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Design And Development of Intelligent Seatbelt Detection System

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Abstract- *In recent years, the integration of advanced technologies into the automotive safety system has become paramount in mitigating traffic accidents and ensuring the safety of passengers. This paper presents an innovative approach to increase vehicle safety through the implementation of an intelligent seat belt detection system (ISDS) with the ability to transmit data from the Internet of Things and a sophisticated on-board camera monitoring system. The primary objective of ISDS is to enforce the use of seat belts by connecting them directly to the vehicle's starting mechanism. The ISDS provides a secure communication link between the seat belt sensor and the vehicle's ignition system through a sophisticated microcontroller unit. Only when all seat belts are securely fastened does the ISDS allow the ignition to start the vehicle's engin*

I –INTRODUCTION

According to the Ministry of Road Transport and Highways (MoRTH), in 2022, 16,715 people died in road accidents due to not wearing seat belts[1] . According to a report titled "Road Accidents in India - 2022", 8,384 of the victims were drivers and 8,331 were passengers[2] .

A revolutionary safety feature designed with an on-board camera and Internet of Things (IoT) capabilities to ensure the vehicle only starts when the seat belt is securely fastened. This innovative system works on a simple but essential principle: The car's ignition is only activated when the seat belt is properly fastened[3] . By connecting the act of putting on the seat belt with the functionality of starting the vehicle. In addition, by leveraging the capabilities of the Internet of Things, the system communicates real-time information about seat belt status, providing invaluable insights for monitoring and analysis[4].

This advanced solution not only supports adherence to safety protocols, but also provides visual documentation of driving conditions[5] . This technology prioritizes passenger safety and encourages responsible driving habits.

II -LITERATURE SURVEY

Seat Belt Control System IEEE 2019

In the already available system, the seat belt is fastened from the back or is not properly fastened and is held on the steering wheel of the car, which controls the vehicle, even if the belt is not fastened, it only beeps[6] . However, road safety is also really important from another point of view, which is why we operate a system based on seat belts.

Smart Vehicle Seatbelts: Accident Detection and Emergency Service in Smart City Environment IEEE 20221

The important point is that to prevent unauthorized people from driving, the proposed system uses a biometric system based on fingerprint recognition to authenticate the driver and start the car. The system then

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uses information collected by sensors installed inside the seat belt to determine whether a crash has occurred[7] . If an accident is detected, the heart rate sensor is used to record the driver's heart rate and adapt to the accident. The proposed system showed a reduction in the number of error rates in accident detection.

Intelligent Car Safety System IEEE 2016

The proposed system uses the NeuroSky Mind-wave headset to capture different levels of electroencephalogram (EEG)[8] levels. In addition, an electric circuit limit switch between the seat belt and the ignition system is configured to control the engine start. Finally, the Arduino microcontroller and software act as a signal processing unit to control the car's security system[9] . Test results show that this system can improve driver safety.

III. PROPOSED METHOD

A prototype is created that mimics the behavior of the proposed system. In this section, we propose a new IOT - based network model for seat belt tightness detection[10]. specifically, we distinguish between these three states: (1) The seat belt is properly fastened, (2) the seat belt is fastened from behind, and (3) the seat belt is not fastened at all [11] .

It also enables real-time fleet monitoring and enforcement. Fleet managers and authorities can remotely access the status of each vehicle, receive violation alerts and take appropriate safety measures[12] .

First, an infrared sensor is attached to the top of the seat belt. Infrared sensors reflect from shiny surfaces, so we set the sensor threshold at a specific location on the seat belt [13] . Data related to various parameters are collected through this sensor and are checked and processed by the internal microcontroller (node MCU). Based on this data, the system verifies the correct use of seat belts [14] . If a passenger does not wear a seat belt or tries to deceive the system by wearing it incorrectly, the system will not allow the passenger to start the engine. The system also generates signals through an alarm to give warnings and instructions[15] . The occupants are wearing their seat belts properly, and if the seat belts are fastened properly, the driver can turn on the ignition and start the engine.

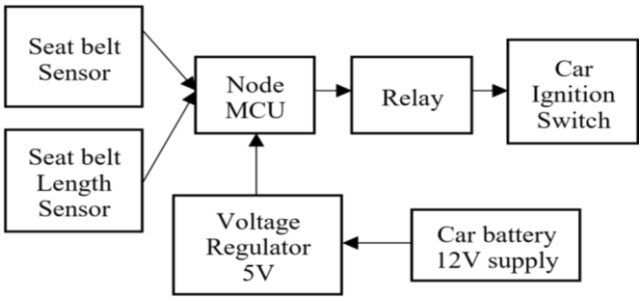

Fig 1.1 Block Diagram Of Seat Belt Detection

Second, a dashcam (ESP32-CAM) is installed in the system which will continuously monitor the passengers, through IOT, fleet managers or authorities can remotely access the status of each and vehicle, receive alerts if the seat belt is not properly fastened, receive alerts for violations and make appropriate decisions to ensure driver and vehicle safety and oublic safety[16].

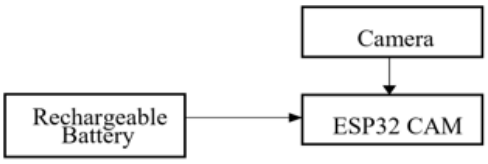

Fig 1.2 Block Diagram For Monitoring

IV. RESULTS

The intelligent seat belt locking system is designed to increase safety by ensuring that occupants fasten their seat belts before driving the vehicle [17]. An infrared sensor in the seat belt detects the length of the seat belt and determines whether the seat belt is properly fastened. If properly worn, the ignition will illuminate if the conditions are not met, and a message will be sent to the owner indicating whether the seat belt is fastened [18].

Fig 2.1 When seat belt not attached properly

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Fig 2.2 When seat belt attached properly

Cameras inside the car monitor whether the driver's seat belt is properly fastened by the car owner. If it detects that it is not installed correctly, it will sound an alarm and display a warning message, but if it is still not installed correctly, the ignition will be turned off [19].

As a result, it will be mandatory for drivers to wear a seat belt and ensure their safety. It will probably reduce the chance of fatal injuries [20].

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