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A REVIEW OF DROWSY DRIVER MONITORING SYSTEM FALSE ALERTS

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ABSTRACT

In any monitoring system, like the drowsy driver monitoring system, it is expected that the system must give accurate result or at least give a range of expected positive results, but when such result is not achieved as expected due to errors resulting in false alerts or alarm, it makes the efforts in setting up the system useless.

So in a drowsy driver monitoring system we will look at the causes of false alerts and suggest ways to get it controlled.

Key words: False alerts,monitoring,drowsy,driver

INTRODUCTION

Drowsy driving is the operation of a motor vehicle while being cognitively impaired by lack of sleep (Wikipedia project, 2020). This lack of sleep is the major cause of drowsiness with 23% of all adult drivers feeling sleepy while driving at least once per month in the last five years

(National sleep foundation, 2014). Drowsiness in driving has resulted to a lot of road catastrophes involving loss of related ones, friends, families, properties (vehicle) among others and have remained a major problem in the world of transportation. Several approaches have been proposed in order to reduce to the minimum such deadly accidents and grave losses. These includes administrative steps, involving rules and regulations and setting up of regulatory bodies.eg Federal Road Safety Corps. Etc. Other steps are physiological approach involving the use of electro-cardiological signals monitored on the driver to check the rate of drowsiness or when the driver is tilting towards drowsy state. Another method is behavioral approach where data is collected through image acquisition and processing. The setup of these approaches, due to the ways they were modeled may give rise to what we call wrong positive alerts or false alarms, we will look at the causes of these false alarms especially on the behavioral approach, which the most popular of most drowsy control systems, as well as propose a more reliable approach to the problem of drowsy driver monitoring system.

STATEMENT OF THE PROBLEM

- Irregular and high frequency of false alerts signal on the monitoring system due to having all the attributes of the drowsy driver monitoring system in a single dataset.

AIMS AND OBJECTIVES

The aim of this paper is to look at causes of false alerts in drowsy driver monitoring system and proffer solutions that will make the monitoring reliable, and the objective is:

- To ensure that all the driver attributes are well categorized through the help of artificial neural network in order of seriousness to avoid false alerts signals in the system.

2.0 Review of Related Works.

According to the federal road safety corps (FRSC) in 2015, over 12,077 road fatalities was recorded. Most recently in the first quarter of 2020, the daily times (August 31, 2020), reported that over 3947 road crashes have been recorded already within the first quarter of the year with over 20% of the causes drowsy driving related. Therefore there is an immediate need to develop a system which will intelligently monitor driver's behavior and detect drowsiness in real time with high accuracy. In the United States for instance, it was reported by the National Highway Traffic Safety Association (2017) that 795 people deaths and over 90,000 car crashes occurred every year because of drowsy driving.In a presented research on Driver's Fatigue Detection

System Based on Facial Features. Ijaz (2014), the research applied Viola Jones algorithm for skin colour pixels detection, detection of the position for eyes and mouth, then the data threshold collected were calculated for result prediction. The technique recorded high detection accuracy of 89%, however the prediction performance signalled false alarm rate of 14%, hence there is need for improvement.

Sajjad et al, (2014), researched on Data Fusion to Develop a Driver Drowsiness Detection System with Robustness to Signal Loss. Several number of detection methods with robustness to the input signal was integrated in one system for drowsiness detection. The purpose is to be able to keep the system on and active even if one or more methods fail. The major methods the work also used are image processing and driver vehicle interaction techniques. The work was implemented using simulation and trained for result, indicating 65% accuracy. However the system produced some degree of false alarm rate which affected the reliability and performance.Skipper et al. (2015) presented a paper on the investigation of low level stimulus induced measured of driver drowsiness. This approach is a physiological based technique which monitors the stimuli of the driver to predict the drowsy behavior. However the technique despite the success, is not reliable as it most times induces false alarm.

Form these reviews we can see that some of the errors are as a result of gathering all the symptoms of drowsiness as one dataset hence giving rise to false alarms or alerts, due to inaccurate predictions. The symptoms of drowsy driving according to American Academy of Sleep, are Frequent yawning or difficulty keeping your eyes open, "Nodding off" or having trouble keeping your head up, Inability to remember driving the last few miles, Missing road signs or turns, Difficulty maintaining your speed, Drifting out of your lane.

Analysis of Conventional Monitoring System

We can see the operational function of the driver monitoring and detection system using visual based eye template technique. The technique employed localization process to detect the eye and predict if it is open or closed using eye estimation analysis. If the eye is closed for a long time (programmed 4 seconds) an alarm is triggered to notify the driver of drowsiness as shown in the figure below..

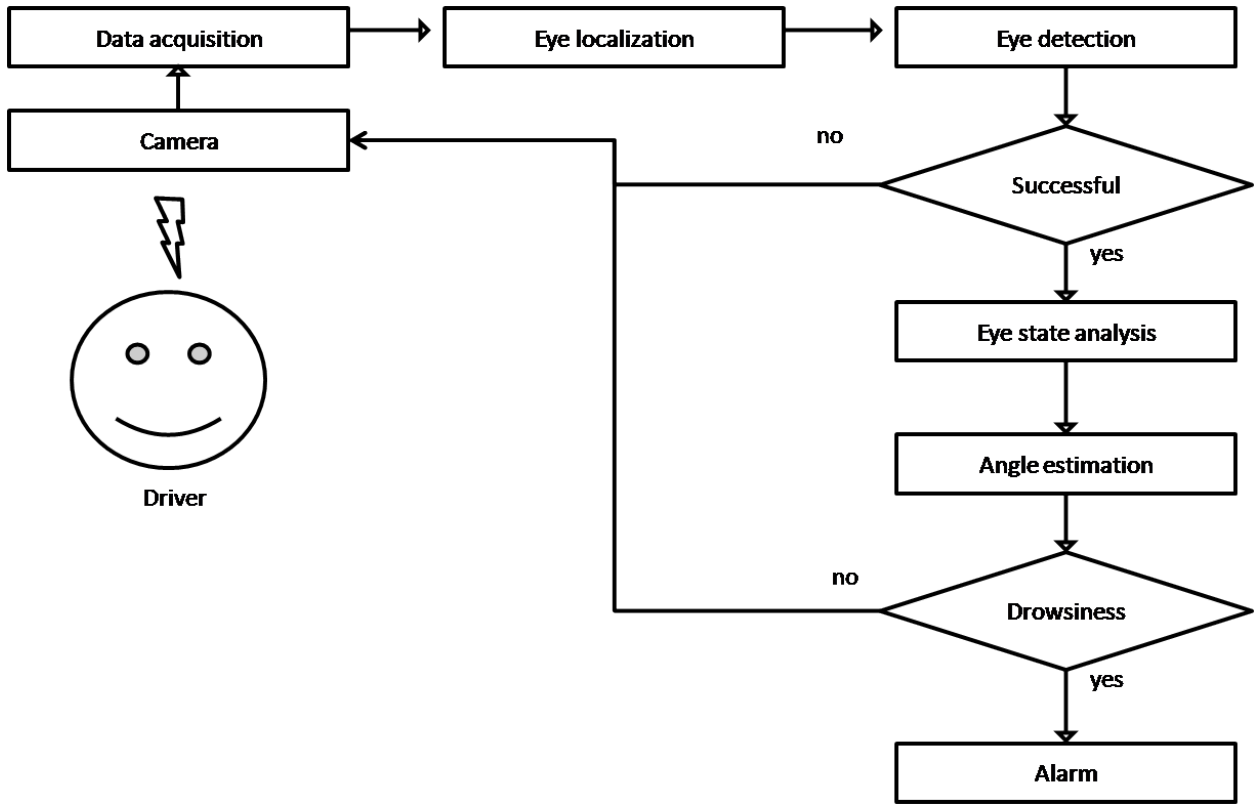


Figure 1

The diagram of visual based eye template drowsy detection system

From the figure, the camera is positioned to focus on the driver's eye when installed so as to effectively collect data from the eye and analyze for drowsiness detection. The drowsy symptom is identified when the eye is closed for some seconds, then the alarm is triggered to notify the driver with warning sign. However for the system to function effectively, the camera must be focused on the eye or vice versa so as to collect desired eye data for analysis and prediction. This system was tested in Taner et al (2018) and the result showed a correct eye blinking based drowsy detection accuracy of 84.3%.

It is also observed that the operational performance of the system will be highly unreliable in practical situation due to the nonlinear dynamics experienced during vehicle translation, thereby affecting the stability and focus of the camera and the driver's position, hence leading to poor data collection and false alarm. Other weaknesses of this system are;

i. Sleep (eye closed for some minutes) is the only drowsy symptom considered, neglecting other drowsy attributes like yawing, heads down, continuous eye blinking among others.

ii. The system lacks adaptive intelligence to track the driver's behavior

iii. Prediction inaccuracy due to poor data collection

Below is the dataset table a sample size of 10 self -volunteered drivers was used as the primary source of data collection.

Table1- The drowsy driver data table (single data class)

DATASET	**DATA CLASS**				
S/N of drivers	**Yawing**	**Frequent eye blinking**	**Heads down**	**Eye closed (sleep)**	**Eyes open**
1	300	100	100	20	300
2	300	100	100	20	300
3	300	100	100	20	300
4	300	100	100	20	300
5	300	100	100	20	300
6	300	100	100	20	300
7	300	100	100	20	300
8	300	100	100	20	300
9	300	100	100	20	300
10	300	100	100	20	300
Total frames	3000	1000	1000	200	3000

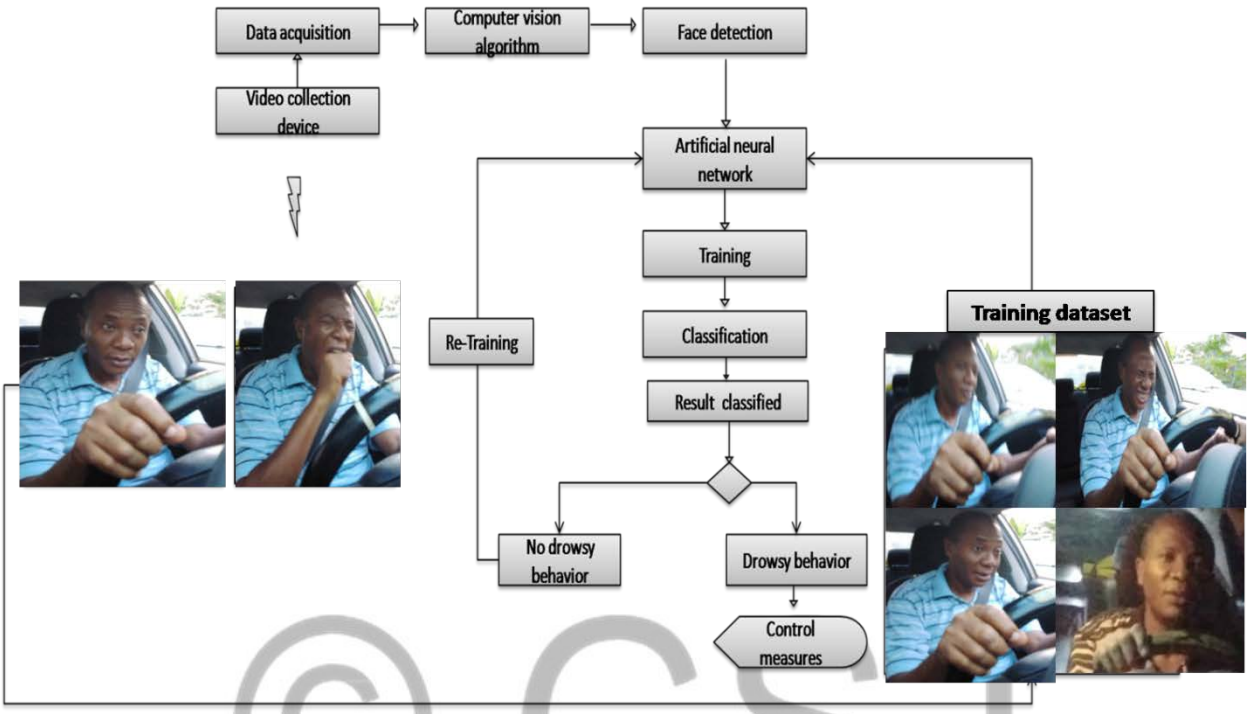
From the above table we can see that the data classes are all arranged as one data class, when this is implemented in the monitoring system it will bring about alerts or alarm for minor drowsy signs or even non drowsy signs, which on normal situations should not be.

In order to cub this issue of false alerts, there is a need to get a more structured system where the datasets are well organized and categorized so as to give the required and expected outcome.

Analysis of the Proposed System

The proposed system will be developed using computer vision based artificial intelligence technique to help address the challenges identified in the existing system. From the existing system analysis it was observed that the accuracy of the system is highly dependent on the

quality of data collection and also the intelligence of the classification approach, hence this paper proposed an adaptive image acquisition algorithm which will ensure intelligent data collection of the driver's behavior and classify drowsiness.



Results and Discussion.

Data will be collected in video format and used to develop the training dataset to learn the artificial intelligence technique of the drowsy reference model process and functionalities. Which is shown on tables 2

Table2: The drowsy driver data table (several data classes)

DATASET	DATA CLASSES				
	Minor drowsy signs		Critical drowsy signs		No Drowsy
S/N of drivers	Yawing	Frequent eye blinking	Heads down	Eye closed (sleep)	Eyes open
1	300	100	100	20	300
2	300	100	100	20	300
3	300	100	100	20	300

4	300	100	100	20	300
5	300	100	100	20	300
6	300	100	100	20	300
7	300	100	100	20	300
8	300	100	100	20	300
9	300	100	100	20	300
10	300	100	100	20	300
Total frames	3000	1000	1000	200	3000

The table 2- present the 820 video data collected for each driver in the three classes as shown and were combined to design the training dataset consisting of 82000 video frames, with 1200 frames representing data of critical drowsy attributes and 4000 frames representing data of minor drowsy attributes and the remaining 3000 video from normal driving without drowsiness. The 82000 videos of five seconds each is therefore 12300000 images classified into three classes and stored. Some of the data in each class are presented as below;

Figure 3.3: Minor drowsy class

Figure 3.4: Critical drowsy class

Figure 3.5: No drowsy class

Form the table and images, it can be seen that the data collected in the second table showed a clear categorization of the of each data class as – i. Non Drowsy, ii.Critical Drowsy. iii. Minor Drowsy

Conclusion and Recommendation

From the two processes described above it can be deduced that improver categorization of the drowsy driver attributes can lead to a false alert or alarm and this is not good for a control or monitoring system, so with the new proposed system a more organized format was used to streamline the attributes in order to get a positive alert or results.
It's recommended for further study that deep generative model should be used in further study to automatically generate and improved the training dataset

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