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Emergency System for Heavy Vehicle Drivers with Heart Dysfunction using Multisensor

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ABSTRACT

Technological ways to detect and monitor driver driving abilities are constantly evolving, with several now in the development, validation testing, or early deployment stages. Previous research examined available fatigue detection and prediction devices and approaches. As the name implies, this project focuses on modern technology in automobiles to make them more intelligent and interactive in order to reduce road accidents. By combining Arduino with multiple sensors, this system becomes more efficient, dependable, and effective. There are very few technologies that detect human behavior in or with cars. In this project, we present a real-time online safety prototype that controls vehicle speed. The system's major components include a number of real-time sensors such as smoke sensor, heart rate sensor, pir sensors, alcohol sensors and IOT module.

KEYWORDS: Smoke sensor, Heart rate sensor, PIR (passive Infrared) sensor, Alcohol sensor..

1. INTRODUCTION

When you think of work-related safety hazards, you probably think about what goes on inside the workplace. But one of the greatest threats to your safety is not in the workplace, but rather on the road. Someone is injured every 18 seconds. Over two million of those injuries turn out to be disabling. A person dies in a crash on Indian roads every 11 minutes. In fact, motor vehicle accidents are the most common cause of death in India more than cancer or heart attacks. When we think about the serious accident, it could change your life- and not for the better. As of now most of the research and implementation on with mechanical behavior of the vehicle, its safety and passengers, but what if the driver misbehavior cause an accident. To prevent this, we are using multiple sensors for the detection and monitor the vehicle, driver and the surroundings. In this we are adding the Heart rate sensor which keeps a track on the heartbeat of the driver if any abnormality is observed within the heart rhythm, then the vehicle stops automatically and sends an alert through IOT. In this we are also adding PIR (passive infrared) sensor for the detection of the living organisms like animals and humans and in this situation if the vehicle is above the regular speed which can be controlled by applying brakes, then vehicle stops automatically. The alcohol is detected by using alcohol

sensor (MQ3) which detects Ethanol amount in the persons breath. If the alcohol is detected in driver breath, then the vehicle will not start and even sends an alert with help of IOT module to the device linked on the other side. Smoke detection in the mechanical parts of the vehicle is detected and stops the vehicle and sends an alert through IOT to the concerned device.

2. DISCUSSIONS

2.1 EMBEDDED SYSTEM

A general definition of embedded systems is: embedded systems are computing systems with tightly coupled hardware and software integration, which are designed to perform a dedicated function. In some cases, embedded systems can function as standalone systems. Oneclass of embedded processors focuses on size, power consumption, and price. Therefore, some embedded processors are limited in functionality, i.e., a processor is good enough forthe class of applications for which it was designed but is likely inadequate for other classes of applications.

Real-time systems are defined as those systems in which the overall correctness of the system depends on both the functional correctness and the timing correctness. The timing correctness is at least as important as the functional correctness.

2.2 APPLICATION OF EMBEDDED SYSTEM

- In real life we are using so many embedded systems for example
- Home application (microvan, washing machine, security system DVD, Mp3 playeretc,)
- Air craft, missiles, automotive, nuclear research, personal use (mobile phone, I pod)

2.3 TYPES OF EMBEDDED SYSTEM:

1. Embedded System is broadly categorized as Standalone embedded system.

Example: Washing Machine,

2. Networking embedded system. Example: Network Printer

2.4 EMBEDDED SYSTEM NETWORK APPLICATIONS:

Embedded systems are designed to do some specific tasks, rather than be a general-purpose computer for multiple tasks. Some also have real-time performance constraints that must be met, for reason such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs. Embedded systems are not always separate devices. Most often they are physically built-in to the devices they control. The software written for embedded systems is often called firmware, and is stored in read-only memory or Flash memory chips rather than a disk drive. It often runs with limited computer hardware resources: small or no keyboard, screen, and little memory.

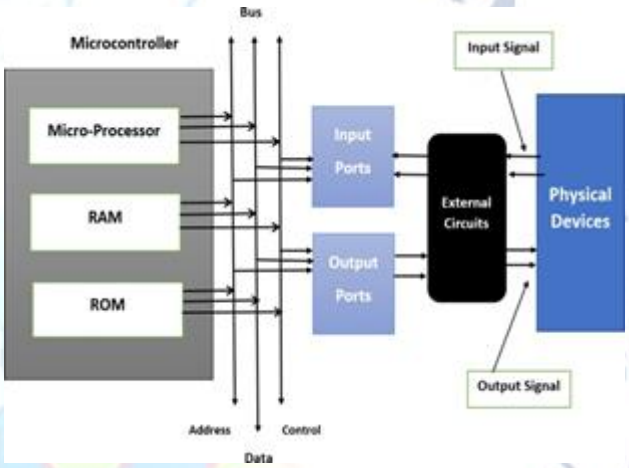

Fig: 1 Embedded System Design

3. METHODOLGY

3.1 EXISTING SYSTEM

ABS (Anti-Locking Braking System): ABS works with your regular braking system by automatically pumping them. In vehicles not equipped with ABS, the driver has to manually pump the brakes to prevent wheel lockup. In vehicles equipped with ABS, your foot should remain firmly planted on the brake pedal, while ABS pumps the brakes for you so you can concentrate on steering to safety.

EBD (Electronic brake-force distribution): Electronic brake-force distribution (EBD or EBFD), Electronic brake-force limitation (EBL) is an automobile brake technology that automatically varies the amount of force applied to each of a vehicle's brakes, based on road conditions, speed, loading, etc. always coupled with anti-lock braking systems.

One of the solutions that is proposed to prevent the accidents is using IR sensors and Arduino Uno technology [1]. 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 GSM module that contains predefined numbers and accident location usingGPS module.

The sudden unintended acceleration avoidance and drowsiness detector for automobile accidents prevention Detection of drowsiness is introduced which can monitor the eye movement and eye blinking of the driver at regular intervals during his/her driving and, if required, can provide an audible alarm within the vehicle to alert the driver or introduce braking system. In case of pedal mix-up, when the vehicle is in parking or traffic jam or under an unconscious state of mind, he/she might mistakenly raise the gas level instead of brake which leads to disastrous accidents [2].

Vehicle Collision Detection and Avoidance with Pollution Monitoring System Using IoT [3]. For accident avoidance, tire pressure is measured whereas in accident detection is implemented with the help of node MCU.MQ7 is used in order to monitor the pollution. The proposed system is useful in reducing the vehicular accidents and pollution monitoring will help to know the environmentalstatus.

Design of Smart Helmet for Accident Avoidance. The main target of the project is designing a smart helmet for accident avoidance and alcohol detection [4]. The IR sensor checks if the person is wearing the helmet or not. If theperson met with an accident, then with help of GPS module, we can get ahold of driver location. If there is no sign of alcoholic substance present and helmet is used, then only the bike will start.

Smart Road Accident Detection and communication System [6]. The number of fatal and disabling road accident are increasing day by day and is a real public health challenge. Many times, in the road accidents, human lives will be lost due to delayed medical assistance. Hence road accident deaths are more prominent.

Cloud Based Intelligent Traffic System to Implement Traffic Rules Violation Detection and Accident Detection Units The urbanization process has marked an ever-increasing growth inthe number of on-road vehicles which has led to a decline in the air quality while an increase in the number of road accidents [7]. In this paper an intelligent system called CBITS has been proposed. CBITS follows a holistic approach as it is well equipped with a network of sensors thatprovide real-time emission levels as well as it alerts the authorities with location in case of an accident.

Vision-based real-time traffic accident detectionRecently, traffic accident detection is becoming one of the interesting fields due to its tremendous application potential in Intelligent Transportation Systems [8]. In this paper, we present a vision-based real time traffic accident detection method. We intend to extract foreground and background from video shots using the Gaussian Mixture Model (GMM) to detect vehicles; afterwards, the detected vehiclesare tracked based on the mean shift algorithm.

Accidents Detection and Prevention System to reduce Traffic Hazards using IR Sensors. Traffic Hazards is one of the major problems facing across the world [9].

Intelligent transportation system for accident prevention and detection. In a developing nation like India, with advancement in the transportation technology and rise in the total number of vehicles, road accidents increase rapidly [10]. This advancement in technology also increased the traffic hazards. Two wheelers' accounts for 25% of total road crash death. Hence the ratio of road accidents that take place frequently increases causing immense loss of life due to poor emergency facilities. Main causes behind these road accidents are lack of training institutes, unskilled drivers, poor road conditions, use of cell phone during driving, consuming alcohol while driving, over loading and poor governmental plans in this regard.

Accident detection and reporting system using GPS, GPRS and GSM technology. Speed is one of the basic reasons for vehicle accident [11]. Many lives could have been saved if emergency service could get accident information and reach in time. Nowadays, GPS has become an integral part of a vehicle system. This paper proposes to utilize the capability of a GPS receiver to monitor speed of a vehicle and detect accident basing on monitored speed and send accident location to an Alert Service Center. The GPS will monitor speed of a vehicle

and compare with the previous speed in every second through a Microcontroller Unit. Whenever the speed will be below the specified speed, it will assume that an accident has occurred.

Accident elements detection based on improved DPM. Deformable Part Models (DPM) has high detection accuracy in the image detection algorithm, while it is at the expense of complex calculation and slowly running speed. In order to improve the development of its application, the algorithms of the weighted PCA (MPCA) and fast level locating are also proposed, MPCA can reduce the model parameters by reducing the dimensions of HOG features and the fast level locating can locate the object's level in the feature pyramid fast [12]. This paper also presents the optical accidents elements detection for the scene of the accident which can be used in varying environment. Our results show that the detection of the accidents elements obtained are sufficiently robust to the changing scene of accident and its speed increases significantly.

An accident detection technique using inertial measurement unit and odometry. Despite the prevention effort, car accident is still one of the major causes of death. Thus, to avoid as many casualties, helps and assistance should reach the accident sites as soon as possible [13]. This can be enabled by quickly detecting the accidents and reporting them to the related official units. To this end, we propose an accident detection device using an inertial measurement unit (IMU) and 3G cellular module along with an accident detection method. Our detection approach combines both IMU sensory data and odometry in order to detect an accident and then send the accident coordinate over cellular network to be reported on a map. The preliminary result based on test scenarios proves the practicality of our approach with satisfactory detection rates.

A comprehensive solution to road traffic accident detection and ambulance management [14]. Delay in providing Emergency MedicalServices (EMS) is the cause of the high mortality rate in road traffic accidents in countries like India. There is delay involved in each and every stage of the process, right from reporting an accident to dispatching an ambulance, till the patient is safely handed over to the casualty. Minimizing this delay can help save lives. We propose a comprehensive solution to both accident detection and ambulance management. When the in-vehicle accident detection module reports an accident, the main server automatically dispatches the nearest ambulance to the accident spot. The android application used by the ambulance driver assists the driver to reach the location quickly and safely. Automation of accident detection and ambulance dispatch, along with providing guidance to the ambulance driver, is achieved here.

3.2 PROPOSED SYSTEM:

Robotic vehicle model is designed and sensors such as PIR, Heartbeat, Alcohol and smoke sensors are connected to the vehicle system. Wehave designed in the manner that if any one of the sensors gets detected the speed of the vehicle will be automatically reduced and stopped thus avoiding accidents and send a message to the person who is entrusted and connected through IOT.

Unlike the Anti-locking braking system and electronic brake force distribution these methods proper updating of information. This can be implemented in all vehicles without exception. This is cost effective when compared to ABS andEBD systems. This is user friendly too.

3.3 WORKING

We are installing a heart rate sensor that monitors the driver's heartbeat and stops the car autonomously if an irregularity is detected within the heart rhythm. We are also integrating a PIR (passive infrared) sensor for identifying the presence of live organisms such as animals and humans, and if the vehicle exceeds the normal speed, which may be adjusted by using brakes, the car will stop automatically. The alcohol is detected using an alcohol sensor (MQ3), which measures the quantity of ethanol in the individual's breath. If alcohol is detected in the driver's breath, the car will not start and will transmit a warning to the device connected on the opposite side via the IOT module. When smoke emerges in the vehicle's mechanical parts, the automobile stops, and an alarm is sent to therelevant device via IOT.

3.4 BLOCK DIAGRAM

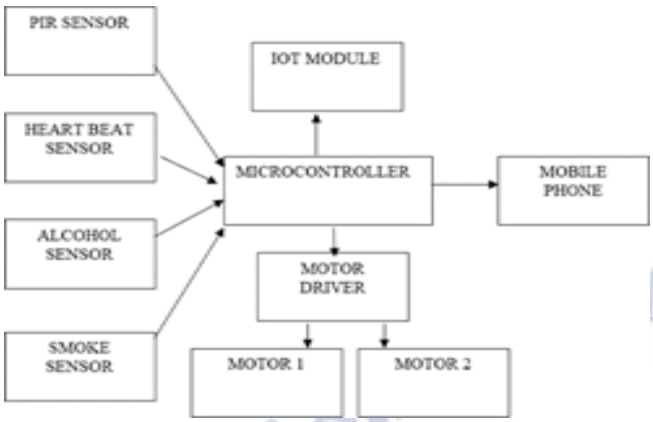

Fig: 2 Block Diagram of the prototype

3.5 PROJECT FEATURES

1. Low cost.
2. High speed networking.
3. Low power consumption.
4. Light weight network 5.Broadcast communication

4. HARDWARE DESCRIPTION

4.1 ARDUINO MICROCONTROLLER

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

4.2 DEVICE FEATURES

Depending on the device selected and features enabled, there are up to five ports available. Some pins of the I/O ports are multiplexed with an alternate function from the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.

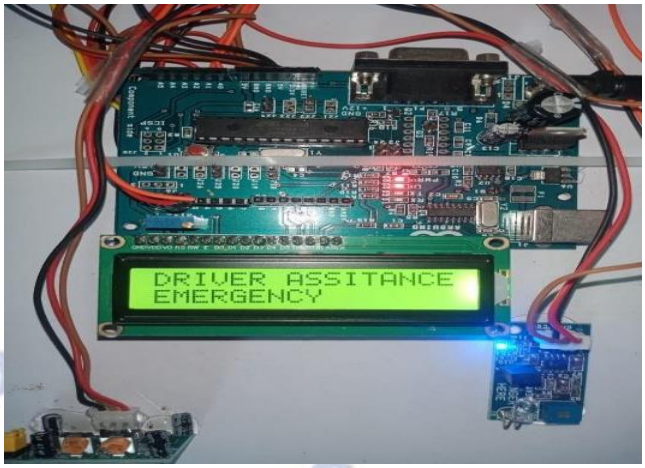

Figure 3: Arduino UNO R3

4.3 MEMORY UNIT

Memory is part of the microcontroller whose function is to store data. For a certain input we get the contents of a certain addressed memory location and that's all. Two new concepts are brought to us: addressing and memory location. Memory consists of all memory locations, and addressing is nothing but selecting one of them. This means that we need to select the desired memory location on one hand, and on the other hand we need to wait for the contents of that location. Besides reading from a memory location, memory must also provide for writing onto it. This is done by supplying an additional line called control line. We will designate this line as R/W (read/write). Control line is used in the following way: if r/w=1, reading is done, and if opposite is true then writing is done on the memory location.

4.4 HEARTBEAT SENSOR

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. An electrocardiogram (ECG or EKG, abbreviated from the German is a graphic produced by an electrocardiograph, which records the electrical activity of the heart over time. An electrocardiogram (ECG / EKG) is an electrical recording of the heart that measures the electrical activity of the heart. This activity reflects the action of the cardiac muscle as it depolarizes and repolarizes during the cardiac cycle. The ECG represents the temporal and spatial summation of the action potentials of the myocardial fibres typically measured with body- surface electrodes. It is the gold standard for the diagnosis of cardiac arrhythmias.

4.5 MOTOR DESCRIPTION

The L293D is a high-voltage, high-current four- channel driver designed for inductive loads like motors and solenoids. It operates with TTL logic levels, enabling bidirectional drive currents up to 600mA from 4.5V to 36V. Each output features a totem-pole drive circuit, and drivers are enabled in pairs. With proper data inputs, each pair forms a full-H bridge drive suitable for motor applications. It comes in a 16-lead plastic package with provisions for heat sinking and internal clamp diodes for protection. The L293DD is assembled in a 20-lead surface mount which has 8 center pins connected together and used for heat sinking. Features of this selected are:

- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs
- Output Current 1 A Per Channel (600 mA for L293D)
- Peak Output Current 2 A Per Channel (1.2 A for L293D)
- Output Clamp Diodes for Inductive Transient Suppression (L293D)

4.6 CENTRAL PROCESSING UNIT

Let add 3 more memory locations to a specific block that will have a built-in capability to multiply, divide, subtract, and move its contents from one memory location onto another. The part we just added in is called "central processing unit" (CPU). Its memory locations are called register.

SMOKE AND ALCOHOL SENSOR Features:

- High sensitivity to LPG, natural gas, town gas
- Small sensitivity to alcohol, smoke.
- Fast response.
- Stable and long life
- Simple drive circuit

SOFTWARE DESCRIPTION

The software tools which are used for the implementation are listed below, they are

MPLAB IDE

MPLAB integrated development environment is a comprehensive editor, project manager and design desktop for application of development of embedded design using Microchip ARDUINO MCU and ARDUINO DSC.

MPLAB is a window operating system software program that runs on a PC to develop application for microchip microcontroller and digital signal controller. It is called an integrated development environment or IDE; it provides a single integrated environment to develop code for embedded microcontroller.

C18 COMPILER

The MPLAB C18 compiler is a free-standing, optimizing ANSI C compiler for the ARDUINO microcontroller unit. The compiler deviates from the ANSI standard X3.159-1989 only where the standard conflicts with efficient ARDUINO micro MCU support. The compiler is a 32-bit Windows console application and is fully compatible with Microchip's MPLAB IDE, allowing secure level debugging with the MPLAB ICE in circuit emulator, the MPLAB ICD 2 in circuit debugger or the MPLAB SIM simulator.

5. RESULT

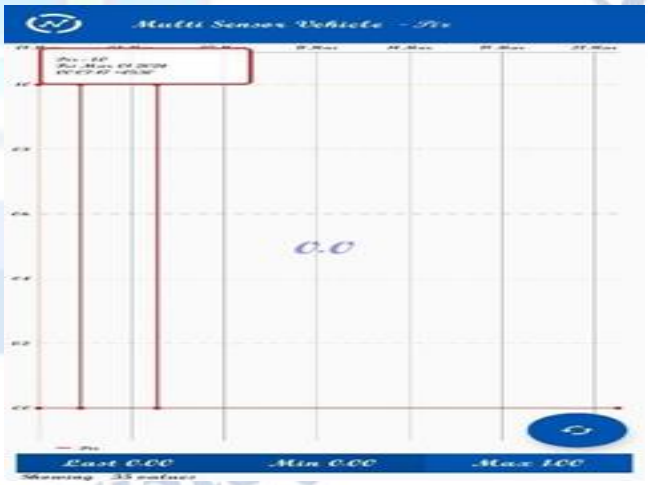

Figure 4: PIR sensor result

Figure 5: Heartbeat sensor result

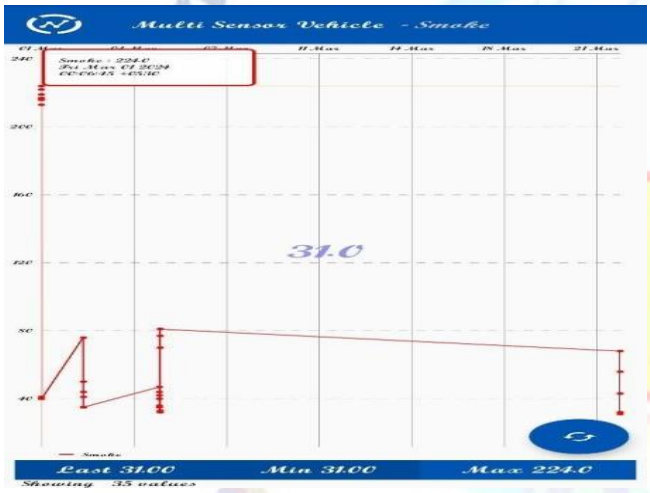

Figure 6: Smoke sensor result

Figure 7: Alcohol sensor result

6. CONCLUSION:

The conclusion of implementing an emergency system for heavy vehicle drivers with heart dysfunction utilizing multi-sensor technology underscores its paramount importance in enhancing both driver safety and overall road safety. By integrating an array of sensors capable of monitoring physiological indicators such as heart rate, blood pressure, and respiratory rate, alongside vehicle parameters like speed, acceleration, and GPS location, the system provides a comprehensive approach to pre- empting potential health-related emergencies while driving.

This amalgamation of sensor data not only enables early detection of abnormalities in the driver's health but also facilitates immediate response mechanisms such as alerting the driver, triggering automated vehicle control actions like slowing down or pulling over, and notifying emergency services or nearby medical facilities as needed. The real-time nature of the system ensures swift intervention, thereby mitigating the risk of accidents caused by sudden incapacitation of the driver due to heart dysfunction.

Moreover, the utilization of multi-sensor technology enhances the system's robustness and reliability by cross-verifying data from different sources, thereby reducing false alarms and improving accuracy. Additionally, the data collected by the system can be analyzed retrospectively to identify patterns and trends, enabling proactive measures for preventing future incidents and optimizing driver health management strategies.

In essence, the implementation of an emergency system for heavy vehicle drivers with heart dysfunction using multi-sensor technology represents a significant advancement in ensuring occupational safety in the transportation industry. By proactively addressing health- related risks and providing timely interventions, such systems not only safeguard the well-being of drivers but also contribute to the overall efficiency and safety of road transportation systems.

7. FUTURE SCOPE

The future scope of emergency systems for heavy vehicle drivers with heart dysfunction using multi-sensor technology holds promising advancements and opportunities for further enhancing driver safety and overall system efficacy.

1. Advanced Machine Learning and AI Integration:

Future iterations of these systems can leverage advanced machine learning algorithms and artificial intelligence (AI) techniques to continuously analyse sensor data and predict potential health emergencies with even greater accuracy. By incorporating deep learning models, these systems can adapt and personalize their responses based on individual driver characteristics and historical data, furtheroptimizing intervention strategies.

2. Integration with Wearable Devices: With the proliferation of wearable health monitoringdevices, such as smart watches and fitnesstrackers, there is potential to integrate these devices into the emergency system ecosystem. By allowing drivers to wear compatible health monitoring devices that seamlessly communicate with the vehicle's multi-sensor system, real-time health data can be collected more comprehensively and non-intrusively, enhancing monitoring capabilities and overallsystem effectiveness.

Telemedicine and Remote Health Monitoring: Future emergency systems could integrate telemedicine capabilities, enabling real-time communication between drivers and healthcare professionals in the event of a health emergency. Remote health monitoring functionalities could also allow medical professionals to remotely monitor drivers' health status and provide timely interventions or recommendations, thereby extending the reach of healthcare services and improving access to medical assistance, especially in remote or rural areas.

3. Integration with Vehicle Autonomy: As autonomous vehicle technology continues to evolve; future emergency systems could seamlessly integrate with autonomous driving systems to enable automated emergency responses. In the event of a driver health emergency, the vehicle could autonomously navigate to a safe location, alert emergency services, and provide assistance to the driver as needed, ensuring uninterrupted transportation operations and minimizing the risk of accidents or disruptions.

4. Data Analytics for Health Management: The wealth of data collected by these multi-sensor emergency systems presents opportunities for advanced data analytics and health management insights. By leveraging big data analytics techniques, transportation companies and healthcare providers can gain valuable insights into driver health trends, identify high-risk individuals, and implement proactive health management strategies, such as personalized wellness programs or preventive medical interventions, to improve overall driver health and well-being.

In summary, the future scope of emergency systems for heavy vehicle drivers with heart dysfunction using multi-sensor technology is characterized by advancements in machine learning, integration with wearable devices, telemedicine capabilities, collaboration with autonomous vehicle technology, and data-driven health management strategies. These advancements hold the potential to revolutionize driver safety in the transportation industry, paving the way for a future where health emergencies are swiftly detected, managed, andmitigated, ensuring safer roads for all.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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