DETECTION OF DROWSY EYES USING VIOLA JONES FACE DETECTION ALGORITHM

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Abstract
The main objective of the paper is to find the drowsiness of a driver for which the system uses a small camera that points directly towards the driver's face and monitors the driver's eyes in order to detect drowsiness. In a case if drowsiness is detected, a warning signal or alarm signal is issued to alert the driver to wake up and come out of the drowsy state. First, the system detects the face and then the eyes, and then determines whether the eyes are open or closed. The system deals with using information obtained for the binary version of the image to find the edges of the face, which narrows the area of where the eyes may exist. Once the eyes are located, measuring the distances between the intensity changes in the eye area determine whether the eyes are open or closed. If the eyes are found closed for 6 or more consecutive frames, then the system finds the inactiveness of the driver and concludes that the driver is falling asleep and issues a warning signal or generate and alarm signal to wake him up.

Keywords: live video, segmentation, viola jones algorithm.

1. INTRODUCTION

Road accident is global tragedy with over-rising trend. India suffers from the highest number of deaths –around 1,05,000 in absolute terms annually-due to road accidents in the world owing to the poor infrastructure and dangerous driving habit. The increasing number of traffic accidents due to a diminished driver's vigilance level has become a serious problem for the society. Statistics show that 20% of all the traffic accidents and up to one-quarter of fatal and serious accidents are due to drivers with diminished vigilance level. Most motor vehicle crashes are caused by driver error (e.g. speeding) or poor operating practices including lack of seat belt use, distractions, fatigue, rash driving, and alcohol or drug use while driving. Most of the road users are quite well aware of the general rules and safety measures while using roads but it is only the laxity on part of road users, which cause accidents and crashes. Of all these issues, the most important issue to be considered is the driver's concentration as well as driver's inattention or distraction. Therefore, human behavior factors affecting the driver's performance are important and should be considered while implementing the reliable systems to assure safe driving. To address this the present paper proposed an algorithm to implement and thereby recreate the face detection algorithm presented by Viola-Jones. Viola Jones algorithm[1] helps in achieving high detection rates. It also processes the images rapidly. It forms the basis of most of the real time systems as it works only on the present single grey scale image This algorithm is capable of functioning in an unconstrained environment meaning that it can detect all visible faces in any conceivable image. The ideal goal of any face detection algorithm is to perform on par with a human inspecting the same image, but this algorithm will constrain itself to only match the figures posted by Viola-Jones. In order to guarantee optimum performance of the developed algorithm the vast majority of images used for training, evaluation and testing are either found on the internet or taken from private collections. The present paper is organized as follows. The section 2 describes the related work and the section 3 describes the methodology. The section 4 describes the results – discussions and section 5 describes conclusion respectively.

2. RELATED WORK

Viola Jones Algorithm [1] forms the basis of this robust system. Viola Jones algorithm helps in achieving high detection rates. It also processes the images rapidly. After the classifier function is developed, AdaBoost algorithm [3] is used for selecting the required features and training the data set. This algorithm basically is used for enhancing the performance of the classifier function. AdaBoost is an effective procedure for searching out a small number of good "features" which nevertheless have significant variety. This algorithm is used for selecting the features like eyes or mouth region. After selecting the features of interest the data sets are trained. Shinfeng D. Lin [7] presents a sleepy eye's recognition for drowsiness detection without the training stage. In the beginning, an Adaboost classifier with Haar - like features is utilized to find out the face area. Then the eyes region is located by ASM. Finally, the binary pattern and edge detection are adopted to recognize the eye's state. Experimental results prove that the proposed method could accurately detect the sleepy eyes. In addition, the comparative performance shows that the proposed recognition system without the training stage is useful for driver's drowsiness detection. Singh himani parmer[9] proposes a drowsiness detection system based on the image processing technique. Here the symmetry of the face is utilized an half the face is only is used as input data hence reducing the data to be processed. After that the region in the face with the maximum darkness is identified and this region is the eye region. The previous mentioned process is only applied for the first frame and for the subsequent frames the eye tracker takes care of updating the information about the eye position. If only there is large deviation in the eye region the initialization phase is repeated. A two circle template matching technique is used for detection of state of the eye. Yiaxiao Yun et. al. [8] here in this paper the authors talk about both inner as well as outer side of the car to be traced. Video recording sensors are used and based on the frames received the status of the driver is drawn. The main distinguishing feature of this method is that the authors also focus on the outside of the car to track the vehicles on both side of the car by using sensors and based on the distance the driver is alerted about the situation. Face analysis and detection here works in a simple manner by reading the frames recorded by the camera and recognizing the face. After face is recognized the other parts of the face are recognized based on the facial geometry, i.e. relative position of various organs on the face.

2.1 Haar-Feature

Haar features are composed of either two or three rectangles. Face candidates are scanned and searched for Haar features of the current stage. The weight and size of each feature and the features themselves are generated by the learning algorithm AdaBoost[3] . Each Haar feature has a value that is calculated by taking the area of each rectangle, multiplying each by their respective weights, and then summing the results. The area of each rectangle is easily found using the integral image. The coordinate of the any corner of a rectangle can be used of a rectangle, the area can be computed quickly.

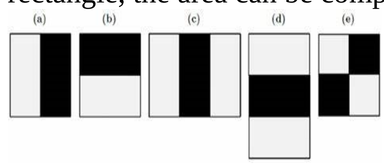


Figure 1 Haar like features

2.2 Classifier

A Haar classifier uses the rectangle integral to calculate the value of a Haar feature. The Haar classifier multiplies the weight of each rectangle by its area and the results are added together. Several Haar classifiers compose a stage. A stage accumulator sums all the Haar classifier results in a stage and a stage comparator compares this summation with a stage threshold. The threshold is also a constant obtained from the AdaBoost algorithm. Each stage does not have a set number of Haar features. Depending on the parameters of the training data individual stages can have a varying number of Haar features.

2.3 Cascade

The cascade eliminates candidates by making stricter requirements in each stage with later stages being much more difficult for a candidate to pass. Candidates exit the cascade if they pass all stages or fail any stage. A face is detected if a candidate passes all stages.

2.4 Methods

The basic principle of the Viola-Jones algorithm [13] is to scan a sub-window capable of detecting faces across a given input image. The standard image processing approach would be to rescale the input image to different sizes and then run the fixed size detector through these images. This approach turns out to be rather time consuming due to the calculation of the different size images. Contrary to the standard approach Viola-Jones rescale the detector instead of the input image and run the detector many times through the image – each time with a different size. At first one might suspect both approaches to be equally time consuming, but Viola-Jones have devised a scale invariant detector that requires the same number of calculations whatever the size. This detector is constructed using a so-called integral image and some simple rectangular features reminiscent of Haar wavelets. The next section elaborates on this detector.

2.5 The scale invariant detector

The first step of the Viola-Jones face detection algorithm [13] is to turn the input image into an integral image. This is done by making each pixel equal to the entire sum of all pixels above and to the left of the concerned pixel. This is demonstrated in Figure 2.

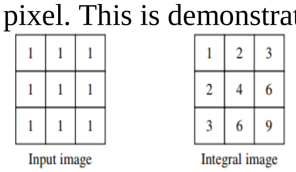


Figure 2 Input and Integral image

This allows for the calculation of the sum of all pixels inside any given rectangle using only four values. These values are the pixels in the integral image that coincide with the corners of the rectangle in the input image. This is demonstrated in Figure 3.

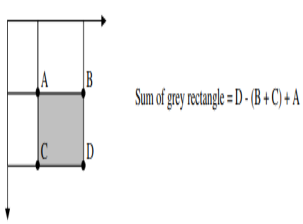


Figure 3 Sum Caluculation.

Since both rectangle B and C include rectangle A the sum of A has to be added to the calculation. It has now been demonstrated how the sum of pixels within rectangles of arbitrary size can be calculated in constant time. The Viola-Jones face detector analyzes a given sub-window using features consisting of two or more rectangles. The different types of features are shown in Figure 4.

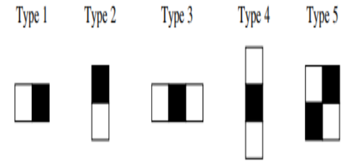


Figure 4 The different types of features.

Each feature results in a single value which is calculated by subtracting the sum of the white rectangle(s) from the sum of the black rectangle(s). Viola-Jones have empirically found that a detector with a base resolution of 24*24 pixels gives satisfactory results. These features may seem overly simple to perform such an advanced task as face detection, but what the features lack in complexity they most certainly have in computational efficiency. One could understand the features as the computer's way of perceiving an input image. The hope being that some
features will yield large values when on top of a face. Of course operations could also be carried out directly on the raw pixels, but the variation due to different pose and individual characteristics would be expected to hamper this approach.

3.PROPOSED METHOD

Viola Jones Algorithm: The Viola-Jones algorithm, the first ever real-time face detection system. There are three ingredients working in concert to enable a fast and accurate detection i.e the integral image for feature computation, Adaboost for feature selection and an attentional cascade for efficient computational resource allocation. Here we propose a complete algorithmic description, a learning code and a learned face detector that can be applied to any color image. Since the Viola-Jones algorithm typically gives multiple detections, a post-processing step is also proposed to reduce detection redundancy using a robustness argument. The following are the main modules of our Algorithm-fig 6 explained as follows

1.Video acquisition using webcam

Video acquisition mainly involves obtaining the live video feed of the Automobile driver. Video acquisition is achieved, by making use of a camera and then dividing into frames: This module is used to take live video as its input and convert it into a series of frames/ images, which are then processed. Similarly, in our project we run the code. Initially the webcam gets activated, takes the live feed and converts into required frames i.e 10 frames.

2 Face detection

The face detection function takes one frame at a time from t frames provided by the frame grabber, and in each and every frame it tries to detect the face of the automobile driver. This is achieved by making use of a set of pre-defined Haarcascade samples.

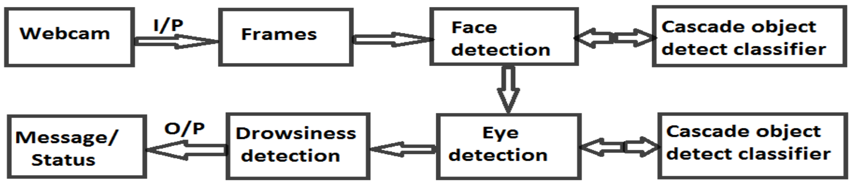


Figure.5 Block diagram

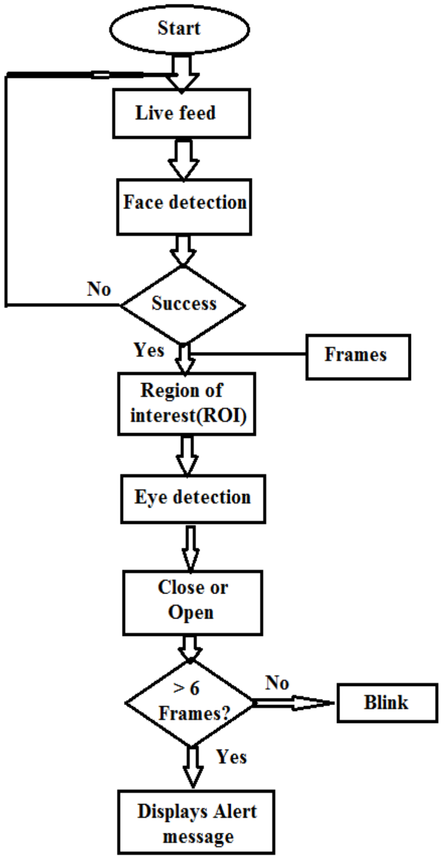


Fig.6 Flowchart

3 Eyes detection

Once the face detection function has detected the face of the automobile driver, the eyes detection function tries to detect the automobile driver's eyes. This is done by Voila Jones algorithm.

4 Drowsiness detection

After detecting the eyes of the automobile driver , the drowsiness detection function detects if the automobile driver is drowsy or not , by taking in consideration the state of the eyes , that is , open or closed and the blink rate.

4.RESULT AND DISCUSSION

Around 1000 positive images and 5000 negative images were taken as sample datasets in-order to train the Face, Eye and Mouth Classifiers [10]. The Output of Viola Jones Algorithm are the Classifier files –face.xml, eye.xml and mouth.xml. The input to the drowsy detector algorithm are these xml Classifier files. Drowsiness of a person can be measured by the extended period of time for which his/her eyes are in closed state. In this system, primary attention is given to the faster detection and processing of data. The number of frames for which eyes are closed is monitored. If the number of frames exceeds a certain value, then a warning message is generated on the display showing that the driver is feeling drowsy. In this algorithm, first the image is acquired by the webcam for processing. Then the Haar cascade file face.xml is used to search and detect the faces in each individual frame. If no face is detected then another frame is acquired. If a face is detected, then a region of interest in marked within the face. This region of interest contains the eyes and mouth. Defining a region of interest significantly reduces the computational requirements of the system. After that the eyes and mouth are detected from the region of interest by using eye.xml and mouth.xml respectively. The following are the test cases given in table 1.

4.1 Decision Making Table

The following are the four test-cases that are encountered [10]

TEST CASES	EYE CLOSER	YAW NING	RESULT
CASE-1	NO	NO	AWAKE MESSGE
CASE-2	NO	YES	STOP YAWNING MESSAGE
CASE-3	YES	NO	ALARM
CASE-4	YES	YES	ALARM

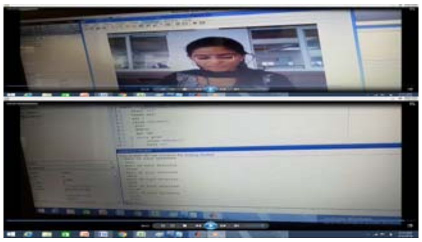
Table 1 Preliminary cases

4.2 Alarm System

When the eyes are closed for more than three frames then it is deducible that the driver is feeling drowsy and similarly if the mouth is open for more than three frames, then it is deducible that the driver is yawning [10]. Hence these cases are detected is detected and an alarm sounded.

4.3 Judging drowsiness

Drowsiness of a person can be measured by the extended period of time for which his/her eyes are in closed state. In our system, primary attention is given to the faster detection and processing of data. The number of frames for which eyes are closed is monitored. If the number of frames exceeds a certain value, then a warning message is generated on the display showing that the driver is feeling drowsy. In our algorithm, first the image is acquired by the webcam for processing. Then we use the Viola Jones Algorithm to search and detect the faces in each individual frame. If no face is detected then another frame is acquired. If a face is detected, then a region of interest in marked within the face. This region of interest contains the eyes. Defining a region of interest significantly reduces the computational requirements of the system. After that the eyes are detected from the region of interest by using Viola Jones Algorithm. If an eye is detected then there is no blink and the blink counter K is set to '0'. If the eyes are closed in a particular frame, then the blink counter is incremented and a blink is detected. When the eyes are closed for more than 4 frames then it is deducible that the driver is feeling drowsy. Hence drowsiness is detected and an alarm sounded. After that the whole process is repeated as long as the driver is driving the car.



The live video is taken as input covert them into frames. From each and every frame the face is detected first. If face is not detected it goes to another frame. If face is detected successfully, it goes to detect the eyes. When the eyes are detected, the eyes are highlighted with a white box given in source code. Then the eyes are compared with the pre-defined templates given in the algorithm. According to the comparison the algorithm detects whether the eyes are open or closed. If the eyes are closed for more than 6 frames then there is an 'alert' message displayed. If the eyes are open for all the frames then there is no message displayed. If the eyes are closed in less than or equal to 4 frames then it displays a message 'blink' in the command window.

There are also many other ways like Open CV to carry out this project. But we have opted for MATLAB as it is much user friendly and easily understood.

5. CONCLUSION

Viola Jones algorithm is used to detect many faces and area of interested features like eyes, nose, mouth etc. Accurate detection of features increase rapidly when a camera of high specifications is used. We are implementing this system in a car, only the driver's face i.e, only one face is detected, When the face is detected and recognized as drowsy, he will get an alert message.

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