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ARDUINO BASED REAL TIME DROWSINESS AND FATIGUE DETECTION FOR BIKERS USING HELMET

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Abstract **– This project aims to address the problem of driver fatigue among bikers which can lead to accidents, injuries, and even fatalities. The proposed solution is an Arduino-based real-time drowsiness and fatigue detection system that can be incorporated into bikers' helmets. This system detects driver fatigue levels by monitoring eye blinks and aims to prevent accidents caused by driver fatigue. The system uses a camera to locate the face and then narrows down to the eye region to detect fatigue. An algorithm, which is a combination of the Viola-Jones object detection framework and the Haar-like feature algorithm, detects the duration of each eye blink. Changes in blink frequency and duration are characteristic signs of drowsiness and fatigue. The solution, which aims to be straightforward, dependable, and affordable, has the potential to greatly reduce the amount of accidents brought on by driver weariness. The experiment conducted on a sample of volunteer bikers demonstrated the effectiveness and accuracy of the system in detecting driver fatigue in real-time. The system was tested using Arduino UNO board and a Raspberry Pi 3 Model B+, with software developed using Embedded C and Arduino IDE. Therefore, the proposed Arduino-based real-time drowsiness and fatigue detection system can easily be implemented in existing helmets and has the potential to improve road safety and save lives by reducing the number of accidents caused by driver fatigue.**

Index Terms **– Driver Fatigue, Embedded C, Arduino IDE.**

I. INTRODUCTION

An open-source electronics platform called Arduino is used to create interactive electronic creations. A microcontroller board and a software development environment are both components of the Arduino platform, which enables programmers to write the code
For bikers wearing helmets, there has been an increase in interest in using Arduino for real-time fatigue and sleepiness detection in recent years. This technology uses a variety of sensors, including accelerometers, gyroscopes, and heart rate monitors, to instantly identify bikers who are feeling sleepy or fatigued.
In order to identify any signs of exhaustion or drowsiness, the system continuously monitors the bikers' vital signs as well as additional information, such as head and body movements. When the system notices such indicators, it warns the rider by vibrating or sounding an alarm.

Arduino's inexpensive cost and simplicity of use are two of its main benefits for drowsiness and fatigue detection in bikers. For Designs and amateurs, Arduino is the best platform because it is accessible and affordable. The tremendous degree of customization offered by Arduino also enables programmers to modify the system to suit their own requirements.

Overall, the use of this project has the potential to improve road safety by preventing accidents caused by driver fatigue.

II. PROPOSED TECHNIQUE

A. Introduction

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This involves the use of an Arduino Uno microcontroller to detect drowsiness and fatigue in motorcyclists. This is achieved by connecting the power supply to both the Arduino and the LCD and connecting the Arduino to both an eye blink detector and an alcohol sensor. The readings provided by these sensors are used by the Arduino Uno to produce outputs that are transmitted to various components, including the LCD, buzzer, and engine relay. The system monitors the motorcyclist's eye blinks and alcohol levels to detect signs of drowsiness or fatigue. This is important because road accidents often result from driver weariness, and detecting it early can prevent accidents. If the system detects signs of drowsiness or fatigue, it triggers alerts or even initiates safety protocols such as disabling the engine to prevent accidents.

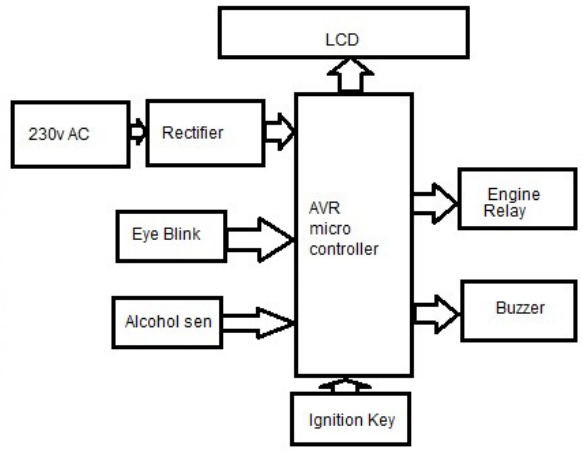

Fig 1. System Architecture

B. Embedded C

The majority of embedded software is developed using embedded C, which is recognised as the most well-liked programming language for embedded software globally. In essence, it is a suite of C extensions developed by the C Criteria group to address issues with commonality that may occur when utilising different C extensions for different embedded systems. There are several factors that contribute to the popularity of Embedded C for programming microcontrollers. Firstly, it is relatively simple to learn, understand, program, and debug. Additionally, there are many skilled C programmers available, and C compilers are easily accessible for the majority of embedded devices in use today. C is a practical choice because, unlike assembly language, it is not restricted to a certain microprocessor or system and is processor-independent, enabling users to create programmes that can operate on several systems. C combines the features of high-level languages with the functionality of assembly language, making it a "middle-level" or "high-level assembly" language. Additionally, C supports input/output (I/O) access, is comparatively efficient, and makes managing big embedded projects easier. While other programming languages offer similar advantages, C is unique in its ability to provide direct hardware control without compromising the benefits of high-level languages. Embedded systems programming differs from desktop application development in several ways, primarily due to the resource constraints inherent in embedded systems, such as limited ROM, limited stack space, limited RAM, and lower processing power, as well as the use of smaller, less power-hungry components. The fundamental elements of both Embedded C and C languages, such as data types, variables, character sets, keywords, component declarations, phrases, and assertions, are used in writing Embedded C programs. The hardware can validate the inputs and regulate the outputs as necessary thanks to embedded system programmes. During this operation, the embedded software could be necessary to directly control the processing device's internal design, including schedules, interruption handling, I/O ports and serial communication ports, and other elements.As a result, CPU operation requires embedded system programming. When compared to desktop computers, embedded systems have key characteristics that distinguish them. These include:

- Resource constraints such as limited ROM, RAM, and stack space, as well as fewer processing resources.
- Compared to PCs, embedded systems often use smaller, less power-hungry components.
- Compared to desktop computers, embedded devices are more tightly connected to the hardware they manage.

C. Buzzer

A buzzer is an audio signaling tool that can be powered by piezoelectric, piezoelectric,

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electromechanical, magnetic, electromagnetic, or electro-acoustic means.

A When a piezoelectric buzzer is in control of an electronic circuit that oscillates or another audio signal source, it can produce a click or ringing to notify that an action has been activated.

Buzzers are instruments that are made to take in some kind of input and produce music in return.

Several methods, such as metal clappers and electromechanical devices, may be used by them to create sound.

Buzzers need to be fed some kind of energy input in order to transform it into acoustic energy. In a larger circuit, a number of buzzers are powered directly from the device's power source.

To ensure that it works during a power outage, the buzzer can also be battery-powered.

This innovative buzzer circuit connects a speaker, a tiny audio transformer, and a relay in series.

The relay will turn on when the switch is depressed using the transformer primary and closed relay contact. The typically closed contact will open as soon as the relay is in operation, disabling it.

The contacts will then shut, and the sequence will continue.

Because everything happens so quickly, the pulse of current creates variations in the transformer primary and, therefore, secondary.

Thus, the speaker's tone and the relay's operating frequency are inversely related.

To "tune" the note, use capacitor C. The buzzer's tone is lowered when capacitance rises from its nominal value of 0.001uF.

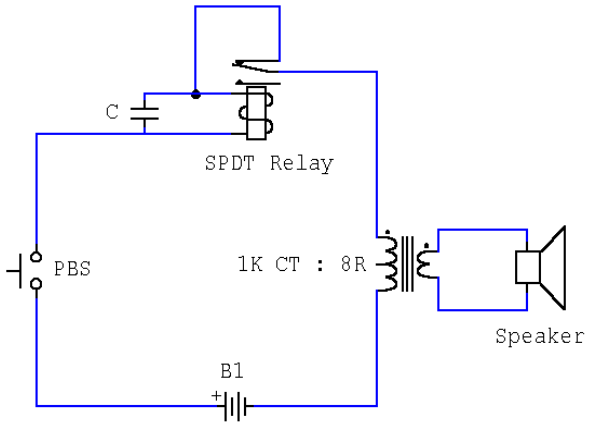

Fig 2. Internal circuit of Speaker

Benefits of Buzzer :

- The usage of warning devices, such as electric buzzers or delta-larms, could be very helpful in reducing the number of fatalities during a disaster or accident. Specialized electric alarm systems could provide warning about harmful liquid level circumstances in lift pump chambers and other non-potable water applications.
- They are crucial equipment in any structure or facility for alerting and informing individuals if a prompt evacuation is required. It is crucial to understand how effectively the sewage system at your residence or place of business operates, and this can be done more precisely if the system is accompanied by an electric sewage alarm.
- Most mechanical buzzers require little setup time. In fact, you don't even need to hire an electrician to install it because often no hard wiring is needed. To do this, the price of employing an experienced installer must be reduced.

D. LCD Display

Alphanumeric and numeric characters are displayed in segmental displays using liquid crystal cell displays (LCDs).They are found in many of the electronic gadgets we use every day, including laptop computers, digital clocks and watches, microwaves, CD players, and many more. Compared to other display technologies, LCDs have a few distinct benefits, which is why they are so widely used. Due to the fact that LCDs operate by blocking light instead of emitting it, they require a lot less electricity than LED and gas-display displays.

LCD displays are constructed using either an active matrix display grid or a passive matrix display grid.Since there is a transistor at each pixel intersection in an active matrix display, the luminance of a pixel can be adjusted with less current. This improves screen

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refresh time by allowing the current in an active matrix display to be turned on and off more often. Dual scanning, or scanning the grid twice in the same direction with current, is a technique used by passive matrix LCDs. The liquid crystal molecules are aligned in a given orientation when enough voltage is applied to the electrodes.

The voltage at pin 3 needs to be correctly adjusted in order to produce an acceptable contrast for the display. The recommended power source for the LCD is +5V with a 10mV transient upper limit. To avoid voltage induction, the power supply's ground terminal needs to be adequately insulated. In order to avoid stray voltages that can result in a flickering display, the module should also be securely insulated. With a few millimetres of thickness, LCD displays are thin and lightweight. They can be powered for extended periods of time since they use less power and are compatible with low power electronic circuits. Since LCDs don't produce light, a light source is necessary to read the display. To enable reading in the dark, backlighting is used. LCDs have a long lifespan and can function in a variety of temperatures. An LCD should be properly initialised before being used for displays. On LCDs with a few segments, like those found in digital watches and pocket calculators, the electrical contacts for each segment are distinct. An electric charge delivered by an external, specific circuit controls each part.

For more than a few display components, this display structure is awkward. Personal organisers and earlier laptop screens with small monochrome displays are examples. By using row and column addresses, each pixel is addressed individually. The term "passive-matrix addressed" describes a sort of display where the pixel is required to maintain its state without the benefit of a steady electrical charge in between refreshes. This style of display is more difficult to implement as the pixel count rises.

Fig 3. Real life Image of LCD Display

E. EYE Blink Sensor

The eye-blink sensor works by illuminating the eye and/or eyelid region with infrared light, then utilising a phototransistor and differentiator circuit to track variations in the reflected light. The exact functionality substantially depends on where and how the emitter and detector are pointed in relation to the eye.
This device offers the following features:

- It indicates EYE BLINK through an LED.
- It provides an instant digital signal output that can be directly connected to a microcontroller.

The emitter and detector orientation and aim in relation to the eye have a significant impact on the functionality. By positioning the detector close to the eyelid, such as by mounting it to an HMD's rubber eyecup, one can easily accomplish a relatively robust detection of blinking. Due to the distinctively quick shift in light reflected from the eye surface during the saccadic jumps, it is harder to detect saccadic eye movements but still easier than absolute location detection.

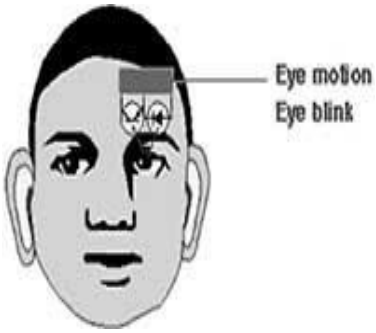

Fig 4. Figure explaining Eye Blink Motion

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F. DC Motor

Utilizing magnetic fields, a DC motor transforms direct current electrical power into mechanical power. DC motors were one of the earliest motor types to become popular due to their compatibility with direct-current lighting power distribution networks that were already established. One of the advantages of DC motors is that their speed can be easily adjusted by manipulating either the amount of current flowing through their field windings or the supply voltage. DC motors find widespread use in numerous applications, including small tools, toys, and household appliances. Universal motors, which are light and can operate on DC power, are commonly employed in portable power tools and appliances. In contrast, larger DC motors drive heavy-duty equipment such as steel rolling mills, lifts, and electric vehicles. However, with the progress of power electronics, AC motors are now a viable alternative to DC motors in many applications. The armature of a typical DC motor comprises one or more insulated wire windings wrapped around a soft iron core to enhance the magnetic field. Large DC motors are deployed in various applications such as driving electric cars, hoists and lifts, and powering steel rolling mills. The commutator connects the ends of the wire winding to each armature coil individually, and brushes facilitate the linkage of the rotating coils to the external power source.

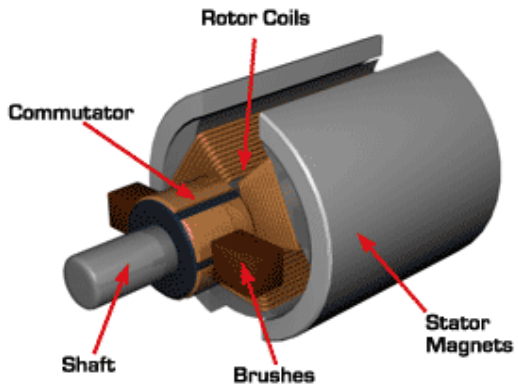

Fig 5. Internal Structure of DC Motor

A component that transforms DC power into mechanical power is referred to as a "DC motor". Its operation is predicated on the notion that when a current-carrying conductor is subjected to a high magnetic field, it will feel a mechanical force. The Fleming left hand rule determines the direction of this force. Since alternating current is provided by all electric supply companies, DC motors are rarely used in typical applications. However, in order to use direct current motors, it is advantageous to convert alternating current into direct current for specific applications, such as in steel mills and electric trains. This explains why d.c. motors' speed/torque characteristics are so much superior to those of a.c. motors.

G. Power Supply

'Power supply' is the name for a source of electrical power. An output load or collection of loads are supplied with energy by PSUs, also known as power supply units, are systems or devices that deliver electrical or other types of energy. Most often, the expression is used in connection with electrical power sources, with mechanical energy sources being used less frequently and other energy sources being used less frequently.

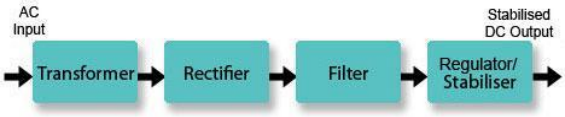

Fig 6. Flow Diagram of Power Supply

H. Transformers:

The operation of a fundamental power supply requires transformers. The mains supply is connected to the primary winding of the input electrical transformer. An adequate amplitude of AC voltage is produced by the secondary winding, which is electromagnetically connected to the primary yet electrically separate from it. The power supply unit (PSU) further processes this voltage before driving the electronics circuit it is designed to supply. Making sure the transformer can provide the necessary current is crucial since using one that is too small could affect the power supply's capacity

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to sustain full output voltage at maximum output current. In such circumstances, losses would significantly rise when the transformer is loaded to capacity.

I. The Rectifier Stage:

A rectifier circuit converts the AC input to DC. The full wave bridge rectifying device generates full wave rectification utilising a total of four diodes arranged in the form of a bridge circuit without the use of a transformer with a centre tap. Another advantage is that they require half of the voltage breakdown capacity of conventional full-wave and half-wave rectification diodes because there are always two diodes conducting. One can utilise a combined bridge rectifier or one that is constructed from individual diodes. The pathways taken by the current on the input's positive and negative half cycles. As can be seen, On every half cycle, opposing pairs of diodes conduct, but the electrical current passing through the source of power keeps the same polarity the entire time.

The low pass filter and the reservoir capacitor are the two components that make up a conventional power supply filter circuit. Differently, each of these components helps to get rid of the leftover AC pulses. Maximum current ratings are used to categorize voltage regulator ICs, which are available with fixed and variable output voltage options. There are other negative voltage regulators, primarily for use with two supplies. Additionally, the majority of regulators have built-in automatic overheating and excessive current protection.

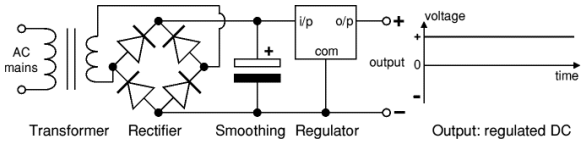

Fig 7. Circuit Diagram of Transformer

J. Arduino

A versatile and user-friendly microcontroller kit called an Arduino is frequently used in the field of communications and to operate a variety of devices. It is an open-source hardware kit that was created in 2005 by Massimo Banzi and David Cuartielles. It can be created at home using various components or bought directly from the provider.The ATmega328 serves as the foundational component of the Arduino Uno, a particular sort of microcontroller board.

The Atmega328 microcontroller is a vital component of the Arduino Uno board, featuring a 32 KB flash memory chip, a 2 KB SRAM chip, and a 1 KB EEPROM chip. The bootloader takes up 0.5 KB of its 32 KB flash memory, leaving 31.5 KB available for user programmes and other data. Its 2 KB of SRAM is fast and allows for efficient data access, while its 1 KB of EEPROM provides non-volatile storage for data retention during power cycles. Running at a clock speed of 16 MHz, the Atmega328 executes instructions quickly, making it well-suited for high-performance applications. Overall, the Atmega328 is a powerful and versatile microcontroller that provides a strong foundation for developing various embedded systems.

The Arduino processor's Harvard design suggests that programme code and programme data are kept in separate memories. Programme memory and data memory are its two memories. The code is saved in the flash programme memory, whilst the data remains stored in the data memory.

One of the main advantages of using an Arduino is the simplicity with which programmes can be loaded into it without the requirement for an external programmer to destroy the software. This is made feasible by the 0.5 KB bootloader, that allows the programming to be consumed into the circuit. You only need to create the code and download the Arduino software to get started. In conclusion, a microcontroller kit called Arduino that is incredibly flexible and user-friendly and can be used to drive a variety of devices. Its open-source hardware feature makes it a popular option for DIY enthusiasts, and its user-friendly design and practical features make it a useful tool for both experts and beginners.

III. METHODOLOGY

The project aims to detect drowsiness and fatigue in motorcyclists by using an Arduino Uno microcontroller. The methodology involves connecting the power supply to both the Arduino and the LCD. The Arduino is also connected to an eye blink detector and an alcohol

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sensor. Based on the readings provided by these two sensors, the Arduino Uno produces outputs that are transmitted to various components such as the LCD, buzzer, and engine relay.

The code for the project is written in Embedded C language and used to program an Arduino board to control a Liquid Crystal Display (LCD), an eye blink sensor, and an alcohol sensor. The first line of the code imports the LiquidCrystal library, which provides functions for controlling the LCD. The next line creates an instance of the LiquidCrystal class, which is connected to the Arduino pins 8, 9, 10, 11, 12, and 13.

In the setup() function, the pins 6 and 7 are set as output pins, and the LCD is initialized to have 16 columns and 2 rows. Additionally, pin 15 is set as an input pin, and pin 6 is set to HIGH. The loop() function is called continuously after the setup() function. It reads the value from the eye blink sensor connected to pin 15 and displays it on the LCD. If the value of the eye blink sensor is 0, the code increments a variable count and displays it on the LCD. If the count becomes greater than 10, the LCD displays "D," and the code activates an alarm by setting pin 7 to HIGH and pin 6 to LOW for 5 seconds. If the value of the eye blink sensor is not 0, count is reset to 0. The code also reads the value from the alcohol sensor connected to analog pin A0 and displays it on the LCD. If the value of the alcohol sensor is less than 30, the code activates an alarm by setting pin 7 to HIGH and pin 6 to LOW for 5 seconds and displays "DD" on the LCD. The delay() function is used to introduce a pause in the program execution for the specified time in milliseconds. The lcd.clear() function is used to clear the display before displaying new data.

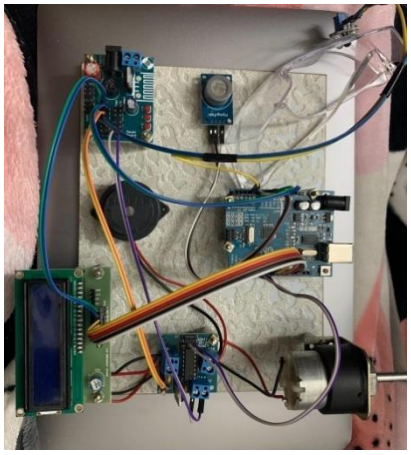

Fig 7. Real Life Model of Completed Project

This methodology provides an effective way of detecting driver fatigue and drowsiness while driving. By monitoring the eye blink and alcohol levels, the system can detect the condition of the motorcyclist and trigger alerts or even initiate safety protocols such as disabling the engine. It has the potential to significantly reduce accidents caused by driver fatigue and improve road safety. With advancements in technology, this project can be further improved and implemented in other areas such as automobiles and heavy machinery to ensure the safety of individuals operating them.

IV. LIMITATIONS

While real-time drowsiness and fatigue monitoring systems for bikers wearing helmets that are based on Arduino have numerous benefits, there are certain drawbacks to take into account as well:

False positives: One of these systems' main drawbacks is the potential for false positives, in which the device might identify exhaustion or drowsiness while the rider is actually completely aware. This may be brought on by elements like motion or other ambient elements that can skew sensor results.

Restricted accuracy: The positioning and calibration of the sensors, as well as the standard of the data gathered, can all have an impact on how accurate the system is. The system's accuracy can also change depending on the particular use case and the physiological traits of the individual rider.

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Dependence on sensors: The system is primarily dependent on sensors, which might be impacted by outside elements like temperature fluctuations or electromagnetic interference. The accuracy of the system may be jeopardized if the sensors are not correctly calibrated or maintained.
User compliance:The system's efficacy also hinges on how well users wear the helmet and use the attached sensors. The system won't work properly if the user doesn't wear the helmet or wears it improperly.
Ethical considerations: There are further ethical issues to take into account, such as privacy issues with the gathering and storage of user data and potential discrimination against people who might have medical disorders that impact their vital signs.

V. CONCLUSION

In conclusion, to address the issue of driver fatigue and speed limit violations, a real-time drowsiness and fatigue detection system for bikers using helmets has been developed. This innovative solution detects driver fatigue by monitoring eye blinks and restricts speed accordingly. Experimental results have shown that the system effectively detects driver fatigue and reduces the speed of the vehicle accordingly. It is easy to implement and cost-effective. By integrating the system into helmets and protective gear, it can be extended to other vehicles and transportation modes. Additionally, it can be adapted to suit different types of drivers with various eye characteristics and can be easily calibrated to provide accurate fatigue detection. The proposed system has the potential to save countless lives and promote road safety. Therefore, it should be considered a promising solution for the transportation industry.

VI. REFERENCES

1. “Real-time Eye Blink Detection using Convolutional Neural Network" by Dong-Yeon Cho et al. (2021)
2. "Deep Learning-based Eye Blink Detection System using EEG Signals" by Sungyong Jung et al. (2019)
3. "Breath Analysis with Wireless Sensor Networks for Diagnosing Sleep Apnea" by M. Shamim Hossain et al. (2020)
4. "Eye Blink Detection with Multi-task Learning for Driver Drowsiness Monitoring" by Xiaohu Zhang et al. (2020)
5. "Breath Analysis for Early Detection of Lung Cancer using Portable Electronic Nose Sensor" by Mingyue Sun et al. (2019)
6. NCSDR/NHTSA Expert Panel on Driver Fatigue &; Sleepiness; Drowsy Driving and Automobile Crashes, Report HS 808 707, 1998.
7. P. P. Caffier, U. Erdmann, P. Ullsperger, “Experimental evaluation of eye- blink parameters as a drowsiness measure”, Federal Institute for Occupational Safety and Health, pp.319-325, March 2003.
8. The Royal Society For The Prevention of Accidents; Driver Fatigue and Road Accidents, A literature Review and Position Paper, 2001.
9. M. S. Bhuiyan, Driver Assistance Systems to Rate Drowsiness: A Preliminary Study; New Advances in Intelligent Decision Technologies, Studies in Computational Intelligence Series Vol. 199, ISBN 9783642009082, Springer, pp. 415-425, 2009
10. A.J. Stern, D. Boyer, D. Schroeder, “Blink Rate: A Possible Measure of Fatigue. Human factors,” The Journal of the Human Factors and

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Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 6- Issue 2, August 2023
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Ergonomics Society, vol. 36, no. 2, pp. 285-297, June 1994.

11. M. Eriksson, & N.P. Papanikolopoulos, “Eye-tracking for Detection of Driver Fatigue”, Proceedings of the 1997 IEEE Conference on Intelligent Transportation Systems, Boston, 9-12 November, pp. 314-319, 9-12 November 1997.