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GENETIC ALGORITHM BASED VEHICLE DETECTION IN SURVEILLANCE SYSTEM

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Abstract— Traffic surveillance is used by private company, government and public organization for efficient management of transport network road safety, public safety in highways and busy street. A static camera observing a scene is an ordinary case of a surveillance system. Traffic surveillance is used by private company, government and public organization for efficient management of transport network road safety, public safety in highways and busy street. A static camera observing a scene is an ordinary case of a surveillance system. Vehicle classification is an inherently difficult problem. The tracked vehicles are classified into two categories: cars and non-cars. The accuracy of the system was impressive, but they only used lateral views of the vehicles for testing. Their results are very good, but they also limited their testing to lateral views. They have produced impressive results, but the question of retrieving the "linearity" feature in frontal view remains unanswered. The Proposed Vehicle Detection technique using Genetic Algorithm performed the Cross over with the help of 1 point crossover and 2 Point crossover with random variables, which increased the speed of detection of the vehicles and accuracy whereas the previous works included tournament method. This method is very useful in detecting a large number of vehicles, and it also decreased the processing time, which was a major issue in the previous works.

Keywords – Traffic surveillance, Vehicle Classification, Genetic algorithm, 1 point crossover, 2 point crossover and tournament method.

I. INTRODUCTION

Traffic surveillance is used by private company, government and public organization for efficient management of transport network road safety, public safety in highways and busy street. A static camera observing a scene is an ordinary case of a surveillance system. Recognizing intruding objects is a significant step in analyzing the scene and successful segmentation of moving foreground object from the background ensure object classification, vehicle recognition, tracking, and activity analysis, making these later steps more efficient. The job of moving object segmentation is to extract significant information about the moving vehicle from video sequence, which provides the convenience of object-based representation and manipulation of video contents.

A computer vision system can monitor both instant unauthorized behavior and long term suspicious behavior, and hence alert the human operator for deeper examination of the event. The video surveillance systems can be manual, semi-automatic, or fully-automatic depending on the human involvement.

This system generally having four modules:-

- Video Acquisition.
- Vehicle detection and tracking.
- License plate extraction.

- Character identification unit.

This system is utilized to detect, identify and track vehicle from incoming video frames in dynamic scenes then extract the license plate from it as shown in Figure 1. It has found numerous applications as large as possible such as: access control in security sensitive areas, securities for communities and important buildings, detection of military target area, traffic surveillance in cities and highway, detection of anomalies behaviour, traffic control management for identify vehicles that commit traffic violation, such as occupying lanes reserved for public transport, breaking speed limit, crossing red light, entering restricted area without permission; and among various other applications.

A) Categorization of Motion Detection

i. Frame Differencing

Frame differencing is a pixel-wise differencing between two or three consecutive frame in an image sequence to detect region corresponding to moving object such as human and vehicle. The threshold function determines change and it depends on the speed of object motion.

ii. Optical Flow

To detect moving areas in an image, optical flow uses flow vectors of the moving objects over time. It is used for motion-based segmentation and tracking applications. It is a dense field of displacement vectors which defines the translation of each pixel region.

iii. Background Subtraction

The background subtraction is the most popular and common approach for motion detection. In this system the current image is subtracted from a reference background image, which is upgraded during a period of time. It works well only in the presence of the stationary cameras. The subtraction leaves only non-stationary or new objects, which include whole silhouette region of an object.

B) Appearance Based Vehicle Cueing

The appearance-based cueing technique detects vehicles based on some specific appearances of a vehicle's rear view. Examples of the appearances are the shadow underneath the vehicle, vertical and horizontal edges, corners, symmetry, texture, color and the vehicle's lights.

i. Shadow Underneath The Vehicle

The shadow underneath the vehicle which is generally darker than the surrounding road surface can give a cue for vehicle location. Christos et al. evaluated the histogram of the paved road to find a threshold for segmenting the shaded areas on the road.

ii. Horizontal and Vertical Edges

Most vehicles' rear view show strong vertical and horizontal edges. These characteristics can be used to hypothesize the presence of a vehicle. A group of horizontal and vertical edges that form a rectangular shape with an aspect ratio between 0.4 and 1.6 are good candidates for potential vehicles. Different techniques of edge detection can be used. For instance Canny, Sobel or morphological edge recognition.

II. Related Work

S.P.Patil and M.B.Patil (2014) have worked on "Moving Vehicle Detection" and the moving vehicle detection was an essential process for Intelligent Transportation system. During the last decade, a large amount of work has been trying to produced output for this challenge; however, performances of most of them still fall far behind human perception. In this paper the object detection problem was studied, analyzing and reviewing the most important and newest techniques. They propose a classification of all these techniques into different categories according to their main principle and features.

D. P. Mishra and G. M. Asutkar (2013) have worked on "Vehicle Detection and Classification Using Wireless Sensor Network" and there was growing need to enhance the performance of contemporary vehicle surveillance technologies using the advances in Wireless Sensor Networks (WSN) Technology. It was widely proposed to use recent advances in WSN technologies for vehicle detection and classification. Traffic surveillance systems provide data for building an efficient Intelligent Transportation System (ITS). Flexibility, ease in installation and maintenance, low cost and high accuracy of WSN gives more accurate vehicle detection and classification. This paper proposes a simple, yet, powerful system for real time vehicle classification. The approach was an improvisation and advancement of already developed algorithms. Presented algorithm was used for extraction of feature vectors.

Edward Jones et al. (2010) have worked on "Rear-Lamp Vehicle Detection and Tracking in Low-Exposure Color Video for Night Conditions" and the automated detection of vehicles in front was an integral component of many advanced driver-assistance systems (ADAS), such as collision mitigation, automatic cruise control (ACC), and automatic headlamp dimming. they present a novel image processing system to detect and track vehicle rear-lamp pairs in forward-facing color video. A standard low-cost camera with a complementary metal–oxide semiconductor (CMOS) sensor and Bayer red–green–blue (RGB) color filter was used and could be utilized for full-color image display or other color image processing applications.

Amirali Jazayeri et al. (2011) have worked on "Vehicle Detection and Tracking in Car Video Based on Motion Model" and this paper aims at real-time in-car video analysis to detect and track vehicles ahead for safety, auto driving, and target tracing. This paper describes a comprehensive approach to localizing target vehicles in video under various environmental conditions. The extracted geometry features from the video were continuously projected onto a 1-D profile and were constantly tracked. They rely on temporal information of features and their motion behaviors for vehicle identification, which compensates for the complexity in recognizing vehicle shapes, colors, and types.

Sang Jun Lee et al. (2013) have worked on "A Fast Evolutionary Algorithm for Real-Time Vehicle Detection" and the evolutionary algorithm (EA) was an effective method for solving various problems because it can search through very large search spaces and can quickly come to nearly optimal solutions. However, existing EA-based methods for vehicle detection cannot achieve high performance because their fitness functions depend on sensitive information, such as edge or color information on the preceding vehicle. This paper focuses on improving the performance of existing evolutionary-based methods for vehicle detection by introducing an effective fitness function that can more accurately capture a vehicle's information by combining a disparity map, edge information, and the position and motion of the preceding vehicle. The proposed method can detect multiple vehicles by using a turn-back genetic algorithm (GA) and can prevent false detection by using motion detection. Our fitness function was designed in a typical manner along with the fitness parameters.

Sayanan Sivaraman et al. (2013) have worked on "Looking at Vehicles on the Road: A Survey of Vision-Based Vehicle Detection, Tracking, and Behavior Analysis" and this paper provides a review of the literature in on-road vision-based vehicle detection, tracking, and behavior understanding. Over the past decade, vision-based surround perception has progressed from its infancy into maturity. They provide a survey of recent works in the literature, placing vision-based vehicle detection in the context of sensor-based on-road surround analysis. They detail advances in vehicle detection, discussing monocular, stereo vision, and active sensor–vision fusion for on-road vehicle detection.

Alberto Faro et al. (2011) have worked on "Adaptive Background Modeling Integrated with Luminosity Sensors and Occlusion Processing for Reliable Vehicle Detection" and this paper presents novel vehicle detection and tracking system with stationary camera that relies on a recursive background-modeling approach, i.e., the adaptive Poisson mixture model, which was integrated with a hardware module consisting of luminosity sensors. The luminosity information side channel allows the system to effectively handle rapid changes in illumination, which was typical of outdoor applications and bottleneck of the existing background pixel classification methods. A novel algorithm for detecting and removing partial and full occlusions among blobs was also proposed.

III. PROBLEM IDENTIFICATION

There were some problems which have been identified from the previous works while researching about the topic. Those are explained in brief.

a) Foreground object detection

Foreground object detection is the backbone of most video surveillance applications. Foreground objects detection is mostly concerned with detecting objects of interest in an image sequence. Not everything we need to be detected as foreground is detected. If we slightly modify the parameters, we might be able to get further objects detected, but this would also increase false positives due to quasi-stationary backgrounds such as waving trees, rain, snow, and artifacts owing to specular reflection. There is also a problem of shadows for outdoor scenes. Researchers have developed several methods to deal with foreground object detection. The simplest one is taking consecutive frame differences. It works well when the background is motionless, which is not the case of video surveillance.

A single 3D Gaussian model for every pixel in the scene is built in, where the mean and covariance of the model were learned in every frame. These methods that employ a single Gaussian work well when the background is relatively stationary. However, the job becomes difficult when the background contains shadows and moving objects (e.g., wavering tree branches). The possibility distribution of such background cannot be captured using a single Gaussian.

b) Vehicle Classification

Vehicle classification is an inherently difficult problem. The tracked vehicles are classified into two categories: cars and non-cars. The classification is based on vehicle dimensions and is implemented at a extremely coarse granularity – it can only differentiate cars from non-cars. The basic idea is to compute the length and height of a vehicle, according to which a vehicle is classified as a car or non-car. In order to achieve a finer-level classification of vehicles, we want to have a more sophisticated method that can detect the invariable characteristics for each vehicle category considered. Towards this goal, a method is developed which used a PCA-based vehicle classification framework. They implemented two classification algorithms – Eigen vehicle and PCA-SVM to classify vehicle objects into trucks, passenger cars, vans, and pick-ups.

c) Low Accuracy

The accuracy of the system was impressive, but they only used lateral views of the vehicles for testing. Their results are very good, but they also limited their testing to lateral views. They have produced impressive results, but the question of retrieving the "linearity" feature in frontal view remains unanswered. The algorithms have difficulty handling shadows, occlusions, and large vehicles (e.g., trucks, and trailers), all of which causes multiple vehicle to emerge as a single region.

IV. METHODOLOGY

The methodology which has been proposed for the solution of the problems identified in the project is as shown in the Figure 1.

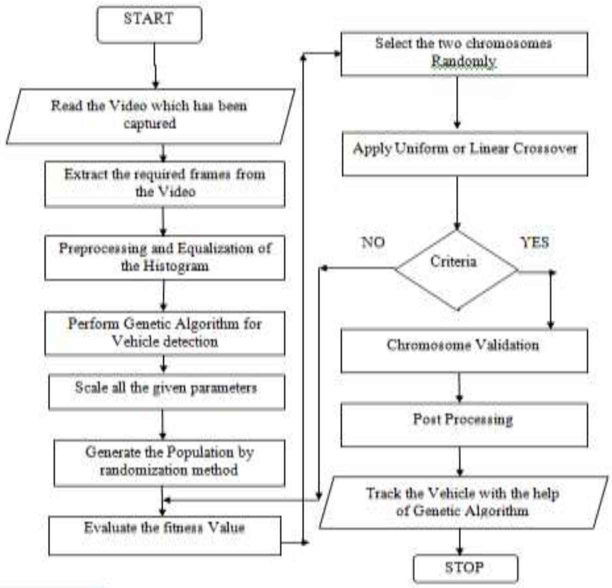

Figure 1 – Flowchart of the methodology

Step 1:- Read the Video which has been captured

- Upload the Video from the system in .mp4 format.
- The Function strictly supports the .mp4 format, which we are using in the given methodology.

Step 2:- Extract the required frames from the Video.

- There are lot of frames in the video as the video itself is a collection of frames, so in this step, extraction of each of the frame is done.
- The extraction process is done by Gaussian method.
- Using the algorithm of Function of Gaussian, which is predefined in the Matlab tool, the frames are easily fragmented.

Step 3:- Pre-processing of the Image which has been fragmented by the Gaussian method.

- Pre-processing includes thinning of the image, canny edge detection and conversion of image into gray scale image.
- First of all the image gets converted to Gray scale image.
- By using Canny Edge detection technique, the edges of the frames of the image are detected by dotted lines.
- Now the image undergoes thinning process.
- The process of Thinning involves the drawing of an outline on the image and it is compared to the previous main image.
- If the outlines of the image match, then it indicates that there is no movement in the image, whereas if the frames mismatch, then it indicates that there is some movement in the image.

Step 4:- Equalization of the Histogram

- The Histogram is drawn by considering a threshold value of the image as 0.5.
- According to it, the region where the object is placed is always denser, and rest of the background is rarer as compared to the denser region.
- So, as soon as the numerical value of the image goes beyond 0.5, the image becomes denser, and that portion becomes white coloured, making rest of the image black coloured.
- Now after this process, the Pre – processing is again carried out which includes Edge detection by canny edge detection method and thinning process as discussed in the step 3.

Step 5: Perform Genetic Algorithm for Vehicle detection.

- A genetic algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based on a natural selection process.
- The algorithm repeatedly modifies a population of individual solutions to get best result.
- It generates solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection and crossover.

Step 6:- Scale all the given parameters.

- Initialize the parameters of genetic algorithm
- Parameter Scaling includes the process of defining the characteristics i.e. how many chromosomes should be taken into consideration, how many times it should be illustrated, and the number of genes which are to be taken.

Step 7:- Generate the Population

- Initialize the chromosome generation by randomization method.
- The population is generated as defined previously in the algorithm.
- Considering the number of chromosomes 10, the number of genes 4, and illustrating it 20 times to define the best fit mutation.

Step 8:- Evaluate the fitness Value

- Analyze whether the considered chromosome is best fit or not.
- It checks whether the chromosome is idol or in movement.

Step 9:- Select the two chromosomes randomly.

- From the population the values of the chromosomes are selected randomly. It is a natural process known as Metaheuristic Process.
- It is a higher-level procedure or heuristic designed to find, generate, or select a heuristic (partial search algorithm) that may provide a sufficiently good solution to an optimization problem
- Metaheuristic is experimental in nature, describing empirical results based on computer experiments with the algorithms
- Stochastic optimization methods are optimization methods that generate and use random variables.
- The random variables appear in the formulation of the optimization problem itself, which involve random objective functions or random constraints.
- Some stochastic optimization methods use random iterates to solve stochastic problems
- Combination of both Method known as Stochastic Optimization

Step 10:- Apply Uniform or Linear Crossover

- In genetic algorithms, crossover is a genetic operator used to vary the programming of a chromosome
- It Produces Chromosomes from one generation to the next.
- 1 Point crossover and 2 point crossover are used in this process.

Step 11:- Chromosome Validation

- Apply mutation on the chromosomes and match the criteria , if yes terminate the loop else continue the same procedure.
- Select the Best chromosome Validation

Step 12:- Post Processing

- In The Post – Processing, the best frame solution is obtained.

Step 13:- Track the Vehicle with the help of Genetic Algorithm

- With the help of Genetic Algorithm the Vehicle has been tracked which is shown in the green colored box.

V. RESULTS

Based on the methodology discussed, we did got some extreme good and improved results while comparing with the previous works, which have been shown with the help of table , screenshot and Graph.

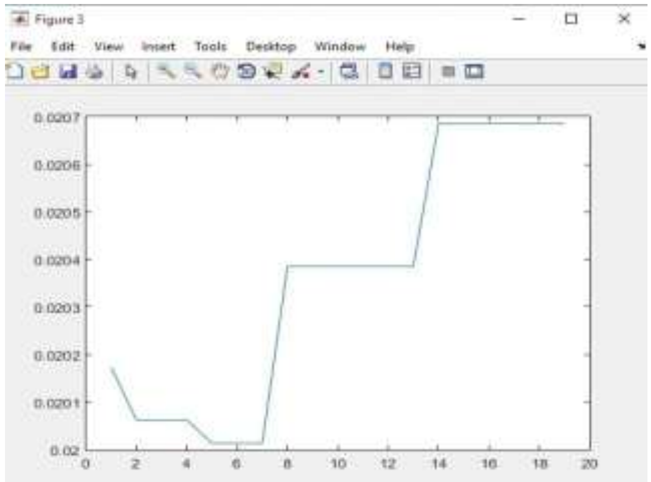

Figure 2 :- Comparison of the Values in Validation of Chromosome

The Image of the vehicle detected by the present method on the basis of the Parameters is shown with the help of screenshot in the following figure 3.

Figure 3:- Image of a detected vehicle

VI. CONCLUSION AND FUTURE SCOPE

The Proposed Vehicle Detection technique using Genetic Algorithm performed the Cross over with the help of 1 point crossover and 2 Point crossover with random variables, which increased the speed of detection of the vehicles and accuracy whereas the previous works included tournament method. This method is very useful in detecting a large number of vehicles, and it also decreased the processing time, which was a major issue in the previous works. In a further study, diverse features of a deformable 3-D vehicle model acquired from the KVBs of the proposed method may be used to improve classification performance. Parameterized 3-D models of exemplars of each category will be used. Given that the camera calibration and a 2-D projection of the given model can be formed from this perspective. This projection may be compared with the vehicles in the given picture to determine the class of the vehicle.

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