Eye Estimation to Detect Drowsiness

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ABSTRACT
An Eye estimation technique has been developed, using a non-intrusive machine vision based concepts. The system uses a small monochrome security camera that points directly towards the driver's face and monitors the driver's eyes in order to detect fatigue This paper describes how to find the eyes, and determine the status of the eyes are open or closed. An application of Viola Jones algorithm is used for Face detection and tracking. The Haar like feature is developed, which was a primary objective of the project. Haar like feature is a classifier which is trained with a few hundreds of positive and negative examples that are scaled to the same size. 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..Taking into account the knowledge that eye regions in the face present in uppermost quadrants, we consider extraction of eyes for calculations. Once the eyes are located, we can use various Matlab image processing tool to determine whether the eyes are open or closed.

General Terms
Image processing, Eye estimation, binary image algorithm. Haar like feature

.Keywords
. Viola-Jones algorithm, Haar like feature., drowsiness detection **Edge Detection**

1. INTRODUCTION
Driver drowsiness is an important factor in the motoring of vehicle accidents [1]. It was demonstrated that driving performance deteriorates with increased drowsiness with resulting crashes constituting more than 20% of all vehicle accidents. There are various traditional techniques developed to alert the drivers. One set of such techniques places sensors [7,9] in various standard vehicle components a second set of techniques measures the psychological factors of the drivers. A third set of solutions focuses on computer vision systems that can detect and recognize the facial motion[2] and appearance changes occurring during drowsiness .The advantage of computer vision techniques is that they are non-invasive, and thus are more amenable to use by the general public. There are some significant previous studies about drowsiness detection using computer vision techniques. Most of the published research on computer vision approaches to detection of fatigue has been focused on the analysis of blinks. However, in the fatigue detection systems developed to date, drowsiness warning system using image processing has become most widely used because it provides a remote detection. Matlab is used for image processing.
MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include

- Math and computation
- Algorithm development
- Data acquisition Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including graphical user interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non-interactive language such as C or FORTRAN

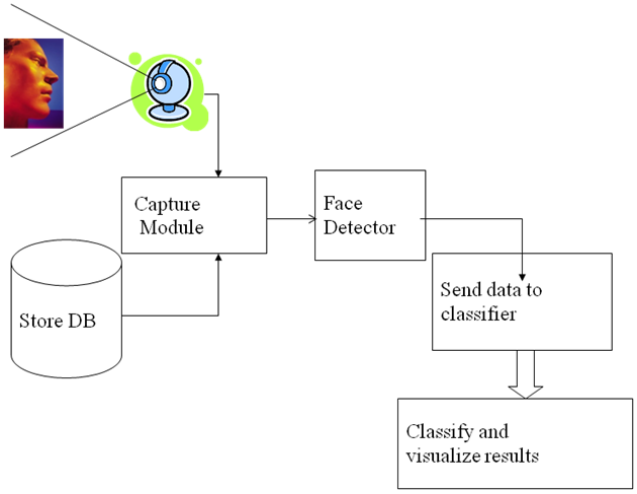
2. EARLIER WORKS
Various algorithms were proposed till date, they can be classified:
1. Biological indicators
2. Vehicle behavior
3. Face analysis

Some of them are intrusive methods and some are non-intrusive. The intrusive methods includes ECG , EOG and Head motion. In some of this type of methods drivers had to wear a head gear while driving [12]. While in other methods they used pulse detectors which were placed in the steering wheel and in the back of the seat. These too were not reliable most of the time .That is why this technique was not much adopted for common people. Methods to detect drowsiness [3,5]on the basis of vehicle behaviors such as vehicle steering activity, vehicle speed and vehicle lateral position were also developed but they were too slow to alert the driver before he fell asleep .these methods alerts driver only after they fell asleep not before they were in the episode of the drowsy state The face analysis done till date are mostly non-intrusive and uses camera to detect the facial expressions [4]. it further uses image processing tools to detect the facial expressions[11,16]. Some methods used the change in intensities in binary images to detect the drowsiness state while others used the facial

expressions such as yawning to detect it. These type of methods were found to be more accurate than those mentioned before

3. TYPESET TEXT

3.1



3.2 Capturing image

An image which taken inside a vehicle includes the drivers face. Typically a camera takes images within the RGBmodel (Red, Green and Blue). However, the RGB model includes brightness in addition to the colors. When it comes to human's eyes, different brightness for the same color means different color. When analyzing a human face, RGB model is very sensitive in image brightness. Therefore, to remove the brightness from the images is second step. We use the YCbCr space since it is widely used in video compression standards .Since the skin-tone color depends on luminance, we nonlinearly transform the YCbCr color space to make the skin cluster luma-independent. This also enables robust detection of dark and light skin tone colors. The main advantage of converting the image to the YCbCr domain is that influence of luminosity can be removed during our image processing. In the RGB domain, each component of the picture (red, green and blue) has a different brightness. However, in the YCbCr domain all information about the brightness is given by the Y component, since the Cb (blue) and Cr (red) components are independent from the luminosity. Below fig.2 represents captured image

Fig 2:-Captured Image

3.2 RGB to YCbCr conversion

Image captured by camera is in RGB (red green blue) color space. RGB color model includes brightness in addition to colors. For human eyes different brightness for the same color means different color. When analyzing a human face, RGB model is very sensitive in image brightness. Therefore, to remove the brightness from the images is second step. We use the YCbCr space since it is widely used in video compression standards. Since the skin-tone color depends on luminance, we nonlinearly transform the YCbCr color space to make the skin cluster luma-independent. This also enables robust detection of dark and light skin tone colors. The main advantage of converting the image to the YCbCr domain is that influence of luminosity can be removed during our image processing.

RGB image is first converted to HSV space and then YCbCr space

V = max (R , G, B)
S = V-min(R,G,B)/V
H = G-B/6S, if V = R
H = 1/3 + (B-R/6S) , if V =G
H =2/3 + (R-G/S) , if V=B

3.3 Skin Detection

At the beginning, due to the different brightness, here are variations of skin color in RGB color space. So we have converted it to YCbCr space in above section. Now in order to get drivers face location we need to eliminate background from the image as shown in fig.3.

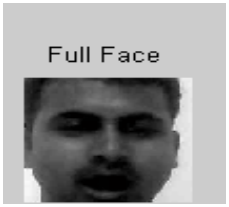


Fig 3: Image with Background Separation

This is done in following manner

Algorithm:

1. Input an image Z
2. Resize image to 300 X 300
3. Convert RGB image into YCbCr space C
4. Find height(H) and width(W) of i/p image (though we have resized image to 300X300 better to find H and W again to avoid any error)
5. For i=1 to W
6. For j=1 to H
7. Show resultant binary image
8. Obtain face region in RGB format

3.4 Edge Detection

Edge detection techniques transform images to edge images benefiting from the changes of grey tones in the images. Edges are the sign of lack of continuity, and ending. As a result of this transformation, edge image is obtained without encountering any changes in physical qualities of the main image[13]. Objects consist of numerous parts of different color levels.

Fig 5.Edge detection

A. Steps in Edge Detection

Edge detection represents in fig.5.contain three steps namely Filtering, Enhancement and Detection. The overviews of the steps in edge detection are as follows.

1) Filtering: Images are often corrupted by random variations in intensity values, called noise. Some common types of noise are salt and pepper noise, impulse noise and Gaussian noise. Salt and pepper noise contains random occurrences of both black and white intensity values. However, there is a trade-off between edge strength and noise reduction. More filtering to reduce noise results in a loss of edge strength

2) Enhancement: In order to facilitate the detection of edges, it is essential to determine changes in intensity in the neighborhood of a point. Enhancement emphasizes Pixels where there is a significant change in local Intensity values and is usually performed by computing the gradient magnitude [6].

3) Detection: Many points in an image have a nonzero Value for the gradient and not all of these points are edges for a particular application. Therefore, some method should be used to determine which points are edge points. Frequently, thresholding provides the criterion used for detection Haar like features[20] are used to detect face and eye of the driver. A Haar like feature is a classifier which is trained with a few hundreds of positive and negative examples[16,17] that are scaled to the same size. Here positive examples refer to the images of an object which is to be detected and negative examples indicate images of anything other than the desired object. A feature based system works faster than a pixel based system.

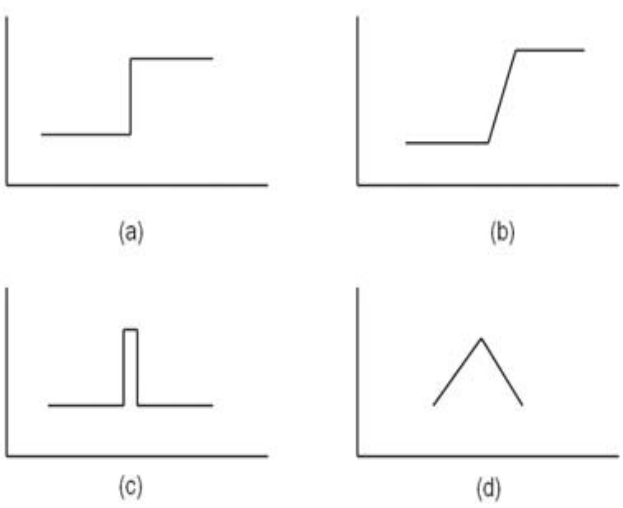


Fig 4. Type of Edges (a) Step Edge (b) Ramp Edge (c) Line Edge (d) Roof Edge

An Edge[18] in an image is a significant local change in the Image intensity, usually associated with a discontinuity in either the image intensity or the first derivative of the Image intensity. Discontinuities in the image intensity can be either Step edge, where the image intensity abruptly changes from one value on one side of the discontinuity to a different value on the opposite side, or Line Edges, where the image intensity abruptly changes value but then returns to the starting value within some short distance. However, Step and Line edges are rare in real images. Because of low frequency components or the smoothing introduced by most sensing devices, sharp discontinuities rarely exist in real signals. Step edges become Ramp Edges and Line Edges become Roof edges, where intensity changes are not instantaneous but occur over a finite distance . Illustrations of these edge shapes are shown in Fig.4.

3.5 Face Detection using Haar like features

As we are going to work on the facial expressions background in an image is of no use to us. In this step we remove the background from an image and only the region containing face is given as output[19,21]. Automatic face detection is very complex task in the world of image processing. Many methods exist to solve this

Viola-Jones algorithm [14] has been developed with face detection

Fig 6:-Image with Haar-Feature

Phases

a) Face Localization.
b) Eye Location.

Captured Faces are stored in xml database. Viola and Jones adapted the idea of using Haar wavelets and developed the so called Haar-like features. A Haar-like feature shown in fig.6.considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums

Haar like features are used to detect face and eye of the driver. A Haar like feature is a classifier which is trained with a few hundreds of positive and negative examples that are scaled to the same size. Here positive examples refer to the images of an object which is to be detected and negative examples indicate images of anything other than the desired object. A feature based system works faster than a pixel based system..

3.6 ROI detection

Face region is separated from captured image next step is to detect ROI[6,8,10]. As our main motive is to analyze eye and eyebrow movement, we need to detect eye region. We divided the face into four quadrants, the region of eyes will be uppermost two quadrants since blinking of the eyes usually happen concurrently, we can then assume that the eye will be positioned at the upper part of the face. Therefore, calculation will be based on only eye to estimate drowsiness. By taking these assumptions, the search for the eye will be limited to the area this limited area will make the search more efficient

Extract frames from the given input .avi file using the 'aviread' function of Image Processing Toolbox of Matlab. Euclidean distance used to detect eyes, is a straight line distance between two pixels

Gray scale image and not the RGB image[16]. Convert the images into 'gray' image using 'rgb2gray' function. Store the Euclidean distance between the vectors of 2 consecutive

indexed images into a vector of distances. The Euclidean distance is computed using 'norm' function

4. RESULTS

Fig.7. i. Face detection

Fig 7.ii.Eye extraction

Fig 7: Estimation of Eye from facial feature

Fig.7. represents the estimation of eyes from the facial features to indicate the state of the eyes. Further Image Processing algorithm is used to determine the drowsiness level of the person

5. CONCLUSION

This paper presented a non-intrusive system to detect the status of the eyes. The paper mainly describes the preprocessing step to detect the status of the eyes using facial expression. This report presented a system in which a camera is used to detect the real time expressions of the driver in the drowsiness episode. The exact facial region and the eye region are detected using various Matlab algorithms. Haar like features is developed by Viola and Jones, to detect face and eye of the drive. Detecting facial region before eye region improves the accuracy to a great extent. Previous approaches focused on assumptions about behaviors that might be predictive of drowsiness. Here, a system for automatically measuring facial expressions was employed to determine spontaneous behaviour during real drowsiness episodes. An advantage is feature based system works faster than a pixel based system

6. REFERENCES

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