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Human Stress and Zone Based Vehicle Speed Control

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Abstract: The "Human Stress and Zone-Based Vehicle Speed Control" system is a cutting-edge strategy created to improve road safety by combining automated speed limitation in specified zones with real-time driver stress monitoring. This system uses a variety of physiological sensors, including temperature, galvanic skin response (GSR), and heart rate monitors, to continuously track signs linked to driver stress. The device dynamically modifies the speed of the vehicle when it detects high levels of stress to reduce the risk of distracted driving or delayed reaction times. Additionally, in crucial locations like hospital and school zones, radio frequency identification, technology is used to control vehicle speed.

The system then automatically reduces the vehicle's speed to comply with the designated limit, enhancing safety without requiring driver intervention. By combining driver-centric stress monitoring with environment-specific speed control, this system addresses two significant factors contributing to road accidents: driver stress and speeding in sensitive zones. This dual approach not only promotes safer driving practices but also ensures better adherence to traffic regulations, ultimately contributing to a reduction in traffic-related incidents. In conclusion, the "Human Stress and Zone-Based Vehicle Speed Control" system represents a comprehensive solution to enhance road safety by leveraging advanced technologies to monitor driver stress and enforce speed regulations in critical zones.

Keywords: Speed Control ,Radio Frequency ,Stress ,Priority zones .

I. INTRODUCTION

In the fast-paced world of today, drivers frequently participate in dangerous behaviours, such as excessive speeding, which is a major contributing factor to traffic accidents, out of a sense of hurry to get to their destinations. According to government data, road accidents account for 60% of fatalities in India, with over speeding being the cause of 35% of these cases. The incidence of infractions and ensuing collisions is still frighteningly high even with the installation of speed limit signs, real-time speed displays, and strict rules. To establish an accident-free future that prioritizes road safety and obedience to traffic regulations, the main goal is to develop an integrated system that uses an easy speed control mechanism. Around the world, driving is regarded as one of the most difficult occupations. Driving requires the complete use of both mental and physical abilities due to its complexity and danger. Due to increased sympathetic nervous system activity, drivers frequently undergo acute stress reactions in dangerous situations. This can prevent them from acting appropriately and promptly, which could have dire repercussions. Professional drivers are especially vulnerable to stress, which has a negative impact on driving behaviour and raises the risk of traffic accidents, which do a great deal of harm to people and property each year. Long-term stress also increases the risk of mental, gastrointestinal, and cardiovascular diseases.

[1-3]

Numerous factors, such as human error, personal circumstances, and environmental effects, can result in dangerous driving situations. Driving errors are responsible for almost 90% of traffic accidents; the most common ones, which account for 41% of incidences, are inattention, distraction, mental overload, and poor observation. While environmental conditions include things like weather, visibility, driver-environment interactions, and driving routes, individual conditions include things like a driver's mood, personality, age, gender, and accident history. Since drivers' emotional states and human error are strongly related, a thorough understanding of these emotions is essential to disaster prevention.[5]

It is possible to determine a driver's stress levels by using contextual, physiological, and physical data. Through the sympathetic and parasympathetic nervous systems, the autonomic nervous system controls physiological reactions. Studies evaluating driver stress detection commonly use a variety of physiological signs, including breathing rates, galvanic skin response (GSR), and electrocardiograms (ECG). Several physiological cues can be integrated to improve the precision of stress level identification. Skeletal, muscular, and tissue motions are all part of physical reactions, which are controlled by the somatic motor system.

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Driver stress levels have been found to be strongly correlated with physical data, such as speech patterns, facial expressions, and vehicle dynamics. Stress levels are also correlated with contextual information, including environmental and personal characteristics. Using multimodal data, which includes physiological signals and details about the surroundings, vehicle, and driver, can improve the classification of driver stress levels by integrating driver stress detection with zone-based speed regulation. This project aspires to mitigate the risks associated with high-speed driving and driver stress, thereby contributing to a safer driving environment. The system's design ensures that speed is automatically adjusted in critical zones, reducing the reliance on driver intervention and minimizing the potential for human error. This comprehensive approach not only addresses the immediate need for speed regulation in sensitive areas but also promotes long-term improvements in driver's behavior and road safety.

II. PROPOSED SYSTEM

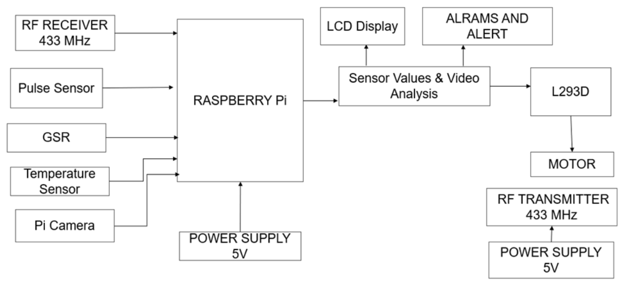

Fig.1 Block Diagram

This proposed system aims to mitigate road accidents by implementing a dual-faceted approach to speed control, incorporating both driver stress levels and zone-based speed limits. The diagram illustrates the core components of the system, focusing on stress detection and zone identification.

A. Stress Detection

The system employs a multi-pronged approach to assess driver stress. A pulse sensor, GSR (Galvanic Skin Response) sensor, and temperature sensor collect physiological data from the driver. Simultaneously, a Pi Camera captures facial expressions, providing visual cues for stress analysis. These sensor inputs are fed into the Raspberry Pi, where sensor values and video analysis are performed. Sophisticated algorithms on the Raspberry Pi process this data, correlating physiological changes and facial expressions to determine the driver's stress level. Machine learning algorithms that have been trained to identify stress signs, such as high temperature, altered skin conductivity, elevated heart rate, and particular facial expressions, may be used in this study. Decisions about speed control could then be influenced by the output of the device, which shows the driver's stress level. To encourage safer driving, the system might, for example, step in and lower the vehicle's speed if the driver is under a lot of stress.

B. Zone Based Speed Control

RF communication is also used by the system to implement zone-based speed control. Priority areas, such school and hospital zones, are where RF transmitters are positioned. A signal displaying the speed limit in the area is continuously broadcast by these transmitters. An RF receiver installed in the car picks up these signals when it enters a specific area. The Raspberry Pi then receives the received signal, processes it, and modifies the vehicle's speed as necessary. This automated speed control in designated zones improves safety in these crucial regions and guarantees adherence to speed limits.

To further encourage awareness and safe driving habits, the system can also include warnings and notifications that are activated by the Raspberry Pi and inform the driver of their stress level or the speed limit in the current zone. The diagram's L293D motor driver and motor imply that the system can physically regulate the vehicle's speed, providing a straightforward and efficient means of enforcing zone-based and stress-based speed limitations. To ensure steady functioning, the system uses separate 5V power supply for the motor and Raspberry Pi. Stress levels, speed limits, and zone information are probably among the crucial details that the driver can see on the LCD display.

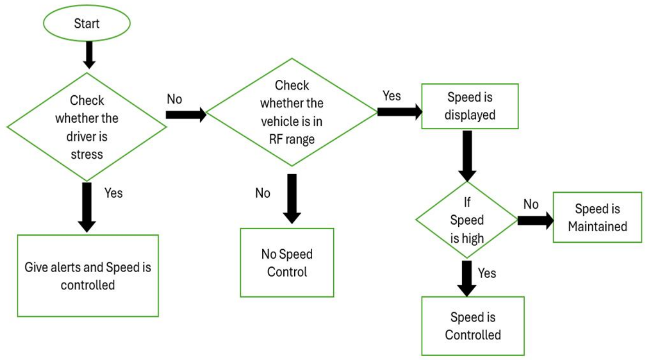

Fig.2 Flowchart of Proposed System

III. SIMULATION AND RESULTS

The Software Model is designed to analyse the parameters of stress and critical zones (school and hospital zones) and bring the appropriate speed control mechanism .The human stress is identified using sensors like GSR ,Heart rate sensor and Temperature sensor .When the sensor value exceed the predefined value speed control of vehicle is done .With the help of RF Transmitter and RF Receiver Module ,zone based speed control is established .The simulation is done in proteus software by using Arduino and the Hardware implementation will be done in Raspberry Pi.

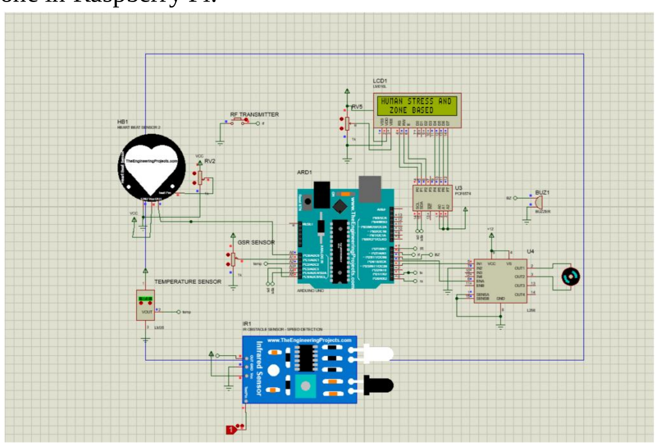

Fig .3 Overall Simulation

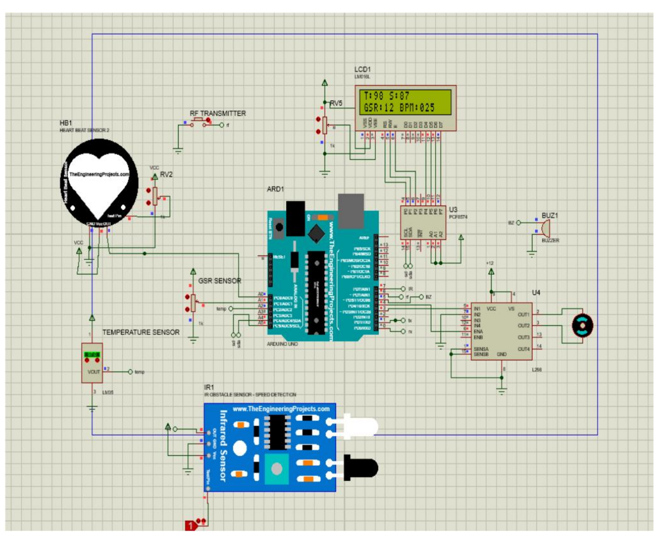

Fig.4 Output under Normal Conditions

When the RF Transmitter is switched on, the signal is received by the RF Receiver and the speed is controlled (there is a reduction in the speed from the range of 80 to 50). A buzzer alarm is also kept indicating that vehicle speed is controlled. This indicates speed control in critical zones like school and hospital zones. The speed is measured using speed sensor

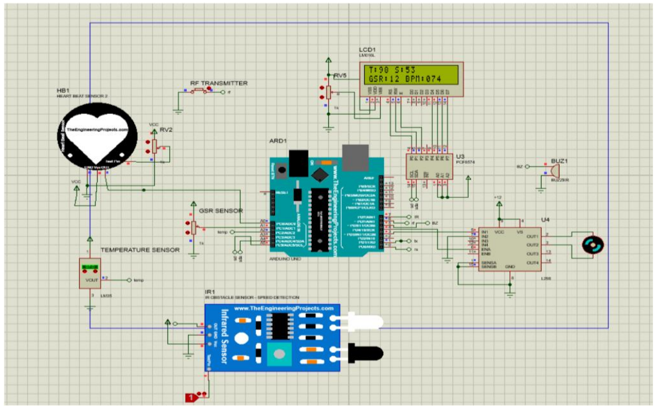

Fig.5 Speed Control under Stressed Condition

The sensors which are used for measuring stress levels are GSR (Galvanic Skin Response), Heart rate sensor and Temperature sensor. A normal human body temperature can range from 97°F (36.1°C) to 99°F (37.2°C), A normal heart rate for adults is between 60 to 100 beats per minute (bpm).
When the value of GSR rises above 12 and temperature falls below 97°F and Heart Rate value falls below 60, the Arduino receives these signals, analyses them and reduces the speed of vehicle.

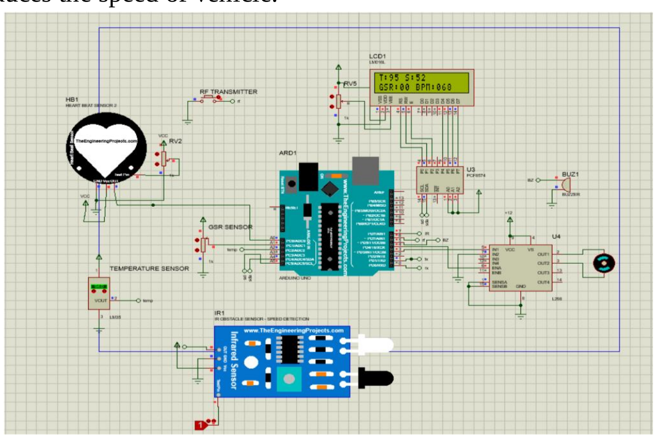

Fig.6 Zone based Speed Control

IV. CONCLUSION

The proposed system offers a multi-layered approach to road safety by addressing both driver stress and zone-based speed control. Enhancements such as incorporating additional data sources—like vehicle sensor inputs (e.g., steering wheel movements, accelerator and brake usage) and GPS data to identify stressful traffic situations—can provide a more comprehensive understanding of driver stress. Developing personalized stress profiles over time would allow the system to detect deviations from a driver's baseline, enabling more effective interventions. Advanced machine learning algorithms can analyze these diverse data streams to differentiate between various types of stress, such as fatigue, anxiety, or distraction. Additionally, integrating real-time data for zone-based speed control, through connections to central traffic management systems or utilizing GPS information, would allow for dynamic speed limit adjustments based on current traffic conditions, accidents, or road closures, creating a more responsive and adaptive system. Providing drivers with feedback regarding the reasons for speed adjustments, such as displaying messages like "Speed reduced due to school zone" or "Speed adjusted due to heavy traffic ahead," can increase transparency and user acceptance. Integrating the system with navigation applications could also offer drivers advance warnings of upcoming zones and speed changes.

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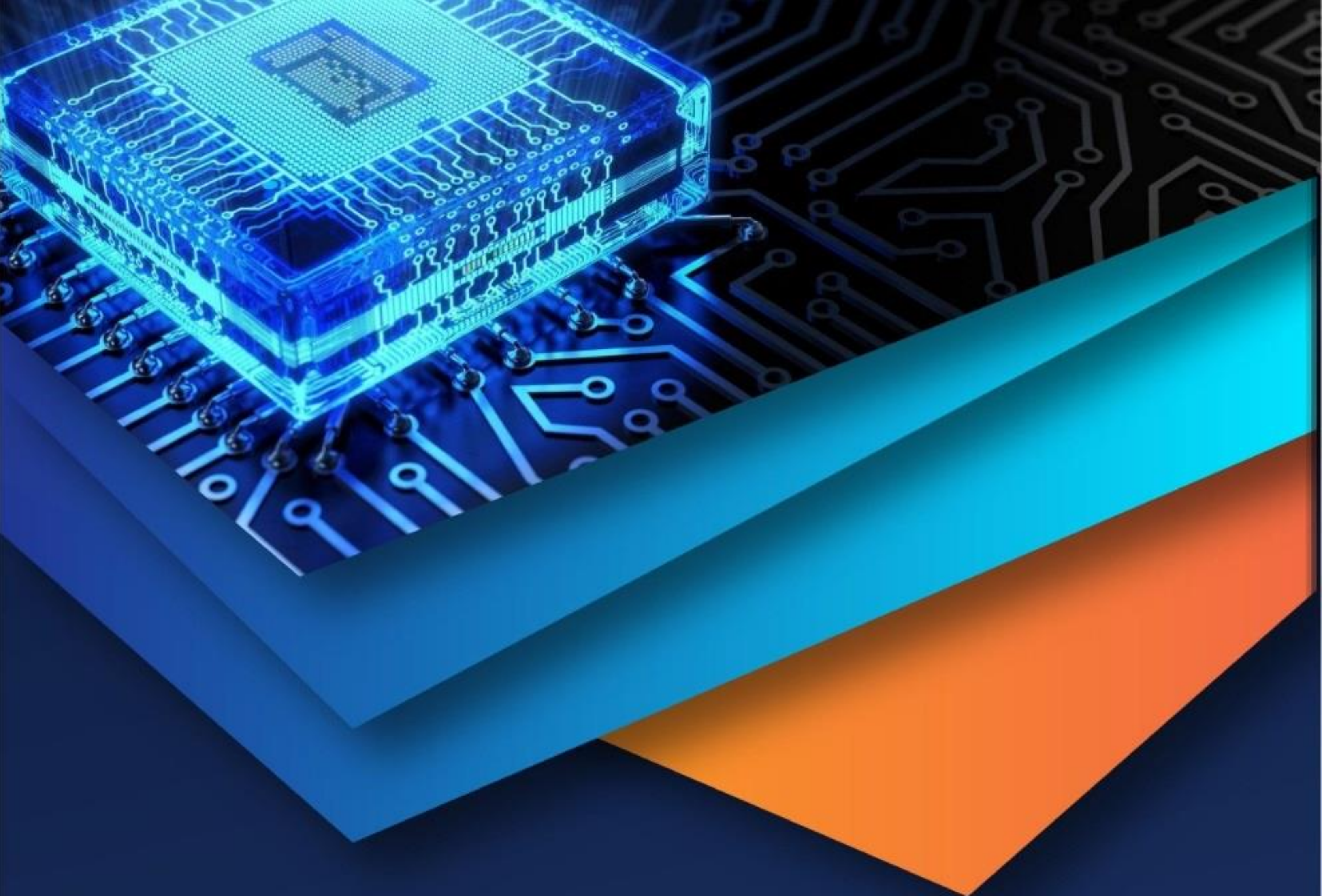

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