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COLLECTIVE APPROACH TOWARDS ON BOARD DRIVER FATIGUE DETECTION: A SURVEY

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Abstract

Fatigue is a feeling of extreme physical or mental tiredness. Almost everyone becomes fatigued at some time, but driver's fatigue is a serious problem that leads to thousands of automobile crashes each year. Fatigue process is often a change from the alertness and vigor state to the tiredness and weakness state. It is not only accompanied by drowsiness but also has a negative impact on mood. There have been studies to detect and quantify fatigue from the measurement of physiology variables such as Electro Encephalo Gram (EEG), Electro Oculo Gram (EOG), and Electro My Ogram (EMG).This project involves a multi modal sensing of driver's drowsiness. The first method is to count the eye blinking rate. In the second level, we authenticate the results of eye blink module with a grip sensor. The grip sensor is placed over the steering wheel. In the third level, the activities are sensed, the time elapsed from the driver's last activity is counted here. The activities in the sense, changing gear, applying brake, pressing sound horns and turning the steering wheel. Absence of these activities is also an indicator of fatigue.

Keywords: Multi modal sensing of driver's drowsiness, Eye blink rate, Steer grip, Alert system

I. INTRODUCTION

Detecting driver distraction has been an important research issue over the past few years. While there are many common reasons for vehicle crashes, driver distraction and inattention are very prominent causes. Drivers fatigue is a feeling of extreme physical or mental tiredness. Almost everyone becomes fatigued at some time, but driver's fatigue is a serious problem that leads to thousands of automobile crashes each year. Earlier studies considered the use of monocular, infrared (IR) and stereo cameras to track driver distractions. Electro Encephalo Graphy (EEG), Electro Cardio Graph (ECG), Electro Oculo Graphy (EOG) and other similar invasive sensors have been considered to estimate relevant biometric signals associated to distraction. This project involves a multi modal sensing of driver's drowsiness. The first method is to count the eye blinking rate. The driver is provided with a special eye gear, where in the edges an IR sensor pair. Whenever the driver closes his eyes, the IR pair will output a voltage change. This voltage change is counted by the micro controller, where the IR pair output is connected. The controller will take the count every 30 seconds and calculates the blink rate for one minute. The count will then be reset. In the second level, we authenticate the results of eye blink module with a grip sensor. The grip sensor is placed over the steering wheel. If the driver is drowsy, his grip pressure over the steering wheel will also be reduced. This is another indication. In the third level, the activities are sensed, the time elapsed from the driver's last activity is counted here. The activities in the sense, changing gear, applying brake, pressing sound horns and turning the steering wheel. Absence of these activities is also an indicator of fatigue.

In this survey, various driver distraction detecting papers are analyzed. The analyzed parameters that make distraction to the driver are: eye blink rate, steer grip, changing gear, applying brake. Based on these parameters the Collective approach towards on board driver fatigue detection system makes the decision that the driver is in normal condition or not. If the driver is not in normal the alert system will alert the driver.

II. RELATED WORKS

Nanxiang Li, Jinesh J. Jain, and Carlos Busso, [1] created a database containing 20 drivers were asked to perform common secondary tasks such as operating the radio, phone and a navigation system. These tasks are sensed by various noninvasive sensors including controller area network-bus (CAN-Bus), video cameras and microphone arrays. By using these studies they build statistical models in the form of Gaussian Mixture Models (GMMs) to compute the driver's deviation from the expected normal driver's behavior. They use an UTDrive car platform to extract and record various CAN-Bus signals, such as steering wheel angle, vehicle speed, RPM acceleration, and brake value,

Luis M. Bergasa, Miguel A. Sotelo, [2] calculated six parameters they are, Percent eye closure (PERCLOS), eye closure duration, blink frequency, nodding frequency, face position, and fixed gaze. And they used a fuzzy classifier to combine these parameters in order to deduce the level of inattentiveness of the drive. They developed a FSM to distinguish between a blink and an error in the tracking of the pupil. By using an uncalibrated camera the face pose is depicted and a model-based approach is used to recover the face pose by establishing the relationship between 3-D face model and its 2-D projections.

Ji Hyun Yang, Zhi-Hong Mao, Louis Tijerina, Tom Pilutti, Joseph F. Coughlin, and Eric Feron, [3] created two major contributions. First, the disguise nature of drowsiness is revealed and second, a probabilistic framework based on Bayesian networks (BNs) for inferring drivers' state of drowsiness is introduced. Five different tracking tasks were given to the driver they are, 1) a curved road; 2) a straight road with changes in steering dynamics; 3) a straight road with a lead vehicle; 4) a straight road without any disturbance; and 5) a straight road with disturbances.

In [4] Afizan Azman, Qinggang Meng, Eran A. Edirisinghe, & Hartini Azman (2011), categorized Driver distractions into 3 major parts: visual, cognitive and manual. Visual and manual distraction on a driver can be physically detected. Driver cognitive can be detected by using several methods: Physiological measurements, 999performance measurements (primary and secondary tasks) and rating scales. They concluded with two important points are: (1) mouth and eye movements are highly correlated to each other; and (2) right eye is more correlated to mouth movement either from eye's height or width compared to the left eye.

Gustavo A. Peláez C., Fernando García, Arturo de la Escalera, and José María Armingol, [5] used three set of sensors: The first set of sensors is biomedical sensor which is based on the measurements of biomedical signals, the second set of sensors used for monitoring the driver are onboard sensors, and finally computer-vision-based sensors are used. They created a database containing various drivers' behavior in which they recorded the three sets of movements: The first set was recorded in a controlled scenario under artificial light; the second set was recorded inside the vehicle, with natural light. A final set involved 30 s of driving movements (free movements).

In [6] Boon-Giin Lee and Wan-Young Chung (2012), describes a method to monitor driver safety by analyzing information related to fatigue using two different methods: eye movement monitoring and bio-signal processing. They found four distinctive driving patterns through analysis by a hidden Markov model (HMM), and they monitor the steering behavior of the driver to detect their fatigue by multi wavelet packet energy spectrum using a support vector machine (SVM).

In [7] Ioannis G. Damousis and Dimitrios Tzovaras(2008), defines fuzzy expert system (FES) for the detection of the physiological appearances of extreme hypo vigilance of the driver. The system contains a Takagi, Sugeno, and Kang (TSK) fuzzy fusion model based on physiological features. The several physiological features are associated with hypovigilance: EEG features such as alpha and theta waves, eyelid activity features such as long eyelid closures and eye-activity-related features such as slow eye movements (SEM) and pupil size.

Yulan Liang, Michelle L. Reyes, and John D. Lee, [8] calculated six parameters: Percent eye closure (PERCLOS), eye closure duration, blink frequency, nodding frequency, face position, and fixed gaze. These parameters are combined by using fuzzy classifier to deduce the level of inattentiveness of the drive. They used an uncalibrated camera for recovering face pose to establishing the relationship between 3-D face model and its 2-D projections.

Federico Baronti, Francesco Lenzi, Roberto Roncella, and Roberto Saletti, [9] trying to measure grip force and hand position on a steering wheel. For that they designed a chain of sensor units, each of them provided with some intelligence and general purpose capabilities. Integrate these sensors into a driving simulator and to match the grip force data with other relevant data, such as steering angle and torque and vehicle speed and position, which are available through the simulator, CAN network.

Priti Gade1, and S. D. Giripunje, [10] proposed a system to warn the driver in critical situations and predict need for braking action. They denoted two types of brake: manual brake and automatic brake. If the driver is planned to apply the braking action then manual brake is applied otherwise automatic brake is used. They used Ultrasonic sensors to detect obstacles because they have several advantages over other types of sensors in short-range object detection.

III. RESULTS AND DISCUSSION

There are various driver distraction methods existing to monitor the drivers behavior by using many types of sensors and technique to alert them while they get any distraction were studied in this survey. The various parameters such as eye blink rate steer grip and brake pressure are discussed in this survey.

IV. CONCLUSION

From this survey, it has been concluded that there are many studies to detect and quantify fatigue from the measurement of physiology variables such as ElectroEncephaloGram (EEG), ElectrooCuloGram (EOG), and ElectroMyoGram (EMG). And many other methods to measure the fatigue of driver were studied, mainly by using various sensors and measured parameters.

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