Photoplethysmographic health monitoring of the driver and Smart Driving Assistant to avoid collisions with vehicles.

Driving for a long time leads to physical, psychological stress, which increases life at higher risk and puts health in all hostile areas. Spending more time behind the wheel leads to uninterrupted sitting, resulting in obesity, mental health risk, poor sleep, and harmful habits such as drug addiction. In this research, reliable emergency services ensure safe driving. Such an experience guarantees continuous monitoring of the driver's health intelligently. An intelligent health system continuously monitors the driver's health status and constantly updates the cloud server to monitor the driver's heart rate. According to a recent study, 60% of road accidents occur due to the driver's restless continuous driving. On motorways, vehicles are faster than those on the city side, and if a vehicle brakes abruptly without notification, it causes severe damage, followed by escort vehicles. In addition, the driver's health is a crucial factor, and the unexpected worsening of health complications such as stroke and cardiac arrest is unpredictable, as the symptoms are prevalent and occur within minutes. To avoid stressful driving, the intelligent assistant must monitor his health and suggests relaxation guidelines.

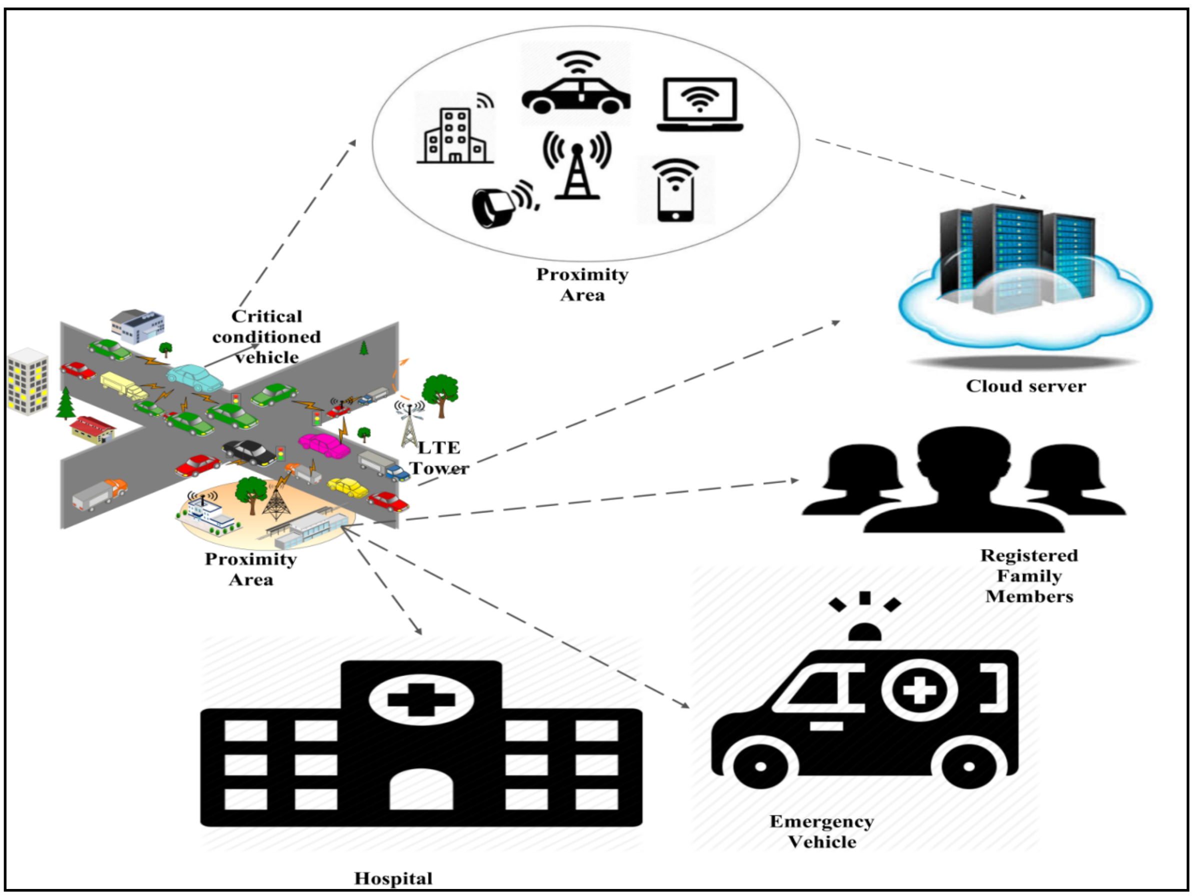


Fig.1. System Architecture

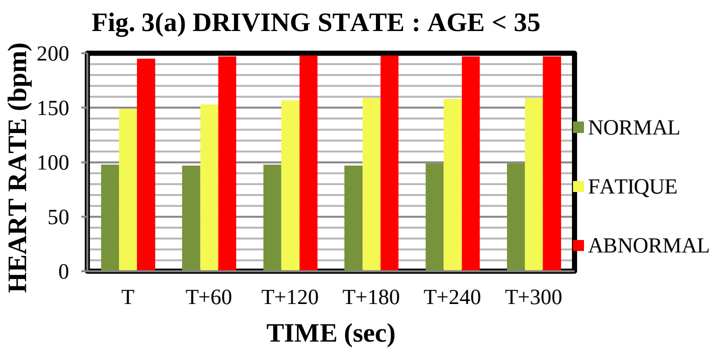
Steering Wheel Sensor

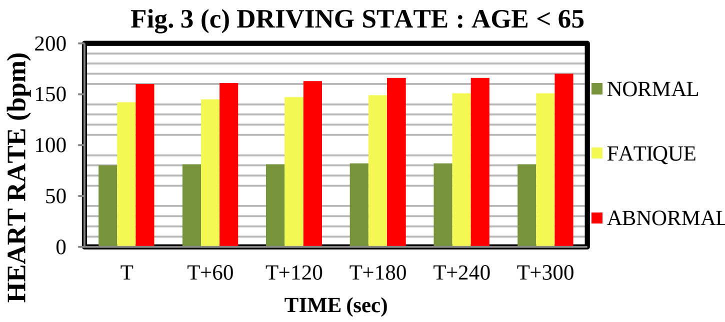
The steering wheel sensor measures the driver's health and continuously monitors his heartbeat. It is used to predict the driver's vital signs effectively and filter readings based on the driver's activity and fitness into normal, fatigued, and abnormal readings continuously stored on the cloud server. Normal fatigue signals indicate normal health, but abnormal signals indicate the driver's poor health and life-threatening condition. We have recorded continuous ECG readings from the driver and forwarded them to the intelligent system on the cloud server. From the heart rate, the intelligent learner calculates the various vital signs and helps to determine the area such as electrocardiogram, heart rate, blood pressure, respiratory rate, oxygen saturation in the blood, blood sugar, skin sweat, capnography, body temperature, and movement evaluation using sensors A1, A2, A3, A4, A5, and A6, as in Fig. 2 & 3, to measure the physical condition of the driver and blood alcohol levels.

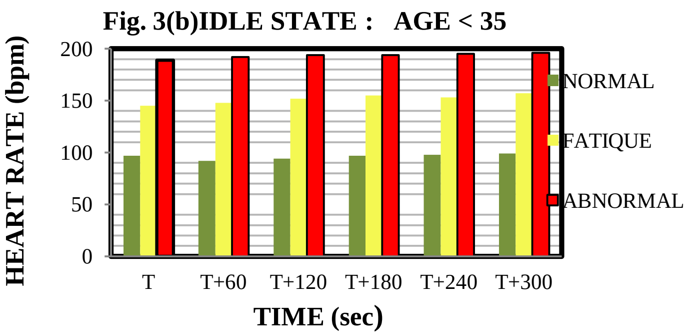
Fig.2. Steering Wheel sensor

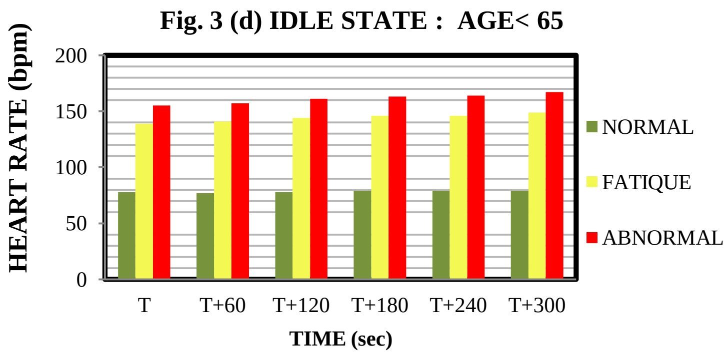
Fig.3. Sensors Position

Sensors attached to the steering wheel remotely monitor health values to the cloud server via close communication, enabling faster and more reliable transmission to the cloud server. Table 3 mentions this type of optical sensor with photoplethysmographic technology, which is used to determine blood flow to calculate the blood pressure, heart rate, and body temperature of the driver and sensor characteristics. This optical sensor uses a light source in the sensor to illuminate the fingertip, and a photoconductor detects changes in light intensity within the finger due to pulsating changes in blood volume, one of which is produced by the heart pumps blood into the arteries and through the vascular system. Plethysmography [48] is an efficient method based on the different light-absorbing properties of tissue and blood to calculate peripheral blood flow in the body. In particular, living tissue in the infrared range is relatively transparent to light, while blood in this frequency range of the blood pressure range of two forces is relatively opaque to light. Increased blood flow through the force of the arteries resists blood flow. This wireless physiological sensor is the unit for the critical observation and monitoring of human health through blood flow. The flow contains a wealth of physiological information collected from laboratories to determine the living blood flow through the sport and find the typical human blood flowmeters by size, weight, and use of optical fibers. The proposed system uses the latest and readily available technology to remedy these drawbacks.









The proposed system uses microtechnology that integrates the Laser Doppler blood flow meter, which uses microelectromechanical technology and measures skin flow in the forehead, fingertips, and earlobes. 3 a, b, c, and d show the real-time sensor values collected from two subjects of different ages to test their normal, fatigue-related, and abnormal heart condition both at idle and while driving.

Automatic Emergency braking (AEB) system

The AEB system performs emergency braking when it receives essential signals from the driver to avoid collisions. An improved intelligent assistant controls the driver and enables the vehicle to park in autonomous driving without an accident. This work calculates the vehicle's current position and determines the number of vehicles moving in the critical condition of the vehicle. An existing GPS is used to determine the vehicle's current location but cannot determine the exact number of vehicles. To calculate the exact number of vehicles, we use in-vehicle magnetic sensors that detect nearby ferrous obstacles up to a height of 28 meters, most of which are made of ferrous material. The AEB system activates the dynamic brake assistance system DBS, which quickly reduces the vehicle's speed by using a hydraulic braking system suspended. The vehicle torque is calculated in plane V_x, V_y and the second Newtonian law of center of gravity of the vehicle position is derived from the equations (1), (2) & (3).

$$\dot{V_x} = V_y r + \frac{1}{m}\sum_{i=1}^{4}(F_{xf}\delta_i + F_{xr}\,\delta_i) \quad (1)$$

$$\dot{V_y} = -V_x r + \frac{1}{m}\sum_{i=1}^{4}(F_{yf}\delta_i + F_{yr}\delta_i) \quad (2)$$

$$r = \sum_{i=1}^{4}\left(\frac{d_f F_{yf}\delta_i - d_r F_{yr}\delta_i}{I_z}\right) \quad (3)$$

Where $\dot{V}_x$ refers longitude and the front tire force defined as F_{xr}, rear tire force as F_{xf}. The lateral velocity is indicated $\dot{V}_y$, steering angle δ_i of vehicle wheel i = (front wheel1, front wheel2, rear wheel3, rear wheel4) front and rear end tires are represented as F_{yf} and F_{yr}. The rate of the yaw is defined as r, obtained using equation (5), and the mass of the vehicle is represented as m, the variable I_z refers the vehicle's moment of inertia to the Z-axis. The distance between the front axle d_f and rear axle d_r is calculated using the Centre of Gravity (CG) of the vehicle, respectively. Now, the magnetic sensor calculates the magnetic flux of nearby vehicles based on their respective flux. The wheel axle is controlled and turns the vehicle into a predefined lane indication (left side) to be parked without any congestion.

The magnetic flux determines the exact number of vehicles based on the iron thickness. Each vehicle has its magnetic flux signal; for example, the bicycle has an iron thickness lower than the bus. From this, the magnetic flux determines exactly the free position of the road. The magnetic sensors installed in the vehicle's chassis can detect the flux up to 28 meters into the environment. The sensor calculates the x-axis, represents the direction of travel, and runs parallel to the direction of travel, the y-axis represents the direction of travel of the vehicle, and the z-axis is perpendicular to the road and is up to the vehicle. The magnetic flux can be described as a magnetic dipole with a magnetic moment m the vehicle's center. The influence of the magnetic field is strictly dependent on the distance from the magnetic dipole to the vehicle. Equations 5, 6 & 7 are used to calculate the magnetic field components induced by m, derived from the Maxwell equations.

$$B_x = \frac{\mu_0 \times (\, m_x(2x^2-y^2-z^2) + 3m_y xy + 3m_z xz).}{4\pi r^5} \tag{5}$$

$$B_y = \frac{\mu_0 .(\, m_y(2y^2-x^2-z^2) + 3m_x xy + 3m_z yz}{4\pi r^5} \tag{6}$$

$$B_z = \frac{\mu_0 .(\, m_z(2z^2-y^2-x^2) + 3m_x xz + 3m_y yz}{4\pi r^5} \tag{7}$$

Where, μ_0 The permeability air content and r is the distance between sensor position(x, y, z) and obstacles. This flux is used to analyze the vehicle's positions and obstacles accurately.

Conclusion

The monitored transport system continuously monitors the driver's heart values and records them as episodes on the cloud servers, providing faster and more reliable services when drivers are in critical condition. The intelligent learning system learns Real-time sensor data collected by different subjects. It is compared with various existing methods to prove that our system is more efficient than any other existing system to show that our proposed system has achieved greater predictive accuracy. This model focuses on predicting vital signals while driving and reduces collateral damage to the environment, nearby vehicles, and passengers. It uses advanced level sensors to detect blood alcohol levels from the sweat glands and monitor stress levels of both physical and physiological signals. In addition, this intelligent system learns driver driving behavior and suggests valuable information to avoid prolonged activity. This model guarantees the safety of passengers and drivers to make intelligent suggestions to drivers based on their health values. The intelligent system predicts serious health complications before they occur and informs them to nearby health centers with their respective EHR. Finally, the overall monitored transport system provides 94.5% of the predictive accuracy of vital readings to ensure safety while driving and continuous monitoring of drivers, and this model saves many lives.

REFERENCE

1. L. Jegatha Deborah, S.C. Rajkumar, P. Vijayakumar, Chapter 4 - Medical decision support system using data mining: an intelligent health care monitoring system for guarded travel, Handbook of Computational Intelligence in Biomedical Engineering and Healthcare, Academic Press, 2021, Pages 93-119, ISBN 9780128222607, https://doi.org/10.1016/B978-0-12-822260-7.00014-5.