Driver Drowsiness Detection Analysis and Survey

T.M.Chenthil Jegan,
Assistant Professor ,
Dept of Mechanical Engineering,
St.Xaviers Catholic College of Engineering,
Chunkankadai,
jegan@sxcce.edu.in

Michel T, Justus
UG Student ,
Dept of Mechanical Engineering,
St.Xaviers Catholic College of Engineering,
Chunkankadai,

Abstract—Driver in-alertness is an important cause for most accident related to the vehicles crashes. Driver fatigue resulting from sleep deprivation or sleep disorders is an important factor in the increasing number of the accidents on today's roads. Drowsy driver warning system can form the basis of the system to possibly reduce the accidents related to driver's drowsiness. The purpose of such a system is to perform detection of driver fatigue. By placing the camera inside the car, we can monitor the face of the driver and look for the eye-movements which indicate that the driver is no longer in condition to driver is no longer in condition to drive. In such a case, a warning signal should be issued. This paper describes how to find and track the eyes. We also describe a method that can determine if the eyes are open or closed. The main criterion of this system is that it must be highly non-intrusive and it should start when the ignition is turned on without having at the driver initiate the system. Nor should the driver be responsible for providing any feedback to the system. The system must also operate regardless of the texture and the color of the face. It must also be able to handle diverse condition such as changes in light, shadows, reflections etc. In given paper a drowsy driver warning system using image processing as well as accelerometer is proposed.

1-INTRODUCTION

Feeling abnormally sleepy or tired during the day is commonly known as drowsiness. Drowsiness may lead to additional symptoms, such as forgetfulness or falling asleep at inappropriate times. Feeling abnormally sleepy or tired during the day is commonly known as drowsiness. Based on these estimates, the AAA Foundation projects that drowsy driving plays a role in an average of 328,000 crashes annually. This total includes 109,000 crashes that result in injuries and 6,400 fatal crashes. The actual impact of drowsy driving may be even higher than the statistics show. It is difficult to know how drowsy someone was prior to an accident. Unlike drunk driving, there is no "breathalyzer" test for drowsiness. So unless a driver admits falling asleep, drowsy driving often goes unreported.

But surveys show that drowsy driving is common. The CDC analyzed survey data from 19 states and the District of Columbia. Results show that 4.2% of people reported having fallen asleep while driving at least one time during the previous 30 days. In 2002 The Gallup Organization surveyed more than 4,000 drivers in the U.S. Survey results show that 37 percent of drivers reported nodding off or falling asleep at least once while driving. Males were almost twice as likely as females to report that they had driven drowsy. Gallup estimated that 7.5 million drivers had nodded off while driving in the past month.

The aim of this paper is to develop a prototype of drowsy driver warning system. Our whole focus and concentration will be placed on designing the system that will accurately monitor the open and closed state of the driver's eye in real time. By constantly monitoring the eyes, it can be seen that the symptoms of driver fatigue can be detected early enough to avoid an accident. This detection can be done using a sequence of images of eyes as well as face and head movement. The observation of eye movements and its edges for the detection will be used. Devices to detect when drivers are falling asleep and to provide warnings to alert them of the risk, or even control the vehicle's movement, have been the subject to much research and development. Driver fatigue is a serious problem resulting in many thousands of road accidents each year. It is not currently possible to calculate the exact number of sleep related accidents because of the difficulties in detecting whether fatigue was a factor and in assessing the level of fatigue. However research suggests that up to 25% of accidents on monotonous roads in India are fatigue related. Research in other countries also indicates that driver fatigue is a serious problem.

The rest of this paper is organized includes the fundamental information on the pre-processing. Details of feature extractions and the process of drowsiness detection (decision making process) are discussed. Provides the description of enhancements and changes in the proposed system. The experimental set-up and results are described. The rest of that section includes an extensive discussion on the performance of the suggested system compared to other recent works on driver's drowsiness detection. Finally, the paper is concluded.

2-LITERATURE SURVEY ON METHOID, SPECIFIC AREA, ACCURACY

Reference	**Method**	**Specific area**	**Accuracy**
Drowsiness Detection Using Image Processing Techniques	Calculation of percentage of white in the eyes 1.Without glasses	Eye	93
	2.with glasses	Eye	65
Drowsy Driver Warning System Using Image Processing	□ Localization of Face □ Localization of the Eyes □ Tracking the eyes in the subsequent frames. □ Detection of failure in tracking.	Face	- -
Drowsiness detection based on the analysis of breathing rate obtained from real-time image recognition	detect breathing	Breathing levels	90
Driver Drowsiness Detection using Eye-Closeness	Face Detection	Face	99.59
Driver's drowsiness detection using an enhanced image processing technique inspired by the human visual system	Feature extraction	face,eye	90

Drowsy Driver Detection Using Image Processing	Feature types and evaluation	eye	94
Real Time Driver Drowsiness Detection Based on Driver's Face Image Behavior Using a System of Human Computer Interaction Implemented in a Smartphone.	Mobile applications in Smartphones	face	88.5
Driver Fatigue Estimation Using Image Processing Technique	GTAV, Face Expression, Math Works Video and VITS	*eye*	*97.7*
Eye State Detection Using Image Processing Technique	Face Extraction, Eye State Detection	Face,eye	89.5
Drowsiness Detection for Drivers Using Image Processing	Haar cascade algorithm,face detection	face	75
Drowsiness Detection Using Image Processing	Overview Of Proposed Method	Face,eye	-

2-METHOIDOLOGY

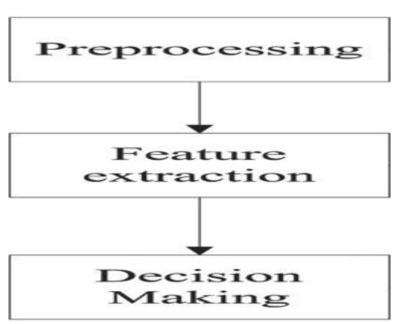

Figure 1. Detection of driver's drowsiness using image processing techniques

3-PRE-PROCESSING

In this section various issues regarding the pre-processing of images in the system will be presented. Pre-processing prepares the bases for the next step; feature extraction. Feature extraction is sensitive to many factors such as illumination variations, movement of subject, and noises. In the pre-processing stage we try to improve the resilience of the system against these variations. The images received by camera have illumination variation. This means that some parts are darker than the others. Also, images might be partially or fully dark due to poor light condition. Therefore, there is a need to pre-process the images in order to extract necessary details from the dark parts of an image as well.

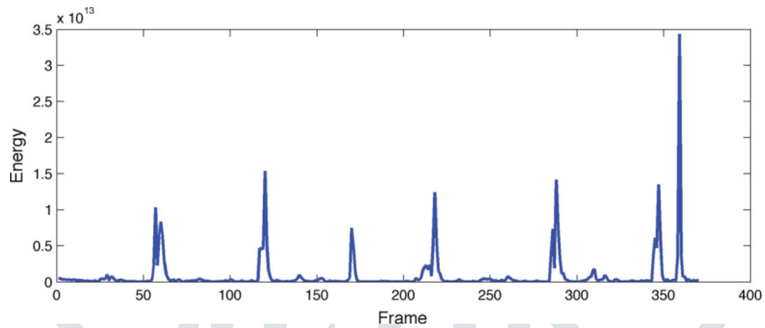

Figure 2. Motion detection using energy spectrum versus frame (HISTOGRAM EQUALISATION)

Motions are obtained by capturing images from a fixed camera. However, it should be noted that several other movements can affect the eye motion detection in the image sequence. Some examples of such movements could be head movement, flickering of the scene or observed object, and other similar movements. Therefore, to avoid false detection, it is important to properly set the parameters. This also improves the processing speed by avoiding the unnecessary processing due to unnecessary stimulation of the motion analyzer.

By analyzing the energy spectrum of each frame, frames in which a motion has happened can be recognized. When a motion happens, the contours and edges perpendicular to motion direction are extracted.

4- FEATURE EXTRACTION

To detect drowsiness, the next step is extracting facial features and their status. For this purpose, first the area of the face, eyes and the mouth should be found, which could be done using the Viola-Jones algorithm (Viola and Jones, 2004). To find the eyes and mouth in a face, a fast eye-tracking algorithm should be applied to the image of the face . Even though these algorithms are written in C++ and are fast, they are not particularly robust in detecting the facial features under every condition. Conditions like head rotation and a blocked face or other facial features could lead to failure in a proper detection of a bounding box for that feature. Performance of these algorithms consequently affects the performance of the fatigue detection system as well.

Location of Eyes: A raster scan algorithm is used for the exact location of the eyes and extracts that vertical location of eyes.

Tracking of the eyes: We track the eye by looking for the darkest pixel in the predicted region. In order to recover from tracking errors, we make sure that none of the geometrical constraints are violated. If they are, we relocalize the eyes in the next frame. To find the best match for the eye template, we initially center it at the darkest pixel, and then perform a gradient descent in order to find a local minimum.

Detection of Drowsiness: As the driver becomes more fatigued, we expect the eye-blinks to last longer. We count the number of consecutive frames that the eyes are closed in order to decide the condition of the driver. For this, we need a robust way to determine if the eyes are open or closed; so we used a method that looks at the horizontal histogram across the pupil.

Judgment whether the eye are open/closed: We constructed a template consisting of two circles, one inside the other. A good match would result in many dark pixels in the area inside the inner circle, and many bright pixels in the area between the two circles. This match occurs when the inner circle is centered on the iris and the outside circle covers the sclera.

5-DECISION MAKING

As mentioned before, the proposed system uses three features to estimate the level of consciousness: head dropping, yawning and closed eyes. In the proposed decision algorithm, the interpretation is performed as following:

• If the eyes are closed for equal or more than 70% of a two second time span, the fatigue event is set to 1 and driver is recognized as being drowsy.

• As mentioned before, a stand-alone yawn does not necessarily imply drowsiness. However, combined with the other variables, a more conclusive decision on drowsiness may be made. Combined decision making helps the algorithm to become more robust. Hence, this event will be saved in the memory for further reference in decision making process. For example, if driver's head drops and a yawn had been detected once or more during the last 15s, the driver is recognized as being drowsy instantly.

• If the head is detected as dropping but eyes are not identified as closed or no yawn has happened during the last 15s, the head dropping is ignored. In such cases dropping the head is most likely due to reasons other than drowsiness. For example, driver may be momentarily distracted with looking at something lower than the dashboard.

• If the head is dropped or turned away from the road in 80% of the last three seconds, the fatigue variable is set to 1 and driver is recognized as being drowsy. Even though the head may not be necessarily falling because of fatigue, but not facing the road for3 seconds or more is definitely dangerous. Therefore, the driver needs to be warned by the alarm system.

• If the closed eyes event or yawning have been saved in the memory of the system during 15 seconds before the head dropping, head dropping is regarded as a fatigue sign and driver is recognized as being drowsy.

6-CONCLUTION

Driving in an unfit condition leads to hundreds of thousands of deaths and injuries every year around the world. More specifically, drowsy drivers are one of the major causes of these incidents. Hence, it is very important to develop robust algorithms to detect such cases and prevent any incidents by providing an in-time alert. In this paper, we first reviewed the concept of driver's drowsiness detection algorithms and the state-of-the-art literature. Afterwards, a new robust approach inspired by the HVS was presented. In the proposed algorithm, new methods to estimate the state of the mouth, eyes and head, have been introduced to help the detection of driver's drowsiness. After extracting these three features from every frame, a new decision algorithm based on the extracted features determines whether the driver is drowsy or not.

To verify the functionality and performance of the proposed system, a series of experiments were run. These experiments proved the effectiveness and robustness of the suggested approach with 90% success rate in detecting drowsiness. The experiments show that the new proposed algorithm is able to reach to a higher success rate in different light conditions as well as in analyzing people with different appearances.

Finally, the proposed work was compared to three other methods of driver's drowsiness detection appeared in the literature during recent years, including a commercial product. Discussion about the respective advantages and disadvantages showed that the suggested algorithm is very reliable and overall, favorable.

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