Introduction

In 2012, the National Highway Traffic Safety Administration (NHTSA) estimated that 35 percent of alltraffic deaths can be attributed to crashes due to driver fatigue and drowsiness or dizziness. In fact, abouteight out of 10 crashes involve some sort of driver inattention within three seconds of that crash. This masks drowsiness as a hazard present on road while driving, and implies the need of counteracting solutions. The aim of this project is to develop drowsiness detection system that will monitor the level of alertness of the driver in a car. The system will accurately monitor the open and closed state of eyes andin real-time. By monitoring the eyes, it is believed that symptoms of driver fatigue can be detected earlyenough to avoid any hazard. This is done on the principle that the eye-blink rate per minute increases asthe driver experiences fatigue.

There are two ways of measuring the drowsiness of the driver. In first method, the physiological changes in the driver are measured which includes monitoring brain waves and heart rate.

This technique is most accurate but it has strict practical limitations. It requires connecting sensors or electrodesdirectly into the drivers body. Hence, it is very annoying and distracting for the driver. Also the sensorsmay undergo perspiration in long drive, weakening their talent to monitor precisely.

The second method, and the one that is used in this work, is to monitor the physical changes such assagging position, tilting of the drivers head and the blinking rate of eyes. This project is focused on thelocalization of eyes, which requires looking at the entire image of the face and determining the positionof the eyes by a self-developed image-processing algorithm. Once the eyes are confined, the system willdetect position of eyes, whether open or closed, to determine fatigue. The system can be made to slow down or stop the car in case the eyes are found to be in a closed state for any certain threshold.

Problem definition and objectives

Driver fatigue is a significant factor in a large number of vehicle accidents. Recent statistics estimate thatannually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes. The developmentof technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident-avoidance systems. Because of the hazard that drowsiness presents on the road, methods needto be developed for counteracting its affects.

By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident. Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink patterns. The analysis of face images is a popular research area with applications such as face recognition, virtual tools, and human identification security systems.

This project is focused on the localization of the eyes, which involves looking at the entire image of the face, and determining the position of the eyes by a self developed image-processing algorithm. Once the position of the eyes is located, the system is designed to determine whether the eyes are opened or closed, and detect fatigue.

The aim of this project is to develop a prototype drowsiness detection system. The focus will be placed on designing a system that will accurately monitor the open or closed state of the drivers eyes inreal-time.

Concepts

According to the observations made, following points can be derived regarding drowsiness:

- Drowsy person will blink distinctly slower than when they are alert;
- Also, drowsy person will close their eyes for a longer time than when they are alert.
- Drowsy person will have a narrow gaze region than when they are alert; Also, drowsy person willhave less saccadic movements than when they are alert.

The Intelligent Car system is designed considering the above annotations. There are several different algorithms and methods for eye tracking, and monitoring. Most of them in some way relate to features of the eye (typically reflections from the eye) within a video image of the driver.

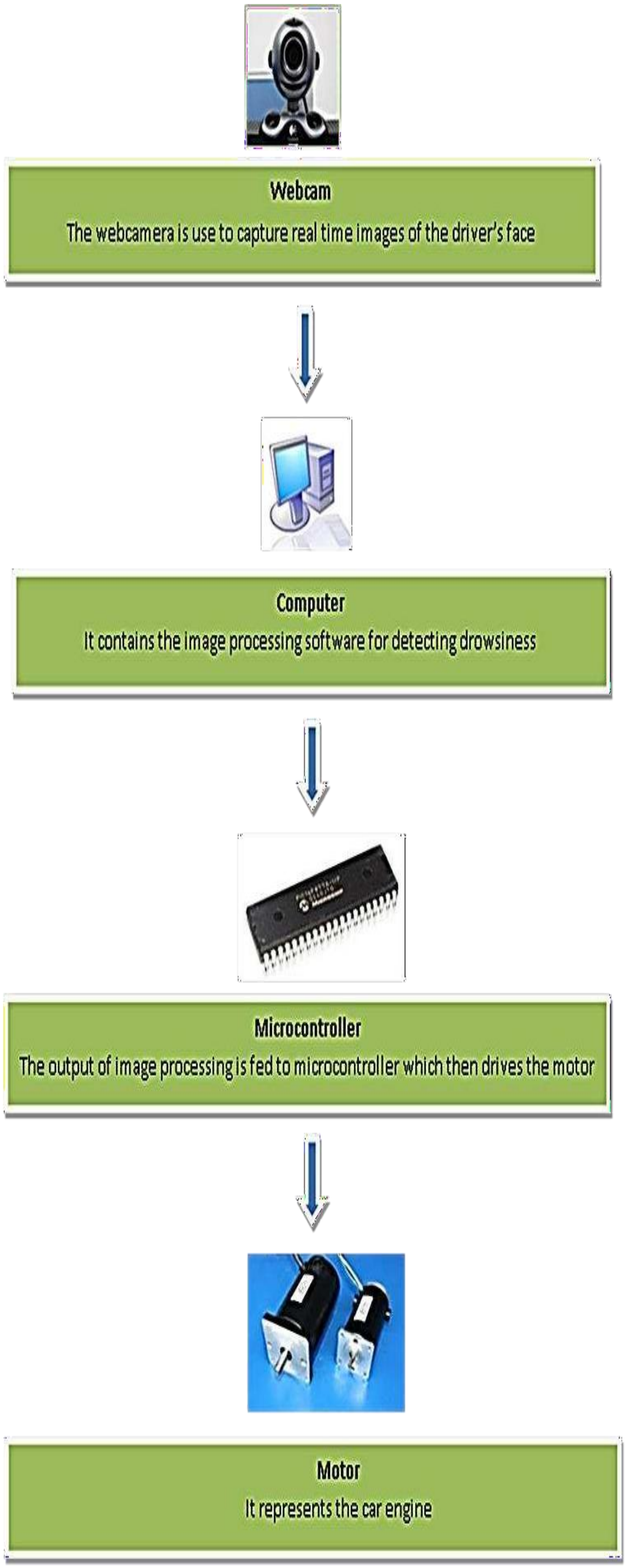

Figure 1.1: Flow Diagram

Literature Survey

Eye Movement Analysis for Activity Recognition Using Electrooculography

Andreas Bulling, Student Member, IEEE, Jamie A. Ward, Hans Gellersen, and Gerhard Troster, Senior Member, IEEE

Summary

In this work the authors investigate eye movement analysis as a new sensing modality for activity recognition. Eye movement data was recorded using an electrooculography (EOG) system. The authors first describe and evaluate algorithms for detecting three eye movement characteristics from EOG signals - saccades, fixations, and blinks - and propose a method for assessing repetitive patterns of eye movements. They then devise 90 different features based on these characteristics and select a subset of them using minimum redundancy maximum relevance feature selection (mRMR). The authors validate the method using an eight participant study in an office environment using an example set of five activity classes: copying a text, reading a printed paper, taking hand-written notes, watching a video, and browsing the web. The authors also include periods with no specific activity (the NULL class). Using a support vector machine (SVM) classifier and person-independent (leave-one-person-out) training, the authors obtain an average precision of 76.1 percent and recall of 70.5 percent over all classes and participants. The work demonstrates the promise of eye-based activity recognition (EAR) and opens up discussion on the wider applicability of EAR to other activities that are difficult, or even impossible, to detect using common sensing modalities.

Advantages

System proves to be robust across a range of participants.

- The developed algorithms for detecting saccades and blinks in EOG signals proved robust andachieved F1 scores of up to 0.94 across several people.
- Under suitable conditions six out of the eight participants returned best average precision and recallvalues of between 69 percent and 93 percent.
- Recognition performance may be further increased by combining eye movement analysis withadditional sensing modalities.

Disadvantages

- Two participants returned results that were lower than 50 percent. On closer inspection of the raweye movement data, it turned out that for both the EOG signal quality was poor.
- Changes in signal amplitude for saccades and blinks - upon which feature extraction and thus recognition performance directly depend are not distinctive enough to be reliably detected. Dry skin or poor electrode placement are the most probably responsible.

Development of a drowsiness Warning system using neural Network

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Summary

In this paper, a vehicle driver drowsiness warning system using image processing technique with neuralnetwork is proposed. The proposed system is based on facial images analysis for warning the driver of drowsiness or inattention to prevent traffic accidents. The facial images of driver are taken by a video camera which is installed on the dashboard in front of the driver. A Neural network based algorithm is proposed to determine the level of fatigue by measuring the eye opening and closing, and warns the driver accordingly. The results indicated that the proposed expert system is effective for increasing safety in driving.

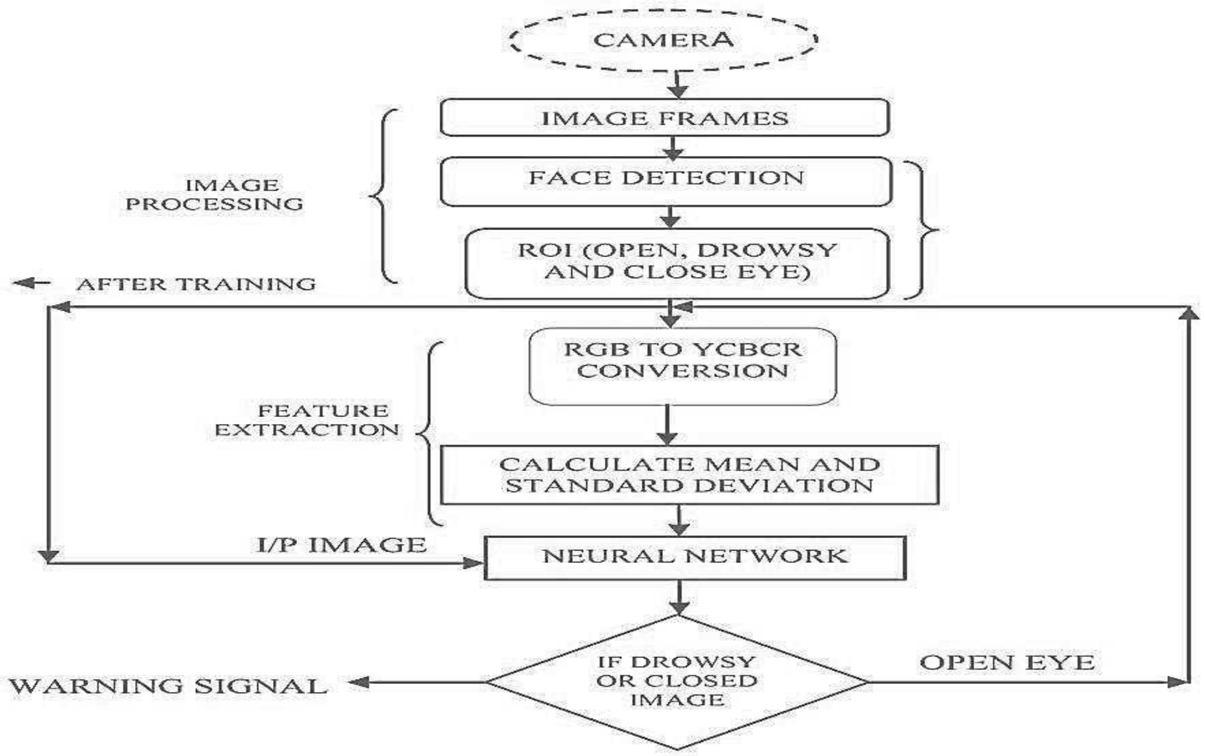

Figure 2.1: Development of a Drowsiness Warning system Flowchart

Advantages

- It is a non-invasive system to localize the eyes and monitor fatigue.
- Information about the degree of eye closure is obtained through various self-developed image processing algorithms.
- Neural network provides a completely different, unorthodox way to approach a control problem,this technology is not difficult to apply.

Disadvantages

- The algorithm is been kept too complex while it can be simplified further.
- The algorithm needs to be trained to detect faces which is a complex and time consuming process.

Proposed Work

Problem Statement

Sleep deprivation and operator fatigue are critical safety issues that cut across all modes in the transportation industry. Fatigue affects physical and mental alertness, decreasing an individual's ability to operate a vehicle safely and increasing the risk of human error that could lead to fatalities and injuries. As with drugs and alcohol, sleepiness slows reaction time, decreases awareness, and impairs judgment. Long hours at the wheel make truck drivers particularly prone to drowsy-driving crashes, but fatigue and sleep deprivation also affect other transportation operators such as railroad engineers, airline pilots, andship captains.

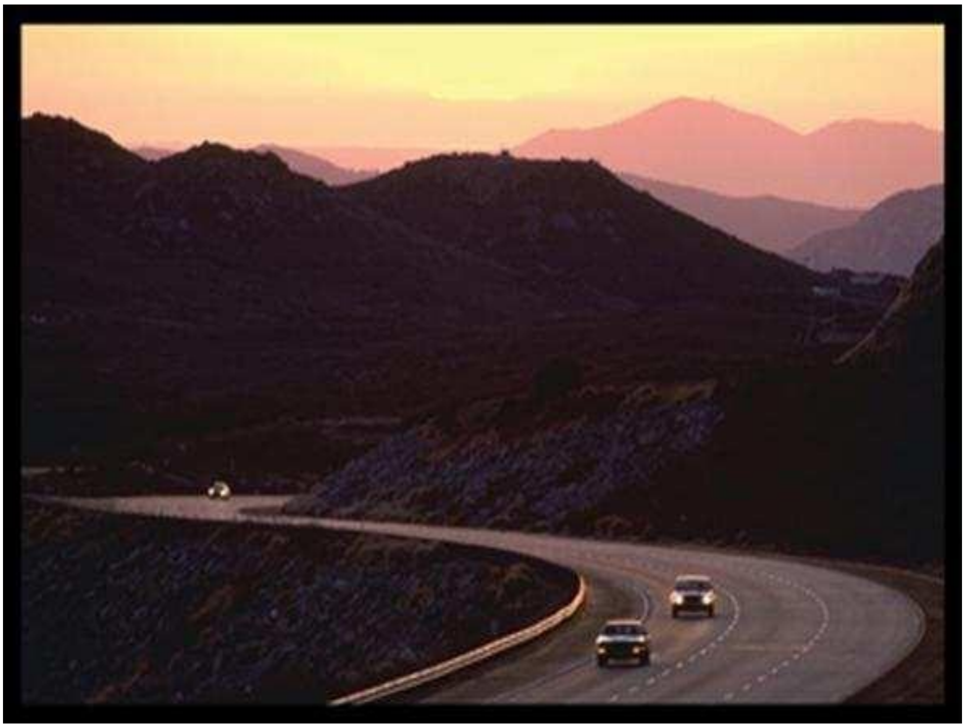

Figure 3.1: Motorists driving at dusk are among the most at-risk for drowsy driving crashes.

Sleepiness impairs driving performance, affecting reaction time, vigilance, attention, and informationprocessing. In a poll conducted by the National Sleep Foundation in 1999, 62 percent of adult survey respondents reported driving a car or other vehicle while feeling drowsy in the previous year. Twenty- seven percent reported that they had dozed off while driving. Twenty-three percent stated that they knewsomeone who experienced a fall-asleep crash within the past year.

For almost a decade, fatigue-related research conducted in laboratories, simulators, and more recently in actual operational environments has helped define causes of driver fatigue and countermeasures. FM-CSA is performing pilot tests to demonstrate the use of various technologies to manage fatigue within the current hours-of-service rules. In one project, a joint effort between USDOT and Transport Canada, FMCSA researchers are investigating the recovery period required for commercial vehicle drivers withcumulative fatigue. The purposes are to determine the minimum duration of off-duty periods that wouldenable drivers to recover from cumulative fatigue and to investigate the individual differences in drivers recovering from fatigue. With the literature review recently completed, the study team is in the process of developing the experimental protocol for the project.

A second initiative looks at using artificial neural networks to detect drowsy drivers. Unlike earlier research directed at identifying and measuring physiological correlates of fatigue, The George Washing-ton University Center for Intelligent Systems Research is using driver performance measures (such as steering) to develop an algorithm to determine when a driver becomes fatigued. Ultimately this neural network-based algorithm could help researchers better understand how roadway and psychological factors interact and affect driver behavior. The research could lead to the development of monitoring and warning systems for drowsy drivers.

However, there still remains a need for a real time drowsiness detector which can readily, accurately and non-intrusively detect the drowsiness level of a driver. As mentioned, there may be many ways to achieve this, but none seems to match the simplicity and adaptibility as tried to be provided in the Intelligent Car system using Image Processing where the camera is placed on the very dashboard of the driver to capture live facial images and process them to indicate fatigueness or drowsiness level.

Block Diagram

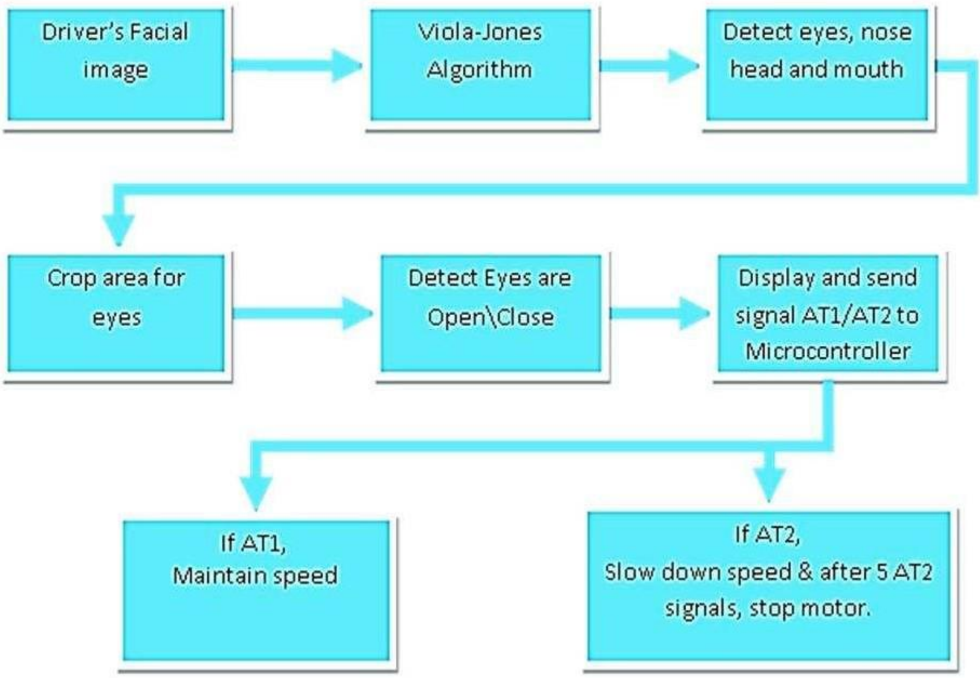

Figure 3.2: Functional Block Diagram

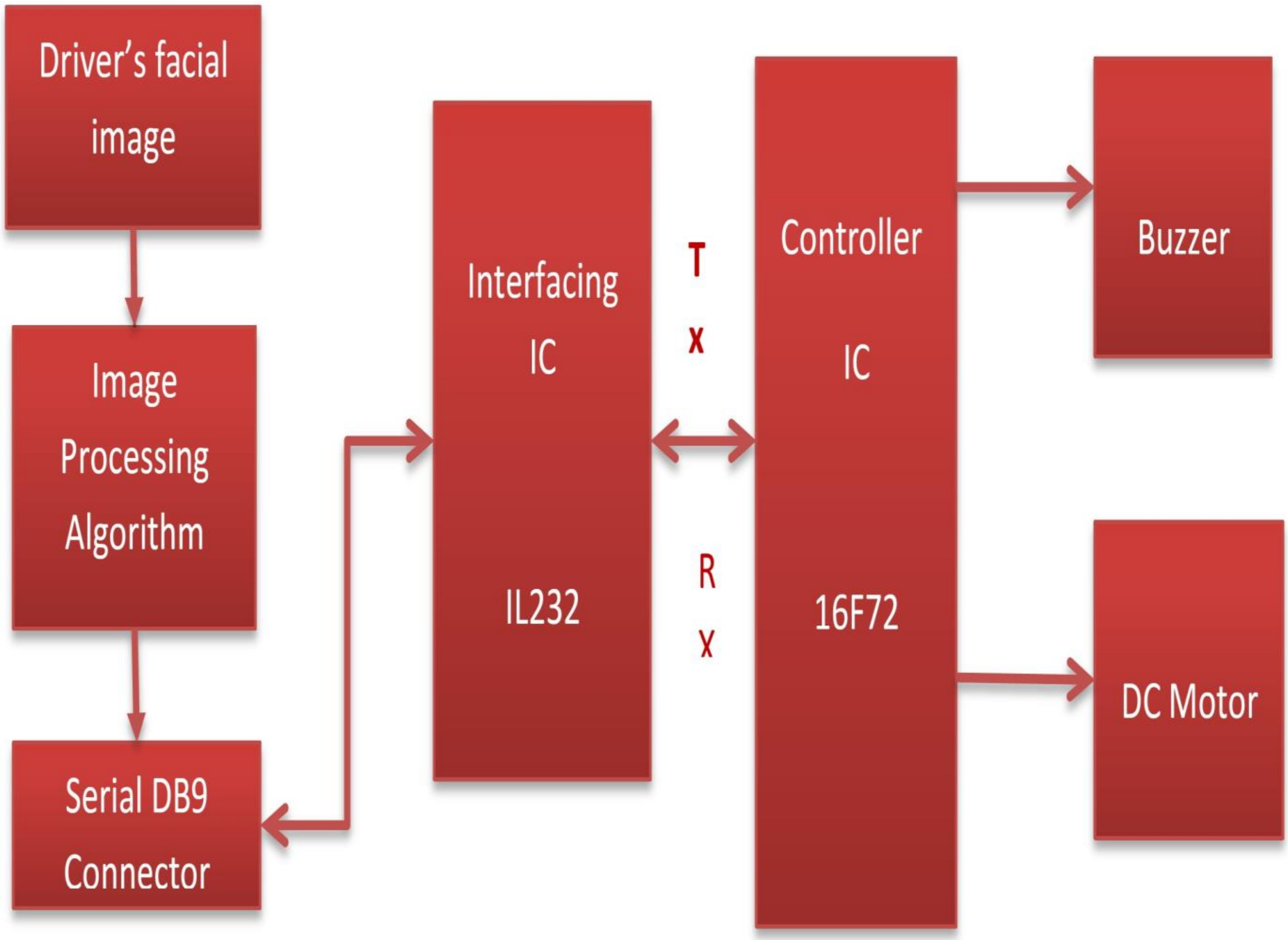

Figure 3.3: System Block Diagram

The system works as illustrated below:

- The facial image of the driver is obtained in real time continuously using a webcam.
- The webcam is connected to a computer in which the image is processed using Matlab and Viola-Jones Algorithm.
- The Viola-Jones algorithm separates face parts as mouth, head, nose and eyes. After that the eyesare localized.
- The eyes are then checked to be open or close.
- Depending upon the state of eyes, the microcontroller unit slows down or stops the motor.

The Webcam being used is a USB webcam of 8 Megapixel that is serially connected to the computervia the Universal Serial Port.

References

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