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Image processing based Tracking and Counting Vehicles

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***Abstract*— In this research work, we explore the vehicle detection technique that can be used for traffic surveillance systems. This system works with the integration of CCTV cameras for detecting the cars. Initial step will always be car object detection. Haar Cascades are used for detection of car in the footage. Viola Jones Algorithm is used in training these cascade classifiers. We modify it to find unique objects in the video, by tracking each car in a selected region of interest. This is one of the fastest methods to correctly identify, track and count a car object with accuracy up to 78 percent.**

***Index Terms*—Digital Image Processing, Automatic Traffic, Computer Vision, Haar-like Feature, Cascade Classifier, Vehicle Detection, Traffic Management**

I. Introduction

In this research paper, we will discuss about the unique car identification and tracking in a selected region of interest with most accurate results. Vehicle detection and counting play an important part of many systems that help to manage and control traffic in cities. Main objective is to detect and count the cars with maximum accuracy and to be able to do so on roads, highways and in small lanes etc. Our method uses foreground objects, i.e haar cascades to detect the cars, which takes input as video or an image and processes it to give the accurate count of vehicles seen in it[10].

A video or live video footage is divided into frames. These frames were transformed into gray frames and these gray frames were given as an input to the system. Then a specific region was selected as a region of interest. By using Haar-like features car was detected. The car was tracked till it goes out of the region of interest. Every frame is compared with the previous frame, if the car is present in both the frames and difference in their x and y coordinates is less than max (Width, Height) pixels then we consider it as a same car. If the difference is more than max (Width, Height) pixels, then we consider them as 2 separate cars.

II. Literature Survey

Object recognition is a method developed overtime by potential algorithms for identification of various objects that we come across in our day-to-day life. We easily classify and recognize these objects in images but this task is particularly difficult for machines in real time [11]. Even if the Object is partially visible it can still be recognized and identified correctly if the trained algorithm is strong enough [10].

In modern life, we have to face many problems, one is traffic congestion, which is becoming more dangerous day by day [2]. As a result of the increasing vehicle traffic, many problems emerged, for example, traffic accidents, traffic congestion, etc. Numerous ways are there in which we can track , identify a car on road like by installing particular ID tags on them, by Image Processing, by detecting their motion etc [1]. Vehicle or traffic density is calculated. This data can be vital in many surveys and play a crucial part in car traffic management. This is one of the best modern methods that countries are seeking to introduce into the traffic system [7]. In this way you can count the number of vehicles in most accurate ways.

III. Methodology

The following block diagram describes complete working of the system.

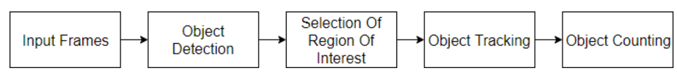


Fig. 1. Overview of the system

1. Input Frames: Input To The System
2. Object Detection: Car Detection Using Haar Cascade Classifier
3. Selection of Region of Interest
4. Object Tracking
5. Object Counting

A. Input Frames: Input To The System

The system uses an existing video sequence. The video is divided into frames, further the frames are transformed into gray level frames and gray frames are given as an input to the system.

B. Object Detection: Car Detection Using Haar Cascade Classifier

Haar Cascade Classifier is a method utilized for detecting object, also called as Viola Jones method due to its introduction by Paul Viola and Michael Jones for face detection. This method has 4 points for detecting an object, such as Haar- like

	1	2	3	4
1	3	7	7	3
2	1	3	3	1
3	5	9	9	5
4	3	6	6	3

	1	2	3	4
1	3	10	17	20
2	4	14	24	28
3	9	28	47	56
4	12	37	62	74

feature, Cascade Classifier, Integral image and AdaBoost learning [2].

Haar-like feature is a rectangular feature providing specific indication to an image. Figure 2(a), Figure 2(b) and Figure 2(c) are the examples of common variety of Haar-like feature. Haar-like feature offers high speed computation depending the number of pixels inside the rectangle feature and not depending on each pixel value of the image [9]. In obtaining object detection value, Haar-like feature value was calculated

using integral image. Integral image could calculate values accurately and relatively quick by creating new presentation of image by using value of region previously scanned by specific Haar-like feature as shown in Figure 3[11]. The value of integral image was obtained by sum value of previous index, started by left top until right bottom; moreover, Integral image

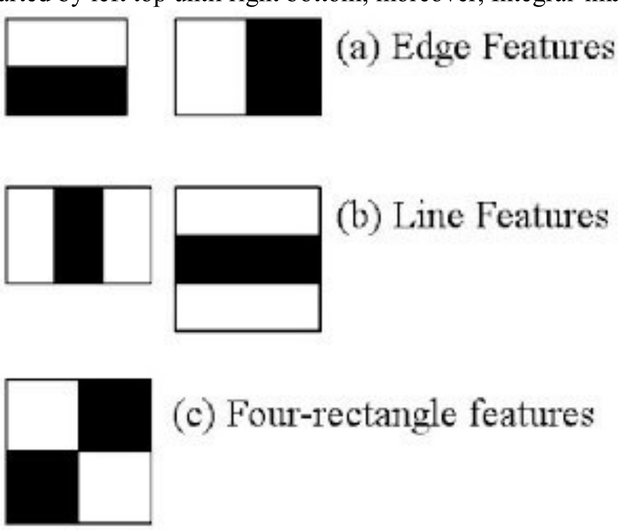


Fig. 2. Haar Features

Fig. 3. Feature Detection Scheme

could be calculated using Equation below, for example the input and new presentation depicted in Figure 4(a) and 4(b).

$$s(x, y) = i(x, y) + s(x, y-1) + s(x-1, y\ 1) + s(x-1, y-1)$$

Fig. 4. (a) Input Image and (b) Integral Image of Input Image

Value which had been calculated by using integral image would then be compared with the threshold value of specific features provided by AdaBoost. This should be completed to find potential features because not all features were relevant to use for specific object detection. AdaBoost combines potential features called weak classifier to become strong classifier. Weak classifier means less accurate or also irrelevant predic- tion [4]. Relevant and irrelevant features shown by Figures 5.

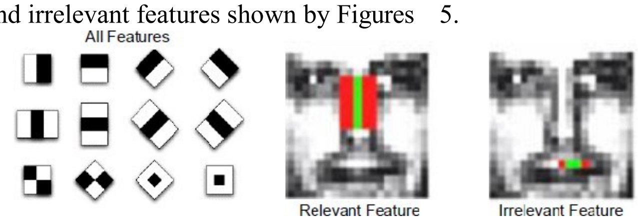


Fig. 5. Examples of Relevant and Irrelevant Features

Strong classifier made by AdaBoost can detect object level by level on a cascade. Every sub-window was scanned for specific criteria on each step; furthermore, a sub-window containing positive object was used as a feed for the next level filtering with more specific criteria until obtaining a sub-window which was predicted as a car. On the other hand, a sub-windows not containing positive object was marked as background and separated by sub-window containing positive object as shown by Figure 6 [3].

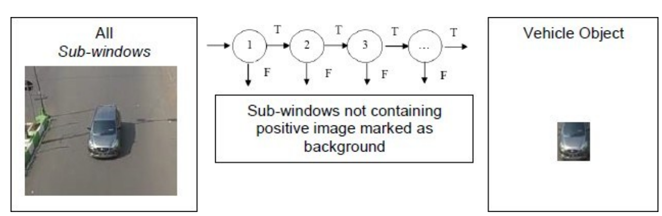


Fig. 6. Cascade Object Detection Scheme

C. Selection of Region of Interest

Region of interest is a specific region of an image that is considered as important in this study in obtaining data[8]. Haar

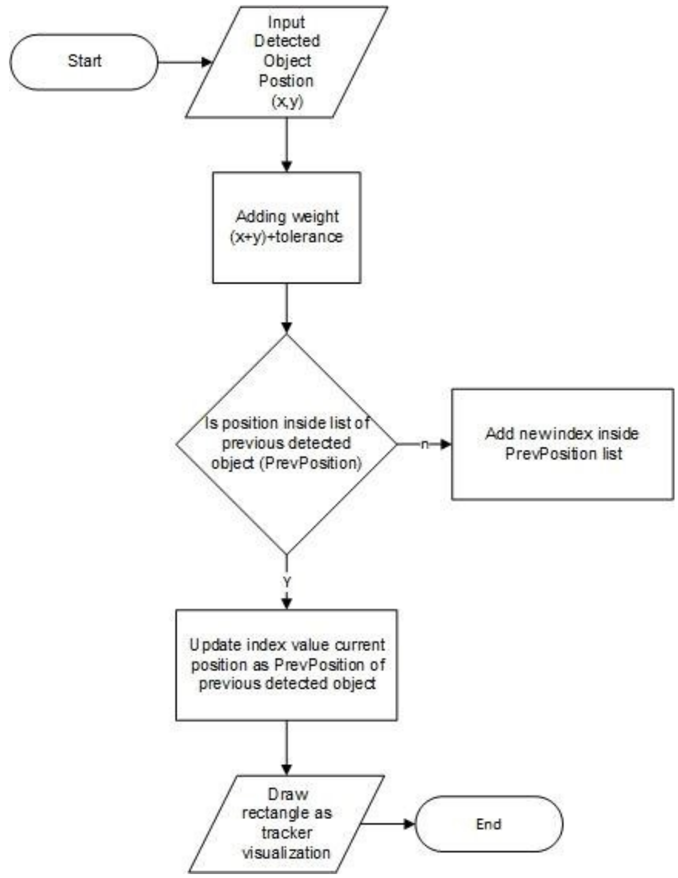
Fig. 7. Region of interest

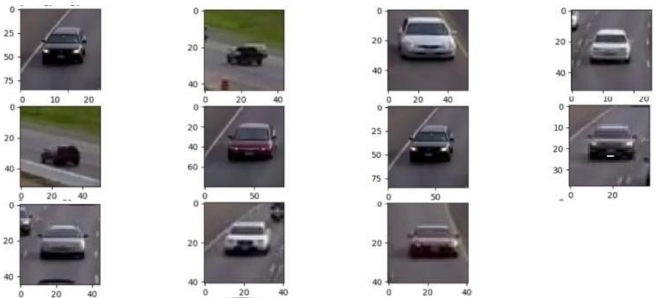
D. Object Tracking

Object tracking was used to obtain the specific position (x, y) of object inside the frame to be compared with list of previous positions of tracked objects; however, new positions or positions not including on the list of tracked object positions was added as a position (x, y) of a new object[5]. If the new position was included in the list of positions of previous tracked objects, it would be used as a new position of a recognized object. Vehicle tracking is composed of identifying the detected vehicle continuously in a video sequence,. It is done by marking the boundary around the detected vehicle [12]. The general process of object tracking is presented by the flowchart in Figure 8.

E. Object Counting

Every passing vehicle object inside ROI (Region of Interest) was tracked based on its position and would be compared with the list of tracked object positions. For a new position or position not including in the list of tracked objects, it was added as a new object and should be counted[6]. If the new position was included in the list of positions of previous tracked objects, it means the position had already been counted as a recognized vehicle. The general process of object counting will be illustrated by the flowchart in Figure 9.





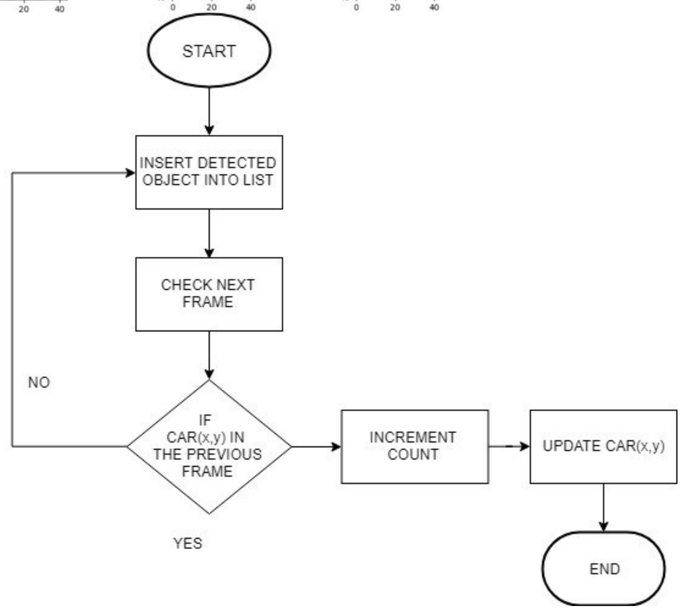


Fig.8. Flowchart of Object Counting

IV. RESULTS AND EXPERIMENTS

The result of the vehicle detection is shown in this section. Figure 10(a), and Figure 10(b) presents the input frame from video footage.

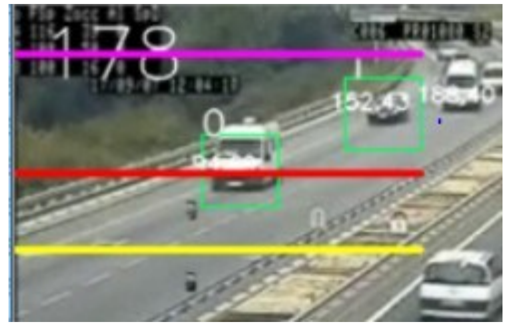


Fig. 10. (a) Original Frame (b) Transformed Gray Frame

Region of Interest is shown in the figure 11 and figure 12, where colored lines represent the region of interest.

Fig. 11. Screenshot of Region Of Interest

A video footage was given as an input to the system, by using Haar-like features car was detected. Then a specific

Fig. 12. Screenshot of Region Of Interest

region was selected as a region of interest. The car was tracked till it goes out of region of interest.

Every frame is compared with the previous frame, if the car is present in both the frames and difference in their x and y coordinates is less than max (Width, Height) pixels then we consider it as a same car. If the difference is more than max (Width, Height) pixels, then we consider them as 2 separate cars.

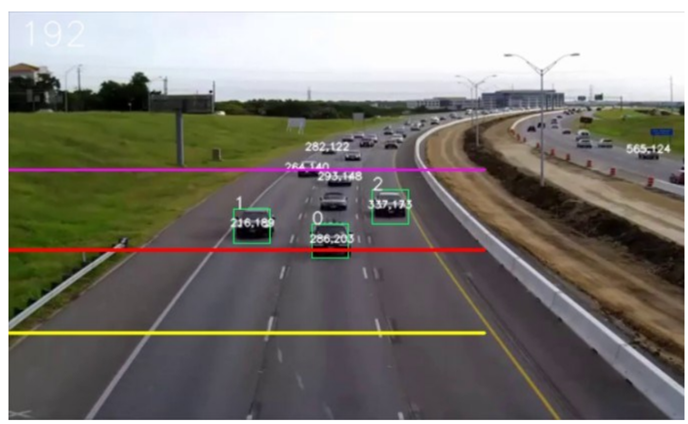


Fig. 13. Positive Image Examples

TABLE I RESULT

1	2:21	87	85	2.29
2	1:29	60	62	3.33
3	1:11	46	43	6.52

background subtraction, use Haar Cascade Classifier method or combining background subtraction to detect more specific vehicle types.

This system works without any human interference and is completely automatic.

CONCLUSION

This research designs a classification system to determine object as specific type of vehicle. Haar Cascade Classifier is used to determine object as car and counted the number of passing vehicles on the specific road using traffic videos as input. The detection rate of this system is affected by the scale factor value, different scale factor value providing varied detection rates. In obtaining high detection rate, the scale factor value giving the best performance to classifier should be determined. . In the future, providing skillful and robust vehicle detection system will be a challenging task in this field.

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