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IoT-Powered Technologies and Machine Learning based Driver Drowsiness Detection System

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Abstract:- The integrated strategy for detecting driver drowsiness described in this work makes use of the driver's physical, physiological, and optical cues. A machine learning image processing algorithm that contributes to the visual behaviour analysis is used to combine facial and eye analysis to assess the driver's level of exhaustion. As part of the physical behaviour method, the steering grip of the driver is measured using a human antenna effect-based touch sensing technology. Driver heart rate data is collected using a sensor and evaluated to detect tiredness based on the threshold value.

Keywords:- *Internet of Things, drowsiness, image processing, heart rate, touch sensing, buzzer.*

I. INTRODUCTION

Road accidents rank among the most common causes of fatal collisions, regardless of the route or the hour.The rise in vehicles on the road worldwide has made this worse. Long-distance driving frequently makes people feel worn out and sleepy. 40% of traffic accidents are caused by tired or fatigued drivers, according to study done by the Central Road Research Institute (CRRI) on the 300-km Agra-Lucknow Expressway. Road safety experts advise against operating a vehicle for more than three hours straight without a break of 15 to 30 minutes.

Drowsy driving refers to driving abilities that have deteriorated as a result of behavioural causes. Long drives can quickly lead to fatigue, especially if the driver doesn't take enough breaks or suitable rest times. The weariness of drivers may also be increased by disruptive or erratic work schedules. Some people may be more prone to driving fatigue due to certain medical disorders including sleep apnea.

Drivers may be less able to notice hazards due to diminished attention and concentration caused by insufficient sleep or feeling worn out. Both the decision-making and reaction times are slowed. All of these factors can cause accidents or worsen existing ones.

Driver fatigue can be more severe than just feeling tired; it usually causes sleepiness or even brief sleep episodes. According to CDC surveys, 1 in 25 adult drivers (age 18 or older) admitted to dozing off behind the wheel at least once within the previous 30 days. More than 20% of all traffic accident victims are shown to have sleep problems including OSA, according to research from AIIMS Neurology India. More than 23% of truck drivers, according to a different research, experience sleep deprivation. These drowsy drivers have the potential to cause fatal crashes.

The proposed system contributes to preventing fatal accidents due to driver drowsiness or fatigue. Although it is not possible to control sleepiness, it is possible to detect it and alert the driver using an alarm/buzzer which will prevent the risk of fatal accidents. It is not possible to detect and alert the driver manually hence this process can be automated using IoT.

Real-time Detection of drowsiness is done using:

- A camera sensor for face and eye detection based on image processing,
- A smartwatch with a heart rate sensor is used for HR sensing and using it as input data for drowsiness detection,
- for the purpose of detecting drowsiness, a straightforward and low-cost passive touch sensor based on the hum-antenna effect is employed,

All the above-mentioned methods are used in combination to achieve a more accurate detection process.

The driver is immediately informed if they are being detected as being sleepy by a buzzer.

N. Sunitha, M S Swathi, Sinchana N Rao, B. V. Ajay Prakash and V V Shreevaishnavi.[1] This study intends to provide a technology that can recognise driver fatigue and send out a timely alert, thereby improving traffic safety. Snoozebreaker (SB) is made to recognise faces using the Haar cascade algorithm and to precisely map facial landmarks like the lips and eyes. It also detects driver tiredness and delivers alert signals.

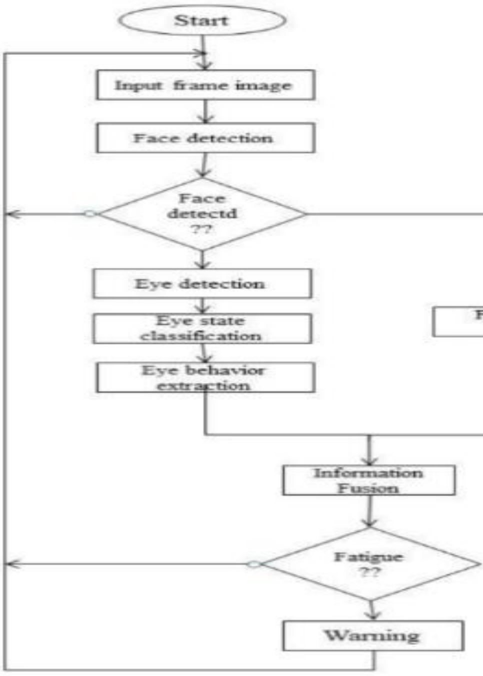

Fig. 1: Proposed methodology

Karim Abbes, Omar Rigane, Mohamed Masmoudi and Chokri Abdelmoula.[2] The paper uses a Fuzzy Logic controller for intelligent driver drowsiness detection. the Fuzzy Logic allows the processing of multiple possible truth values (0 and 1) to be processed through the same variable. face detection in each frame of the video is done using a Haar feature-based cascade classifier.

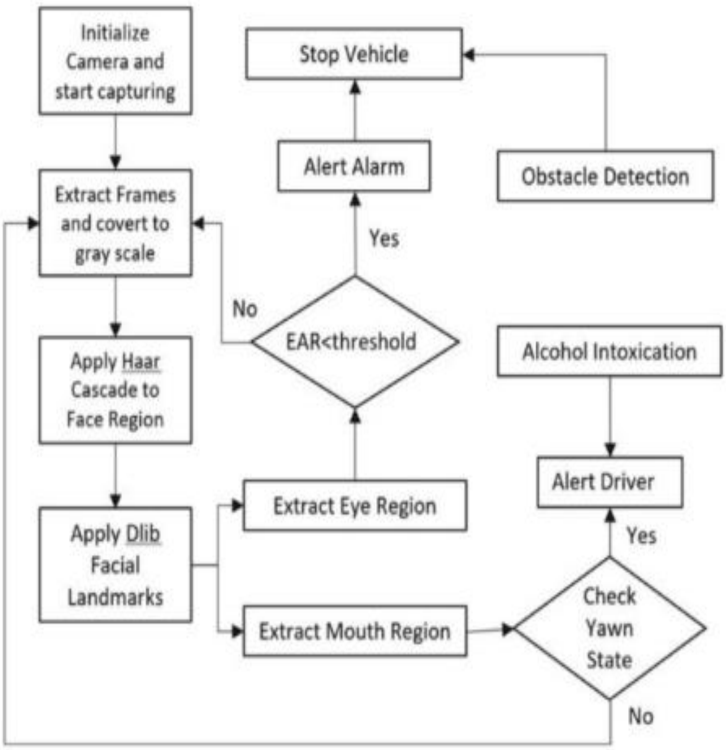

Fig. 2: Flowchart

Rajasekar .R, Vivek Bharat Pattni, S. Vanangamudi.[3] In this paper, IR sensors are used to measure eye blinks. In the IR sensor, there are two portions. Using the IR transmitter the infrared rays that reach our eye. The reflected infrared rays from the eye are picked up by the IR receiver. The output of the IR receiver is higher when the eye is closed than when it is open. This is done in order to determine whether the eye is closed or open under those circumstances.

Algorithm	Parameters	Accuracy (%)				
		A	B	C	D	Average
Naïve Bayes		96,02	96,59	88,66	91,66	93,23
IBk	1 neighbor	93,92	96,96	90,74	94,23	93,96
	5 neighbor	94,88	97,03	92,52	94,60	94,76
	10 neighbor	95,11	97,57	92,08	94,23	94,75
J48	Pruned	92,01	95,90	87,49	92,51	91,98
	Binary Tree	92,01	95,90	87,49	92,51	91,98
SVM	Linear Kernel	64,85	85,08	67,20	58,49	68,90
	Polynomial Kernel	83,57	96,24	69,05	88,54	84,35
	RBF Kernel	55,27	66,90	52,89	55,43	57,62
Voted Perceptron	1 iteration	84,53	92,87	52,89	77,20	76,87
	3 iteration	87,16	93,62	52,74	80,57	78,52
	5 iteration	87,57	94,00	52,66	82,86	79,27

Fig. 3: Block diagram

Erdem Uçar , Ozan Aki , Levent Öztürk and İlhan Umut1.[4] Create and build a system that can identify drowsy driving This technology measures the eye positions in real-time using image processing and machine learning techniques. Images from the left and right eyes are merged to form one image. These characteristics were employed to categorise pictures of the open and closed eye. The J48 Tree method has a classification speed of 91.98% accuracy, while the IBK algorithm has the highest accuracy of 94.76%. PERCOLS measures how many times the eye closed in a minute, while CLOSDUR determines how long it was closed for. When PERCOLS detects a value of 0.15 or higher, the first alert sounds. When PERCOLS detects a value of 0.3 or higher, the second alarm sounds.

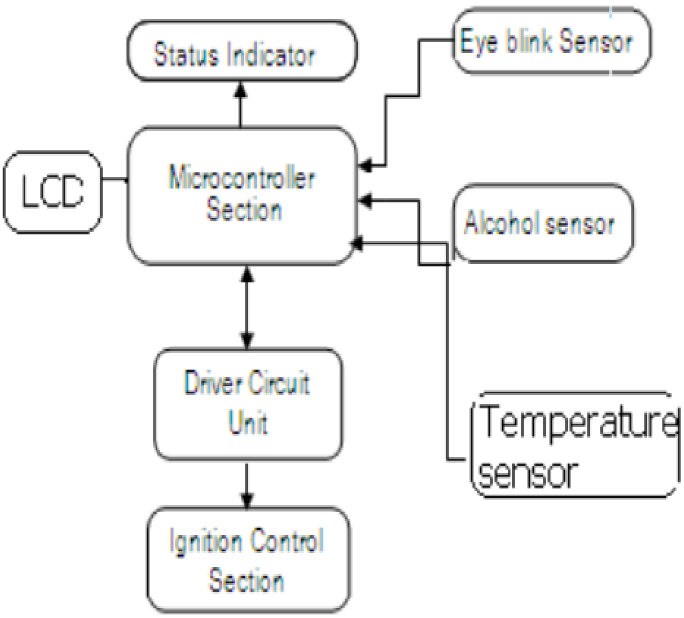

Fig. 4: Using data sets, machine learning algorithms' truth values

Aouatif Amine , Nawal Alioua , Driss Aboutajdine and Mohammed Rziza.[5] The eye state analysis algorithm is applied to detect the driver's drowsiness. Here we are using CHT which is a circular hough transform method for detecting drowsiness, through this it reduces the computational cost required, subsequently for faces extracted from video frames. Using the SVM technique the reduced region of the face image will detect the upper and downside of the effective eye boundaries. CHT modifies the image of the face to recognize the eye edge points and it will detect the radius of the edge point. This system will sense the detection of micro-sleep periods. Once the driver falls asleep, the system will alert with a micro sleep period.

P Aravind, S Nachammai, V Praveen Kumar, S Prathyush,Devi Pooja, K R Sarath Chandran and S AngelDeborah.[6] This study will aid in keeping an eye on the physiological reactions of the driver, which will help to maintain the stability of the car and prevent accidents. Collaboration between input and output extractions, hardware tools, and software algorithms is necessary to implement this variety of software algorithms. Three interconnected modules make up this system: one detects driver fatigue using the "Haar Cascade Classifier" and "OpenCV," another detects alcohol contact using the "MQ3 sensor," and the third detects accidents or crashes using the "Piezoelectric Sensor." The MQ3 gas sensor is utilised to implement for identifying the ethanol gas molecules at concentrations from "0.05mg/lLto 10 mg/L" in these prototypes, which feature many embedded sensors for the drivers. The driver assistance system was developed and put into use using a variety of hardware and software algorithms that were compatible and economical.

Aouatif Amine, Nawal Alioua,Driss Aboutajdine and Mohammed Rziza.[7] In this research, a robust novel technique for eye state analysis is proposed utilising "iris detection based on circular Hough transform (CHT)". This new approach does not require any training data at any stage or specialised cameras. The test used real video sequences captured by a cheap webcam to assess the performance of our eye state analysis method produced positive findings with precise value detection based on human-machine interfaces and face alignment for an automatic face recognition system. This approach (CHT) uses statistical measurements to expose the results and phase extraction based on the "SVM methodology" to exhibit real video sequences of varied subjects and lightning circumstances.

Kuo Hao Chen, Mohan M. Trivedi and Ashish Tawari.[8] This study introduces a distributed camera infrastructure that uses head and eye cues to determine drivers' coarse gaze direction. To accurately predict gaze direction while driving in a realistic, naturalistic environment is difficult. The majority of the gaze zones in the head-alone experiment yielded decent results, with an overall weighted accuracy of 79.8%. Some of the most frequent causes of inattention at that time include using a cell phone or another electronic device, including a vehicle's infotainment system. A little gap in concentration might also lead to distraction. sophisticated driver assistance system that may track the driver's attention span and send alerts. The pseudocode for the method describes the training process for getting a series of regressions. the existing implementation solely utilised video clips forIris tracking.

Zhang Kehua, Qianyang Zhuang, Qianqian Chen and Jiayi Wang.[9] This study presents a reliable method for detecting fatigue based on pupil and iris segmentation. Convolutional neural networks are utilised to precisely calculate with PERCLOS to determine the eye status in real time. The eye images are obtained directly as input. Due to the fact that many features concentrate on the pupil and iris, the two-step model performs better than an end-to-end fatigue detection.

Kuo hao chen, Mohan M. Trivedi and Ashish tawari.[10] In this system we use the Iris sensor. If the driver doesn't sleep for a long period or doesn't take adequate rest, due to this the driver will fall asleep. At this time using Iris Recognition will warn the driver when the driver falls asleep by detecting the iris of the eye if the iris is visible then no warning is given else the Iris is not visible then it warns the driver. We are using ARM processor for LCD to detect eye postures.based on neural networks the facial detection can be identified and another algorithm is used that is viola-jone used to detect skin color it may also detect the drowsiness while driver in sleep mood.

Nawal Alioua, Aouatif Amine, Yassine Ruichek, Nabil Hmina and Frederick Zann.[11] This study suggests employing wide-angle and fisheye lenses to create a reliable and non-intrusive device for monitoring driver drowsiness. When utilising a wide-angle lens, it is possible to identify tiredness by separating out micro-sleep from some frontal and profile faces that have the iris present. The circular hough transform is the foundation of the eye state analysis. In contrast to traditional lenses, the wide-angle lens enables us to determine the condition of the eye even when the driver has a moderate profile. The sequences were recorded in SeTcars, an intelligent vehicle, as well as regular cars.Microsleep periods are monitored in real-time, and an alarm is immediately sent to the drowsy driver. The experiment's automatic face and eye recognition has also been included, albeit it hasn't been assessed in this work. On a Mac with an Intel Core 2 Duo processor running at 2.4 GHz, Matlab is used for all tests. Our technology has a 95% success rate with these kinds of lenses and can detect abnormal behaviour, including those who aren't staring straight ahead. are watching for prolonged lengths of time in the rearview mirror on individuals who regularly close their eyes, etc.

Brandon C. Li,Zeyu Yan and Zheren Ma.[12] Bulky components are needed for both behaviour change detection and vehicle-based measurements. Additionally, they catch the driver's sleepiness too late to avert accidents. The early stage physiological signal changes can be used to identify the onset of driver sleepiness. This study introduces the creation of a wearable sleepiness detection system. This system measures the electrooculography (EOG) signal, wirelessly sends the signal to a smartphone, and may sound an alarm if it predicts the behaviour of the EOG signal 0.5 seconds in the future. This system is lightweight, cosy, and economical. A driver has just enough time to change their conduct because to the 0.5-second prediction capabilities, which ultimately saves lives.

Venkata Phanikrishna B, Suchismitha chinara.[13] Like many other sleepiness detection techniques, the EEG-based approach is regarded as a quick, efficient, and useful tool.EEG-based sleepiness detection has made use of a variety of feature types. In this study, a brand-new feature extraction method based on a particular Hjorth parameter was introduced, and the classification performance of the method was contrasted with that of the already-in-use Power spectral density (PSD) feature.The findings show that the suggested H-parameter characteristics outperform the prior work's PSD characteristics. Conventional feature extraction techniques fail in this area.To the best of our knowledge, this effort is the first to actually analyse EEG and its sub-bands using Hjorth characteristics in order to identify driver fatigue.

Mansoor Ahmed, Anilkumar C.V, Thejashwini R, Anisha P.S and Sahana R.[14] This study's primary goal is to offer a device that reduces accidents brought on by unusual human behaviour. This is done by tracking the driver's head movements, looking for indicators of drowsiness, and monitoring the driver's heart rate using image processing algorithms. The frame difference algorithm, which detects head motion, and the R-peak detection method, which tracks heart rate, can both be used to identify drowsiness. If any anomalies are found during detection, a buzzer alarm is issued to the driver for both their safety and the protection of the passengers. As an initial step, we are modelling the procedure using MATLAB.

Angelica Poli, Andrea Amidei,Federico Tramarin, Grazia Iadarola, Susanna Spinsante, Luigi Rovati and Paolo Pavan.[15] This study focuses on large and intrusive multi-modal acquisition systems to gather information about drivers yfrom various sensors, whether chosen to wear by the person or embedded in the car cabin, to identify the driver's fatigue through a suitable wrist-worn gadget by evaluating just the sensory signal of skin conductance for earlier detection of the impending tiredness, for execution of a real-time alert system based on internet of things, machine learning, and a variety of other technologies. Physiological modifications are influenced by the activity of the autonomous nerve system (ANS), which is related to drowsiness. Cross-validation utilising various techniques does not contain a single participant.

George S. Maximous, Hany A. Bastawrous.[16] This study looks at a range of sensors that are currently used to determine how safe an automobile is. The complexity and implementation costs of such sensors are onerous design factors that restrict their widespread adoption. It is hypothesised and proven that the hum-the-antenna effect can serve as the foundation for a simple, affordable passive touch sensor that can detect drowsy driving. The majority of studies have come to the conclusion that drowsy driving is the primary cause of accidents, as per the European e Survey of Road User Attitude (ESRA).The functioning principle of the system is based on the use of spectroscopy to measure the level of blood alcohol in the tissue of the driver's palm using a touch-sensing device. A place near the Controller and the Alarm should exist.

Le DinhDat, Gao Zhenhai, Yu Ziwen, Wu Xinyu and Hu Hongyu.[17] This study is based on a time series analysis of the behaviour of the steering wheel's angular velocity while investigating temporal detection after Windows was terminated. If the detection feature meets with the extent constraint and variability constraint in that window, a drowsy condition is recognised. In order to detect fatigue when there is a sudden change in direction, this study employs a novel intelligent vehicle and steering wheel angle technique. This considerable alteration in the driving process is an indication of declining driving skills in a motorist. It recommends using the temporal detection window to find the steering wheel's angular velocity inside a time series that includes specific steering wheel indicators.

Qing Xu, Rongrong Fu and Fuwang Wang.[18] Driver weariness can be quickly and accurately detected, which is a huge step toward increasing traffic safety. This suggestion is based on the man-machine reaction mode (MRM), a technique that can be used in trucks since it is affordable and useful. One of the major contributing factors in road accidents is driver weariness [1, 2]. According to earlier studies, 15.20% of fatal crashes involve driver fatigue. The MRM is used to treat driving fatigue brought on by extended periods of monotonous driving; on average, the subject needs 0.16 seconds in normal driving modes and 0.535 seconds in the MRM to respond to an emergency stop of a vehicle in front of them. The delay report buzzing sound helps to slow down the rate of fatigue.

Pratyush Agarwal, Rizul Sharma.[19] Detecting fatigue using the OpenCV library from python, this language is very easy to implement for detecting the faces of drowsiness. This technique is used to detect the face frame and eyes and can make this process at least twenty times faster. This system uses input as video to analyze both eyes and mouth to detect the drowsiness of drivers. Two components Luminance (EYEMAPLl)and chrominance (EYEMAPC), can help in detecting faces and complexity of eyes after removing the eye frame that will help to detect drowsiness and structural similarity measure (SSM) also can be used. Here we are using Tensorflow and OpenCV for monitoring data to detect drowsiness in drivers.

Luigi Pugliese, Massimo Violante, Sara Groppo.[20] The public health concerns around car accidents brought on by drowsy drivers are covered in this essay. The algorithm for analysing respiratory rate variability aids in the identification of tiredness. Among the signals, quality levels are provided using the respiratory signal. The "Novel algorithm" is employed to identify alertness monitoring and monitor the driver's state. The screen-based virtual scenario is displayed via a projector-based method. The webcam used to record the videos is a Logitech C120.

Brian Meneses-Claudio, Melissa Yauri-Machaca, Avid Roman-Gonzalez and Natalia Vargas-Cuentas.[21] The sleepiness of the driver is covered in this essay. Here, drowsiness is detected utilising image processing using a camera module. It will process the photos taken by the camera that is trained on the driver's face. When a camera is connected to MatLab software and the command "Imaqhwinfo" is used, it is possible to learn the name of the camera that is being used in the software, which is "win video." This activity can be interrupted by a variety of factors, especially when a driver, and it worsens the psychomotor and cognitive functions such as reaction time and surveillance capacity.The system comprises of a camera that once belonged to the Micronics brand with the model number W360mic; it has a high resolution and excellent clarity and is connected to the laptop through USB. Following processing, the system generates a stage of hierarchical knowledge where faults can be identified utilising hierarchy.

Zazilah May, Noor A'in A.Rahman and Amin Azizi Suhaiman.[22] Several traffic incidents over the years have been heavily influenced by drowsy driving. One method of preventing traffic accidents is the development of an intelligent system that can recognise tiredness in drivers and sound an alarm to inform other drivers. The camera has trouble detecting eye positions due to poor lighting because of the considerable unpredictability of the environment's factors and the present techniques' greater limits. This research therefore proposes a real-time system that makes use of the computerised camera to automatically monitor and process the driver's eye using "python-Dlib and OpenCV." In order to forecast and identify the left eye, right eye, eyebrow, nose, as well as mouth, a facial landmark visualisation script is employed.

Shin-ichi Shikii, Mika Sunagawa, Makoto Mochizuki, Wataru Nakai,Hiroki Kitajima and Koichi Kusukame.[23]This work presents a drowsiness detection programme that can recognise all degrees of tiredness, from weak to strong. Our strategy is based on the basic tenet that the sitting posture-related index may be an indicator of insufficient tiredness that drivers are unaware of. In the beginning, we tested how sensitive the postural score and other indices were to different degrees of drowsiness. Then, to account for all sleepiness stages, we created a sleepiness detection model with multiple indicators sensitive to both mild and severe sleepiness. Using a dataset that contained information gathered from about 50 riders during simulated driving exams, the model was trained and validated. The findings of our suggested model, which combined the driver's blinking and posture data, showed that posture data increased the accuracy of mild drowsiness detection and covered all phases of exhaustion (F1-measure 53.6%, root - mean - square error 0.620). Future applications of this strategy might include systems that can intervene before a driver starts to nod off as well as warning systems for drivers who are really weary. The model given here, which is dependent on blinking and posture information, could be employed in a variety of real-world situations because collecting the information doesn't require constraining hardware like on-body electrodes.

Mireya fernández-chimeno, Federico guede-fernández, Miguel a. garcía-gonzález and Juan ramos-castro.[24] The strategy for identifying fatigue suggested by this study is based on variations in the respiratory signal. To determine if the driver is awake or asleep, the breathing signal, which was acquired using an inductive plethysmography belt, is being evaluated in real time.The suggested algorithm is based on the monitoring of respiratory rate variability to determine the difficulty falling asleep (RRV). Furthermore, a method for displaying the respiratory signal's quality level is recommended. Both methods have been combined to reduce false alarms caused by fluctuations in recorded RRV associated with body movements as opposed to sleepiness.External observers rated the drivers' levels of awareness during the validation tests, which were conducted in a driving simulator cabin, to determine how well the algorithm worked. By using a leave-one-subject-out cross-validation, it was possible to achieve an accuracy of 96.6%, a responsiveness of 90.3%, and an aggregate Cohen's Kappa agreeing score of 0.75 across all subjects.It has been demonstrated that a novel method for monitoring a driver's level of consciousness by identifying efforts to doze off is efficient. The proposed algorithm could be a helpful auto safety system to alert drivers when they are driving when fatigued.

Hiroyuki Oishi, Haruki Kawanaka and Koji Oguri.[25] We investigated the data preprocessing approach to improve the effectiveness of the driving recorder data-based drowsiness detection system. The precision of lane line recognition is crucial for evaluating driver weariness because it is based on information from the lateral location with in the driving lane in a driving recorder using a lane departure warning (LDW) feature.The characteristics of lane changes and junction passage were recovered as low-reliability components for these events, which are described as disruption elements that reduce accuracy.When the results were contrasted with the footage that had been recorded, it was determined that they had been successfully deleted. The importance of the sleepiness estimation for improving estimation accuracy was further shown by comparing the findings.

P Aravind,V Praveen Kumar,S Prathyush,S Nachammai Devi Pooja, K R Sarath Chandran and S AngelDeborah.[26] The "Haar Algorithm" is the foundation of this paper. Real-time sleepiness monitoring of a driver utilising video capture and face detection can help achieve the primary goal of preventing traffic accidents. The alert will sound after the drowsiness has been recorded and detected using a camera. AdaBoost is used to concentrate on eye movements at the same instant, "Local binary pattern" to sense the facial expression and "Haar Cascade" to identify the gaze customised eye blinking detection—as well as "Haar Cascade Classifier" to evaluate blinking period and eye aspect ratio—to capture real-time sleepiness (EAR). The presence of drowsiness is indicated if it lasts longer than two seconds and affects eye blinking.

Ramya V,Ramya G Franklin and Ratna Kaavya M.[27] When a person drives a car without taking a break, concentration is lost, which makes them drowsy and causes serious accidents. The "Rasberry Pi" and a number of sensors, including vibration and gas sensors, are used in this proposed system to identify the type of drowsiness. Human sleep may be divided into three categories: completely awake, non-rapid eye movement, and rapid eye movement sleep, and the anti-fatigue system can be divided into two categories: (1) estimating drowsiness by capturing the driver's vision. (2) use heart rate to gauge drowsiness uses EEG (Electroencephalogram), ECG (Electrocardiogram), and HRV (Heart Rate Variability), it is always preferable to take safety precautions by integrating the system type into the car.

Brandon C. Li, Zeyu Yan and Zheren Ma.[28]In order to solve difficulties, this study makes use of a number of newly developed technologies, including vehicle-based measurements, behaviour change detection, and physiological signal processing. This study introduces the creation of a wearable sleepiness detection system. This technology wirelessly delivers the "Electrooculography(EOG)" signal, which it uses to measure sleepiness detection, to a smartphone. Here, a prediction algorithm may alert the driver based on an estimate of "0.5 seconds" prior to the transmission of the EOG signal. To identify sleepiness, numerous algorithms have been created. The signal is processed by a "Novel EOG signal" and transmitted via Bluetooth to an Android phone. A sliding window feature extraction method was used with a "ARIMA Model" to create a "Novel EOG Signal Prediction Algorithm".

Ramya V, Ramya G Franklin and Ratna Kaavya M.[29] Driver fatigue is a prominent factor in many incidents involving motor vehicles around the world. Due to this, it is essential to recognise oncoming tiredness. Three sense-able algorithms have been evaluated using random forest and found to be the best features for automatically classifying drowsiness status. Overall, the accuracy is 84.1%. According to the World Health Organization's (WHO) most recent data, 1.35 million people each year die as a result of automobile accidents. The format of this essay is as follows: For detection, the acquisition process is described. The recommended method for diagnosing driver fatigue was tested for viability by first analysing the data in a "MatLab environment" and then utilising the "WEKA Tool" for the machine learning performance evaluation.

Debabrata Singh, Anil Kumar Biswal, Debabrata Samanta, Ming-Hour Yang and Binod Kumar Pattanayak.[30] Numerous accidents have been caused by weary drivers, tiresome road conditions, and adverse weather conditions. The method here uses video streaming processing to examine the idea of the eye blink via an eye aspect radio. The video monitor and "mark algorithm" function are utilised to identify eye closure, face detection, and head position in this system, which warns the driver whether they are falling asleep or daydreaming.

II. PROBLEM STATEMENT

Driving while sleepy or fatigued is referred to as drowsy driving. The most common cause of this is insufficient sleep, although other causes include untreated sleep problems, drugs, drinking alcohol, or working shifts. Unconscious driving is a known threat to traffic safety.

Driver weariness and sleepiness cause 10 to 30 percent of fatal collisions. Although it is technically impossible to prevent or regulate drivers from nodding off while driving, it is possible to identify and warn them. It is not possible to manually identify and warn the motorist.

III. SYSTEM DESIGN

The system is designed on a combined method approach and has three layers as shown in the figure.

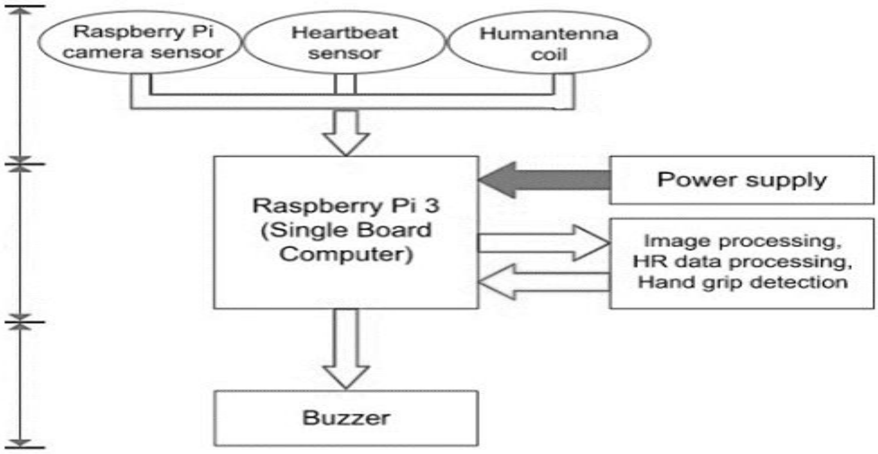

Fig. 5: System design

As depicted the raw data from input components is fed to the Raspberry Pi 3 board for data analysis and processing. To analyze and process data means to identify the features of data and process them to identify drowsiness in drivers.

IV. METHODOLOGY

The suggested system has the following three phases:

A. Data collection

Data here refers to any changes in the visual, physiological, and physical behavior of the driver. These changes are identified using:

- Image acquisition: A camera is used for visual image capturing of the driver and to set the Region of Interest(RoI) for detecting drowsiness based on eye closure. Typically fatigue is measured using the percentage of eyelid closure. The collected data is given as input for image processing for drowsiness detection.

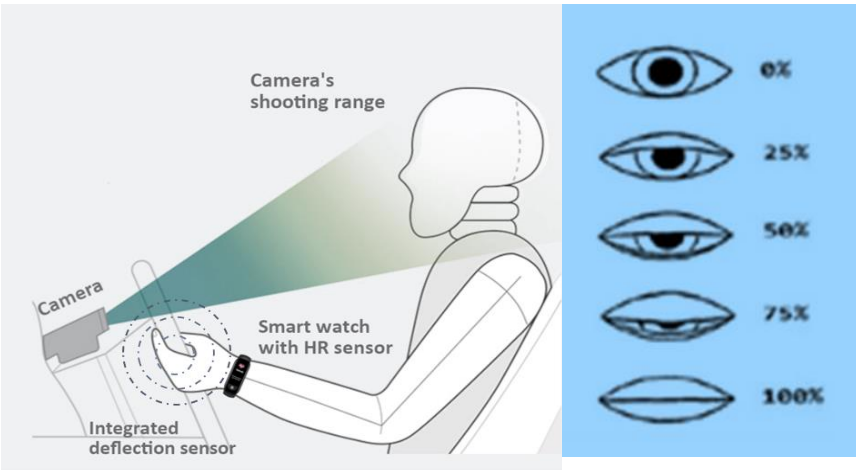

Fig. 6: Stages of eye blinking/closure.

- **Heartbeat rate:** A heart rate sensor embedded device like a smartwatch is used to obtain the heartbeat rate of the driver and analyze it using threshold data.

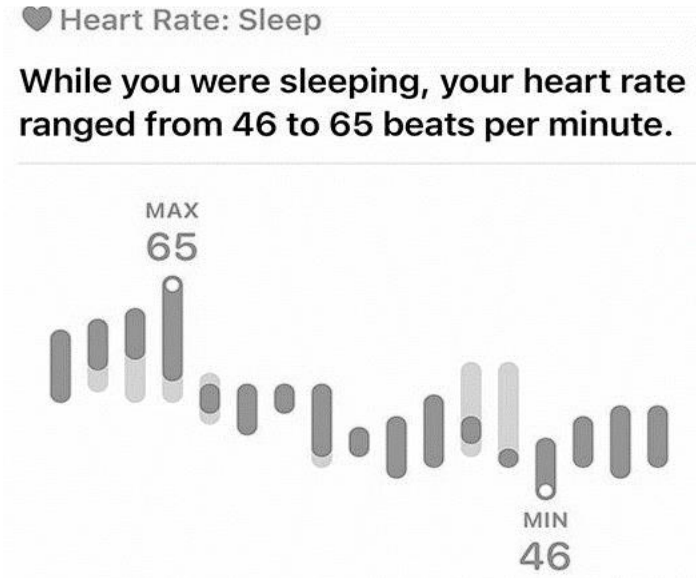

Fig. 7: Typical smart device HR data

- Touch sensing: Humantena effect-based touch sensing is used to obtain driver steering grip strength.A deflection sensor is used to obtain the induced voltage value. The sensor is intended to produce a greater voltage value in the event of a slack hand grasp, or a case of intoxication.

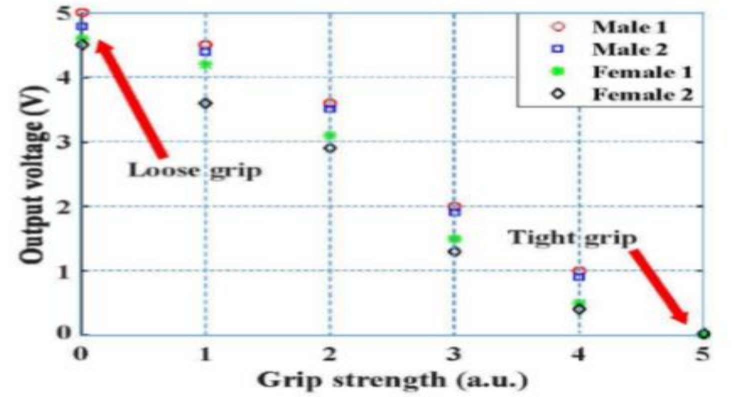

Fig. 8: voltage difference in steering grip pattern

B. Data processing

Once the data is collected it is processed using the Raspberry Pi 3 interface. The raw data obtained by the sensors must be analyzed for Region of Interest(RoI) and must be processed for drowsiness detection.

C. Alert

If data processing detects drowsiness, a siren/buzzer is used to alert the driver.

V. COMPONENTS

- **Raspberry Pi 3:** A single-board computer or microcontroller which is used for IoT applications. The new Raspberry Pi 3 Model is speedier and more potent than its predecessors thanks to its 64-bit processor. It consists of 1 GB memory, Quad-core, 1.2 GHz processor, HDMI video port.

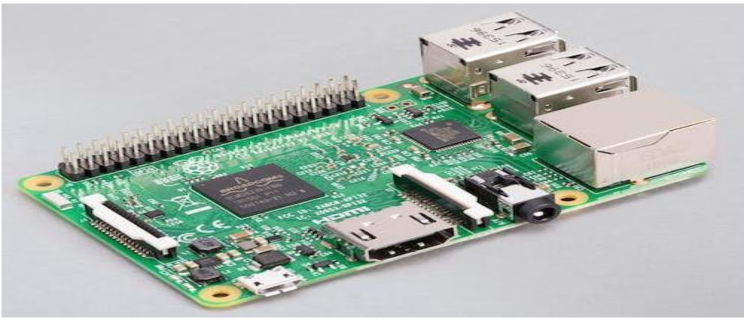

Fig. 9: Raspberry Pi 3 model B

- **Camera:** A webcam is used for image capturing.

Fig. 9: Hp webcam

- **Heart-rate embedded device:** A device with a heart-rate sensor is used to obtain the driver's heartbeat rate.

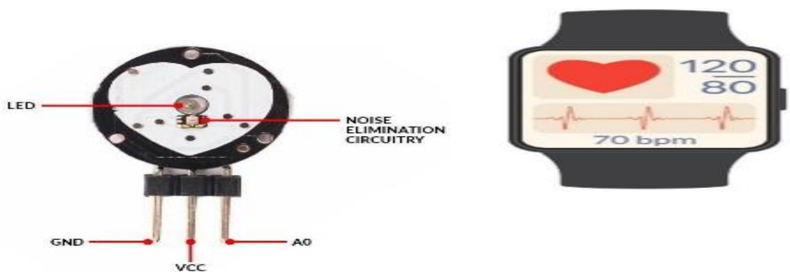

Fig. 10: Heartrate sensor or HR embedded device

- **Deflection sensor:** A sensor designed on basis of the hum antenna effect is used for sensing the steering wheel grip of the driver.

Fig. 11: SparkFun deflection sensor

- **Buzzer:** A buzzer is used to alert the driver of drowsiness.

Fig. 12: 5V Passive Buzzer

VI. CONCLUSION

This survey is used for the implementation of the proposed system. We use literature for the knowledge and betterment of the project implementation.

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