RESEARCH ARTICLE
International Journal of Multidisciplinary and Scientific Emerging Research

Available at http://www.ijmser.com/ (ISSN 2349 – 6037)

Drowsiness Detection System for Real Time Driving Conditions

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Accepted **19** March 2015, Available online **12** April 2015, **Vol.4, No.1 (April 2015)**

Abstract

The increasing technological inventions like cellular phones and GPS devices, we observe increasing number of distractions to divert the driver's attention. This distraction has led to increasing number of accidents on road, which brings a need of a Drowsiness Detection System that calculates various eye parameters to help the driver stay alert. This type of system brings about alertness and accuracy in the driver towards risk and safety. This technology uses face and eye detection methods to create a prototype which can be further developed into a software to reduce the risk of road accidents.

Keywords and phrases: *Face Detection, PCA, Eye Detection, Pupil radius.*

1. INTRODUCTION

This prototype uses an AVI video camera that continuously monitors the driver. Different real time eye and face detection algorithms will be then applied on the frames captured by the video camera to calculate the pupil radii. The project works on how to locate the eyes and also how to determine whether the eyes are open or close. Using a C program, the AVI movie file is extracted into frames where the movie contains 30.003 frames per second. The system searches for the eyes in each frame using PCA algorithm.

2. TRACKING PARAMETERS

2.1 Eye Detection

Eye regions in the face present varied intensity changes, the eyes are located by finding the significant intensity changes in the face. For eye detection, we calibrate the color space, primary eye template and other basic PCA data. Snake is the approximate edge of the eye region. For detecting snake line we use binary thresholding and edge detection. In binary thresholding, we compare the input image with the stored image of the eye in the database. The portion of the eye that matches the eye in the database appears to be white and the rest of the background is black. In edge detection, comparison of different color spaces of an image takes place. If the program comes across a change in intensity of the color space, it identifies that change as an edge.

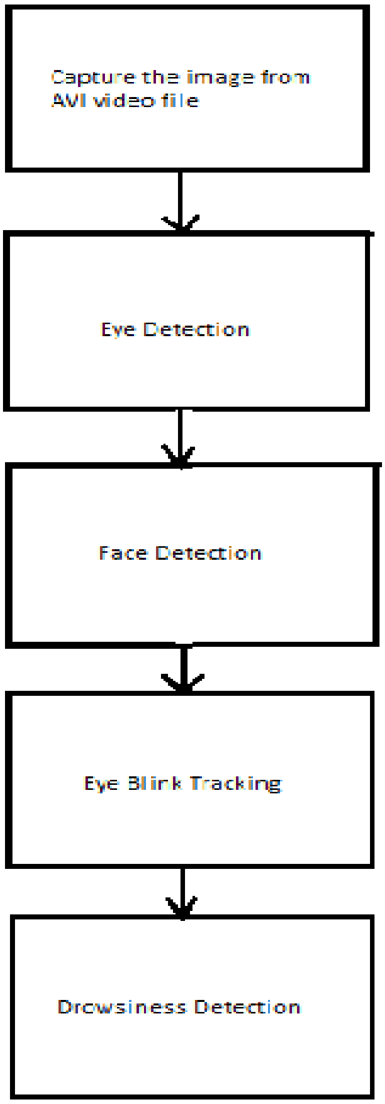
2.2 Face Detection

Every person has different hue for skin and hence it is difficult to extract the facial features. Thus we set a pre-defined hue for skin. Every hue of the skin that is captured by the AVI video is converted in a pre-defined hue and then further operations are carried out. Usually the eye to face ratio is 1:3, a rectangular box is drawn around the face by calculating the distance of eye and processing such as binary thesholding, edge detection, and skin segmentation are carried out. By identifying the edges of the face, the search limit for the eyes is narrowed.

2.3 Pupil Radius

The pupil radius is calculated matching the database template with the acquired image. Plotting the X and Y coordinates of the image, we can further observe the pupil radius, its distance from the left eye and its distance from the right eye.

3. BLOCK DIAGRAM



4. PRINCIPAL COMPONENT ANALYSIS (PCA)

Principal Component Analysis is a reduction procedure used for extracting relevant information from confusing data set. This results into reduction in number of variables which are Principal Components. Goal of PCA is to reduce the dimensionality of the data by retaining as much as possible in the original data set. Advantage is that it uses Eigen Face approach which helps in reducing the size of DataBase.

4.1 Eigen Face Approach

It is adequate and efficient method to be used in face recognition due to its simplicity, speed and learning capability. Eigen faces are a set of Eigen vectors that refer to an appearance based approach to face recognition that seeks to capture the variation in a collection of face image and use this information to encode and compare images of individual faces in a holistic manner.

4.2 Steps in PCA

1. The mean valve S of the given data set" S" is found.
2. Subtract the mean value say from S. from these valves a new matrix is obtained. Let say "A"
3. Covariance is obtained from the matrix i.e., C = AAT Eigen values are obtained from the covariance matrixes that are V1V2V3V4…VN.
4. Finally Eigen vectors are calculated for covariance matrix C.
5. Any vector S or S - S can be written as linear combination of Eigen vectors.
6. Because covariance matrix is symmetric it form basis V1V2V3V4…

VN S - S = b1u1+b2u2+b3u3+…+bNuN

7. Only Largest Eigen values are kept to form lower dimension data set independent only if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables.

5. RESULTS AND OBSERVATIONS

These are some of the eye conditions that are defined. If in 8 continuous frames the eye conditions observed is one of the above then we can conclude that he driver is drowsy. The extracted image is compared to the images in the database and the pupil radii is simultaneously measured in real time. If the calculated value of pupil falls below a pre-defined value, driver fatigueness is observed.

CONCLUSION

This paper shows how by using various image processing techniques we can calculate the pupil radius in real time. This prototype can be used in softwares , which can be further integrated with a hardware device to physically alert the driver of his fatigue and sleepiness. This area appears promising in terms of future research because accidents caused by fatigued drivers are fairly common and this system makes them less likely to occur. In order for the system to detect sleepiness successfully a set of parameters need to be given to the system manually and might vary. The algorithm that was implemented is naiive and there are many enhancements that can be done.

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