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DESIGN AND IMPLEMENTATION OF COOPERATIVE ADAPTIVE CRUISE CONTROL USING CAN PROTOCOL

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Abstract: The project "Design and implementation of cooperative adaptive cruise control using CAN protocol" aims to enhance automotive safety and traffic flow through the implementation of an intelligent cruise control system. The system utilizes the Controller Area Network (CAN) protocol for seamless communication between vehicles and employs Microchip technology for efficient control and coordination. This cooperative approach optimizes traffic flow, reduces congestion, andenhances overall road safety byminimizing the risk of collisions.

Keywords: CAN, CACC.

I. INTRODUCTION

The rapid evolution of automotive technologies has led to the development of advanced driver assistance systems (ADAS) aimed at enhancing vehicle safety, efficiency, and overall driving experience. One such innovation is Cooperative Adaptive Cruise Control (C-ACC), a sophisticated extension of traditional Adaptive Cruise Control (ACC) systems. This project focuses on the design and implementation of C- ACC using the Controller Area Network (CAN) protocol, a widely adopted communication standard in the automotive industry. In recent years, the automotive industry has witnessed a paradigm shift towards intelligent and connected vehicles. C-ACC represents a significant stride in this direction, which enable cooperative interactions among vehicles on the road. Unlike conventional ACC systems that operate independently, C-ACC allows vehicles to share information, such as speed, acceleration, and braking status, facilitating smoothertraffic flow and improved safety.

The motivation behind this project stems from the growing need for advanced driver assistance systems that can address the challenges posed by modern traffic scenarios. Traffic congestion, unpredictable road conditions, and the demand for increased fuel efficiency necessitate cooperative systems that enable to coordinate their movements. By implementing C-ACC with the CAN protocol, we aim to develop a robust and efficient solution that enhances overall traffic management and safety.

II. OBJECTIVES

a. Design to help vehicles in order to maintain speed limit and safeguarding.
b. Increase safety by maintaining safe following distance.
c. Automatically adjusts the speed of the car to match the speed of front going vehicles.

III. METHODOLOGY

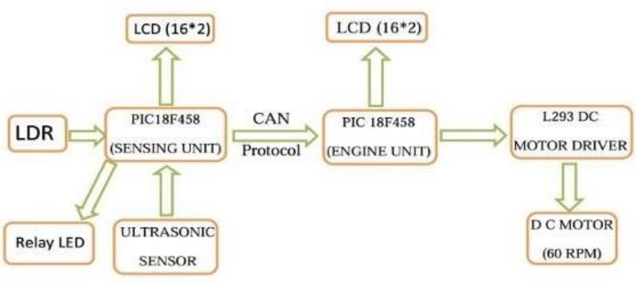

Fig 1: Design and implementation of cooperative adaptive cruise control usingCAN protocol.

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The figure involves a comprehensive system outlined in a block diagram. The system comprises a sensor suite, including radar and lidar sensors, to collect data on the vehicle's surroundings. This information is processed by a microcontroller, connected to a CAN communication module for seamless interaction with other vehicles. The Cooperative Communication Layer integrates algorithms and data fusion, facilitating cooperative decision-making. The Cruise Control Algorithm adjusts vehicle speed based on sensor inputs and communication feedback. Actuators, such as throttle and brakes, are controlled to maintain safe following distances. The Human-Machine Interface provides user feedback, and the system operates within the power supply and safety frameworks for effective CACC functionality. The entire system operates within a well-regulated power supply framework and prioritizes safety, adhering to established standards foreffective Cooperative Adaptive CruiseControl implementation.

The design flow of the "Design and Implementation of Cooperative Adaptive Cruise Control using CAN Protocol (CACC)" project follows a structured path. It begins with radar and lidar sensors collecting data on the vehicle's surroundings. The microcontroller processes this data, interfacing with a CAN module to establish real-time communication with other vehicles. A dedicated Cooperative Communication Layer integrates advanced algorithms, enabling cooperative decision-making based on data fusion.

The Cruise Control Algorithm dynamically adjusts the vehicle's speed, with actuators executing precise commands. A user- friendly Human-Machine Interface provides real-time feedback to the driver. The system operates within a regulated power supply framework, prioritizing safety with fault detection mechanisms and regulatory compliance. Rigorous testing, both simulated and real-world, ensures optimal performance. Upon deployment, continuous monitoring and feedback mechanisms facilitate ongoing improvements, enhancing the Cooperative Adaptive Cruise Control system's effectiveness.

IV. IMPLEMENTATION

Hardware Setup:

a. Equip vehicles with CAN-enabled devices(e.g., microcontrollers, CAN transceivers).
b. Install sensors (e.g., radar, lidar) fordistance and speed measurement.

Software Design:

c. Include necessary libraries and headers forCAN communication.
d. Define CAN message structures for C-ACCdata (e.g., speed, distance).
e. Implement the C-ACC control algorithmfor speed and distance management.

CAN Message Structure:

f. Define message IDs, data formats, anderror-checking mechanisms.
g. ExampleCAN message structure(assuming 8-byte messages).

CAN Communication Functions:

h. Create functions for sending and receivingCAN messages.
i. Example code (using a hypothetical CANlibrary)

C-ACC Control Algorithm:

j. Implement the C-ACC algorithm tocalculate desired speed and distance.
k. Examplepseudo-code for C-ACCalgorithm.

V. RESULT

CACC integrates radar sensors for distance measurement and CAN bus for communication. Each vehicle has a CACC controller that adjusts speed based on sensor data.

The exact figure of resulted Design and implementation of cooperative adaptive cruise control using CAN protocol is shown below,

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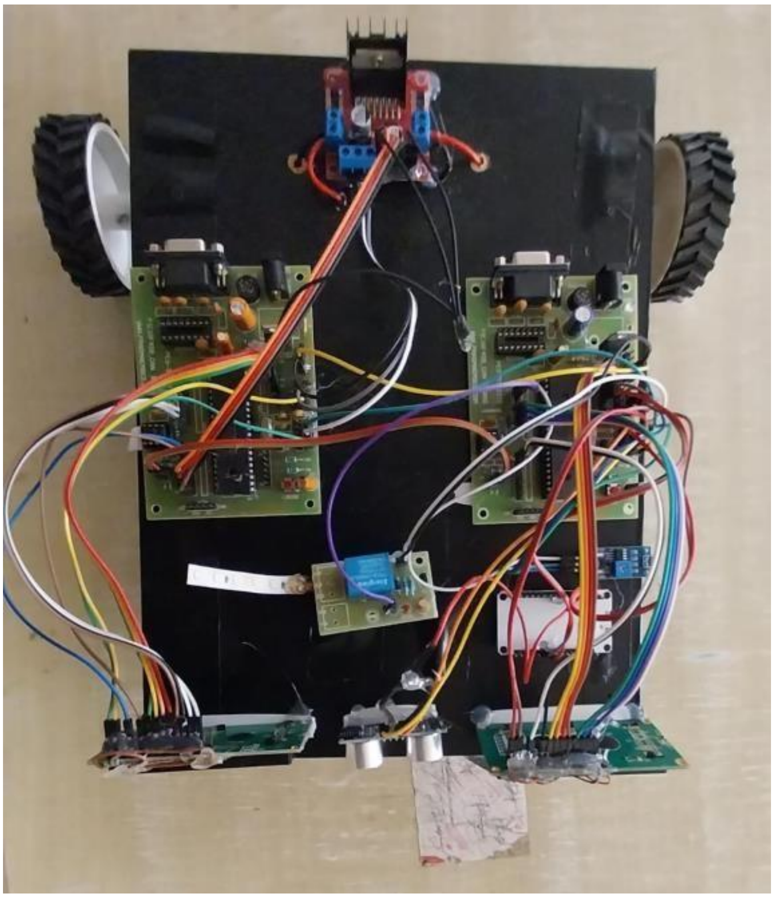

Fig1: Hardware connection

Fig2 : LCD Display

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Fig3: Working Model

VI. CONCLUSION

In conclusion, the project design and implementation of Cooperative Adaptive Cruise Control (C-ACC) using the Controller Area Network (CAN) protocol showcase significant advancements in enhancing road safety, traffic efficiency, and driving comfort. The successful integration of C-ACC functionalities with CAN-based communication systems demonstrates the feasibility and practicality of cooperative driving technologies. Looking ahead, the future scope for C-ACC lies in further refining algorithms for more precise speed and distance control, addressing security concerns through enhanced protocols, and expanding interoperability across diverse vehicle platforms.

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