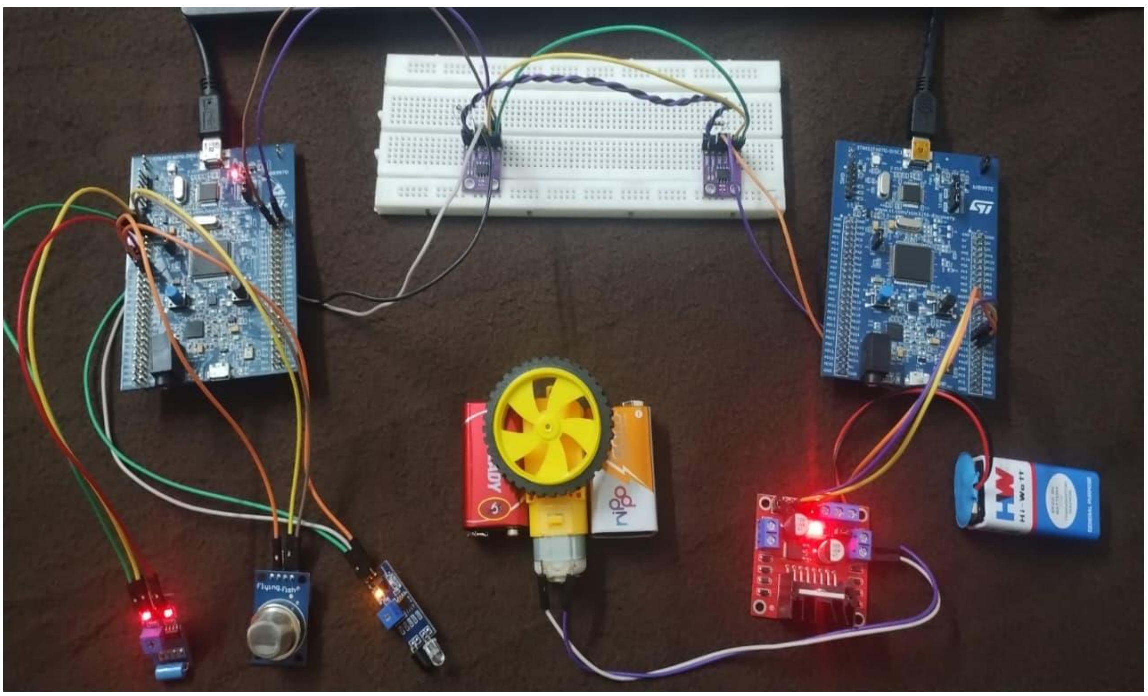
# ACCIDENT DETECTION MODULE USING STM32 AND CAN PROTOCOL

**PG-DIPLOMA IN C-DAC SUNBEAM.**



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PROJECT REPORT

Submitted by

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# INTRODUCTION

Modern vehicles rely heavily on embedded electronic systems to ensure safety, reliability, and real-time decision making. Various Electronic Control Units (ECUs) are used in vehicles to monitor critical parameters such as vibration, alcohol detection, and driver condition. Efficient communication between these ECUs is essential for timely accident detection and prevention.

The Controller Area Network (CAN) protocol is widely used in the automotive industry due to its high reliability, real-time performance, noise immunity, and robust error handling mechanisms. CAN enables multiple nodes to communicate over a shared bus without the need for a central controller.

This project, "Accident Detection System using STM32 and CAN Microcontroller", focuses on detecting abnormal vehicle conditions using sensors and transmitting this information over a CAN bus to take appropriate safety actions. The system uses STM32 microcontrollers as CAN nodes, sensor interfacing, actuator control, and real-time data display.

The project provides practical exposure to embedded systems, CAN communication, firmware development, and automotive safety concepts.

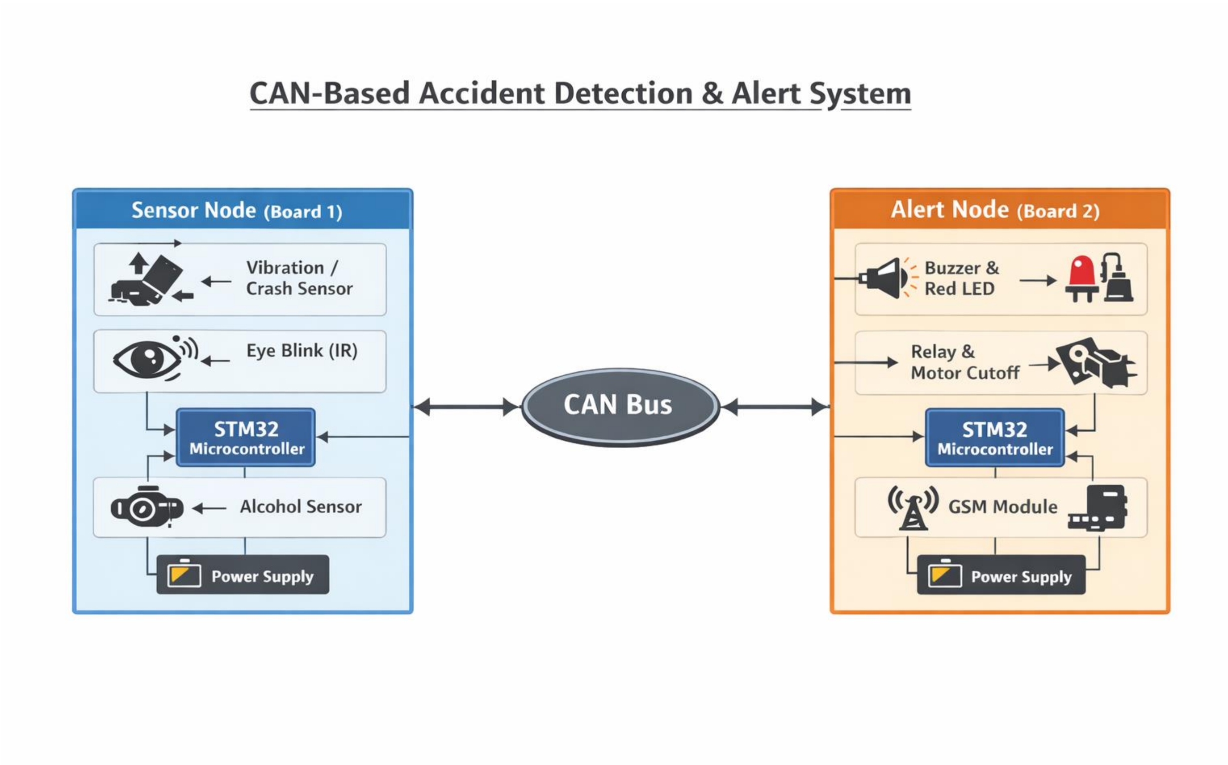
# ABSTRACTION

This project presents the design and implementation of an Accident Detection System using STM32 microcontrollers and CAN communication protocol. The system continuously monitors vehicle conditions using sensors such as a vibration sensor and MQ-3 alcohol sensor.

When abnormal conditions such as excessive vibration or alcohol are detected, sensor data is processed in real time and transmitted over the CAN bus using CAN controllers and transceivers. The receiving node analyzes the CAN messages and controls actuators such as a DC motor and LED indicators based on predefined safety thresholds.

The system demonstrates reliable inter-node communication, real-time decision making, and safety-oriented control logic, similar to real automotive embedded systems.

# BLOCK DIAGRAM



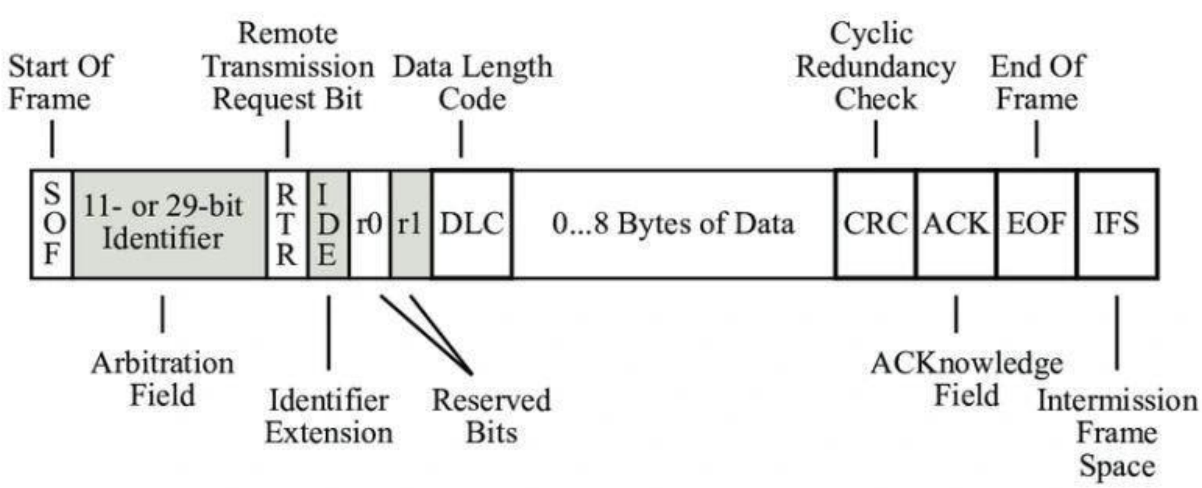
# COMPONENTS

| Sr. No | COMPONENT NAME | QUANTITY |
|---|---|---|
| 1. | STM32 Microcontroller | 2 |
| 2. | CAN Transceiver Module | 2 |
| 3. | Vibration Sensor | 1 |
| 4. | MQ-3 alcohol sensor | 1 |
| 5. | I-R Sensor | 1 |
| 6. | DC Motor | 1 |
| 7. | 120-ohm resistors | 2 |
| 8. | LED’s | 4 |
| 9. | L298N Motor Driver | 1 |

# CAN-PROTOCOL

The Controller Area Network (CAN) protocol is a high-speed, reliable serial communication protocol specially designed for automotive and industrial embedded systems. It allows multiple electronic control units (ECUs) to communicate with each other over a common two-wire differential bus without the need for a central controller. CAN follows a multi-master architecture, which means any node can transmit data when the bus is free. If two or more nodes attempt to transmit at the same time, a priority-based arbitration mechanism using message identifiers ensures that the highest-priority message continues transmission without data loss.

CAN communication uses differential signaling through CAN High (CANH) and CAN Low (CANL) lines, which provides strong immunity against electrical noise, making it suitable for harsh automotive environments. The protocol supports data rates up to 1 Mbps in classical CAN and allows both standard (11-bit) and extended (29-bit) identifiers to uniquely define message priority and content. Each CAN frame can carry up to 8 bytes of data along with control and error-checking bits.




One of the key features of CAN is its strong error detection and fault handling capability. It uses cyclic redundancy check (CRC), bit monitoring, acknowledgment checking, and frame validation to detect transmission errors. If an error is detected, the faulty frame is automatically retransmitted, and nodes that continuously generate errors are isolated from the network using fault confinement mechanisms. These features make CAN highly reliable for safety-critical applications such as vehicle braking systems, engine control units, and airbag systems.

In this project, CAN protocol is used to transfer real-time sensor data between two STM32F407 microcontroller-based ECUs, simulating an in-vehicle communication network. This ensures fast, reliability, and deterministic data exchange required for timely safety actions, closely resembling real automotive communication systems.

## DESCRIPTION OF COMPONENTS

### 1. STM32 Microcontroller

The STM32 microcontroller is the core processing unit of the accident detection system. It is based on a high-performance ARM Cortex-M core and is widely used in embedded and automotive applications.

In this project, the STM32 performs the following tasks:

- Reads sensor data such as vibration, alcohol level, and eye-blink status
- Processes the data in real time using embedded C firmware
- Transmits and receives messages using the CAN protocol
- Controls actuators like DC motors and LEDs.

The STM32's built-in peripherals such as ADC, GPIO, CAN controller, make it suitable for real-time safety-critical applications.

### 2. CAN Transceiver (MCP2551 )

The CAN transceiver acts as an interface between the STM32 CAN controller and the physical CAN bus. It converts logic-level CAN signals from the microcontroller into differential signals (CANH and CANL) suitable for long-distance and noise-resistant communication.

In this project:

- The transceiver enables reliable communication between transmitter and receiver nodes
- It improves noise immunity, which is critical in automotive environments
- It allows multiple nodes to communicate over the same CAN bus

## 3.Vibration Sensor

The vibration sensor is used to detect sudden shocks or abnormal vibrations that may indicate a vehicle accident or collision.

Working principle:

- The sensor generates an electrical signal proportional to vibration intensity
- The STM32 reads this signal using its ADC
- If the vibration value crosses a predefined threshold, it is considered an accident condition

This sensor plays a key role in accident detection logic.

### 4.MQ-3 Alcohol Sensor

The MQ-3 sensor is specifically designed to detect alcohol vapors and is commonly used in breath analyzers and vehicle safety systems.

Working principle:

- The sensor contains a tin dioxide ($SnO_2$) sensitive layer
- When alcohol vapors are present, the sensor's resistance changes
- This change produces an analog voltage proportional to alcohol concentration

### 5.Eye-Blink Sensor(IR Sensor)

The eye-blink sensor is used to monitor the driver's alertness by detecting eye closure.

Working principle:

- An IR transmitter emits infrared light toward the eye
- An IR receiver detects reflected light
- When the eye is closed, the reflection pattern changes

### 6.L298N Motor Driver

The L298N motor driver is used to control the DC motor because the STM32 cannot drive motors directly.

Functions:

- Amplifies control signals from the STM32
- Allows direction control using IN1 and IN2 pins
- Enables or disables motor operation using the ENA pin

This driver ensures safe and reliable motor control.

# FUTURE SCOPE

The project can be enhanced further by:

- Adding GPS module for real-time location tracking during accidents
- Integrating GSM or IoT modules for emergency alerts
- Adding more sensors such as ultrasonic or accelerometer
- Developing a mobile application for monitoring vehicle status

These improvements can make the system suitable for real-world automotive safety applications.

# CONCLUSION

The Accident Detection System using STM32 and CAN Microcontroller has been successfully designed and implemented. The project demonstrates reliable CAN communication, real-time sensor data processing, and safety-based actuator control.

Through this project, practical knowledge of STM32 microcontrollers, CAN protocol, embedded firmware development, and automotive communication systems was gained. The system effectively simulates a real automotive safety network and provides a strong foundation for advanced vehicle safety and intelligent transportation systems.