The Smart Vehicle Management System for Accident Prevention by Using Drowsiness, Alcohol, and Overload Detection

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***Abstract*— The principal intent behind the titled project is to make a smart vehicle management system that will prompt us to reduce traffic accidents. There are three major elements in this prototype of the smart vehicle management system. Firstly, there is a drowsiness detector, which will identify the drowsiness of the driver throughout driving time. Secondly, an alcohol detector will trace if there is any presence of alcohol on the body of that particular driver. Lastly, there is an overload detector, which will show if the vehicle is overloaded, or not.**

Keywords— Drowsiness detector, Pressure sensor, Alcohol detector, Smart vehicle, Accident prevention.

I. Introduction

With the progress of technology, dynamic transport systems have been invented and it has undoubtedly had an immense impact on both the society and the lives of individuals. Despite having zillion benefits, it has brought many adverse circumstances. Along with polluting and over-crowding the city, the most destructive feature of the vehicles is due to vehicle accidents. A traffic accident has become one of the serious threatening matters due to the overcrowded population. Because of road accidents, sometimes people lead their whole life bearing serious disorders or even lose their life. Apart from the miseries in people's lives, the vehicles got damaged very badly and the repairing process of the damaged, accident affected vehicles is very cost-effective and sometimes few vehicles have no longer in drivable conditions after a clash. Drowsy-drunk driving, driving being fatigued, carrying out-numbered passengers or goods are some major causes of road accidents. The project named "Distinguish Features for Smart Vehicle Management System in Bangladesh" has the vision to prevent road accidents with the best possible technologies. The smart vehicle management system includes several features to ensure the safety of passengers for the betterment of road transportation. In this project, our fundamental goal is to ensure safety issues while driving, detecting the drowsiness of drivers, the presence of alcohol on the driver's body, and the overload of vehicles. The focus will be on the smart vehicle management system, which may reduce road accidents in the recent future. We are aiming to condense the risks of losing life with the proper help of this system.

II. Earlier Research

In 1994, a three-year research project was conducted to develop reliable algorithms to detect loss occurred because of drowsiness. The algorithm indicates psychophysiological measures of driver alertness by producing low false alarm rates [1]. In 1996, there was research work to monitor driver performance. This was a computerized revised algorithm of the previous work that described simulation of driving and studies to perform the development, validation, and algorithmic advancement, and these all could detect accidental issues like drowsiness [2]. In 1999, L Reyner and J Horne published an article where they figured out tiresome driving for the utmost cause of accidents [3]. In 2000, there was a journal named "Accident Analysis and Prevention" where they focused on the factors of getting exhausted in the long-distance covering truck drivers [4]. A research was accomplished at Carnegie Mellon Driving Research Centre on drowsiness for a long route driving in 2002. The driving monitoring system that calculated and estimated PERCLOS (percentage of eye openness tracking) based on data obtained from vehicle performance with the help of a video-based system [5]. Active IR illuminator used on a computer vision system that performed software implementation was conducted in 2006 for monitoring a few parameters. To interpret negligence, the parameters are then linked using a fuzzy classifier [6]. A workshop named "International Workshop on Human-Computer Interaction" published a research in 2007 on drowsy driver detection through facial movements. This system included a digital video camera sensor (classification of SVM) and detected drowsiness [7]. In the same year, there was another research for commercial vehicle driver's drowsiness detection, which was an evaluation of the smart algorithms. Algorithm-based neural networking was performed on a truck driver who was subjected to drowsy conditions [8]. In 2008, a new technique, named Partial Least Squares Regression (PLSR), to deal with linear relations based on the positioning of the eyelid for drowsiness detection was introduced. In the same year, the Brain-Computer Interface (BCI) system was

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proposed to collect as well as investigate electroencephalogram (EEG) signals based on different psychological states of human and emotional states that provide warning signals [9]. In the same year, some researchers of Sabanci University utilize machine learning to identify actual human performance during the drowsiness period [10]. In order to upgrade driver's safety, Journal of Beijing University of Technology proposed a technique in 2009 by extracting texture features from mouth corners for monitoring drivers' drowsiness [11]. In 2010, some researchers used visual information and Artificial Intelligence for identifying the position of the eyes and face of a driver [12]. In 2012, some researchers of University Malaysia Perlis, Ulu Pauh measured driver carelessness level on the basis of some measurements like a vehicle, physiological and behavioral. The analyzed outcomes were published in the US National library of medicine [13]. In 2013, an eye blink sensor was used on research for detecting drowsiness of drivers, which results in buzzing the alarm if the driver was found sleepy and which in turn makes the vehicle ignition off [14]. In 2014, García et. al. combines dimensional techniques (2D,3D) that yield head gesture estimation as well as region-of-interest recognition [15]. In 2014, a drunken driving detection project was developed using an alcohol sensor with a microcontroller, where an alcohol detector gas sensor detects the level of alcohol that is contained in blood from human breaths [16]. In 2015, two researchers from Pukyong National University, Korea proposed a BMI (Brain-Machine-Interface) to detect driver drowsiness by collecting the EEG data [17]. In 2016, Vinoth A, Prabu L, and Ragunath K published a project on "International Research Journal of Engineering and Technology" (IRJET) where they formed a setup for overloading detection using coil spring, metallic rod, and an electric circuit. The process was both applicable to heavy or lighter vehicles [18]. In 2017, researchers used Google glass from where they gained the proximity sensor for monitoring eye-blinking frequency. The researchers conducted research to confirm their system. They compared the alert and drowsy state on driving performance and eye blinks [19]. In 2017, there was a journal published by Siquan Hu, Min Kong, and Chundong She where they used Geophone to detect the overloading of a vehicle. When an overloaded vehicle passed this Geophone sensor, it detected tiny vibrations on the ground and sent information [20]. In 2017, a project was developed by integrating an alcohol sensor with an Arduino board for safe driving and avoiding accidents that can be fitted with any vehicle [21]. In 2018, Xin Xin Qiao and Yi Ding Zhao published a project on the International Conference on Electronics Technology (ICET) where they used magnetoresistance sensors on real-time overloading detection [22].

A broad review of previous works signifies the progress of different categories of drowsiness detectors. Lincino Manuel Franca de Oliveira did a thesis in 2018 where an algorithm was settled based on an assessment of computer visualization for face analyzing and the algorithm was implemented in Python. He developed a framework that had three main steps. At first, the initial work was to identify the driver's face. Then, the next step was the facial landmarks detection. Lastly, drowsiness related measures are computed with the help of these landmark locations. The fundamental gaze of the driver was determined by the relative pupil-eye corner displacement. Estimation of heart rate was accomplished by studying the average optical intensity gained from the forehead of the driver's area and did landmarks validation and heart rate validation by applying algorithm [23].

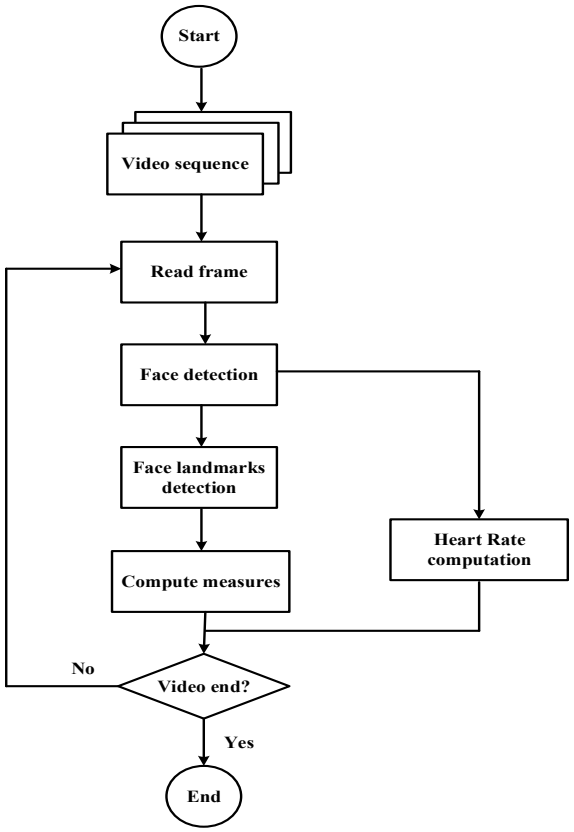


Fig. 1. Total workflow on extraction process of drowsiness measurement [23].

III. Project Description

A. Block Diagram

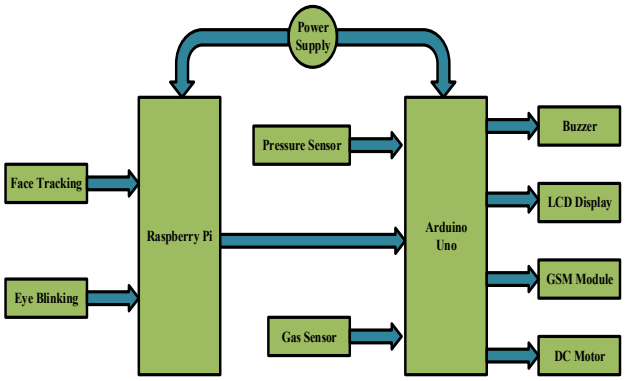


Fig. 2. System block diagram of the project.

Fig. 2 shows that two microcontrollers are used to accomplish the whole work. One is the Raspberry Pi and another one is the Arduino Uno. Both are connected with power supply. The main operation of Raspberry Pi in our project is to track facial movement and eye blinking of the driver. This operation is done by python code used in Raspberry Pi. The alcohol sensor and load cell are connected with Arduino Uno. For completing the whole operation,

buzzer, LCD display, and GSM module are connected commonly with Arduino Uno. After tracking facial movement, eye-blinking rate, a signal will be transferred to Arduino via Raspberry Pi. This action will turn the buzzer on and slow down the engine as well as an alert message will be sent to the control room via GSM module. In case of overloading, when the present load will exceed the threshold load then the signal will be delivered to Arduino, and the buzzer will start to buzz. Following these operations, the engine will start to slow down. For alcohol detection, the process will be the same as overloading. The whole activity will be notified on the display of the LCD.

B. System Flow Chart

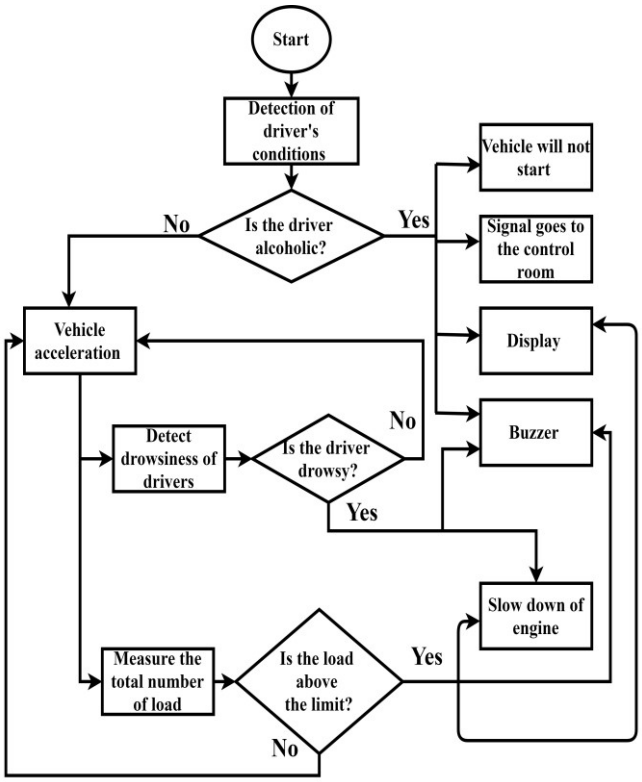


Fig. 3. System flow chart of the titled project.

Fig. 3 illustrates the system flowchart of the Smart Vehicle Management System. The total system will work in three steps. First of all, it will start to check the driver's condition. In the first step, the device will check whether the driver is alcoholic or not. If yes, then the vehicle will not start, and the signal will go to the control room, the result will be shown in the display, and the buzzer will start to give an audio signal. If the driver is not alcoholic, vehicle acceleration will remain the same. If the vehicle keeps accelerating, the devices will track facial movement and eye blinking to detect drowsiness. If it detects drowsiness, then the buzzer will start to beep, and the engine will slow down. If drowsiness is not found, the engine's speed will remain unchanged. At the same time, while accelerating, the device will measure the load of the vehicle. If the pressure of the passengers is above the threshold limit then it will be shown on the display, the buzzer will give an alarm, and the engine will slow down. If the load of the passengers is below the threshold, then vehicle acceleration will remain as before. This process will be done by a load cell, which will be put underneath the floor of the vehicle so that the whole pressure of the passengers present in that particular vehicle can be measured.

C. Hardware Implementation

Fig. 4. Preliminary circuits.

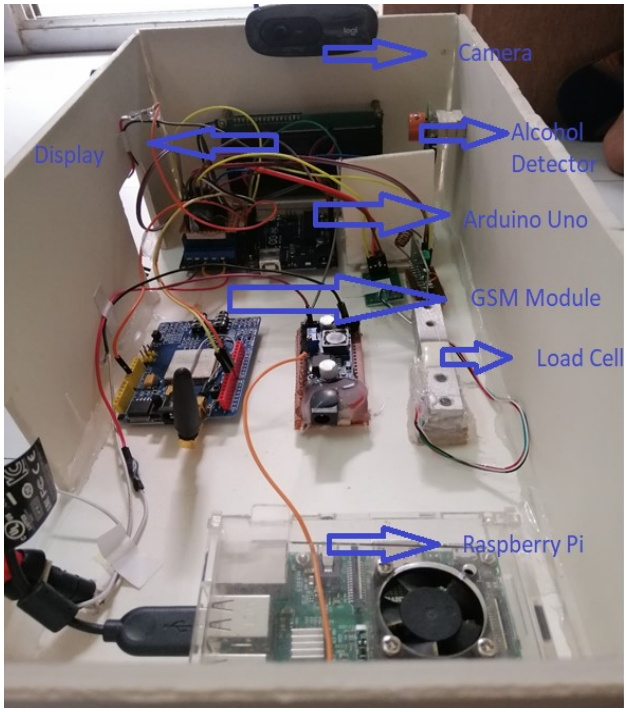
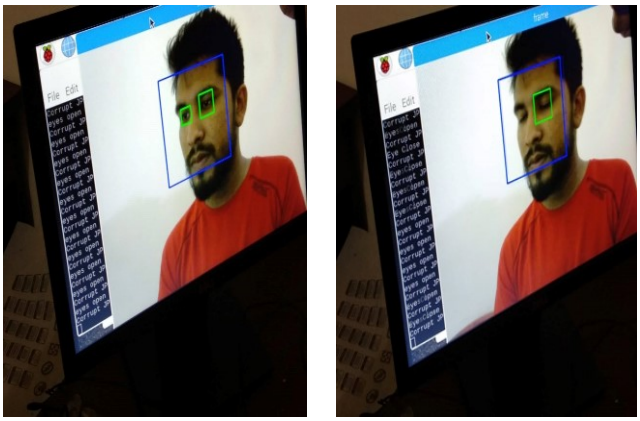


Fig. 5. Completed structure of the project

The above Fig. 5 displays the prototype of our fabricated smart vehicle management system. We used Raspberry Pi and Arduino Uno microcontrollers along with Load Cell, which has been used to detect overload, the Gas sensor that has been used as an Alcohol detector. For sending alerting signals to the control room, the GSM module is used. For alarms, we have used buzzers which will notify us while

there will be anyone mentioned incidents like drowsiness detection, alcohol detection, or overload detection.

D. Results



a b

Fig. 6. Raspberry Pi camera detecting eyes conditions (a) eyes open and (b) eyes close.

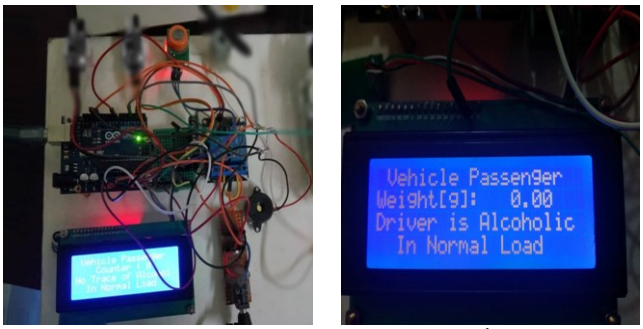


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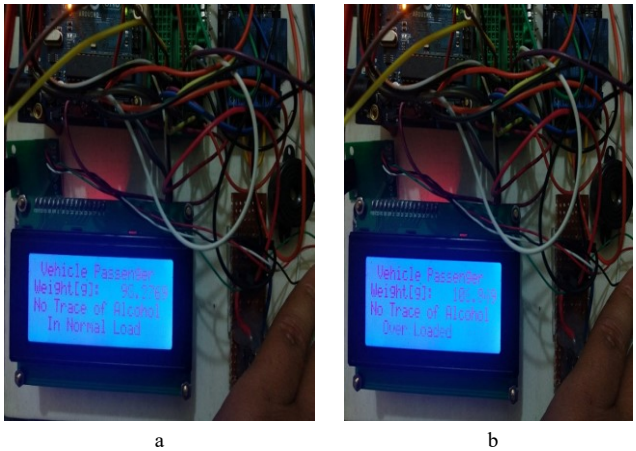
Fig. 7. Output on LCD display when driver is (a) non alcoholic and (b) alcoholic.



a b

Fig. 8. Output on LCD display when load is (a) under limit and (b) over limit.

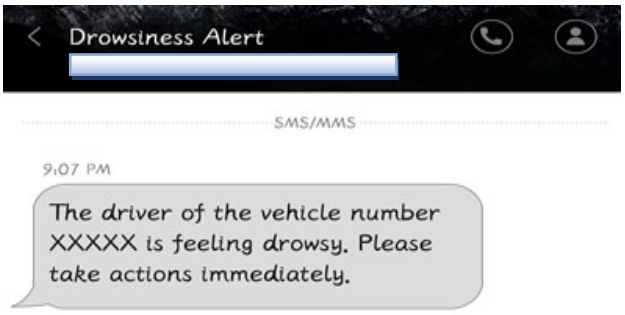


Fig. 9. Drowsiness alert text to control room via gsm module.

The figures under this section represent the result analysis of "Distinguish Features for Smart Vehicle Management System". Fig. 6 (a) represents the Raspberry Pi camera, which is detecting the person's eye condition, who is sitting in front of the camera. On the above Fig. 6 (b), the person sitting in front of the camera seems drowsy. The function detected it and sent the information as the output with an alarm through the SIM900 GSM Module to the control room. In this process, drowsiness has been detected and the engine will slow down to prevent accidents. Figs 7 (a), (b) show the outputs of Alcohol detection. Figs 8 (a), (b) represent the outputs of overloading. And finally, Fig. 9 shows the alert message when the driver is feeling drowsy and the eyelids are closed. The drowsiness detector detects it and the GSM module is activated through the Arduino and sends an alert text to the control room.

IV. Discussinos And Suggestion For Future Work

The main purpose of our project is to ensure the safety issues of a particular vehicle. We have provided safety issues by forming a drowsiness detector, which will detect drowsy drivers to avoid the accident. We have formed an alcohol detector, which confirms whether the driver is alcoholic or not. For maintaining a normal load for any particular vehicle, a load cell was used.

The transportation sector has been working sincerely for the betterment of the road condition of our country. As well as, reconstruction in the system of vehicles is up to the mark. Modern technologies have been adding to automobiles in recent years such as high beam control, backup cameras, smart home integration, and the GPS system. In this project, by fabricating a drowsiness detector, modernization can be taken to the next level. A more precise image processing system will lead this device to perform at a higher accuracy rate. Few more detectors such as a speed detector, harmful chemical detectors, a radiation detector, a motion detector, etc. can be added to this system to make it more enriched. These integrations will bring major significance on the evaluation of this project.

V. Limitations Of The Work & Ethical Concerns

The distinguishing features for the smart vehicle system have few limitations. As the system requires sensors, the accuracy may not be as sharp as always. On the other hand, as the image processing for the drowsiness detector has been done by high-level programming language, errors can occur on the optimization.

As the project has real-time data of vehicles such as vehicle number, location, and others which are confidential and can be used to harm the vehicles if it falls into the wrong hands. Therefore, these real-time data must be off-limit for public use. The main server of the system must be connected through a secure connection to prevent any sort of leakage or hacking of data.

The designing and the implementation of the whole project was done while keeping the ethical concern in mind and if any references were taken, it was properly cited in the reference section.

VI. Conclution

In this project, a few common reasons for road accidents were discussed in a populated as well as developing countries like ours to eradicate these problems. The causes of accidents that were discussed earlier can be prevented with this smart vehicle management system. By integrating features for this system, it is expected that casualties caused by road accidents can be reduced drastically. Though we have a large number of populations in our small country, these traffic problems cannot be solved too quickly and manually. As nothing is perfect at all, our project also does have some flaws and limitations. Considering all these in mind, it is being hoped that society can be helped in necessary ways and more research with the help of adequate sponsors will lead this product dynamically in the future.

Reference

[1] W. W. Wierwille, L. A. Ellsworth, S. S. Wreggit, R. J. Fairbanks , and C. L. Kirn, “Research On Vehicle-Based Driver Status/Performance Monitoring; Development, Validation, And Refinement Of Algorithms For Detection Of Driver Drowsiness, Final Report,” *ROSAP*, 01-Dec-1994. [Online]. Available: https://rosap.ntl.bts.gov/view/dot/2578. [Accessed: 27-May-2020].

[2] E. Blana, “Survey of Driving Research Simulators Around the World”, Institute of Transport Studies, University of Leeds, Working Paper 481, Dec-1996. [Online]. Available: http://eprints.whiterose.ac.uk/2110/1/ITS170_WP481_uploadable.pdf. [Accessed: 27-May-2020].

[3] Horne J and Reyner L, “Vehicle accidents related to sleep: a review”, *Occup Environ Med*. 56(5):289-94. May-1999. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1757738/pdf/v056p00289.pdf. [Accessed: 27-May-2020].

[4] M. A. Abdel-Aty and H. T. Abdelwahab, “Exploring the relationship between alcohol and the driver characteristics in motor vehicle accidents,” *Accident Analysis & Prevention*, vol. 32, no. 4, pp. 473–482, Jan. 2000.

[5] R. Grace *et al*., "A drowsy driver detection system for heavy vehicles," *17th DASC. AIAA/IEEE/SAE. Digital Avionics Systems Conference. Proceedings (Cat. No.98CH36267)*, Bellevue, WA, USA, 1998, pp. I36/1-I36/8 vol.2, doi: 10.1109/DASC.1998.739878.

[6] L. M. Bergasa, J. Nuevo, M. A. Sotelo, R. Barea and M. E. Lopez, "Real-time system for monitoring driver vigilance," in *IEEE Transactions on Intelligent Transportation Systems*, vol. 7, no. 1, pp. 63-77, March 2006, doi: 10.1109/TITS.2006.869598.

[7] E. Vural, M. Cetin, A. Ercil, G. Littlewort, M. Bartlett, and J. Movellan, “Drowsy Driver Detection Through Facial Movement Analysis,” *Lecture Notes in Computer Science Human–Computer Interaction*, pp. 6–18, 2007.

[8] A. Eskandarian and A. Mortazavi, "Evaluation of a Smart Algorithm for Commercial Vehicle Driver Drowsiness Detection," *2007 IEEE Intelligent Vehicles Symposium*, Istanbul, 2007, pp. 553-559, doi: 10.1109/IVS.2007.4290173.

[9] H. Su and G. Zheng, "A Partial Least Squares Regression-Based Fusion Model for Predicting the Trend in Drowsiness," in *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans*, vol. 38, no. 5, pp. 1085-1092, Sept. 2008, doi: 10.1109/TSMCA.2008.2001067.

[10] E. Vural, M. Cetin, A. Ercil, G. Littlewort, M. Bartlett and J. Movellan, "Detecting driver drowsiness using computer vision techniques," *2008 IEEE 16th Signal Processing, Communication and Applications Conference*, Aydin, 2008, pp. 1-4, doi: 10.1109/SIU.2008.4632673.

[11] X. Fan, B. C. Yin, and Y. F. Sun, “Yawning detection based on gabor wavelets and LDA,” *Journal of Beijing university of technology*, vol. 35, no. 3, pp. 409-413, 2009.

[12] M. D. L. Flores, J. D. L. Armingol, and A. D. L. Escalera, “Driver Drowsiness Warning System Using Visual Information for Both Diurnal and Nocturnal Illumination Conditions,” *EURASIP Journal on Advances in Signal Processing*, vol. 2010, no. 1, p. 438205, Nov. 2010.

[13] V. Saini, and R. Saini, “Driver drowsiness detection system and techniques: a review,” *International Journal of Computer Science and Information Technologies*, vol. 5, no. 3, pp. 4245-4249, Nov. 2014.

[14] K. Srijayathi and M. Vedachary, “Implementation of the Driver Drowsiness Detection System,” *International Journal of Science, Engineering and Technology Research (IJSETR)*, Vol. 2, no. 9, ISSN: 2278 – 7798, Sep. 2013.

[15] G. A. Peláez C., F. García, A. de la Escalera and J. M. Armingol, "Driver Monitoring Based on Low-Cost 3-D Sensors," in *IEEE Transactions on Intelligent Transportation Systems*, vol. 15, no. 4, pp. 1855-1860, Aug. 2014, doi: 10.1109/TITS.2014.2332613.

[16] Vaishnavi.M, Umadevi.V, Vinothini.M, Bhaskar Rao.Y and Pavithra.S, “Intelligent Alcohol Detection System for Car,” *International Journal of Scientific & Engineering Research*, Vol. 5, no. 11, pp. 598-601, Nov. 2014.

[17] G. Li and W.-Y. Chung, “A Context-Aware EEG Headset System for Early Detection of Driver Drowsiness,” *Sensors*, vol. 15, no. 8, pp. 20873–20893, 2015.

[18] Vinoth.A, Prabu.L and Ragunath.K, “A Design and Fabrication of Overload Detection System in an Automobiles,” *International Research Journal of Engineering and Technology (IRJET)*, Vol. 3, no. 11, pp. 2395-0072, Nov. 2016.

[19] J. He, W. Choi, Y. Yang, J. Lu, X. Wu, and K. Peng, “Detection of driver drowsiness using wearable devices: A feasibility study of the proximity sensor,” *Applied Ergonomics*, vol. 65, pp. 473–480, Nov. 2017.

[20] S. Hu, M. Kong, and C. She, “Design of vehicle overload detection system based on geophone,” *Journal of Physics: Conference Series*, vol. 887, p. 012021, 2017.

[21] P. Ingalepatil, P. Barhate, B. Nemade and V. D. Chaudhari, “Alcohol Detection System in Vehicle Using Arduino,” *International Research Journal of Engineering and Technology (IRJET)*, Vol. 4, no. 6, Jun. 2017.

[22] X. Qiao and Y. Zhao, "Vehicle overload detection system based on magnetoresistance sensor," *2018 International Conference on Electronics Technology (ICET)*, Chengdu, 2018, pp. 102-105, doi: 10.1109/ELTECH.2018.8401434.

[23] L. M. F. D. Oliveira, “Driver drowsiness detection using non-intrusive signal acquisition,” *A method for non-invasive acquisition of drowsiness measure,* Chapter 4, pp. 55-68, Jul. 2018.