Driving Towards Sustainable Future Through EV Health Monitoring System

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I. Abstract

Driving is a complex activity performed in a continually varying and stimulating environment. The coordination and execution of various skills like cognitive, sensory, psychomotor and physical are extremely necessary to drive safe. Most of the studies related to driving highlighted that 75% of traffic accidents occurs due to human factors including driver's fatigue, deprived health condition, attention loss, bad emotional state, and lack of skills. Most of the developed country is ageing. Hence, the drivers above 60 years is also increasing. Ageing results are weakening in cognitive function and threaten driver safety. The aged drivers (age above 60 years) have a comparatively more significant risk of accident due to medical emergency than other factors like bad emotional state and lack of skills. The wellness of drivers' is considered as a key factor of traffic accidents. Heart failure and non-traumatic disease (i.e., stroke) are the main risk factors for drivers' death. Many of the victims have no prior knowledge of the presence of the condition. Stroke is a disease caused due to the disturbance in blood supply to the parts of the brain. After experiencing stroke, a driver's ability to drive is generally affected by the visual, perceptual, motor, and cognitive deficits. Stroke leads to arm weakness, facing dropping, blurred vision, dizziness, coordination issue and speech difficulties of victims which are essential for driving. It is necessary to protect the driver's those are possibly be the victims for stroke. Since, stroke onset during driving lead a serious threat to the other drivers and the general public. Now-a-days, there are lots of automotive industry competing not only to provide better performance in terms of the vehicle but also to provide the driver with better comfort even in long rides. Automakers are developing vehicle that could provide health monitoring service with Internet of Things (IoT). In IoT, an automobile or vehicle-treated as a "thing". IoT plays an important role in connected vehicles development. It provide us cloud connectivity, health monitoring, safety and security. Automakers are developing vehicles with IoT enabled including healthcare, accident prevention, vehicle safety, driver safety, driver and passenger comfort, vehicle monitoring, etc. The paper aimed on summarizing the current developments in driver's health and comfort monitoring through IoT.

II. Introduction

Driving is a complex activity performed in a continually varying and stimulating environment. The coordination and execution of various skills like cognitive, sensory, psychomotor and physical are extremely necessary to drive safe. Most of the studies related to driving highlighted that 75% of traffic accidents occurs due to human factors including driver's fatigue, deprived health condition, attention loss, bad emotional state, and lack of skills. Most of the developed country is ageing. Hence, the drivers above 60 years is also increasing. Ageing results are weakening in cognitive function and threaten driver safety. The aged drivers (age above 60 years) have a comparatively more significant risk of accident due to medical emergency than other factors like bad emotional state and lack of skills. The wellness of drivers' is considered as a key factor of traffic accidents. Heart failure and non-traumatic disease (i.e., stroke) are the main risk factors for drivers' death. Many of the victims have no prior knowledge of the presence of the condition. Stroke is a disease caused due to the disturbance in blood supply to the parts of the brain. After experiencing stroke, a driver's ability to drive is generally affected by the visual, perceptual, motor, and cognitive deficits. Stroke leads to arm weakness, facing dropping, blurred vision, dizziness, coordination issue and speech difficulties of victims which are essential for driving. It is necessary to protect the driver's those are possibly be the victims for stroke. Since, stroke onset during driving lead a serious threat to the other drivers and the general public. Now-a-days, there are lots of automotive industry competing not only to provide better performance in terms of the vehicle but also to provide the driver with better comfort even in long rides. Automakers are developing vehicle that could provide health monitoring service with Internet of Things (IoT). In IoT, an automobile or vehicle-treated as a "thing". IoT plays an important role in connected vehicles development. It provide us cloud connectivity, health monitoring, safety and security. Automakers are developing vehicles with IoT enabled including healthcare, accident prevention, vehicle safety, driver safety, driver and passenger comfort, vehicle monitoring, etc. The paper aimed on summarizing the current developments in driver's health and comfort monitoring through IoT.

III. Problem Definition

Following main problems while driving:

1. Unknown health conditions triggers while driving.
2. Significant risk of accident due to medical emergency.
3. Drink and drive.
4. Panik attacks.

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IV. Literature Survey

- Park S J, Subramaniyam :- Older Driver's Physiological Response Under Risky Driving Conditions. In Advances in Applied Digital Human Modelling and, 107, Springer, Cham. At present, many automakers are paying attention to develop vehicles with IoT enabled including healthcare, accident prevention, vehicle safety, driver safety, driver and passenger comfort, vehicle monitoring, etc.
- One of the leading automaker Faurecia, produced an active wellness seat (Active Wellness TM 1.0) used to monitor drivers heart rate variability and breath rhythm data. Faurecia claims that no smart car without a smart seat. This seat monitors both the mental and physical status of drivers and passengers via embedded sensors for heart rate variability and respiration rates
- Jee S H, Park J W:-Stroke is a brain attack triggered by the unexpected disruption of blood supply to the brain and its parts. Based on the area and side of the cerebrum affected by this attack, the victim may experience some of these effects: arm drift, movement difficulty, loss of vision or blurred vision, balance loss, severe headache. If someone is experiencing stroke while driving, it not only risks his/her life and safety, also decreases the safety of others on the road and increases the risk of an accident. Hence, prediction of stroke disease is essential.

V. Hardware Description

1. Heart Rate sensor

A heart rate sensor is a device that measures the heart rate, typically expressed in beats per minute (bpm). These sensors use various technologies such as optical sensors, which detect blood flow through the skin, or electrical sensors, which measure the electrical activity of the heart. Heart rate sensors are commonly found in wearable fitness trackers, smartwatches, and medical devices. They provide valuable information about an individual's cardiovascular health, fitness level, and activity intensity. Monitoring heart rate during exercise can help optimize workouts by ensuring that intensity levels are appropriate and safe. Additionally, tracking resting heart rate over time can provide insights into overall health and fitness improvements.

Figure 1.1: Heart rate sensor

2. Temperature Sensor (DS18B20)

The DS18B20 is a digital temperature sensor manufactured by Maxim Integrated. It operates using the one-wire communication protocol, enabling multiple sensors to be connected to a single microcontroller pin. The DS18B20 provides high accuracy temperature measurements with a resolution of up to 12 bits and a temperature range typically from -55°C to +125°C. Its compact size, low power consumption, and robust design make it suitable for a wide range of applications, including environmental monitoring, industrial automation, and consumer electronics. With its digital output and simple interface, the DS18B20 is easy to integrate into various projects and systems for precise temperature monitoring and control.

Figure 1.2: Temperature sensor (DS18B20)

3. Alcohol Sensor (MQ5)

The MQ5 is a gas sensor module specifically designed to detect the presence of alcohol vapor in the air. It operates based on the principle of a semiconductor gas sensor, where the resistance of the sensor changes in the presence of alcohol molecules. The MQ5 alcohol sensor is sensitive to various concentrations of alcohol vapor, making it suitable for applications such as breathalyzers, alcohol detection systems for automotive safety, and industrial safety monitoring. This sensor module requires a heater voltage to operate and produces an analog output voltage that varies with the concentration of alcohol detected. With its compact size, ease of use, and high sensitivity to alcohol vapor, the MQ5 sensor is widely used in alcohol detection applications for both personal and industrial use.

Figure 1.3: Alcohol and Smoke sensor (MQ5)

4. Arduino UNO

The Arduino Uno is a popular microcontroller board based on the ATmega328P microcontroller. It features digital input/output pins, analog inputs, PWM outputs, UART communication, SPI, and I2C interfaces, making it versatile for a wide range of projects. The Uno is known for its simplicity and ease of use, making it a favorite among hobbyists, students, and professionals alike for prototyping and creating interactive electronic projects. It can be programmed using the Arduino IDE (Integrated Development Environment) and supports a vast array of sensors, actuators, and modules, making it suitable for various applications including robotics, home automation, IoT devices, and more.

- Digital I/O Pins: 14
- PWM Pins: 6 (Pin # 3, 5, 6, 9, 10 and 11)
- Analog Input Pins: 6 • DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA • Size: 68.6 mm x 53.4 mm
- Weight: 25 g
- ICSP Header: Yes

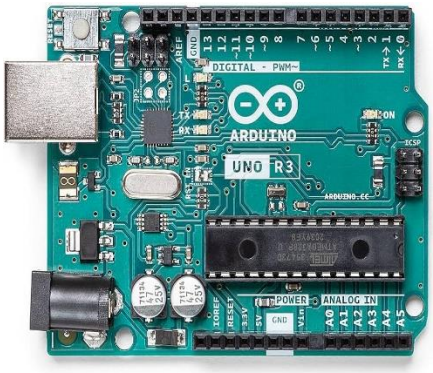


Figure 1.4: Arduino UNO

5. Motor Driver (L298)

The L298 is a popular dual H-bridge motor driver integrated circuit (IC) used to control DC motors and stepper motors. It's capable of driving two motors bidirectionally, meaning it can control the speed and direction of rotation for each motor independently. The L298 chip can handle a wide range of motor voltages (up to 46V) and currents (up to 2A per channel), making it suitable for a variety of motor control applications.

The L298 typically requires external components such as diodes, capacitors, and resistors to function correctly. It's commonly used in robotics, RC vehicles, CNC machines, and other projects where precise motor control is required. Additionally, there are many motor driver boards and modules available that incorporate the L298 chip, simplifying the process of integrating it into projects.

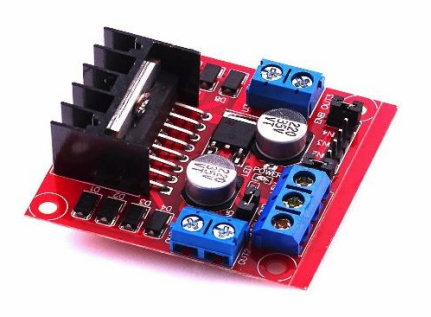


Figure 1.5: Motor Driver (D298)

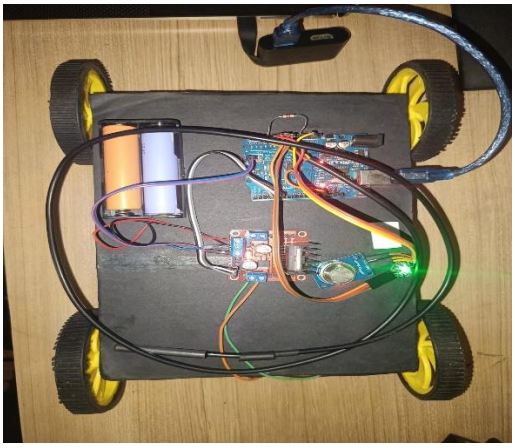
6. DC Motor
   Brushed DC Motors: These motors have carbon brushes that make physical contact with the commutator to provide power to the rotor windings. They are relatively simple and inexpensive but require maintenance due to brush wear.

Figure 1.6: DC Motor

VI. Working

To monitor health of a driver we are using heartbeat sensor, alcohol sensor and temperature sensor to monitor heartbeat, alcohol through his/her breath and temperature respectively. Heartbeat sensor will be installed in seatbelt near the heart of the driver. Temperature sensor will also be installed in seatbelt near the neck and alcohol sensor will be installed in steering wheel/ handle of the EV.

The sensors start working when drive enters the EV and the seatbelt is locked. As the seatbelt is locked the sensors starts recording the data from heartbeat sensor temperature sensor and alcohol sensor and the recorded data is monitored by t6he microcontroller which then shows the output on the display of EV. If the vehicle is moving and abnormal reading is observed the vehicle will turn on the parking lights and decrease the speed of vehicle by interval of 2 seconds and slowly comes to rest.



VII. Conclusion

In conclusion, the project aimed to control the speed of an L298 motor using an Arduino Uno in response to sensor data from a heart rate sensor, alcohol sensor, and DS18B20 temperature sensor. The primary objective was to decrease the motor speed gradually based on the sensor readings, particularly focusing on heart rate and alcohol level.

The implementation involved:

Hardware Setup: Connecting the sensors and motor driver to the Arduino Uno according to their specifications and requirements.

Code Implementation: Writing Arduino code to continuously read sensor data and adjust the motor speed accordingly. This involved interpreting sensor readings to determine the desired motor speed and implementing PWM control to adjust the motor speed gradually.

Testing and Safety: Thorough testing of the system was conducted to ensure it responded appropriately to changes in sensor readings. Safety precautions were taken into consideration, especially when dealing with alcohol sensors and motor control.

Optimization: Fine-tuning the code and sensor readings was carried out to enhance the system's responsiveness and accuracy.

Through this project, a prototype system was developed that could dynamically adjust motor speed based on real-time physiological and environmental data. Further iterations and improvements could be made to enhance its functionality and reliability. Additionally, considerations for scaling, robustness, and user interface could be addressed for practical applications in contexts such as personal health monitoring or safety systems.

VIII. Reference

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