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Drowsiness Warning System Using Artificial Intelligence

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Abstract**—**Nowadays, driving support systems, such as car navigation systems, are getting common, and they support drivers in several aspects. It is important for driving support systems to detect status of driver's consciousness. Particularly, detecting driver's drowsiness could prevent drivers from collisions caused by drowsy driving. In this paper, we discuss the various artificial detection methods for detecting driver's drowsiness processing technique. This system is based on facial images analysis for warning the driver of drowsiness or in attention to prevent traffic accidents.

Keywords**—**Neuro-Fuzzy Model, Halstead Model, Walston-Felix Model, Bailey-Basili Model, Doty Model, GA Based Model, Genetic Algorithm.

I. Introduction

DRIVERS drowsiness is an important factor in the motoring of vehicle accidents [1,2,3,4]. It was demonstrated that driving performance deteriorates with increased drowsiness with resulting crashes constituting more than 20% of all vehicle accidents [9]. Traditionally transportation system is no longer sufficient. Recently artificial intelligence techniques has emerged and became a popular topic among transportation researchers In recent years, there has been growing interest in intelligent vehicles. A notable initiative on intelligent vehicles was created by the U.S. Department of Transportation with the mission of prevention of highway crashes [9]. The ongoing intelligent vehicle research will revolutionize the way vehicles and drivers interact in the future. The US National Highway Traffic Safety Administration estimates that in the US alone approximately 100,000 crashes each year are caused primarily by driver drowsiness or fatigue. Thus incorporating automatic driver fatigue.

Detection mechanism into vehicles may help prevent many accidents. One can use a number of different techniques for analysing driver exhaustion. One set of techniques places sensors on standard vehicle components, e.g., steering wheel, gas pedal, and analyses the signals sent by these sensors to detect drowsiness [5,7]. It is important for such techniques to be adapted to the driver. A second set of techniques focuses on measurement of Physiological signals such as heart rate, pulse rate, and Electroencephalography (EEG) [6]. It has been reported by researchers that as the alertness level decreases EEG power of the alpha and theta bands increase. Hence providing indicators of drowsiness. However this method has drawbacks in terms of practicality since it requires a person to wear an EEG cap while driving. A third set of solutions focuses on computer vision systems that can detect and recognize the facial motion and appearance changes occurring during drowsiness [3,10,12]. 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 focused on the analysis of blinks and head movements [8,11]. However the effect of drowsiness on other facial expressions has not been studied thoroughly. 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 [8].

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After long hours of driving or in absence of mental alert state, the attention of driver starts to loose and that creates risks of accidents. These are typical reactions of fatigue, which are very dangerous. In image fatigue detection, correct and real time decision is very important.

II. Drowsiness Warning System Based On Fuzzy Logic Image Analysis

In this system a CCD camera is installed on the dashboard for taking consecutive facial images of the driver in windows BMP. It then uses program, which is written in C++ to calculate the positions of the eyes and the eyelid closure duration based on the images taken. Finally a fuzzy logic is used to detect the driver’s alertness. a fuzzy logic determined algorithm is proposed to determine the level of fatigue by measuring both the blinding duration and the blinding frequency and then warn the driver accordingly.

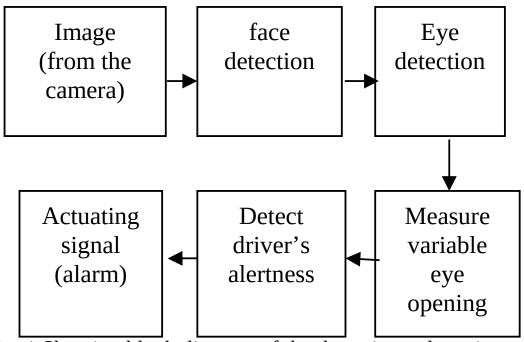

Fig. 1 Showing block diagram of the drowsiness detection system

III. Machine Learning Systems For Detecting Driver Drowsiness

This paper presented a system for automatic detection of driver drowsiness from video. Previous approaches focused on assumptions about behaviors that might be predictive of drowsiness. Here, a system for automatically measuring facial expressions was employed to data mine spontaneous behavior during real drowsiness episodes. This is the first work to our knowledge to reveal significant associations between facial expression and fatigue beyond eye blinks. The project also revealed a potential association between head roll and driver drowsiness, and the coupling of head roll with steering motion during drowsiness. Of note is that a behavior that is often assumed to be predictive of drowsiness, yawn, was in fact a negative predictor of the 60-second window prior to a crash. It appears that in the moments before falling asleep, drivers yawn less, not more, often. This highlights the importance of using examples of fatigue and drowsiness conditions in which subjects actually fall sleep.

IV. Detecting Method For Driver Drowsiness Applicable To Individual Features

In this method i.e. the driver status monitor system, the method or the timing for offering information to a driver is changed according to the level of the consciousness or the attention of a driver, and the media or its method to offer information is changed according to assent or urgency level of the information. The purpose of this study is to realize a system that wins driver‘s confidence by the ways mentioned above. The driver Stan’s monitor detects drowsiness from the change in the duration of eye closure during blinking and in attention from the change in the gaze direction. This method describes the detection of degradation of consciousness.

V. Smart Algorithm For Commercial Vehicle Driver Drowsiness Detection

This method describes an experimental analysis of commercially licensed drivers who were subjected to drowsiness conditions in a truck-driving simulator and evaluates the performance of a neural network based algorithm, which monitors only the drivers’ steering input. Correlations are found between the change in steering and the state of drowsiness. The results show steering signals differences can be used effectively for detection. This is a supervised training in which the known input-output patterns are presented to the network and the ANN learns (stores) the information The input patterns are the exemplars, i.e. 15-second summed of discredited steering angle, and the output is known state of the driver, i.e. the desired output vector, D(n). D(n) is represented by a classifying vector value of [1,0] for awake and [0,1] for sleep. Therefore, for training, for each input example X corresponds to a known output D(n). The presentation of input-output patterns is random, selected from the 600 exemplars. Training an ANN requires selecting the right and optimum architecture for the various training parameters. The ANN training is performed multiple times. An evaluation of the ANN model shows good performance under the crash prediction metric. The system issued at least one detection for 97% of all the observed crashes experienced by any of the subjects. Steering behavior is characterized by a period with no steering correction. Therefore, the ANN algorithm cannot detect these events since it was trained for.

VI. Hybrid Driver Drowsiness Detection System

Application of piezo-film movement sensors integrated into the car seat, seat belt and steering wheel was proposed for development of a non-invasive and hybrid systems for detecting driver drowsiness. A

Car simulator study was designed to collect Physiological data for validation of this technology.

Methodology for analysis of physiological data, independent assessment of driver drowsiness and development of drowsiness detection algorithm by means of sequential fitting and selection of regression models is presented. Statistical analysis shows that during the episodes of transitions to dangerous levels of drowsiness movement variations recorded by the seat sensors are decreasing. This finding indicates that the piezo-film movement sensors could be used as non-invasive devices for detecting the level of drowsiness on their own or in combination with other physiological signals.

Comp medics proposed use of non-invasive piezo-film movement sensors that can be incorporated into car seat, seat belt and steering wheel [3]. These sensors are potentially capable of recording patterns of

Driver’s movements, breathing and even heart rate that could be used for identifying the level of drowsiness. Another aspect of Comp medic’s patented technology includes integration of different kinds of signal analysis including morphological processing of EEG and eye movement. During the transitions to significant drowsiness states there is statistically significant reduction in a measure of variation of the piezo-film movement sensors located in the back of the car seat. This finding can be considered as the first step in deriving the accurate and reliable

Algorithm for detection of driver drowsiness. The logic of the algorithm development can be viewed as a sequence of fitting the appropriate statistical models while determining suitable methods of processing different physiological indicator signals, combining those parameters in an optimum way and expanding the temporal scope of these models in the process. The first step would comprise investigation of significance of time course of changes in functions of individual physiological signals during the episodes of transitions to the dangerous drowsiness states. The signals and respective processing methods that are found to have statistically significant variations over the transition episodes could be selected as potential candidates for being the algorithm components.

The Second step of algorithm `development would comprise determination of the combinations of individual drowsiness measures that are most strongly associated with the odds (or log odds) of a state of dangerous drowsiness or a number of different drowsiness stages based on the observations from the episodes of transitions to drowsiness. Finally a number of selected combinations of individual drowsiness measures could be validated across the complete set of recorded observations including determination of sensitivity and specificity. The important aspects of development of the drowsiness detection system are its practicality, robustness and non-invasiveness. While the discussed approach to the algorithm development is capable of integrating and comparing different combinations of physiological measures those that are minimally invasive will be given priority. This consideration was the reason behind the focus on analysing properties of the seat movement sensors as presented in this technique.

VII. Detecting method for Drivers' drowsiness

A method to extract the driver's initial stage of drowsiness was developed by means of the blink measurement irrelevant to the surrounding brightness and individual characteristics with motion pictures processing [1]. The result was that an increase of the long eyelid closure time was the key factor in estimating the initial stage of driver's drowsiness while driving. And the state of drowsiness could be presumed by checking the frequencies of long eyelid closure time per unit period. The objective method to perceive the drivers' drowsiness was surveyed through the motion picture processing CCD camera system, focused on measuring the eyelid's opening that strongly shows the drowsiness well. A neural network computer system was used to capture a driver's face and eye area. We contrived to determine the eyelid's location using the

Maximum and minimum points in the 1st derivatives of the individual eye area, and to determine the blink duration at zero Crossing points in the 2nd derivatives, which eliminate the characteristics of blinks among the individuals. Experimental results showed this method could be applicable to presume the drowsiness of a driver by the fact that the frequencies of the long eyelid closure time per unit period matched well with the drowsy intensity proposed by subjects themselves and the side watcher.

VIII. Conclusion And Discussion

This review paper describes the various methods for detecting driver's drowsiness by analyzing facial images taken by a camera installed in the dash board. This system involves two steps firstly the eye detection then detecting the drowsiness of the eye. Detection of the eye is done by the image processing technique. In the second step we apply the various artificial techniques like the fuzzy logic, the neural network, detecting the various movements of the body etc. lack of proper light after sunset can cause problems in reading the images. It may also be difficult for the system to detect the driver's eye wearing spectacles. In future implementation of the infrared light source could be a better solution for the lack of light after sunset.

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