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Automated Vehicle Detection and Tracking Using Raspberry-Pi

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Abstract

As the world's population grows, the number of physical items, such as cars and trucks, on the road grows at an unparalleled rate. Heavy traffic causes a rise in the frequency of road accidents. In this study, computer vision paradigms are used to monitor traffic movement and improve the road perspective using photos or sequences of images. The camera module of the Raspberry Pi is used in conjunction with the Raspberry Pi to identify cars, monitor and predict traffic flow utilising low-cost electrical equipment. When there are changes in the monitored region, a remote access utilising a raspberry-pi will be used to identify, track, and count cars. An open-source, Python-based video solution is suggested that utilises video streams captured from automobiles in the monitored region. This video data is then processed and transferred using a compression algorithm. The suggested technique is thought to be a cost-effective alternative for companies that are developing cost-effective traffic control systems.

Keywords: Vehicle Detection, Raspberry Pi , Tracking, IoT, Sensor.

1. Introduction

During peak hours, particularly when people are commuting to and from work, excessive traffic may cause substantial delays on the road. In addition to impeding emergency vehicles, such as fire trucks and rescue helicopters, an overabundance of automobiles and other things pollutes the environment in ways that aren't conducive to economic development. The road transportation system must be automated to the greatest extent feasible in order to produce an efficient, dependable, clean, and safe means of transportation. In order to maintain track of cars in a specific region of interest, the key research emphasis is on object identification and tracking. Construction engineers and other associates require a traffic monitoring system so that they may make cost-effective judgments based on the density of cars and information gathered by low-cost electronic gadgets. [1]. It also solves key issues, such as automobile accidents, vehicle theft detection, parking lot management, and other security risks. Moreover In order to apply computer vision methods in real-time traffic control, there is a strong interest. [2] Vehicle segmentation under varied weather circumstances, such as darkness, snow or dust, was a serious obstacle to our task. A distinct [3] pre-processing unit based on Histogram Equalization (HE) has been used to increase the resolution of video and morphological processing to add or subtract pixels in the borders of objects, which are structured by their form and size. Vehicle detection is made more difficult by the fact that cars travelling towards the same location in either a brighter or darker zone, or vice versa, may have the same colour as the backdrop [4]. Our idea is to use background subtraction to record a vehicle ID if it reaches a certain threshold.

In this study, a continuous video feed is utilised to determine automobiles' movements. At chosen spots on roadways, at high-rise buildings, and at certain traffic crossings, cameras are used to capture the footage.. Passenger cars, trucks, and other types of vehicles may all be monitored to assist reduce accidents and identify those who caused them due to their negligence by monitoring their movements. There are now four lanes on each side of the road, unlike the previous days when there were only one or two lanes on each side of the road when there were few or no automobiles[5]. At a maximum speed of just a few kilometres per hour, the cars remained calm and orderly. It was always simple to keep up with the motions of these automobiles. Nowadays, it is difficult to keep track of moving automobiles, much alone supervise their behaviour. Vehicle tracking may be made easier by using techniques such as the installation of cameras, the use of GPS, and the addition of counting sensors.

2. Literature Survey

As a result of the abundance of information available in the picture, computer vision methods have become more common in traffic scenario surveillance systems. There were several important research points in the last decade when image processing and other analysis techniques were widely employed. However, segmentation results are greatly influenced by two issues: shadows cast by moving objects and reflecting areas. Post-processing is required to minimise the loss of accuracy.

As stated in [6], the majority of tracking situations are increasingly restricted to local goals such as monitoring vehicle growth inside cities and monitoring raw materials within industrial domains. Both Figure.1 and Figure.2 depict the transmission and reception of vehicle data via the transmitter and receiver, respectively.

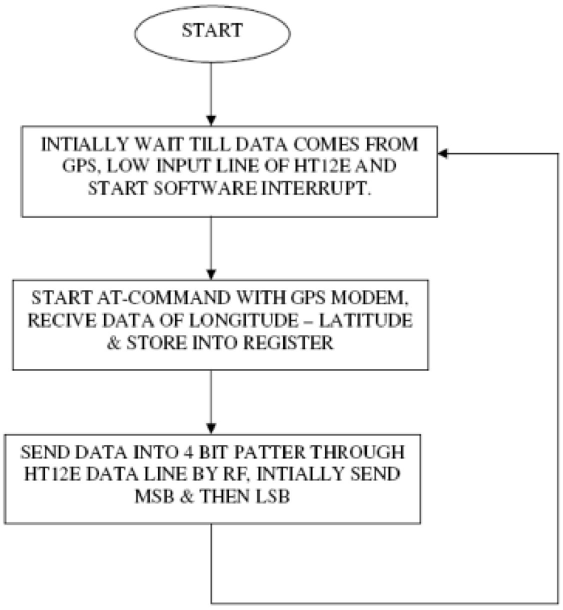

Figure.1. Flowchart for Transmitter

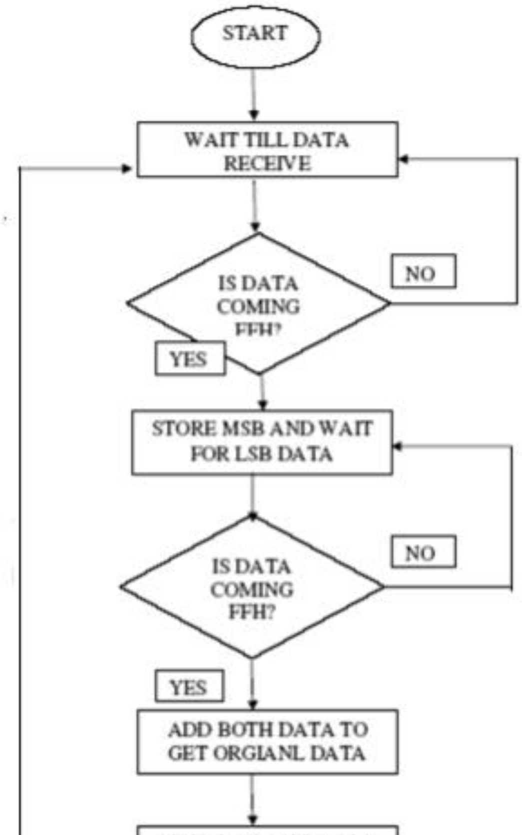

Figure.2. Flowchart for the receiver

According to [7], a land vehicle following system combines the use of preprogrammed vehicle areas. Programming in each car captures data for a complete image of the vehicle's inside and outside. Today's automobiles are outfitted with satellite navigation systems such as the Global Positioning System (GPS) (GLONASS). It's a step forward in the search for automobiles. As a further alternative, several forms of scheduled automobile habitation area development may be used. The Internet and explicit programming are used to provide vehicle information on electronic maps. Vehicle tracking frameworks' primary customers are unquestionably urban open travel authorities. This is a problem only in large cities. Progress in areas such as business vehicle activities, armada the board, shipping, crisis salvaging, hazard material inspection, and security have been made possible by the advancement of vehicles.

In [8,] it is said that the ceaseless roadways turned parking lots at key crossings demand appropriate traffic the board structure to be built up. These frameworks may eliminate the ensuing waste of time and increase in pollution levels on a city-wide scale. Devices for processing and analysing images are reviewed, and these devices are linked to certain traffic-related frameworks. Ordering handling strategies according to their information as highlighted, zone-driven, or show-based and the planning space as spatial or transitory boundaries is done clearly. – Various edge-recognition and article-tallying methods are used to determine the most efficient technique of analysing the image groups from a camera. As a result, the number of cars at the intersection is counted and traffic is monitored more effectively. It is now possible to find vehicles in the event of a catastrophe at any time. It is given precedence over all other routes if a crisis vehicle is seen.

On authentic information, an information-driven technique was used to construct a framework for vehicle tracking and characterisation in [9]. The framework's primary goal is to track cars to learn about course alterations, door travels, and other traffic analytic procedures. Electronic truck tolling necessitates the division of vehicles into two categories (trucks and cars). Tracker and classifier are the two pieces of a system that performs both arrangements online, without the need for a controller to adjust the structure's configuration based on observed circumstances. Investigations have shown that the structure is superior to the rest of the competition in terms of data. Using GSM and GPS, he conducted research on several vehicle methods in Dinesh Suresh Bhadane's 2015 paper. The most important aspect in determining a driver's route is the vehicle route, which is often used by many drivers. The installation of the electronic device is made more secure by using a vehicle-following framework. In a car, or inside of a vehicle, something is put. A computer application is used to help the owner or a customer. This is to keep track of where the car is. The car is located using a satellite navigation system (GPS). Using the electronic Google Maps[7], it is possible to see and locate the automobile, as well as to mark it with a variety of mixed media features. Vehicle-related data and all of the memories that come with it may be stored and viewed with this programme. It is possible to see all of the locations visited, notes recorded, and photos taken by a vehicle tracker on a map at the exact location where everything happened. All of the data is organised into a single location, making it easy for clients to access and understand. Google Maps is a useful tool for drivers. The customer keeps track of the vehicle's progress. According to [10], an Android-based application allowing explorers to acquire the geo-area and designate it with mixed media highlights is referred to in [11]. Vehicle-related data and all of the memories that come with it may be stored and viewed with this programme. It is possible to see all of the locations visited, notes recorded, and photos taken by a vehicle tracker on a map at the exact location where everything happened. All of the data is organised into a single location, making it easy for clients to access and understand. Each vehicle may be plotted on the map using Google Maps, showing all the regions it has visited, as well as the route followed. With this information readily available, customers will be able to determine whether or not their chosen picture has been altered. The Android version of Vehicle Tracker has a broad variety of options, allowing it to be one of the greatest travel-planning applications.

3. Proposed System

In order to monitor and capture video using Raspberry-Pi, this article makes use of a well-known platform called Linux server. When anything moves in the watched area, the Raspberry pi is used to capture a video. Cars can be distinguished from the surrounding environmental variability thanks to the Histogram equalisation approach, which enhances low-quality movies in terms of clarity and also removes noise from the videos. The background subtraction method then helps to discover and track objects based on the particle filter technique, which is then implemented. Depending on the region in which the vehicle is tracked, various sized cars are tallied based on the threshold.

Since the dawn of computer vision, visual tracking has been a difficult issue to solve. Visual tracking may be used for a wide variety of purposes, from security and surveillance to smart homes and offices[12]. They demonstrated an object tracker based on RBF networks with quick learning. An RBF classifier based on object and background pixel-based colour characteristics is developed here. Classifiers' posterior probabilities are utilised to build an efficient object model for tracking in the following frames. Video sequences of real-world complexity are used to assess the proposed tracker's performance and compare it to the color-based mean-shift tracker. As shown in Figure 3, the suggested tracker is capable of real-time robust object tracking owing to its low computing cost.

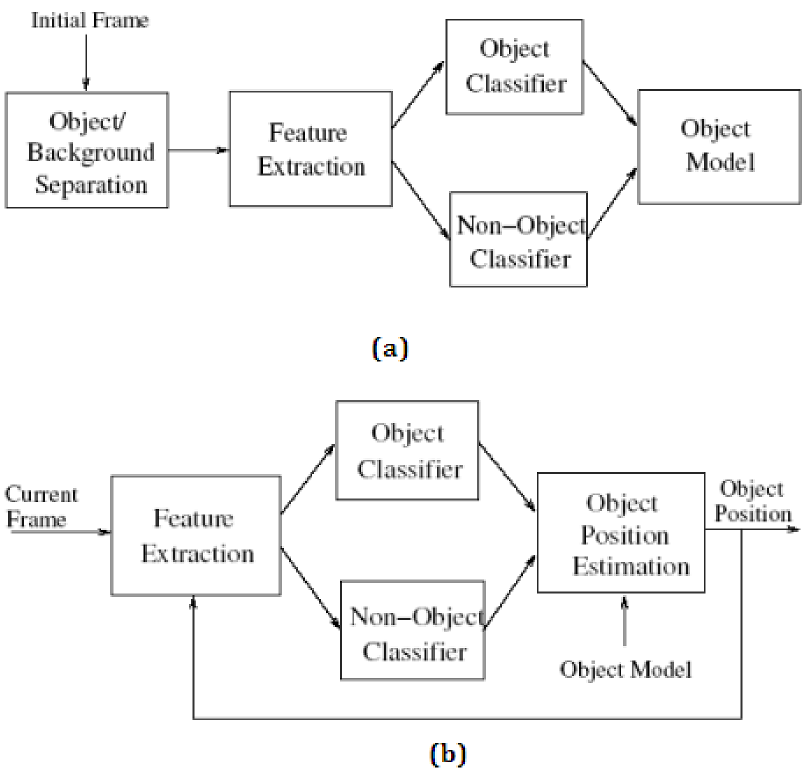

Figure.3. Phases of object model development (a) Training (b) Testing

Computer vision may be used to monitor highway traffic. Congested roadway conditions where it is difficult to follow individual automobiles because they obstruct one other or are joined by shadow were studied [13]. In addition, weather conditions and/or video compression tend to make traffic monitoring video sequences noisy.

These researchers provided a technique (Figure.4) that can distinguish occluded vehicles by monitoring feature points and allocating over-segmented picture fragments to the motion vector which best depicts the fragment's motions. The suggested approach has been tested on traffic recordings collected from Turkish roads, and the results show that it is capable of separating automobiles in densely congested scenarios.

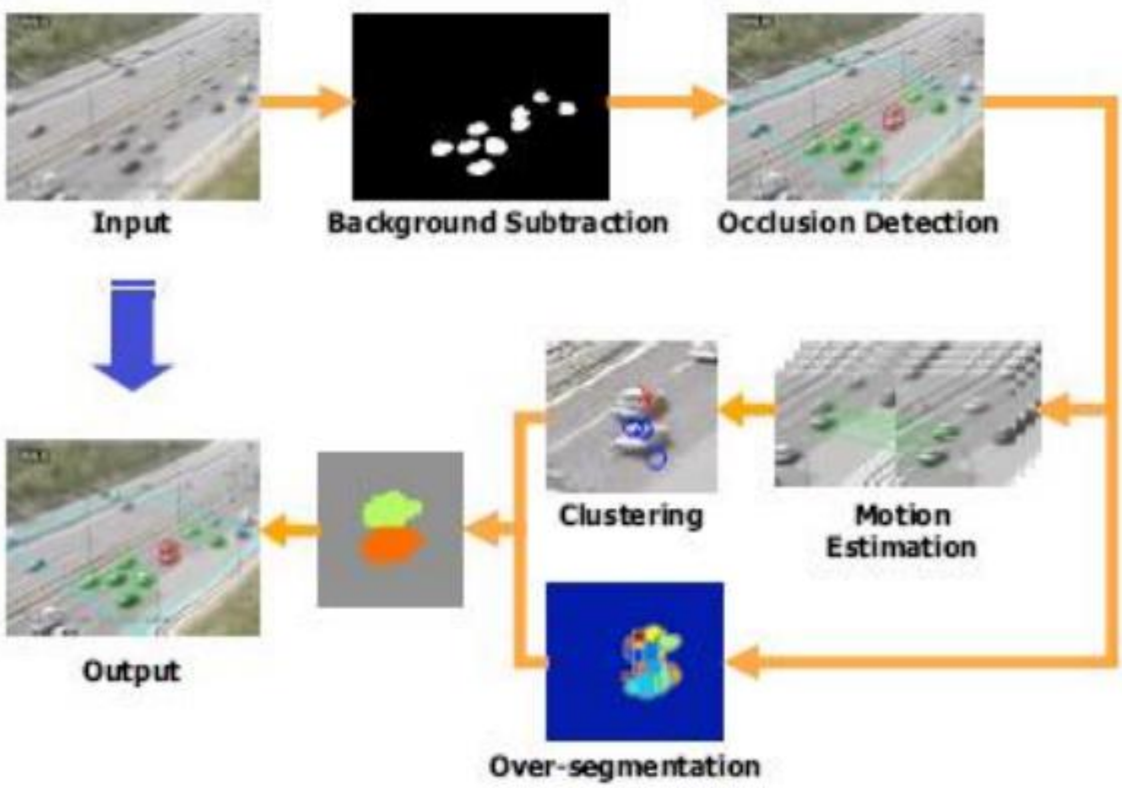

Figure.4. System architecture

based on active contours, a video object tracking method was suggested. In order to keep track of an item, active contours are used to match the object's appearance model across subsequent frames in the series. The tracking was defined as a reduction of an objective function that included information about the area, border, and shape. Furthermore, they presented an adaptive mixture model for the object representation in order to deal with variations in object appearance due to self-shadowing, changing lighting circumstances, and camera geometry[14]. The level set method is used in the technique's implementation. They used genuine video sequences to test the strategy, comparing it to two current state-of-the-art tracking approaches.

One of the most common causes of death is motor vehicle collisions. It is critical that emergency medical workers arrive at the scene of an accident within a reasonable amount of time after an accident has occurred. In order to save lives, reducing the time it takes for first responders to arrive at the site of an accident reduces fatality rates. The usage of An Collision Alert and Vehicle Tracking System, which detects when a traffic accident is likely to occur and promptly inform emergency services, is one way to reduce the wait between the accident occurrence and the dispatch of first responders. GPS receives data from the satellite in a continuous stream, which is originally stored in the ATmega16 microcontroller's internal buffer. Sending a text message to the GSM device activates it, allowing you to track the car. It may also be triggered by a shock sensor attached to the Raspberry Pi. Relay deactivates GPS at the same time. When GSM is engaged, it sends a message to a predetermined central emergency dispatch server using the most recent values of the buffered latitude and longitude locations. In order to monitor traffic, this system employs a Raspberry Pi, vibration sensors, GPS, and GSM modules.

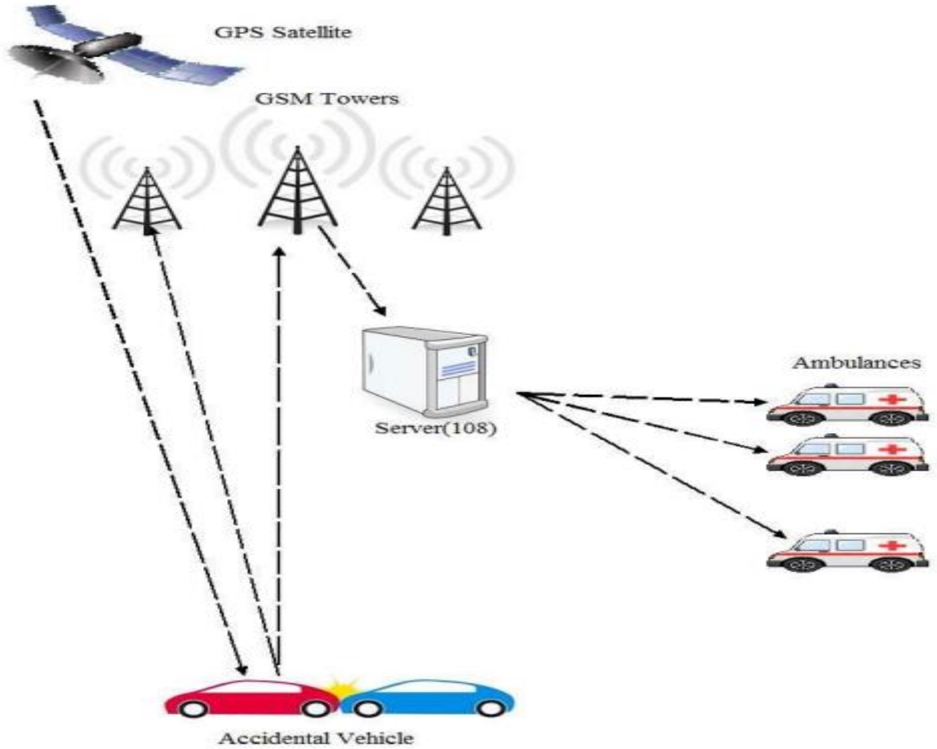

Figure.5. Vehicle Location Detection

The Accident Alert and Tracking System functions as follows, according to the system architecture (Figure.5). When an accident occurs, the system will immediately transmit an accident alert message to the emergency dispatch server, which will then send the alert message to the nearest ambulance to ensure that it arrives at the scene. It is possible to reduce the number of deaths caused by accidents by employing a method like this.

4. Results and Discussion

The paradigm of computer vision offers vision for the identification of items in videos that correspond to classes such as vehicles or people. A person or vehicle may be detected via video surveillance using object detection in the computer vision paradigm [15] to tackle real-world difficulties. An picture of the road without automobiles is subtracted from an image of the road with vehicles. The backdrop pixels would be cancelled out by the automobiles or other things in the foreground, allowing them to stand out. An area of fewer than 20000 people may be used for background subtraction, which makes it simple to spot cars. There are people, animals, and carts all over the place. Moving across the screen resizes and reshapes the items in the scene.

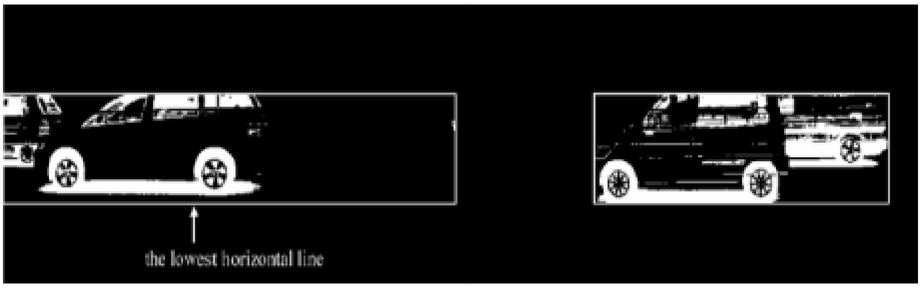

Figure.6. Shadow at the bottom of the vehicle (a) Bottommost line and the area considered for the measurement (b) Shadows and vehicles

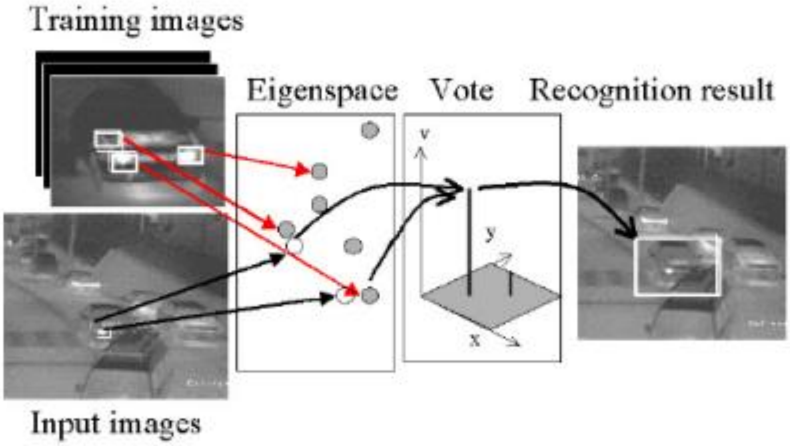

Figure.7. Usage of Eigen-window process

On a near real-time surveillance and security for traffic management without human computer intervention, an item follows a predetermined path to identify the observed direction of target. In video tracking, the primary purpose is to identify the target objects in the sequences of video frames. A motion model is needed to recover trajectories and models with high accuracy for a limited number of vehicles in such settings [3]. A detected item is surrounded by a ring of bounded boxes. The item spotted is identified by its location at the centroid of its surrounding box. For As a means of keeping track of current objects, we calculate distances between them by comparing input centroids to already-existing object centroids [8]. If the number of consecutive frames between two objects decreases, the item must be recorded. An item may only be registered as a tracking object if the number of input centroid exceeds the number of existing centroids.

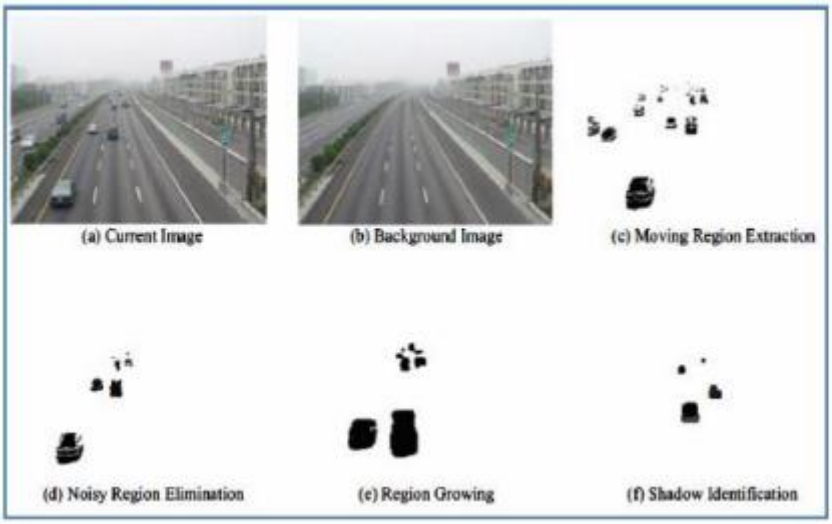

Figure.8.Detection and tracking of moving regions

At an exit point or when a line is crossed, vehicles monitored are counted [4]. To keep track of automobiles travelling in opposite directions, we use counting lines, with the red line representing the number going down and the blue line representing the number going up. When counting vehicles, perimeter is used to categorise them. Vehicles with a perimeter of less than 300 are counted as a bike; those with a perimeter of less than 500 are counted as cars; and those with a perimeter of more than 500 are considered trucks/buses. The board and urban traffic planning are used in road traffic surveillance control. For example, a driver's normal vehicle speed, traffic inspection, and vehicle orchestration goals may all be accomplished in a variety of various conditions. A concise overview of image preparation procedures and inspection tools used in the development of previously cited applications, such as traffic reconnaissance frameworks, is offered in this paper.. Shadows cast by driving automobiles may be seen in Figure 6. Figure.7. shows how to photograph cars. Vehicles are characterised by their proportion and thickness in Figure.8. Geometric attributes are used in order to eliminate the fake locations and for an even more exact division procedure, the removal of colours is applied.

5. Conclusion

In this study, we've discussed the unitized strategies we used to enhance and surpass the car counting procedure. Using a background removal method is a common way to enhance vehicle detecting systems. A more precise way of distinguishing between cars is provided by the new technique, which cuts out the extraneous parts. In addition, we keep track of moving objects based on the preceding frame's data. Even in adverse weather situations, such as at night or during snowstorms or in dusty conditions, we find that the suggested approach is able to track and count moving cars more accurately. It is possible to make significant gains by updating the raspberry pi to a newer version. There is a significant reduction in processing time as a result. Because of the huge volume of traffic on highways, occlusions are common, therefore two cars are treated as if they were one. The camera may be damaged if there is a lot of wind. This results in a reduced ability to identify automobiles. The installation of an alarm system might be in the works in the near future.

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