving vehicles is used to detect the objects frame by frame in video. It can be used in numerous regions such as video investigation, traffic monitoring and people tracking.

In the fast developing cities, Traffic organisation is becoming one of the most important concerns. May be a huge amount of man-hours get wasted due to bad traffic organization [3]. Growing traffic jams on public road and difficulties related with current detectors has created an attention in vehicle recognition equipment such as video image processing. Computerized motion detection and tracking is an interesting task in traffic surveillance. Data science based algorithms are the top most trending research topic. The humans has the ability to easily identify and recognize the moving targets from complex scenes in a flash. Transforming this knowledge to a machine requires data science based object detection algorithm with computer vision techniques [4]. One more thing, the human can't track the vehicles manually in heavy traffic areas. But the automatic computer vision based traffic surveillance system could easily

track a number of useful things simultaneously like number of vehicles presented in particular day, traffic time, types of vehicles crossing the road, and so on [5]. Video based traffic congestion observing systems are most puzzling problem. The urbanization drives the growing of traffic flow. Usually, traffic control is a complex issue, it requires monitoring. But the monitoring system are tedious. Recently, with the development of computer, network, image processing, transmission technology, and hardware, video monitoring systems are widely used in different domains and areas. But most of them rely on high Performance of hardware, limiting effectiveness and efficiency, especially in accuracy and response. Hence we will focus on optimization of the video input based traffic congestion observing system, mainly in image processing and moving object finding.

In this research, an arrangement is designed to collect beneficial statistics from stationary cameras for sensing moving items in digital videos. The moving detection and tracking system is created based on optical flow estimation composed with application and mixture of various relevant computer vision and image processing techniques to improve the progression [6]. Median filter is utilized to remove noise and the undesirable items are detached by applying thresholding algorithms with morphological operations. The tracking tool initially read out the video in frame format and then translates them into grey scale images. Also the object type restrictions are set using the blob analysis. The outcomes display that the proposed system productively detects and tracks moving vehicles in urban videos.

II. MATERIALS AND METHODS

The huge rise of the vehicles is creating the roads full results in lot of traffic jam and it becoming more serious issue day by day. So, the finding to vehicles is of great importance [7]. Video tracking system is the most standard way of finding due to its vast advantage. Generally, the traffic management system uses the immovable and static camera for nonstop observation. It investigates the selected sequential images from the video and frame, in order to detect and track the moving item. Automated visual surveillance is currently a hot topic in computer vision research [8]. The proposed research can implement great useful high-value application such as surveillance, fighting crime, traffic management, etc. using object detection systems. The idea behind the detecting and tracking the moving target in videos is computer vision algorithm, since the object tracing is an attractive research in computer vision applications [9]. Most importantly the entire research is going to deal with video data. Usually the moving target detection problem follows multiple ways of techniques to resolve the issues. In that one of the main techniques is training the model with deep learning models or pre-trained model based training. These both methods are supervised learning methods and they have need of labelled files to train the object detection system. So the proposed work concentrates on the unsupervised way of object detection in videos, that means object detection without using any labelled data [10].

The objective of this project is to identify and track moving vehicles within a video sequence. The detection of the moving vehicle is depends on the optical flows between the two continuous video frames, which is opposite to the process of image background-based detection [11]. Moving target detection includes the following techniques Frame differencing, background subtracting, image thresholding finding contours, and morphological operation. Frame differencing is one of the main technique in moving object detection from video files. A video is a combination of frames [12]. When tracking the moving vehicle in a video, that vehicle is at a different position at every frame. Other than these moving objects, other things will be stable in position. So in the process of frame differencing, noticing the pixel difference of the first frame from the following frame will highpoint the pixels of the moving object. The next process is image thresholding, in that step the pixels are assigned in two values based on threshold value. If the pixel value is less than threshold, then the pixel is represented as black and white colour; greater than threshold value pixel is represented by opposite value of previous representation. By using this image threshold, the unwanted part of the image will remove. The next steps are detecting the contours and image dilation [13]. The frame differencing is given in the equation form at Equation 1. Where 'Th' is threshold value.

$$|\text{Frame i}–\text{frames i-1}| > \text{Th} \quad (1)$$

The background subtraction techniques are the main process to diagnose the moving target from the sequence of video frames that varies considerably from a background [14]. Generally, the background image will demonstrate about the parts without moving target. So there are many practical challenges in choosing the best background subtraction technique. Mostly the researchers consider the frame differences to analysis the moving object and find object boundary, which may be pretty time consuming [15]. Since the video can be defined as sequence of frames which consist of images, where each sequence of image is displayed with high speed, so that normal human eye cannot visual the time gap among the frames. Mostly computer system uses a fixed still camera and it is used in object detection process much more feasible. Usually, a frame taken from a video sequence is split into two distinct set of pixels, where the next one is complementary to the first one. The first set belongs to the foreground object while the other one belongs to the background objects. The definition of foreground and background objects very much depends on the application being used [16]. Normally, the objects like people, vehicles, and animals etc. are considered as a foreground objects and rest of the things are considered as background. The background subtraction is displayed in Figure 1.

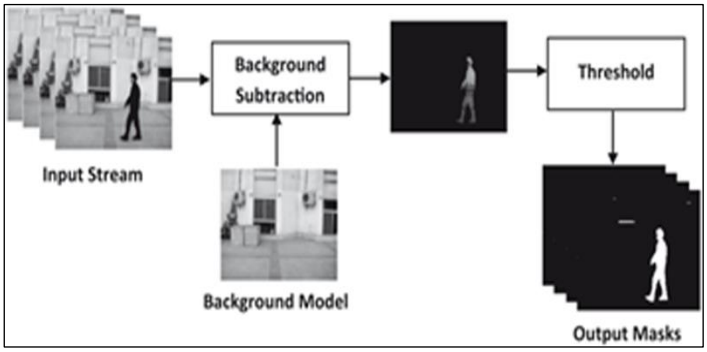

Figure 1: Back ground subtraction.
Source: Authors, (2020).

Tracking moving vehicle from a video has different kinds of challenges like shadows, illumination issues, and quality of video in closed location [17]. When compare with close location, the open scenario based moving vehicle detection is more challenging due to moving shadows, and occlusion issues. So this section explains the challenges in moving vehicle tracking from a video. Illumination is the one of the main challenge. Illumination means false positive value, which is occurs due to variation in

lighting. In closed scenario light on-off changes is the main reason for illumination. At the same time, in closed location sun light, rainy clouds and reflection from other objects affects the tracking [18]. If the back ground colour is similar with moving vehicle colour also one of the reason for illumination problem. Complex background also affects the result of tracking moving vehicle from the input video.

III. ARCHITECTURE OF MOVING VEHICLE TRACKING SYSTEM

As a core component of intelligent transportation, the real-time and effective vehicle counting method is of great significance for the expressway management department to implement traffic management and control violations. Since expressway has the characteristics of large traffic flow and high speed, once traffic jam and parking events occur, it is easily to cause traffic accidents, which is extremely harmful to traffic safety. Over the previous numerous years, video surveillance tools was connected in entirely key segments of the expressways, however the moving vehicle counting is still depends on sensors or simply out-dated image processing approaches, which consequences in serious road damage, costly information structure, and less moving vehicle counting accuracy. As a result, it is of best theoretical manner and practical manner significance to create full use of existing monitoring resources and apply the methods of modern algorithms and computer vision to study the video-based vehicle counting method for traffic violation handling, traffic guidance, and traffic safety.

The widely applied methods of vehicle counting mainly include vehicle detection and vehicle tracking. The initial stage vehicle recognition technique was to extract the moving goals from the input image frame from video sequence and recognize the extracted goals. The vehicle detection method during this era mostly encompassed background subtraction method, frame difference method, and optical flow method. On the other hand, the background subtraction technique considers the weighted average process for background update, and the consequence of background update will upset the integrity of the moving vehicle extraction and the precision of vehicle fining. Moreover, the frame difference technique is greatly affected by the vehicle speed and the time intermission of continuous frames. Additionally, the optical flow technique is pixel-level density estimation, which is not appropriate for instantaneous presentations due to its big calculation.

A tracking moving vehicle system from the video input for traffic management system is developed. The architecture design is exposed in Figure 2. The architecture of a tracking moving vehicle system contains the following steps such as frame converting, frame differencing, image thresholding, image binarisation, morphological operation, object location finding through foreground and back ground subtraction, vehicle detection and counting. Initially the input video is converted into separate frames [19]. Because, the video is made up of with sequence of frames. Next the frames are compared and find out the frame differencing output. Next the frames are involved into image thresholding, image binarisation, image dilation and morphological operation [20]. Background and foreground detection is the significant section of moving vehicle tracking systems that are very beneficial in traffic surveillance systems. Extracting the background and foreground from the input frames is known as background and foreground modelling. From the difference between the background and foreground modelling, can be able to detect the moving vehicle from video sequence [21].

The proposed procedure is explained in this section. Initially, the input is selected as a scene, which should be taken from a static camera. This research work is concentrated on traffic surveillance. So the input test videos are carefully chosen from city surveillance videotapes [22]. First the videos are properly converted to proper and useful format. So certain pre-processing procedures have to be finished for creating the scene prepared to process. Due to the camera's auto white balance and the effect of sudden environment intensity changes, the mean of every frame is calculated on grayscale format [23]. The optical flow estimation is the essential part of the algorithm which is executed next. Filtering speckle, impulse and general external noises induced due to weather conditions is one of the supreme essential sections of the procedure. Median filter is used in our framework [24]. During filtering operation, some holes are created in the frames. To fill these holes and prevent detection mistakes morphological closing is implemented.

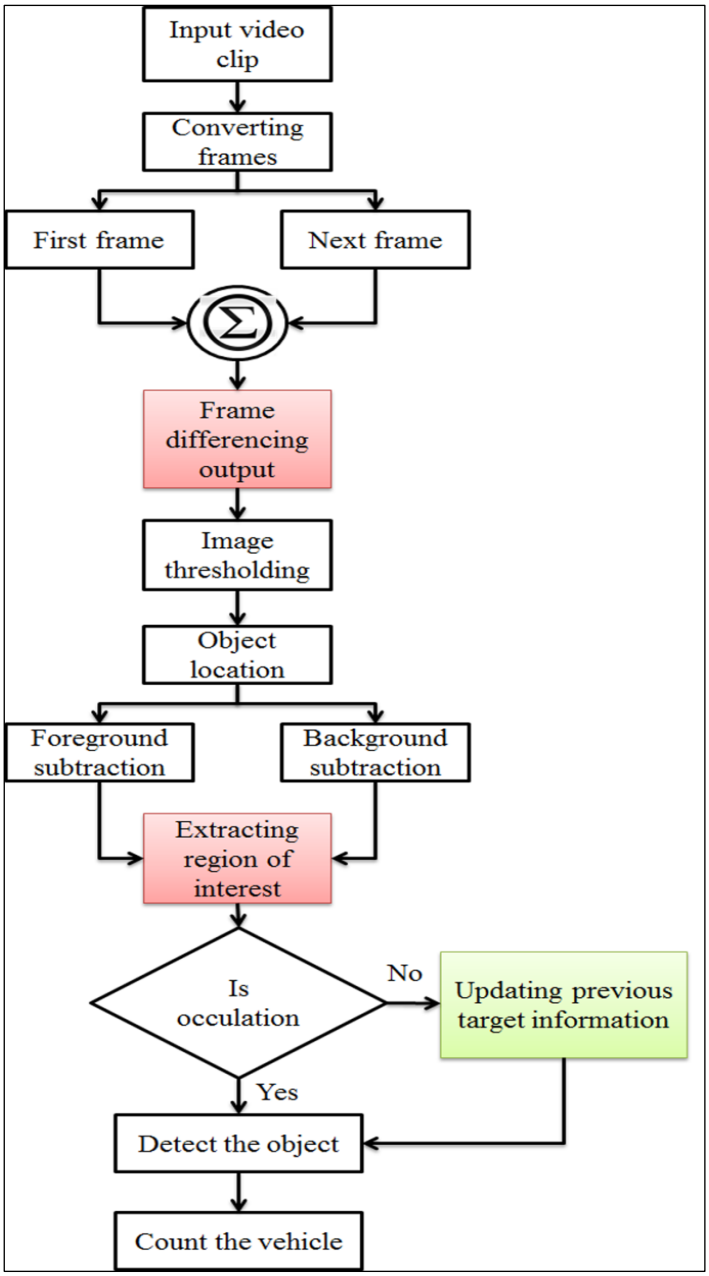

Figure 2: Architecture of moving vehicle tracking system.
Source: Authors, (2020).

III.1 IMAGE SEGMENTATION

Thresholding is the modest technique of image segmentation approach. From a grayscale input image, thresholding algorithms can be utilized to generate binary images. Thresholding function is considered to transfigure the grey level image to binary level image, so the objects of interest can be underlined by setting a threshold boundary. In the thresholding practise, if the pixel range is higher than selected threshold range, at that time those pixel values are noticeable as object; if the pixel range is lesser than selected threshold range, at that time those pixels are noticeable as background. That means the object pixels are represented by one and the background pixels are represented by zero. Next the image is converted to binary format image, which means that two colour image. The image is in white or block depends on pixel value. There are countless procedures and techniques for threshold value selection [25]. Particularly histogram is a promising method. The histogram method accepts that there is certain average rate for the background and object pixels, however that the actual pixel values have specific deviation around these average values.

The next process is image segmentation to find moving vehicle. Generally, image is generally segmented into blobs or regions with certain standard segmentation methods such as background subtraction method, clustering technique and graph cuts approach [26]. Segmented areas are then clustered together to denote an object based on particular deterministic conditions. This paper follows Optical flow method, which is used to find the pattern of motion of vehicles, surfaces, and edges from the video input. In tracking system the information of each frame is read and the background detail is assessed. The undesirable and interested objects are identified by removing the background. This proposed work also follows blob analysis. [27, 28] In the region of computer vision application, blob detection states to visual modules that are intended at sensing points, regions in the frame that vary in properties like brightness or colour compared to the settings.

III.2 FRAME DIFFERENCING

Frame differencing method is the algorithm has concentrated on the trajectory of movement of the objects. Initially the video stream from the stationary camera and is taken as an input. This video is then decomposed into frames that vary from one frame to another frame. Then the incoming frames are converted to grey scale to avoid unwanted noises. Next Frame-differencing method is used to segregate the moving pixels from stationary pixel in the sequence of frames. The region of interest is identified by the difference of the relative positions of the pixels in the subsequent image frame. The optical flow determines the direction of group of pixels. This is calculated to capture the degree of displacement of the pixel density between the two frames. The flow vectors of the moving object are taken as an input. The morphological operation is used to consolidate the pixel density around the segmented region to avoid the inaccurate detection of false positives and false negatives in the image. The blob analysis is used to detect a two-dimensional shape of an image. This is motion-based method. The main task of blob analysis can eliminate the objects which is not determined as vehicles. The performance of the algorithm mainly depends on the quality of the given input video. This method predicts inappropriate number of vehicles.

III.3 BACKGROUND AND FOREGROUND SUBTRACTION

Background and foreground Subtraction technique is deliberated to be one of the most reliable methods for moving vehicle finding. Background subtraction works by initializing a background model, then difference between current frame and presumed background model is obtained by comparing each pixel of the current frame with assumed background model colour map. In case difference between colours is more than threshold, pixel is measured to be belonging to foreground. Performance of traditional background subtraction method mainly gets affected when background is dynamic, illumination changes or in presence of shadow. Plentiful approaches have been developed so forth to upgrade background subtraction method and overcome its drawbacks. Different methods of background subtraction are used, they are: Eigen backgrounds, Kernel estimation, Concurrence of image differences, Mixture of Gaussians, Sequential density approximation, Running Gaussian average, and Temporal median filter. Dynamic autoregressive moving average is specially considered for background modelling for the proposed work.

The processing of vehicle object detection is that devising foreground object (vehicle) from background real time from video sequence, i.e. the subtraction of foreground and background. Such object detection is the main part of digital image processing technique, and form the basis of follow up high level processing tasks such as recognition and tracking system. There exist two stages to detect target, they are background subtraction, and finally target extraction. In this system, the input signals are colour video sequences. The useful message is moveable vehicle object. Firstly, we extract background in each fame, then using subtraction with still frame and binarization, we can get movable object image, and this result is object extraction. Generally, the traffic surveillance camera is typically fixed at a certain spot and hence the background is motionless. So, the background subtraction is suitable to be employed to detect the moving vehicles in the process of change detection. Initially, a static background is derived to be a reference frame and then frame-difference technique is used for change detection. In order to achieve the vehicle-flow counting, the proposed method will track each moving vehicle within successive image frames. However, after segmenting moving objects, these objects with their bounding boxes and centroids are extracted from each frame. Also, the area of a vehicle is also considered for the vehicle tracking. For every target in the present frame, target with the lowest distance and same size among two successive frames needs to be examined in the previous frame.

III.4 SPEED IDENTIFICATION

The speed of the moving vehicle in every frame is founded by using the location of the moving vehicle in every frame; therefore the following stage is to discover the spots by bounding box method. Bubble centroid distance is significant to realize the moving vehicle in consecutive frames and therefore is known as the frame rate for motion capture, the speed calculation becomes possible. The detail statistics must be documented in a continuous array cell in the identical dimension as the camera input frame captured from the video sequence, since the distance moved by the centroid is wanted is a pixel with a particular coordinate on the input frame to conclude the moving vehicle speed. This research work aims to present alternative tactic to evaluate the vehicles velocity. This research work necessitates a video

sequences, including the succeeding mechanisms: moving vehicle opening reference point and end point of reference. Shrinking algorithm is considered to identify the speed of the moving vehicle. The speed of the estimation procedure is associated with the tracking objects in binary variance of input video frames.

This research work grants an innovative and different moving vehicle counting technique based on image video sequence, which comprises moving vehicle recognition, moving vehicle finding, and moving vehicle counting. The detecting, counting and speed estimation consists of the following steps.

Step 1. Use frame differencing method to separate the input video sequences into separate frames, concentrated on the trajectory of movement of the objects. The video is then decomposed into frames that vary from one frame to another frame.

Step 2. Apply the particular thresholding value and pre-processing approaches to handle the input. The pre-processing techniques includes grey scale conversion, binarisation, and so on.

Step 3. Apply the foreground and background subtraction technique, and extract the region of interest, since the Background and foreground Subtraction technique is deliberated to be one of the most reliable methods for moving vehicle finding.

Step 4. Detect the moving vehicle and count the number of moving vehicle presents in the particular video frame image file.

Step 5. Use the binary image and separate it into collections of moving objects utilizing the shrinking algorithm to determine the speed of the moving vehicle. And track each in successive frames and discover its spatial bounding box coordinates.

IV. EXPERIMENTAL SETUP AND RESULT

Detecting and tracking the moving vehicles in the traffic circumstances during driving are significant characteristics in harmless driving, accident escaping, and spontaneous driving and detection. This planned research paper premeditated a structure that is talented of recognizing vehicles ahead, moving in the similar track as vehicle, by following them continuously with the video sequences from camera. The central problematic issue is to recognise vehicles in fluctuating surroundings and illumination. Even though there have been abundant research work on common moving vehicle recognition and tracking, or a arrangement of them, not numerous of these practices could efficaciously be functional in real time for fining moving vehicle from the video sequences. This research work announces an modern approach to design and implement such real-time oriented algorithms and arrangements that are extremely adaptive to the road and traffic scenes based on domain-specific knowledge on traffic surveillance from the video sequence.

Video is the knowledge of electronically recording, storing, capturing, transmitting, processing, and reconstructing a sequence of still images demonstrating scenes in motion. An image is a rectangular grid of pixels. It has a certain height and a definite width counted in pixels. A video commonly contains of scenes, and every scene contains one or more shots. A shot is an uninterrupted segment of video frame sequence with static or continuous camera motion, while a scene is a series of consecutive shots that are coherent from the narrative point of view. In this research work, present an effective technique for calculating direction of motion of a vehicle and evaluate its speed.

Moving vehicle detection system is designed for traffic surveillance system using python. The proposed system using the Opencv computer vision frame works. The video is givern as input for the system. The video is converted to separate frames. Reading of frame from a video sequence, Firstly we have taken a video and then read the entire frame in the video. Frame Differencing Frame difference method identifies the existence of moving target by considering the difference among two next frames. The traditional method using the image subtraction operative that gets output image by subtracting second image frame from first image frame in equivalent successive frames. Frame differencing method lacks in obtaining the complete contour of the object as a result of which morphology operations are general used to obtain better results. It is hard to find any difference in continuous two frames. Two consecutive frames are displayed in Figure 3. Taking the difference of the pixel values of two consecutive frames will help us observe the moving objects. Next basic image processing techniques are applied.

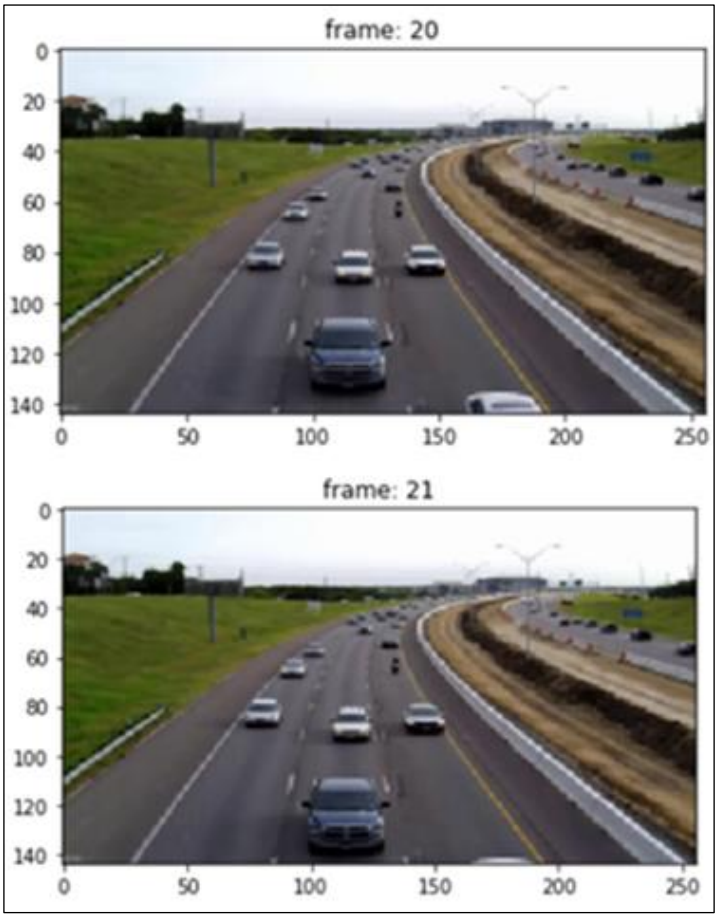

Figure 3: Continuous frames from input video.
Source: Authors, (2020).

If the luminance value of a pixel differ significantly from the background image, the pixel is marked as moving object, otherwise, the pixel is regarded as background. Binarisation is applied on this subtraction result and gets moving vehicle objects. For each pixel in the frame, judge the value difference with the corresponding value in background image. If the difference is higher than a threshold, we regard it as foreground and output 1, otherwise as background and output 0. In this way, many situations which may cause trouble in conventional approaches

can be handled properly without using complicated operations. Finally, each 1 or 0 construct a binarisation image and finish object extraction of Vehicle processing. Threshold segmentation method is mainly used in this object extraction stage, after obtaining background image, used background subtraction to obtain the object. In this processing, a proper threshold will have an important impact on object extraction. All the grey pixels is larger than the threshold were fixed to 255, which means white in colour, and all the less than the threshold were fixed to zero in black colour. As the constantly changing of forward image and background image, it cannot use a fixed threshold to split each frame image, so for different images in each frame we must select a most appropriate threshold for segmentation.

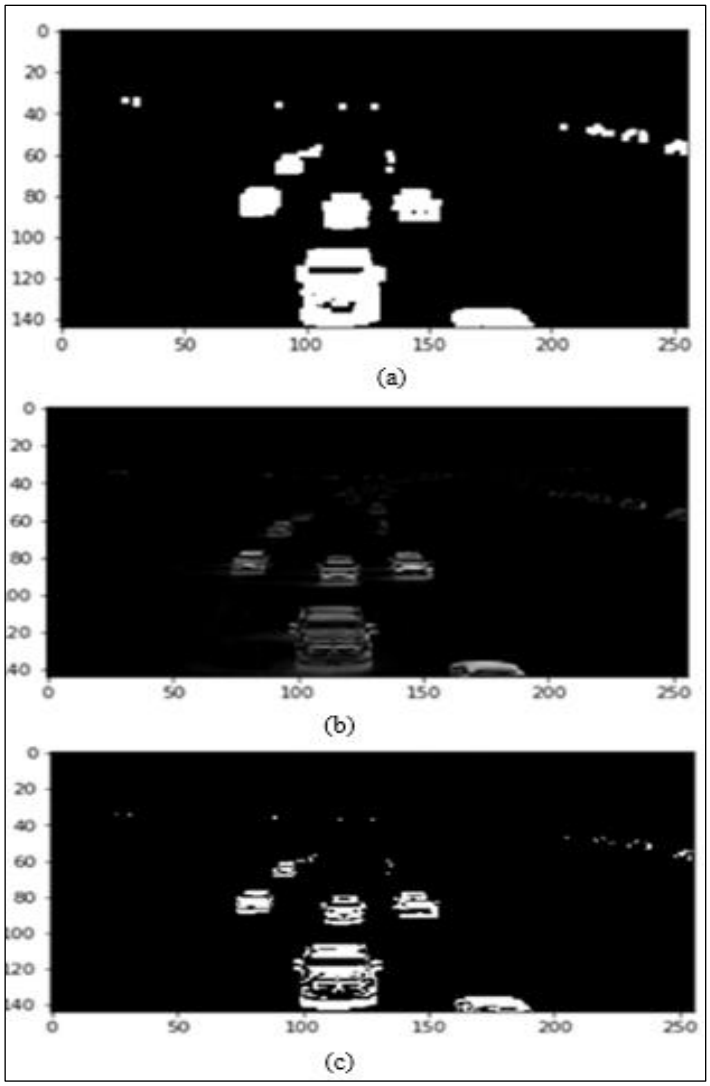

Figure 4: Image processing technique result (a) Grey image (b) Threshold image (c) Dilated image.
Source: Authors, (2020).

A background reference image is mandatory for background subtraction approach. It will be used to as reference to each fresh frame which will result in the outline of target and their shadows. The system used the initial frame of each video as the background reference image. The Background reference not necessary that it will be first frame of the video sequence but it can be other frames also. The background reference image is put away in variable matrices format which will be utilized in further handling of the image. Normalizing factor of each frame initially extract the background reference from the first frame image.

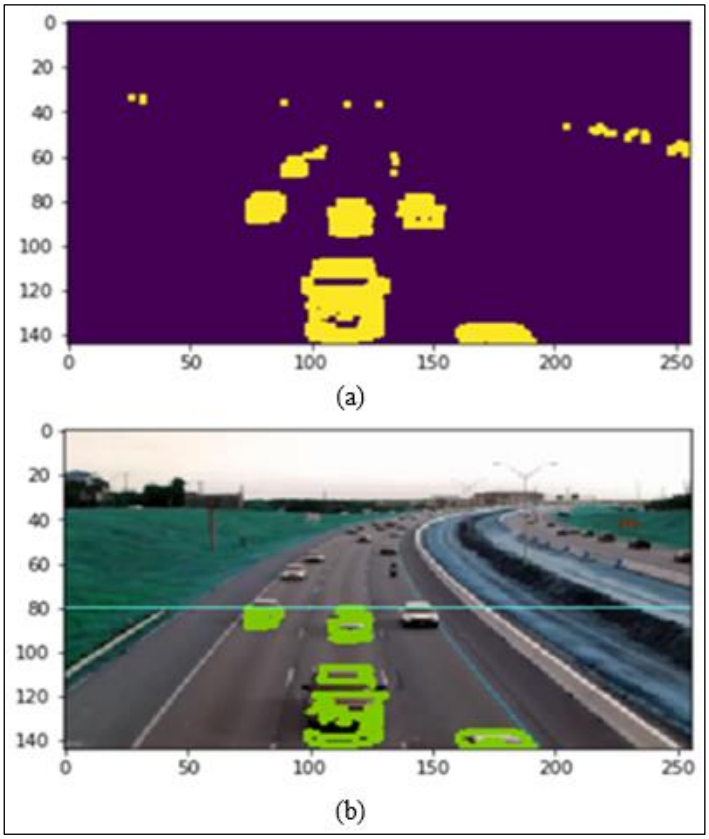

Figure 5: Moving vehicle detection (a) Finding vehicle zone (b) Detect vehicles.
Source: Authors, (2020).

In any frame, converting an RGB image into normalized image format removes the effect of any intensity variations. Gray scale image has no colour information. It only contains brightness data of the image. By graying, the system converts colourful image which contains brightness and colour information to the one which has only brightness data. Graying is an important step in image processing, whose output is the foundation of subsequent processing. The result of the image processing techniques presented in Figure 4. In the next step, the location of the vehicles are identified. From this able to find vehicles from the zone. Finding vehicle zone is given in Figure 6 for reference. Similarly Figure 5 display the vehicle detection of the proposed model for traffic surveillance system. This research paper provides a unsupervised based technique which provides the number of present vehicle in the frame. And also it gives the location of the moving vehicle in the frame. The moving vehicle count detection is given in Figure 7.

Figure 6: Detecting moving vehicles.
Source: Authors, (2020).

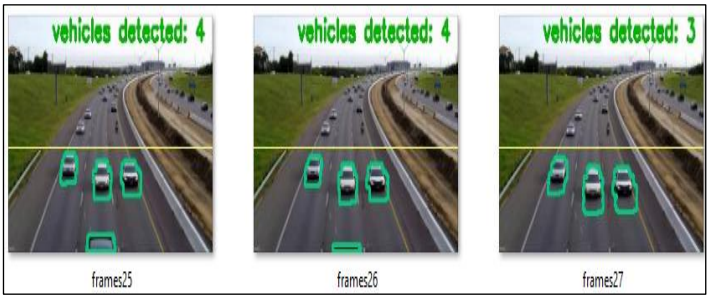

Figure 7: Counting the vehicle number.
Source: Authors, (2020).

The main aim has been to discover the moving vehicles and subsequently, analyse the speed of that moving vehicles. However previous the research is working with the aim of moving vehicle detection, which includes some important sub process like pre-processing, frame differencing, image segmentation and moving vehicle counting. Additional this research work made a shot to find the speed of the moving vehicle, using the shrinking algorithm method. Even though that it does not produce a very great density of flow vectors, shrinking algorithm is tough in presence of Noise. The speed rate is given in Table 1.

Table 1: Speed rate of detected moving vehicle.

Vehicle number	True speed (Km/h)	Estimated speed (Km/h)	Error (Km/h)
1	71.80	72.63	0.83
2	67.62	68.91	1.29
3	65.86	66.72	0.86
4	73.56	73.99	0.43
5	67.95	68.05	0.1
6	72.57	72.79	0.22
7	69.02	70.21	1.19
8	68.43	69.54	1.11
9	73.55	73.94	0.39
10	71.82	72.94	1.12

Source: Authors, (2020).

V. CONCLUSION

Computer Vision is an interdisciplinary field concerned with giving computers the ability to see or be able to understand the contents of digital images such as photos and videos. While vision is a trivial task for humans and animals, it's currently quite difficult for machines. However, a lot of progress has been made in the field in the last few decades and new techniques and technologies to make computer vision faster and more accurate are actively being researched. The key importance of the traffic surveillance structure is emerging a arrangement to track the moving vehicle from the traffic video sequences. Tracking the moving vehicle includes the following sub process like background subtraction, counting the number of vehicles. In this study, an efficient moving vehicle tracking from video sequence algorithm is established. A background location image method is used to create reliable background information from the input traffic video sequence. After this, every input frame from video sequence is compared with the background input image. Lastly, a post-processing techniques are used to eliminate the noise regions and produce a more smooth shape boundary. After enhancement, the various methods like conversion from RGB to grey image, binarisation algorithms, thresholding and watershed algorithm are used for the segmentation of the image. From this research, it can be seen in the final output that it is working very good and accurately. The above algorithms can be used in different applications like moving object tracking, vehicle counter and traffic controlling.

VI. AUTHOR'S CONTRIBUTION

Conceptualization: Jency Rubia J, Babitha Lincy R and Ahmed Thair Al-Heety.
Methodology: Jency Rubia J, Babitha Lincy R and Ahmed Thair Al-Heety.
Investigation: Babitha Lincy R and Ahmed Thair Al-Heety
Discussion of results: Jency Rubia J, Babitha Lincy R and Ahmed Thair Al-Heety.
Writing – Original Draft: Jency Rubia J and Babitha Lincy R.
Writing – Review and Editing: Babitha Lincy R and Ahmed Thair Al-Heety.
Resources: Babitha Lincy R
Supervision: Jency Rubia J.
Approval of the final text: Jency Rubia J, Babitha Lincy R and Ahmed Thair Al-Heety.

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