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Implementation of Driver Drowsiness Detection and Accident Prevention System Using Wireless Sensors

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Abstract: *Nowadays we can see a lot of accidents occurring on the road. And nearly 78.4% of road accidents are occurring due to the drowsiness of drivers riding the vehicles. To avoid road accidents, there is a need for a driver assistance system for monitoring the activities of drivers. The proposed technique monitors the driver's eye movements using an eye blink sensor located in the device, in case of driver closes the eye frequently or other abnormal moments occurred, the eye blink sensors produce the alarm sound for altering the driver to stop the vehicle with an IR sensor attached to it. Also, an alcohol sensor is attached to it which detects the alcohol consumed by the driver and in case of alcohol is detected, it buzzes an alarm which in order avoids the road accidents.*

Keywords: *ESP 32, Eye blink sensor, IR sensor, Alcohol sensor, LiPo Battery.*

1. INTRODUCTION

When coming to road safety, drowsy driving is a controversial topic. Everyone who drives a car on regular basis already experienced drowsiness or even some micro–sleep during their driving. And it is a topic with low awareness in society. According to a survey throughout the years 2018 to 2021 the frequency of drowsiness–induced accidents are increased. This indicates a higher need for reliable drowsiness monitoring systems in vehicles. The fault of driver in any vehicle is very dangerous problem facing the community. It can cause a lot of accidents when most of the drivers are out of control. There are various things which are involved in motor vehicle crashes such are drunk and drive, high speed, other distractions like sleeping while driving, playing with children, texting while driving, etc. About 1373 people die every day, and around 402 people die, approximately 56 road accidents and 16 deaths per hour as a result of motor vehicle accidents. In motor vehicle accidents, 54.2% are between the ages of 18 and 34. The Department of Highways and Border Transport, Government of Indiaisaiming to reduce the number of road accidents by 50% by the year 2022. Globally, accidents have proven to be one of the world's biggest security concerns. In 2016 about 5 lakh road accidents occurred in India. A driver will be unable to drive the car or any vehicle when he is tired, and he cannot follow the entire adequate steps which lead to an accident, so it is necessary to monitor the driver's drowsiness to avoid such type of accidents. We focused on this issue and by using eye blink sensor to introduce a road accident prevention system. This paper discusses the detection of various things which led to an accident and the prevention of such a system. Also, in the recent huge traffic taking into consideration the mindset of the present generation, drunk driving is a leading cause of road accidents these days. We have other issues or problems like rash driving, bad road conditions, etc., which contribute to the same but drunk-driving tops the list.So to overcome this problem we even used an alcohol sensor attached to the eye blink sensor, which is used to detect the consumption of alcohol by driver’s breatheand helps in preventing the accidents. In case of high consumption is detected, and then the alarm will buzz which makes driver get alert from that and act accordingly.Thus the system helps to detect and prevent drunken driving accidents on roads efficiently.

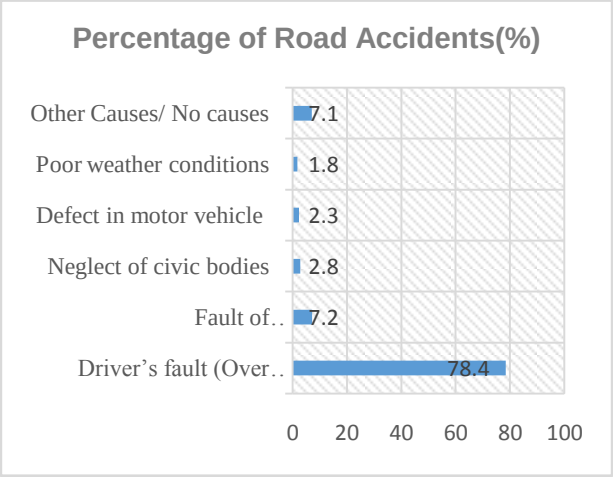

FIGURE1: Survey On Road Accidents

2.LITERATURE SURVEY

M. Shahbakhti et al., "Simultaneous Eye Blink Characterization and Elimination From Low-Channel Prefrontal EEG Signals Enhance Driver DrowsinessDetection," which Blink-related features derived from electroencephalography (EEG) have recently arisen as a meaningful measure of driver's cognitive state. When comparing the synergy of eye blink and EEG features before and after filtering by the proposed algorithm, a significant improvement in the mean accuracy of driver drowsiness detection was achieved (71.2% vs. 78.1%, p $< $ 0.05). This paper validates a novel view of eye blinks as both a source of information and artifacts in EEG-based driver drowsiness detection. [1] F. Guede-Fernández, M. Fernández-Chimeno, J. Ramos-Castro and M. A. García-González, "Driver Drowsiness Detection Based on Respiratory Signal Analysis," In this paper, a drowsiness detection method based on changes in the respiratory signal is proposed. The respiratory signal, which has been obtained using an inductive plethysmography belt, has been processed in real-time to classify the driver's state of alertness as drowsy or awake. The proposed algorithm is based on the analysis of the respiratory rate variability (RRV) to detect the fight against falling asleep. [2] D. Mashru and V. Gandhi, "Detection of a Drowsy state of the Driver on-road using wearable sensors: A survey," This paper demonstrates a wearable device that measures the drowsiness of the person on road by various methodologies like measuring the physiological measurements of the person like heart rate, pulse rate, etc., by changes in facial features like the frequency of eye blinks, frequency of eyebrows movement, etc., by measuring the vehicular behavior like deviations from a particular lane, frequency of steering wheel drifting, etc. when the person is drowsy, etc. [3] G. Li, B. -L. Lee and W. -Y. Chung, "Smartwatch-Based Wearable EEG System for Driver Drowsiness Detection," This paper proposes a support vector machine-based posterior probabilistic model (SVMPPM) for DDD, aimed at transforming the drowsiness level to any value of $0 sim 1$ instead of discrete labels. A fully wearable EEG system that consists of a Bluetooth-enabled EEG headband and a commercial smartwatch was used to evaluate the proposed model in a real-time way. [4] A. Dasgupta, D. Rahman and A. Routray, "A Smartphone-Based Drowsiness Detection and Warning System for Automotive Drivers," This paper presents a smartphone-based system for the detection of drowsiness in automotive drivers. The proposed framework uses three-stage drowsiness detection. The first stage uses the percentage of eyelid closure (PERCLOS) obtained through images captured by the front camera with a modified eye state classification method. The second step uses the voiced to the unvoiced ratio obtained from the speech data from the microphone, in the event PERCLOS crosses the threshold. A final verification stage is used as a touch response within a stipulated time to declare the driver as drowsy and subsequently sound an alarm. First, the three-stage verification process makes the system more reliable. [5] B. Lee, B. Lee and W. Chung, "Standalone Wearable Driver Drowsiness Detection System in a Smartwatch," The main objective is to detect the driver's drowsiness level based on the driver behavior derived from the motion data collected from the built-in motion sensors in the smartwatch, such as the accelerometer and the gyroscope. For this purpose, the magnitudes of hand movements are extracted from the motion data and are used to calculate the time, spectral, and phase domain features. The features are selected based on the feature correlation method. [6] A. A. Jordan, A. Pegatoquet, A. Castagnetti, J. Raybaut, and P. Le Coz, "Deep Learning for Eye Blink Detection Implemented at the Edge," In this letter, they proposed to embed a

convolutional neural network (CNN)-based solution in smart connected glasses to detect eye blinks and use them to estimate the driver's drowsiness level. [7] F. You, X. Li, Y. Gong, H. Wang and H. Li, "A Real-time Driving Drowsiness Detection Algorithm With Individual Differences Consideration," This paper proposes a real-time driving drowsiness detection algorithm that considers the individual differences of the driver. A deep cascaded convolutional neural network was constructed to detect the face region, which avoids the problem of poor accuracy caused by artificial feature extraction. [8] A. A. Jordan, A. Pegatoquet and A. Castagnetti, "A Comprehensive Study of Performance-Autonomy Trade-off on Smart Connected Glasses," In this paper they proposed to take into account the QoS during the power consumption study so that both performance and autonomy can be conjointly optimized for smart connected glasses. To do so, a methodology based on a system-level power modeling approach and a performance characterization using several performance metrics is introduced. [9] N. T. S. A. Wadhahi, S. M. Hussain, K. M. Yosof, S. A. Hussain and A. V. Singh, "Accidents Detection and Prevention System to reduce Traffic Hazards using IR Sensors," One of the solutions that are proposed in this paper is using IR sensors and Arduino Uno technology. The system has two phases-Accident Detection and Accident Prevention. The detection phase is carried out using IR sensors that could detect and alert the people by sending SMS using the GSM module that contains predefined numbers and accident locations using the GPS module. Second Phase, Accident prevention is carried out using IR sensors by warning the driver about the neighboring vehicles when the distance between them is beyond the threshold value. [10] E. P. Becerra-Sánchez, A. Reyes-Muñoz and J. A. Guerrero-Ibáñez, "Wearable Sensors for Evaluating Driver Drowsiness and High Stress," The proposed prediction model consists of three phases: 1. - Acquisition of electroencephalographic signals from drivers in real-time. 2. - Select and extract the main characteristics of the signals. 3. - Develop the prediction model using the Support Vector Machine (SVM) algorithm. [11] A. Altameem, A. Kumar, R. C. Poonia, S. Kumar and A. K. J. Saudagar, "Early Identification and Detection of Driver Drowsiness by Hybrid Machine Learning," In the proposed work, an emotion detection method based on Support Vector Machines (SVM) has been implemented using facial expressions. The algorithm was tested under variable luminance conditions and outperformed current research in terms of accuracy and achieved 83.25 % to detect the facial expression change. [12] J. K. Suhr and H. G. Jung, "Rearview Camera-Based Stixel Generation for Backing Crash Prevention," The proposed method represents obstacles utilizing the Stixel World, and it consists of two stages: free space boundary detection and obstacle height estimation. In the first stage, obstacles are three-dimensionally reconstructed, and the 3D points are spatially interpolated and sequentially accumulated. In the second stage, this method combines some complementary information to reliably estimate the obstacle height using spare 3D points. Finally, Stixels are generated by integrating the free space boundary and obstacle height. In the experiment, the proposed method was quantitatively evaluated and compared with the previous methods in various road, obstacle, and background conditions. [13] R. Mounika, S. Hussian. Sk and L. Venkateshwara Kiran, "A Novel Approach for Accident Prevention Using IoT," The project is designed with the microcontroller, alcohol sensors, relays, power supply, etc. the program written in the microcontroller for the above task. In case of extension, they send an alert to the respective owner of the vehicle and police authorities by sending an SMS along with the vehicle ID through the GSM network, the same data is posted in IoT cloud. [14] I. Vatsaraj et al., "VIGILANT – A Car Accident Prevention System based on Driver Drowsiness," This system precisely detects unusual blinking of eyes and mouth movements commonly known as yawning. A pre-trained model which uses facial landmarks algorithm is used to detect the eye and mouth movements. After detecting the eye and mouth movements drowsiness is calculated based on predetermined thresholds. All the data required in the process is collected and updated on a firebase cloud service. When the drowsiness is detected, an in-vehicle buzzer alarm is triggered. SOS signal is sent to an emergency contact number. This system is implemented using a Raspberry Pi Board. [15] B. Pansambal, "IOT Based Vehicle Accident Prevention System", They proposed the usability of a new conceptual autonomous emergency braking (AEB) system that uses Car-to-Car (C2C) communication technology in the existing AEB system. Thus, a method that can lower the collision risk of the existing AEB system, which uses only a sensor cluster installed on the vehicle, is realized. [16] S. Rana, M. R. H. Faysal, S. C. Saha, A. A. Noman and K. Shikder, "Road Accident Prevention by Detecting Drowsiness & Ensure Safety Issues," The implemented system uses Artificial Intelligence-based advanced algorithms to detect the expressions of the driver and can calculate the rate of the driver's drowsiness. The system detects drowsiness by extracting the `Eye Aspect Ratio' (EAR) calculation of facial landmark localization and the authentication is verified by incorporating with the facial recognition technology. [17] M. Kumar, A. Kant, P. Kaktan, R. Bishnoi and K. Upadhyay, "Arduino Based System to Prevent Vehicle Accidents," If any vehicle suddenly hits the road and the vehicle applies the brakes, the system will control the speed and prevent accidents These all sensors take the data from surrounding and send to the microcontroller

(ATmega328P) and this microcontroller takes the action automatically. With the help of an IR sensor we will monitor the driver's eyes. The presence of an Ultrasonic sensor detects the speed of the vehicle and simultaneously decreases the speed to zero. [18] T. Jamil, I. Mohammed and M. H. Awadalla, "Design and implementation of an eye blinking detector system for automobile accident prevention," In this paper, design of an eye blinking detector system is presented which can monitor the physical state of the driver at regular intervals during driving and, if needed, can raise an audible alarm within the vehicle to alert the driver or initiate application of vehicle's braking system. In case of multiple failures to raise the alertness level of the driver, the designed system can automatically inform the law enforcement authorities about the rogue driver on the road. [19] R. C. Luo, C. H. Hsu and Y. C. Wen, "Multi-model Fusion on Real-time Drowsiness Detection for Telemetric Robotics Tracking Applications," In this paper, they proposed a multi-model fusion system which is composed of the three models to capture driver's face and detect drowsiness in the real-time for telemetric robotics tracking applications. [20] S. Nanda, H. Joshi and S. Khairnar, "An IOT Based Smart System for Accident Prevention and Detection," this system detects accidents by vibration sensors, accelerometers. For detection, used GPS and GSM module which locates the site of the accident and correspondingly informs the person's near ones and nearby hospitals through a text message. This system also provides a mechanism by which it identifies whether the person that will be riding the bike has a valid driving license or a driving license at all by already embedded RFID on driving license. [21]

3. PROPOSED SYSTEM

This systemdeals withavoiding accidents due to unconsciousnessfrom Eye blink movements. In this proposed system, one eye blink sensor is fixed to helmet or an eye glass, where if the driver loses consciousness and then itindicates through a buzzer. This measures and controls the eye blink movements using an IR sensor attached to the eye blink sensor. The IR transmitter is used to transmit the infrared rays in our eye and the IR receiveris used to receive the reflected infrared rays of an eye from the IR transmitter. If the eye is closed means the output of the

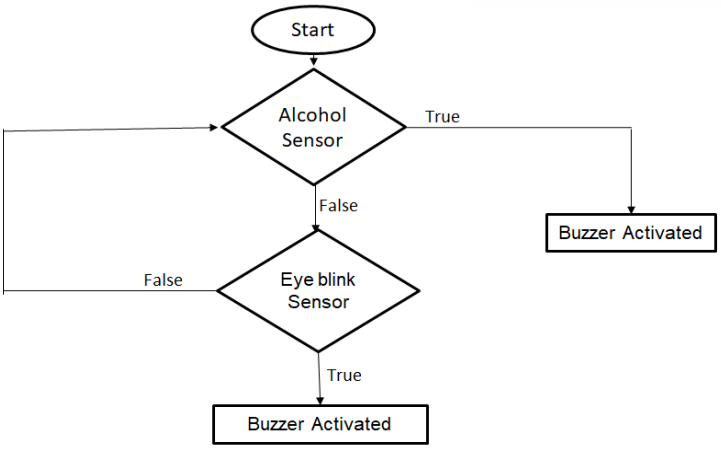

FIGURE1: proposed system

IR receiver is high otherwise the IR receiver output is low. This is to know if the eye is in a closing or opening position. This output is given to the logic circuit to indicate the alarm or buzzer. A **buzzer or beeper is a signaling** device, usually, it is electronic, and it is typically used inautomobiles, household **appliances such** as washing machines, or game shows. Most commonly it consists of several switches or sensors connected to a control unit that determines which button was pushed and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous buzzing or beeping sound. This sound comes from buzzer when it founds any abnormal eye movements from the eye blink sensor. The alcohol detector detects the consumption of alcohol in a person or driver's breath and makes an alert by that sound of buzzer

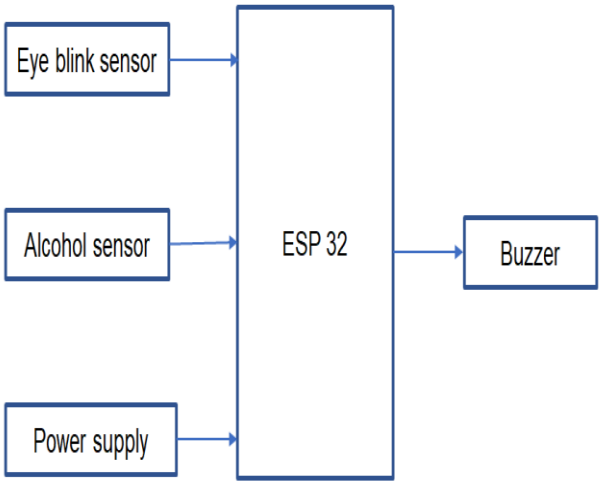

FIGURE 3: Block Diagram of the System

The principle of working of the proposed system is primarily based on the accident prevention system using wireless sensors. For the implementation of this system, we use an eye blink sensor and alcohol sensor inside the car or any other motor vehicle which analyzes whether the driver is drowsy or not. Based on this data, a buzzer will turn ON or remain OFF. If the driver becomes normal by the sound of the buzzer then it will stop. Else, it continuously makes alert which in turn prevents or avoids of causing an accident on the roads and save lives of the people. Also, the alcohol sensor named, MQ3 sensor is set up to detect the alcohol consumption by the driver before he starts Figure 3: Flow Chart of the System driving the vehicle, and if it detects the consumption of alcohol by the driver then it makes an alert to the driver which in turn helps to prevent the drunk and driving, which is already a major cause for most of the road accidents. And a rechargeable battery is also used in order to help the system with the power supply. The battery here we used is Lithium Polymer (LiPo) battery which is of lower weight, easy to use, cost effective, power delivery and can lasts up to 300 charge cycles. A flow chartissimplya graphical presentation of the system. The flow chart shows the steps in sequential order, as per the below flowchart it indicates that at first the driver is tested for alcohol consumption, if alcohol is consumed by him then the buzzer will makes a beeping sound otherwise it will be kept OFF. Once after it checks the alcohol consumption then it looks for the eye blink movements with the help of eye blink sensor, if the eye movements are abnormal then the buzzer will be activated else not activated.

Hardware Description

- ESP 32
- Eye blink sensor
- Alcohol sensor
- Buzzer
- IR sensor
- LiPo Battery

Software Description

- Embedded C
- Arduino IDE

4. RESULTSANDDISCUSSION

The figures which resemble the prototype of implementation of driver drowsiness detection system and accident prevent system are attached below. Below readings are plotted with the help of serial monitor which captures the consumption of alcohol by the driver when he is drunk. An alcohol sensor is used here to detect the alcohol consumed by the driver in order to save them from the accidents.

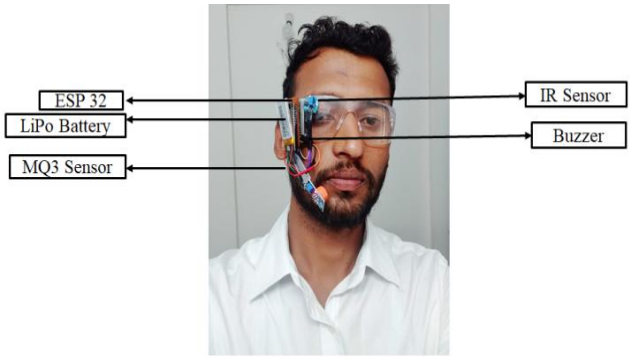

FIGURE 4: Driver Drowsiness Detection System with Components Description

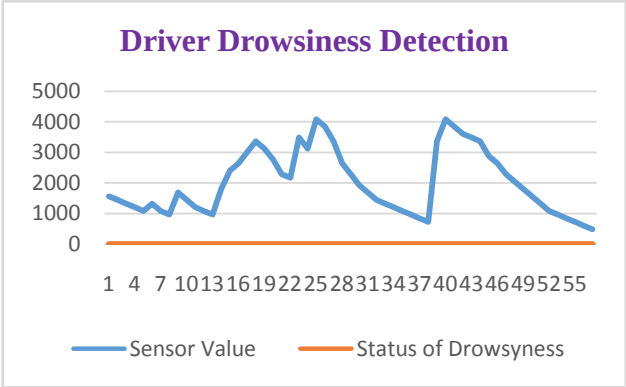

FIGURE 5: Reding Of the Drunken Driver

The whole system of driver drowsiness detection and accident prevention system using wireless sensor is attached in the below image, which resembles the detection of alcohol and eye blink movements using IR sensor and Alcohol sensor is implemented successfully which in turn is used to avoid the accidents of motor vehicles on the road and can save lives of the people.

FIGURE 6: Driver Drowsiness Detection and Accident Prevention System

5. CONCLUSIONS

The system Implementation of driver drowsiness detection and accident prevention system using wireless sensors has been implemented successfully.This, in turn, have many advantages of preventing road accidents by using an eye blink sensor, and an alcohol sensor that detects the eye blink movements and the consumption of alcohol by the driver. It detects the drowsiness of the driver and avoids accidents by alerting the driver with the help of buzzer which makes a continuous beeping sound and in this way it avoids the road accidents and save people's life.

REFERENCES

[1] M. Shahbakhti et al., "Simultaneous Eye Blink Characterization and Elimination from Low-Channel Prefrontal EEG Signals Enhances Driver Drowsiness Detection," in IEEE Journal of Biomedical and Health Informatics, vol. 26, no. 3, pp. 1001-1012, March 2022, doi: 10.1109/JBHI.2021.3096984.

[2] F. Guede-Fernández, M. Fernández-Chimeno, J. Ramos-Castro and M. A. García-González, "Driver Drowsiness Detection Based on Respiratory Signal Analysis," in IEEE Access, vol. 7, pp. 81826-81838, 2019, doi: 10.1109/ACCESS.2019.2924481.

[3] D. Mashru and V. Gandhi, "Detection of a Drowsy state of the Driver on road using wearable sensors: A survey," 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT), 2018, pp. 691-695, doi: 10.1109/ICICCT.2018.8473245.

[4] G. Li, B. -L. Lee and W. -Y. Chung, "Smartwatch-Based Wearable EEG System for Driver Drowsiness Detection," in IEEE Sensors Journal, vol. 15, no. 12, pp. 7169-7180, Dec. 2015, doi: 10.1109/JSEN.2015.2473679.

[5] A. Dasgupta, D. Rahman and A. Routray, "A Smartphone-Based Drowsiness Detection and Warning System for Automotive Drivers," in IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 11, pp. 4045-4054, Nov. 2019, doi: 10.1109/TITS.2018.2879609.

[6] B. Lee, B. Lee and W. Chung, "Standalone Wearable Driver Drowsiness Detection System in a Smartwatch," in IEEE Sensors Journal, vol. 16, no. 13, pp. 5444-5451, July1, 2016, doi: 10.1109/JSEN.2016.2566667.

[7] A. A. Jordan, A. Pegatoquet, A. Castagnetti, J. Raybaut and P. Le Coz, "Deep Learning for Eye Blink Detection Implemented at the Edge," in IEEE Embedded Systems Letters, vol. 13, no. 3, pp. 130-133, Sept. 2021, doi: 10.1109/LES.2020.3029313.

[8] F. You, X. Li, Y. Gong, H. Wang and H. Li, "A Real-time Driving Drowsiness Detection Algorithm With Individual Differences Consideration," in IEEE Access, vol. 7, pp. 179396-179408, 2019, doi: 10.1109/ACCESS.2019.2958667.

[9] A. A. Jordan, A. Pegatoquet and A. Castagnetti, "A Comprehensive Study of Performance-Autonomy Trade-off on Smart Connected Glasses," 2020 IEEE Sensors Applications Symposium (SAS), 2020, pp. 1-6, doi: 10.1109/SAS48726.2020.9220041.

[10] N. T. S. A. Wadhahi, S. M. Hussain, K. M. Yosof, S. A. Hussain and A. V. Singh, "Accidents Detection and Prevention System to reduce Traffic Hazards using IR Sensors," 2018 7th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO), 2018, pp. 737-741, doi: 10.1109/ICRITO.2018.8748458.

[11] E. P. Becerra-Sánchez, A. Reyes-Muñoz and J. A. Guerrero-Ibáñez, "Wearable Sensors for Evaluating Driver Drowsiness and High Stress," in IEEE Latin America Transactions, vol. 17, no. 03, pp. 418-425, March 2019, doi: 10.1109/TLA.2019.8863312.

[12] A. Altameem, A. Kumar, R. C. Poonia, S. Kumar and A. K. J. Saudagar, "Early Identification and Detection of Driver Drowsiness by Hybrid Machine Learning," in IEEE Access, vol. 9, pp. 162805-162819, 2021, doi: 10.1109/ACCESS.2021.3131601.

[13] J. K. Suhr and H. G. Jung, "Rearview Camera-Based Stixel Generation for Backing Crash Prevention," in IEEE Transactions on Intelligent Transportation Systems, vol. 21, no. 1, pp. 117-134, Jan. 2020, doi: 10.1109/TITS.2018.2889603.

[14] R. Mounika, S. Hussian.Sk and L. Venkateshwara Kiran, "A Novel Approach for Accident Prevention Using IOT," 2019 International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN), 2019, pp. 1-5, doi: 10.1109/ViTECoN.2019.8899717.

[15] I. Vatsaraj et al., "VIGILANT – A Car Accident Prevention System based on Driver Drowsiness," 2021 IEEE 18th India Council International Conference (INDICON), 2021, pp. 1-6, doi: 10.1109/INDICON52576.2021.9691707.

[16] B. Pansambal, "IOT Based Vehicle Accident Prevention System", SSRN Electron. J, 2020.

[17] S. Rana, M. R. H. Faysal, S. C. Saha, A. A. Noman and K. Shikder, "Road Accident Prevention by Detecting Drowsiness & Ensure Safety Issues," 2021 2nd International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), 2021, pp. 348-352, doi: 10.1109/ICREST51555.2021.9331043.

[18] M. Kumar, A. Kant, P. Kaktan, R. Bishnoi and K. Upadhyay, "Arduino Based System to Prevent Vehicle Accidents," 2021 International Conference on Design Innovations for 3Cs Compute Communicate Control (ICDI3C), 2021, pp. 140-144, doi: 10.1109/ICDI3C53598.2021.00037.

[19] T. Jamil, I. Mohammed and M. H. Awadalla, "Design and implementation of an eye blinking detector system for automobile accident prevention," SoutheastCon 2016, 2016, pp. 1-3, doi: 10.1109/SECON.2016.7506734.

[20] R. C. Luo, C. H. Hsu and Y. -C. Wen, "Multi-model Fusion on Real-time Drowsiness Detection for Telemetric Robotics Tracking Applications," 2020 International Conference on Advanced Robotics and Intelligent Systems (ARIS), 2020, pp. 1-6, doi: 10.1109/ARIS50834.2020.9205780.

[21] S. Nanda, H. Joshi and S. Khairnar, "An IOT Based Smart System for Accident Prevention and Detection," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-6, doi: 10.1109/ICCUBEA.2018.8697663.

