ISSN No:-2456-2165

Drowsy Driving: A Look at the Monitoring and Detection System

Okeke, Ogochukwu C.*[1], Okonkwo Chinonso J*[2]
*[1] Department of Computer Science, Chukwuemeka Odumegwu Ojukwu University, Uli, Anambra State.
*[2] Department of Computer Science, Chukwuemeka Odumegwu Ojukwu University, Uli, Anambra State

Abstract:- The rate at which cars and other motor vehicle related accidents have increased in recent years is becoming mind bulging and fearful and majority of these mishaps are drowsy driver related. This has resulted in the loss of lives, goods and properties etc. The essence of this analysis is to study and review the previous works on drowsy driving related accidents, their causes and measures taken. The gaps in these studies were noted in order to propose and design a new or a robust system. This was achieved using various techniques such as image acquisition, computer vision, face detection, feature extraction, training and classification. The techniques were designed using universal modeling diagram and mathematical modeling approach based on the requirements for object oriented analysis design methodology adopted for the study. The designs were implemented as a prototype system using MATHLAB and tested with real time driving behaviors.

Keywords:- *Drowsy-Driving, Mathlab, Computer Vision, Face Detection, Image Acquisition.*

I. INTRODUCTION

➢ *Background to the Study*

In the World Bank report of 2014, it was estimated that over 900 million people are being transported with their goods and services every day by vehicles all over the world (World Bank, 2014). Majority of these people depends on public transport for this locomotive process, to perform various daily routines like going to work, schools, service delivery system among other day to day activities.

Drowsy driving is the operation of a motor vehicle while 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 sleep 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 loved ones, friends, families, properties (vehicle) among others.

To solve this problem, various administrative steps have been proposed and implemented over time such as the federal high way road safety commission, motor traffic division of the police sector among other agencies which have all established and put into law various rules and regulations to help control accident on the high ways.

Other steps towards solving this problem is the physiological approach which employs electro-cardiological signal collected from the driver for monitoring.

The other approach is the behavioral approach which collected data from the driver using image acquisition tool and the process using various image processing technique like in (Barr et al., 2019) and artificial intelligence technique (Metin Kaya, 2018), however these approaches suffers from lack of adaptive intelligence.

This research work therefore proposes a new technique to solve this problem using computer vision based artificial intelligence technique.

➢ *Statement of the Problem*

(a) High rate of false alarm prompting in the conventional system due to combination of all attributes drowsiness in one dataset.
(b) Poor data quality due to lack of intelligence by existing image acquisition system.

➢ *Aim and Objectives of the Study*

The aim of this research is the development of a drowsy driver monitoring and detection system with the following setout objectives;

i. To design a drowsy driver dataset using universal modeling approach in order to pinpoint the exactness of whether a driver is drowsy or not before the alarm comes up.
ii. To develop a Computer Vision based algorithm for tracking of drivers' behavior attributes.

II. LITERATURE REVIEW

Driving is a complex task that requires the driver's full attention. When the driver is not completely engaged within this task, many factors can reduce his/her ability to detect and to react to risky situations. These factors which contribute to the nonlinear physiological state of a driver includes stress, fatigue, spending much time on the steering driving, hunger, lack of sleep, night driving which all can cause physiological state of drowsiness in drivers.

Drowsiness can be defined as the state when one has a strong desire for sleep or sleeping unusually for a long period of time. It is associated with reduction in response time gradually, processing a less vigilant behavior, inability to process available information promptly and errors in

short-term memory according to Ahmad et al, (2019). This state of drowsiness can also be associated with stress and fatigue that limits the performance of an individual unexpectedly.

Drowsiness is a dangerous state of physiology that has been proven to have significant impact on the passengers, drivers and road safety, reflecting driver's unsafe behavior. In a research conducted by Williamson et al. (2014) using driving simulator on drowsy driving revealed that higher levels of sleepiness were more likely to be involved in road crashes and centerline crossings. Furthermore, they revealed that drowsy drivers have slower response to sudden nonlinear vehicle dynamics.

Drowsiness is a major contributor to most of the road disasters happening everyday which results to numerous injuries, deaths and economic cost to the society. 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.

Over time, various researches have been done to identify the main causes of drowsiness during driving. Ting et al. (2018) identified time on task (increased time on the steer wheel driving) as the most well known cause of driver drowsiness. This was justified by other studies which revealed that increase driving time with increasing subjective sleepiness and fatigue, increasing steering wheel movement and longer blink durations all result to drowsiness during driving (Morales et al., 2017) revealed that deprivation of sleep is a strong factor that clearly induces higher rate of sleepiness and opined that even mild levels of sleep deprivation of two hours can impair the performance of driver on the steering. In the same vein, the research suggests that temperature, light settings, geometry's monotony, traffic conditions, are some of the external factors which can influence drowsiness in real time.

In the year 2018, Taner et al., published a paper on Drowsy Driver Detection System using Eye Blinking Patterns. The horizontal symmetry feature of the eyes was used to detect the visual changes in the eye locations. The detection was performed in real time with the use of a standard webcam with high resolutions and aspect ratios to detect eye blinks and then result was predicted from ground truth driver image using similarity differential model. Marco et al, (2015) researched on Driver Drowsiness Warning System Using Visual Information for Both Diurnal and Nocturnal Illumination Conditions. A new module for Advanced Driver Assistance System (ADAS) was introduced which uses facial visual information to detect driver drowsiness based on already trained Artificial Intelligence. The real-time system works in different light conditions (day and night driving). Ijaz (2014) presented a research on Driver's Fatigue Detection System Based on Facial Features. 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.

Wei et al, (2017), researched on Driver Drowsiness Recognition Based on Computer Vision Technology. They focused on eliminating nonlinearity on image captured due to illumination and driver posture. They used eye-tracking and image processing algorithms like Fisher's linear discriminant functions to measure some the nonlinear features based on stepwise method to reduce co-relations and then extract an independent index which was used for drowsy recognition. Ashish and Rusha (2018) researched on Driver Drowsiness Monitoring System using Visual Behaviour and Machine Learning, they acquired real time data for analysis using webcam that records the face of the driver and then process the data captured with image processing techniques. Machine learning was used to train and then predict the visual behaviour of the driver.

From the review it was revealed that the two main approach which are physiological and behavioral based approaches having used in the past to solve this problem of drowsy driver monitoring and detection despite their success have recorded many constraints such as false alarm, design complexity, poor detection and prediction accuracy, unreliability, high cost among others. These challenges have undermined the performance of the existing system as identified in the empirical review, hence there is need for an intelligent system which is adaptive to localize and collect drivers behavior in real time and then use the data collected to classify drowsiness with high accuracy using artificial intelligence technique.

- *Proposed System and Implementation.*

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 the research proposed an adaptive image acquisition algorithm which will ensure intelligent data collection of the driver's behavior and classify drowsiness.

The artificial intelligence technique will be trained using a new data model which will be designed using data containing various drowsy attributes such as eye closed (sleep), yawning, continuous eye blinking and drivers head down. This data will be collected in video format and used to develop the training dataset to learn the artificial intelligence technique of the drowsy intelligence as a drowsy reference model. Other process and functionalities of the proposed system are portrayed in the proposed diagram below;

ISSN No:-2456-2165

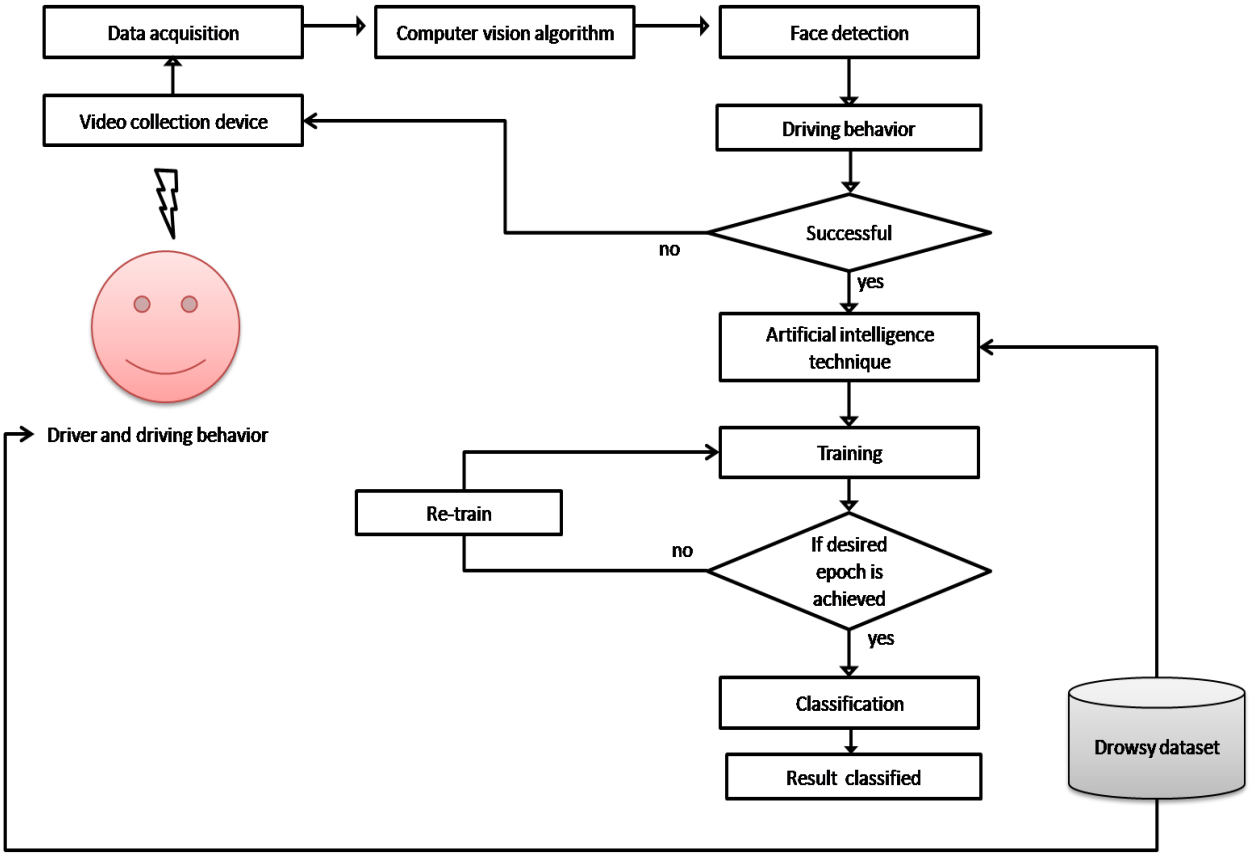

Fig 1:- The proposed system

➢ *System implementation*

The system is implemented using the models developed, image acquisition toolbox, computer vision toolbox, neural network toolbox, statistics and machine learning toolbox and Mathlab. The image acquisition toolbox is used to activate the hardware device, and then the computer vision is used for face tracking and detection. The data collected is converted using the activation function based on the statistics toolbox and feed forward for training with the neural network training tool to classify the desired result.

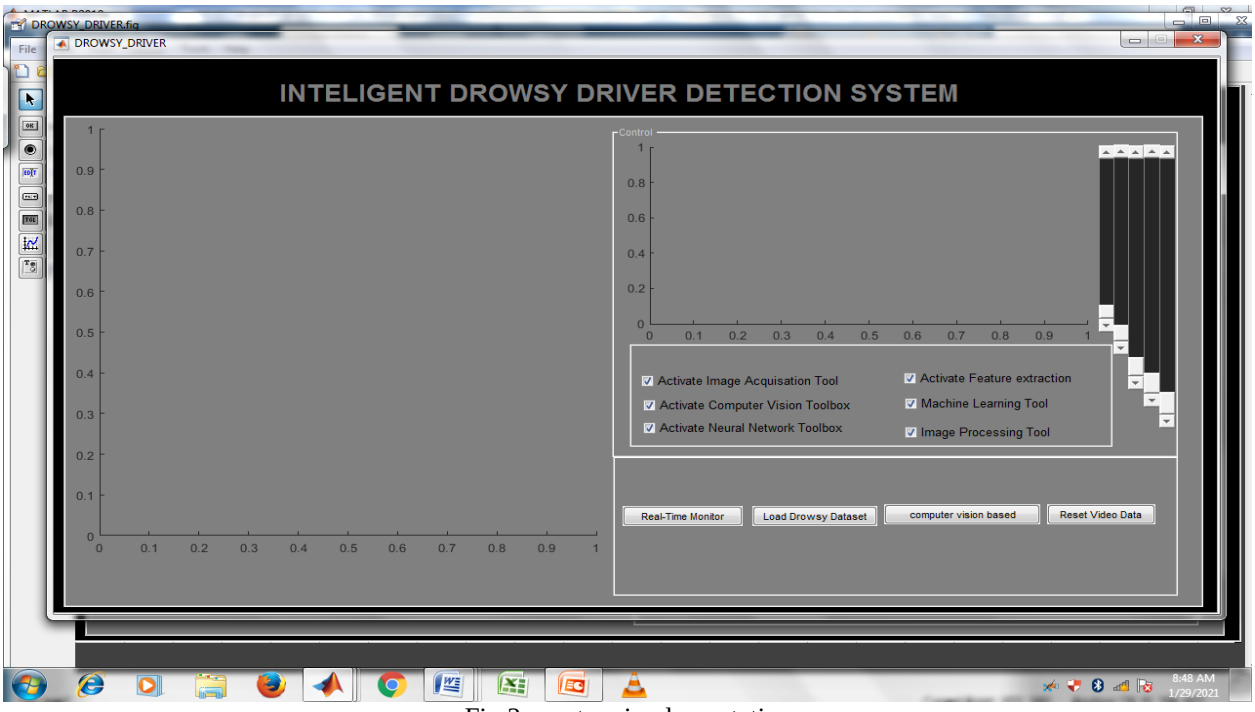

Fig 2:- system implementation

III. METHODOLOGY

This section discussed the methodology employed for the development of the new system. This was developed based on object oriented analysis design methodology (OOADM). This methodology was employed to bring out detailed description of the system as well as providing avenue for easy modification of the system as need may arise in future. OOADM suits in analyzing and designing large system like the case study as it gives out a clearer view of the modules, procedures, functions and sub-systems alongside with their respective relationships. This also gives a clearer picture and the representation of the objects (data and processes) as contained in the drowsy driver software as such giving the designers a complete analysis for the development of efficient system that meet specifications as contained in the specification documents and provides design with ease in modification.

IV. CONCLUSION

This study has successfully developed a drowsy driver monitoring and detection system. The research designs a standard drowsy dataset, intelligent video based drowsy data collection system using computer vision and also an intelligent classification system using artificial neural network. The systems were designed using universal modeling diagram and mathematical models and then implemented with MATHLAB programming editor as a prototype system. The system was tested and the result shows correct driver behavior classification accuracy of 98.6%.

REFERENCES

[1]. World bank funded research on transportation and road accident, 2014 (Accessed August, 31st , 2020).
[2]. National Sleep Foundation, (2014). Facts and Stats, http://drowsydriving.org/about/facts-and-stats/. Accessed on January 30th
[3]. Barr L., Howrah H., S. Popkin, RJ. Carrol l(2019) " A review and evaluation of emerging driver fatigue detection, In Proceedings of the IEEE International Conference on Intelligent Transportation Systems, Maui, Hawaii, HI, USA, 5–8 November 2019; pp. 1394–1402.
[4]. Marco Javier Flores, José María Armingol and Arturo de la Escalera, (2014). Real-Time Drowsiness Detection System for an Intelligent Vehicle. Intelligent Systems Laboratory at Department of System Engineering and Automation, Universidad Carlos III de Madrid, Leganés (Madrid) Spain.
[5]. Metin Kaya, "Image Clustering and Compression Using an Annealed Fuzzy Hopfield Neural Network", 2018
[6]. Ahmad Kamran, Malik M. Naeem Mannan and Myung Yung Jeong, (2019). Drowsiness, Fatigue and Poor Sleep's Causes and Detection: A Comprehensive Study. Pusan National University, Busan, South Korea. (No.2017R1A2B2006999). DOI 10.1109/ACCESS.2019.2951028.
[7]. Williamson, A.; Friswell, R.; Olivier, J.; Grzebieta, R. Are drivers aware of sleepiness and increasing crash risk while driving? Accid. Anal. Prev. **2014**, 70, 225–234.
[8]. National Highway Safety Administration Report (NHSAR), United Sates, 2016
[9]. Ting, P.-H.; Hwang, J.-R.; Doong, J.-L.; Jeng, M.-C. Driver fatigue and highway driving: A simulator study. Physiol. Behav. **2018**, 94, 448–453.
[10]. Morales, J.M.; Díaz-Piedra, C.; Rieiro, H.; Roca-González, J.; Romero, S.; Catena, A.; Fuentes, L.J.; Di Stasi, L.L. Monitoring driver fatigue using a single-channel electroencephalographic device: A validation study by gaze-based, driving performance, and subjective data. Accid. Anal. Prev. **2017**, 109, 62–69
[11]. Wei Zhang, Bo Cheng, Yingzi Lin (2017). Driver Drowsiness Recognition Based on Computer Vision Technology. TSINGHUA SCIENCE AND TECHNOLOGY ISSNll1007-0214ll18/18llpp354-362 Volume 17, Number 3, June 2012.
[12]. IJAZ KHAN (2014). DRIVER'S FATIGUE DETECTION SYSTEM BASED ON FACIAL FEATURES. Degree of Electrical and Electronics Engineering, Faculty of Electrical and Electronics Engineering Universiti Tun Hussein Onn Malaysia.