Vehicle Collision Avoidance System In Curved Roads

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Abstract: **In the traffic monitoring system, where efficient traffic management and safety is the main concern, vehicle detection and tracking plays a vital role. In this paper, we discuss and address the issue of a method that helps in reducing the rate of accidents in curved roads by giving indication about the number and speed of the vehicle coming on the either sides of the roads by processing the image captured using a video- cam erected on the two sides of the lane and the message is displayed on the display screens. The algorithm used for the vehicle recognition to obtain the count is Gaussian Mixture Model and Blob Detection method. Speed is monitored by detecting position of the moving vehicle and position of the reference points .This value is compared with a certain frame count set by the designer depending on the average speed rate of the area to give indication whether the vehicle is approaching at a high speed or low speed. This application is developed using MATLAB.**

*Keywords***: Image processing, MATLAB, Vehicle Counting,VehicleDetection,Vehicle Speed Detection, Vehicle Tracking.**

I. INTRODUCTION

Unplanned and unexpected events give rise to injury, ill - health, death and damage to property, damage to surroundings or any combination of these. In this paper we are aiming to reduce the accidents that are occurring in the curved roads, by giving information about the speed and count of the vehicle on the other side of the curve, to the driver. This is achieved by combining vehicle detection and speed monitoring techniques.

Here an Automatic vehicle counting system is used. It makes use of video data acquired from stationary traffic cameras. Causal mathematical operations are
performed over a set of frames obtained from the video to estimate the number of vehicles[3].

Counting vehicles gives us average information needed to obtain a basic understanding over the flow of traffic in any region under observation .So very first we have tried to gather the information about vehicle count from available traffic videos. In each video frame, Gaussian Mixture Model differentiates objects in Motion from the background by tracking detected objects inside a specific region of the frame and then counting is carried out. At first we differentiate the foreground from background in frames by learning the background. Then the foreground detector detects the object and a binary computation defines the rectangular regions around every detected object. Detection of the moving object and removal of the noise is achieved by some morphological operations. Finally, the counting is done by tracking the detected objects and their regions.

The next parameter to be obtained is the speed .With a typical video recording system and a normal computer we can create a speed detection device. By using the basic scientific velocity theory, we can calculate the speed of a moving vehicle in the video from the known distance and time which the vehicle has moved beyond. In our paper, we detected the speed by monitoring the frame count of vehicle between two reference points.

The remaining part of this paper is organized in various sections. Section II describes the image processing based method of detection and tracking of vehicles. Section III shows the experimental results done on traffic videos. Finally conclusions are drawn in section IV.

II. METHODOLOGY

A. Gaussian Mixture Model

A Gaussian Mixture Model (GMM) is a function to measure parametric probability density represented as a weighted sum of Gaussian component densities. GMMs are applicable in wide functional areas such as machine learning, astronomical science, Computational biochemistry etc. In this application, GMM carries out the job of in a traffic monitoring system. At first, for all pixels in the set, Gaussian Mixture Model uses a common observable property change factor between the current image and the reference image i.e. modeled background, to deal with the changes in the image frames and automatic gain by the camera. Then, the Mahalanobis distance of the Gaussian is calculated based on the common observable property change factor, current intensity of color and estimation of mean of Gaussian component. The objective specification of the quality of a color regardless of its luminance in the image is obtained by considering the color brands using rescaling of color values with the help of pixel standard deviation. A threshold value is calculated to determine the similarities of the objective specification of the quality of a color regardless to its luminance between the background learnt by GMM and the current observed image is a pixel in the foreground obtained by the GMM.

B. Blob Detection

Blob Detection is a technique by which a system can trace the movements of objects within a frame using image processing[7]. A blob is a region of a digital image in which some properties are constant or vary within a prescribed range of values .This detection mechanism finds the blob's position in successive image frames. The blob area must be defined before any detection of blob where pixels with similar light values or color values are grouped together to find the blob. When trying to group images into useful components it might be useless as a complete unit. The system must detect the blobs in the new image and make meaningful connections between them. It defines the relative importance of factors including location, size and color to decide if the blob in new frame is similar enough to the previous blob to receive the same label. It can be explained in the following steps[7].

- Search through each pixel in the array
- Check if the pixel is a blob color, label it as 1
- otherwise label it as 0

separating the foreground and background from the image frames by learning the background. To deal with the current challenges in this area, our work aims to achieve the need of robust vehicle detection and tracking algorithm that can be used

□ Search for the next pixel
□ If it is blob color, adjacent to blob 1, label it as 1
□ Repeat the loop until all pixels aredone.

In this paper blob detection uses contrast in a binary image to compute a detected region, centroid and the area of the blob. The GMM supplies the pixels detected as foreground. These pixels are grouped in current frame together by utilizing a contour detection algorithm.

The Contour Detection algorithm groups the individual pixels into disconnected classes and then finds the contours surrounding each class. Each class is marked as a candidate blob (CB). These CB are then checked by their size and small blobs are removed from the algorithm to reduce false detections. To identify the vehicles in each region the positions of the CB in current frame are compared using the K-means clustering that finds the centers of clusters and groups the input samples CB around the clusters. The moving vehicle is counted when it passes the base line. When the vehicle passes through that area, a frame is recorded. In each region the blob with the same label are analyzed and the vehicle count is incremented.

C.GMMs and Image Noise Filtering

The GMMs were trained for 150 images, with typical frame rate of video being 30fps; the first five seconds are lost in training the GMMs. A GMM foreground detector with three Gaussian Models and a minimum background ratio of 0.7 produces foreground separation.

D. Blob Analysis

Blob Analysis identifies potential objects and puts a box around them[7]. It finds the area of the blob and from the rectangular fit around each blob, the centroid of the object can be extracted for tracking the object. An additional rule that the ratio of area of blob to the area of rectangle around a blob should be greater than 0.4, ensures that unnecessary objects are not detected [3].

E. Tracking and Counting

To ensure unnecessary redundancy in computation and higher performance, tracking is carried out only inside a specific region of the frame called Count Box. The green box in the figure (d) is the count box region. Tracking is done by searching for centroids in a small rectangular region around centroids detected in the earlier frame, if not found then it is added to a 'tracks' array as a newly found object.

F.Vehicle Speed Detection

In order to obtain the vehicle speed level, the count of the vehicle in the frames between two reference points is monitored and is compared with a specific value. If the count is greater than the value then it indicates low speed and if the count is less it indicates high speed. The value depends on the location like whether it is a curve, straight line etc. To find out the pixel distance between two positions of the vehicle, feature selection process is used [1]. In this, the first centroid of the object entering the starting point will be subtracted with the last centroid of the object at the ending point [4].The result of the process will be a pixel distance of two objects which will be used in speed calculation.

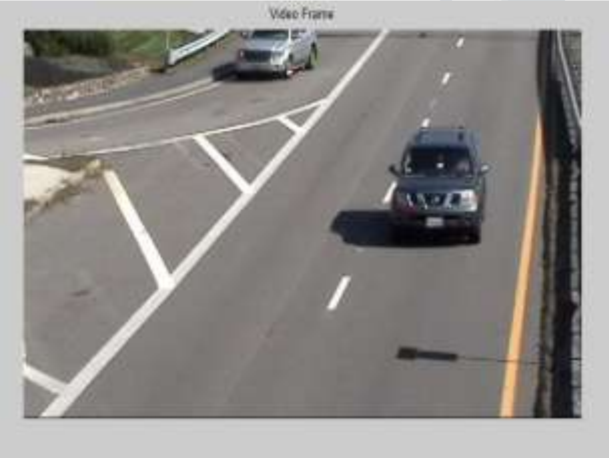
III. IMPLEMENTATION AND RESULTS

A. Simulation software

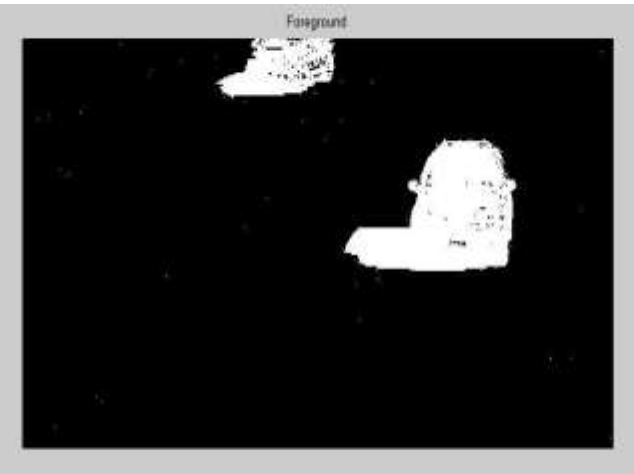
The system is developed using MATLAB software. The basic element in this interactive software is an array that does not require dimensioning. This is a widely used tool to formulate solutions for many problems faced in technical computing that includes matrix representation. This tool emphasizes mainly on comprehensive prototyping environment in the solution of digital image processing.

B. Results

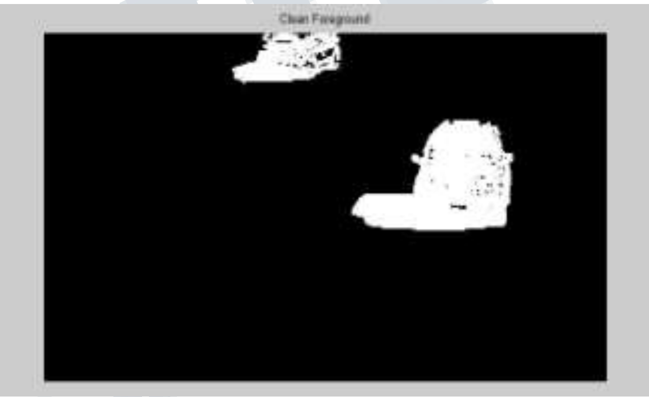
We have tested the algorithm on various videos. The vehicle count and speed was detected and displayed accurately for the image sequences tested. The output stages are a) vehicle detected, b) count taken, c) speed level determined. This information is passed to the LED display boards when hardware implemented and alerts the drivers.



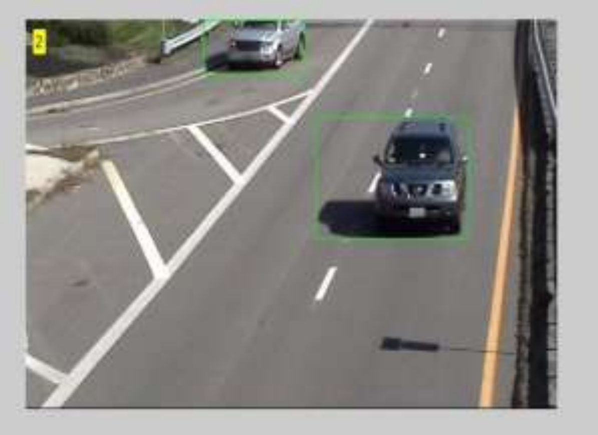
a) Original image



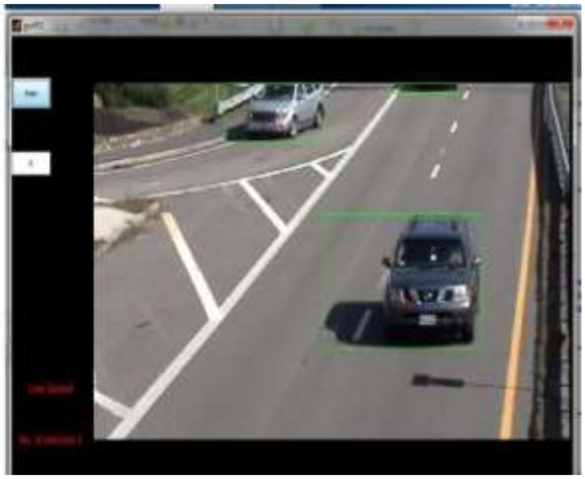
b) Detected foreground



c) Clean Foreground



d) Object Detected



e) GUI display of speed level and count

CONCLUSION

A simple and effective system to help reduce vehicle collision in curved roads has been developed. The simulation results show the better performance towards feasible implementation of the model. As the information regarding the object under surveillance is reached within seconds to the designated control station, it can be considered as robust. Further exploration can be done on extending this system to many other applications like reporting accidents,so that nearest ambulance services may reach the spot thereby saving more lives.

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