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Sleep Detection System Using Image Processing

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ABSTRACT

The main objective of the paper is to findthe drowsiness of a driver for which the system uses a small camera that points directly towards the driver's face andmonitors the driver's eyes in order to detect drowsiness. In a case if drowsinessis detected, a warning signal or alarm signal is issued to alert the driver to wakeup and come out of the drowsy state.First, the system detects the face andthen the eyes, and then determineswhether the eyes are open or closed. Thesystem deals with using informationobtained 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 thedriver and concludes that the driver is falling asleep and issues a warning signalor generate and alarm signal to wake himup.

INTRODUCTION

With the ever increasing population andusage of automobiles, there is an increasein the number of fatalities as well. India,unfortunately, boasts of a very high number of 142,485 traffic-related fatalities. There are a number of reasons that can be attributed to this astonishing statistic, a few of primary concern being Fatigue, Alcohol Consumption and Sleep Deprivation. Hence, we developed a method to test for the closing of eyes of a person driving an automobile and provide an alarm indication if the eyes are detected to be closed for more than a specified amount of time. MATLAB 2013a Image processing techniques are adopted to detect the closure of the eye by sectioning only that portion of thedriver's face from a live video relay obtained using a front camera.

DESCRIPTION

1. Processing a Static Image

The method is based on the Viola-Jones algorithm. The project started off with detecting the eyes of a static image storedin the computer. The first step involved storing the image in a variable mentioning the location and the type of image. From the given image, only the eyes are sectioned out and processed to detect for closure or fatigue. The image isprocessed only to detect the eye region ofthe image by giving the position, width and height of the region as inputs to the rectangle () function. The position, width and height are obtained by using the Vision class in MATLAB. The built in object detector function Cascade Object Detector is used to detect the eyes. The Eye Detect object is given as input to thestep function along with the image and the values returned correspond to the X- Coordinate, Y-Coordinate, Width and Height of the eye region. The image is then cropped using the imcrop () function with one input as the n*4 matrix and the other being the image itself. The RGB

image thus obtained is first converted to its equivalent grayscale form using the rgb2gray() function. This is followed by converting the thus obtained gray scale image to its black and white form using
the im2bw () function. The BW image thus obtained is then dilated to get only the eyes. The purpose of performing the dilation function is to enhance the foreground features.

IM2 = imdilate (IM,SE) dilates the grayscale, binary, or packed binary image IM, returning the dilated image, IM2. SE is a structuring element object, or array of structuring element objects, returned by the STREL function. Thebasic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (white pixels).

2. Processing a live feed

The next step of the project was to perform the same on a live video feed obtained by either using an external USBoperated camera or by using the built-in webcam. The accuracy of this method ofeye detection is based on the sensitivity of the camera. It is found to have a directrelationship with the accuracy. The greater the accuracy needed, the better quality of webcam has to be used. The first step towards implementing this, is tofirst identify the webcam drivers installedand then configure the webcam to obtainthe necessary video feed. The associated webcams were identified by using the imaqhwinfo() function. The next step was to configure the webcam and assignthe video properties.

This involved setting the FramesPer Trigger and Returned Color Space properties of the video object. The live feed was then obtained using the start(video-object) function.

The vision. Cascade Object Detector statement for detecting the face was usedto initialize an object Face Detect. The next step was to crop the image such thatonly the face is retained static for furthereye detection. This is achieved by visualizing the live video feed as individual frames and processing each frame distinctly. The vision. Cascade Object Detector for detecting the eye region was used to initialize an object Eye Detect. The video capturing was initially performed for the first 50 frames.The video was converted to individual frames using the getsnapshot() function which returns a matrix corresponding to an RGB image. The next step involved was similar to identifying the eye regionin a static image, the difference being instead of the image being stored in the computer memory, it is stored virtually ina MATLAB script.

Since the getsnapshot() function works by contacting the webcam every time it iscalled, the processing time is increased. In order to minimize the time taken by the get snapshot(), the trigger config()property of the video object was set to manual mode. The Eye Detect object is given as input to the step function along with the image and the values returned correspond to the X-Coordinate, Y-Coordinate, Width and Height of the eye region.The image is then cropped using the imcrop() function with one input as the n cross 4 matrix and the other being the image itself. The RGB image thus obtained is first converted to itsequivalent grayscale form using thergb2gray() function. This is followed by converting the thus obtained gray scale image to its black and white form using the im2bw() function The BW image thus obtained is then dilated to get only the eyes.The dilated image thus obtainedis a matrix. The sum of all the elements ofthe matrix are obtained using the sum() function. The value of this sum iscompared with a temporary value(20) , which is used to decide whether the eyesare closed or not. This temporary value isthe specified time frame to check forclosure of the eyes. This is done by calculating the sum of the elements of thematrix for a particular set offrames (50).If the value does not exceed the threshold and stays constant for ashort time it corresponds to a normalblink. If the value stays for more than 5

frames it means that the eye has been closed for more than 5 frames indicatinga drowsy state. The MATLAB code immediately sends a warning messagethat the driver is drowsy. This can be improved by interfacing an audio amplifier and speaker to produce a warning sound or can be interfaced with a vibrator to produce a vibration.

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 typicallygives multiple detections, a post-processing step is also proposed to reducedetection redundancy using a robustness argument. The following are the main modules of our Algorithm-fig 6 explainedas 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 andconvert it into a series of frames/ images, which are then processed. Similarly, in ourproject 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 frameat a time from t frames provided by the frame

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 automobiledriver , the drowsiness detection function grabber, and in each and every frame it triesto detect the face of the automobile driver.This is achieved by making use of a set ofpre-defined Haarcascade samples.

detects if the automobile driver is drowsy ornot , by taking in consideration the state of theeyes , 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 inclosed state. In this system, primary attention is given to the faster detection andprocessing 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 generatedon 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 isdetected 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.

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 themouth is open for more than three frames, then it is deducible that the driver is yawning. Hence these cases are detected isdetected and an alarm sounded.

Judging drowsiness

Drowsiness of a person can be measured bythe 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 closedis 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. Inour algorithm, first the image is acquired bythe 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 thenanother frame is acquired. If a face is detected, then a region of interest in markedwithin 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 incrementedand 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 thecar.

5. CONCLUSION

The sleep detection system proposed has a specific set of advantages over the existingmethod and proves to be more efficient and economical in comparison. Although there is a constraint on the quality of the camera required for processing the live video feed, this method offers a non-invasive system for sleep detection. An improvement over the existing method, this system is indeed afeasible and easily implementable alternative.

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