1. Introduction

In today’s world, road safety is one of the most critical concerns due to the rising number of vehicle-related accidents. Traditional vehicle safety systems often fail to provide real-time monitoring, data sharing, or predictive alerts that can prevent accidents or reduce their impact. According to the World Health Organization, over 1.3 million people die each year due to road traffic crashes — highlighting the urgent need for smarter safety technologies.

To address these challenges, this project proposes the development of a Vehicle Safety System that integrates the Controller Area Network (CAN) protocol with the Internet of Things (IoT). The CAN bus, widely used in modern automobiles, ensures reliable and real-time communication between various Electronic Control Units (ECUs), including those handling engine performance, braking, and airbag deployment. The addition of IoT enables wireless transmission of sensor data to cloud platforms for live monitoring, alerts, and data analytics.

This system incorporates various sensors such as:

* Accelerometer and Gyroscope for crash detection,
* Gas/Alcohol sensors for driver sobriety monitoring,
* GPS module for real-time location tracking,
* Temperature and Flame sensors for fire hazard detection.

Data is collected and processed by a STM32 microcontroller and transmitted using an ESP32 Wi-Fi module to cloud platforms like ThingSpeak or Firebase, enabling live dashboards, remote access, and emergency alerts.

The goal of this project is to design a scalable, real-time, and cost-effective safety system that enhances vehicle safety, supports post-crash response, and enables smarter fleet or personal vehicle monitoring.

. This integration allows for a range of safety enhancements, including predictive maintenance, driver behavior analysis, and accident prevention through vehicle-to-everything (V2X) communication.

CAN and IoT Integration for Vehicle Safety:

Data Collection and Analysis:

CAN networks provide a robust communication system within the vehicle, enabling sensors to gather real-time data on vehicle parameters like speed, acceleration, braking, and location. IoT devices, in conjunction with CAN, can analyze this data to detect abnormal or unsafe driving patterns and alert drivers

* Predictive Maintenance:

By analyzing CAN data, IoT systems can predict potential vehicle issues, allowing for proactive maintenance and preventing breakdowns or malfunctions.

Driver Behavior Monitoring:

IoT systems can analyze driving behavior patterns, such as excessive speed, aggressive acceleration/braking, or lane departures, and provide alerts or interventions to improve safety.

V2X Communication:

IoT enables vehicle-to-everything (V2X) communication, allowing vehicles to exchange information with other vehicles, infrastructure, and even pedestrians. This enables features like collision detection, lane departure warnings, and emergency braking.

Accident Detection and Alerting:

IoT systems can detect accidents or collisions and alert emergency services or designated contacts, potentially saving lives or reducing the severity of injuries.

Remote Vehicle Monitoring:

IoT allows for remote monitoring of vehicle parameters, such as location, speed, and engine status, enabling security measures and quick response to potential incidents.

**Key Benefits:**

Improved Safety:

Enhanced real-time data analysis and alerts lead to safer driving conditions and reduce the risk of accidents.

Proactive Maintenance:

Predictive maintenance capabilities minimize downtime and prevent costly repairs due to breakdowns.

Enhanced Driver Awareness:

Real-time alerts and feedback help drivers make safer decisions and avoid potentially dangerous situations.

Increased Security:

Remote monitoring and alerts provide better vehicle security and help prevent theft or accidents.