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Design and Validation of a Real Time CAN–Based Automotive Instrument Cluster System

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ABSTRACT:

This Research on Project focuses on the development of a real-time automotive dashboard system using the CAN (Controller Area Network) communication protocol. The system consists of two electronic control units, Node A and Node B, both based on the LPC2129 microcontroller. Node A collects input data from a temperature sensor (MCP9700), a potentiometer used as a speed sensor, and multiple control switches for indicators and headlights. The acquired data is processed, encoded into CAN frames, and transmitted through the CAN bus. Node B receives and decodes the CAN messages to extract speed, temperature, and indicator status information. The decoded data is displayed on a 16×2 alphanumeric LCD in real time. The CAN protocol ensures reliable, high-speed, and error-free communication between the nodes. This system significantly reduces wiring complexity, cost, and overall vehicle weight. The design is modular and scalable, making it suitable for future automotive and industrial dashboard applications.Keywords: Keywords are important word in paper **Example** Weather Prediction, forecast accuracy

Introduction:

The rapid advancement of automotive electronics has led to an increasing demand for efficient, reliable, and real-time communication systems within vehicles. Modern automobiles integrate multiple Electronic Control Units (ECUs) to manage various functionalities such as engine control, safety systems, and driver information displays. Traditional point-to-point wiring systems result in increased complexity, higher cost, and added vehicle weight, which makes them less suitable for modern automotive architectures.To address these challenges, the Controller Area Network (CAN) protocol has become a widely adopted communication standard in automotive systems. CAN enables multiple ECUs to communicate over a shared bus without the need for a central host, ensuring high-speed, robust, and error-resilient data exchange. Its ability to prioritize messages and handle faults efficiently makes it ideal for real-time embedded applications. In this research, a real-time automotive instrument cluster system is designed and validated using the CAN protocol. The system is implemented using two nodes based on the LPC2129 microcontroller. Node A is responsible for acquiring real-time data from sensors such as temperature and speed inputs, along with control signals for indicators and headlights. This data is processed and transmitted over the CAN bus. Node B receives the transmitted data, decodes it, and displays the relevant information on an alphanumeric LCD. The proposed system demonstrates a significant reduction in wiring complexity while ensuring reliable communication between distributed nodes. Additionally, the modular design approach enhances scalability, allowing easy integration of additional sensors and functionalities. This makes the system suitable not only for automotive dashboards but also for various industrial monitoring and control applications

Modern vehicles rely on multiple Electronic Control Units (ECUs) for real-time monitoring and control. Traditional wiring systems increase complexity, cost, and weight. The Controller Area Network (CAN) protocol addresses these issues by enabling efficient communication between multiple nodes over a single bus. This paper presents the design and validation of a real-time automotive instrument cluster system using CAN. The system uses two LPC2129-based nodes, where one node collects sensor data such as temperature, speed, and control signals, and transmits it over the CAN bus. The second node receives the data and displays it on an LCD.

The proposed system ensures reliable communication, reduces wiring complexity, and provides a scalable solution for automotive and industrial applications.

Methodology:

- **Hardware Components**

- **Temperature Sensor:** MCP9700 (analog temperature sensor)
- **Microcontroller:** LPC2129 (ARM7-based microcontroller)
- **Speed Input:** Potentiometer (used as a speed sensor)
- **Communication Interface:** CAN Bus (with CAN transceiver)
- **Display Unit:** 16×2 Alphanumeric LCD
- **Power Supply:** Regulated Power Supply Unit (+5V / +3.3V)

- **Software Tools**

- Keil µVision IDE (program development and compilation)
- Flash Magic (programming the LPC2129 microcontroller)

.Climatology Method:

1. Input Stage (Node A)

- Switches (SW1, SW2, SW3): Used for operations such as indicators (left, right) and headlight controls
- Temperature Sensor: Continuously monitors engine/environment temperature
- Potentiometer (Speed): Acts as a speed sensor to simulate real-time vehicle speed
- Power Supply Unit (PSU): Provides stable power to Node A.

2. Processing Stage (Node A)

"C:\Users\Manju\OneDrive\Desktop\ECU Major\NODE_A.pdf" path where you can find code of this node

- Node A (Microcontroller) collects data from the switches, temperature sensor, and speed potentiometer.

- The data is encoded into CAN frames and sent to the CAN bus through a CAN transceiver.

3. Communication Stage (CAN Bus)

- The CAN Bus is the communication backbone that transfers sensor and control data efficiently between ECUs (Node A → Node B).

- It ensures error-free transmission using arbitration and priority mechanisms.

4. Output Stage (Node B)

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- Node B receives the CAN frames from Node A, decodes them, and extracts the information (speed, temperature, indicator status, etc.).

- Node B is powered by its own PSU.

- The processed data is displayed on the Alphanumeric LCD.

5. Display Stage (Dashboard) The LCD shows:

- Vehicle speed (S: 10 Kmph)

- Engine/temperature (T: 20°)

- Indicator status (left, right arrows, headlights, etc.)

Objective:

- To design and develop a real-time automotive dashboard system using the CAN protocol.
- To acquire vehicle parameters such as speed, temperature, and indicator status using sensors and switches.
- To implement reliable and error-free communication between two ECUs (Node A and Node B) using CAN bus.
- To reduce wiring complexity, system weight, and cost compared to traditional point-to-point wiring systems.
- To display real-time vehicle information clearly on a 16×2 alphanumeric LCD.
- To ensure timely updates and alerts for improved driver safety and comfort.
- To develop a modular and scalable system suitable for future automotive and industrial applications.

Results

The developed CAN-based automotive instrument cluster system was successfully implemented and tested using two LPC2129 nodes. Node A accurately acquired real-time data from the MCP9700 temperature sensor, potentiometer (used as speed input), and control switches for indicators and headlights. The data was encoded into CAN frames and transmitted efficiently over the CAN bus.

Node B successfully received and decoded the transmitted CAN messages without data loss. The parameters such as vehicle speed, temperature, and indicator status were displayed correctly on the 16×2 LCD in real time. The system demonstrated stable communication with minimal delay and high reliability under multiple test conditions.

The implementation of the CAN protocol significantly reduced wiring complexity compared to conventional point-to-point systems. Reliable data transmission, fault tolerance, and proper synchronization between nodes were consistently observed. The modular design also allows easy scalability for integrating additional sensors and functionalities.

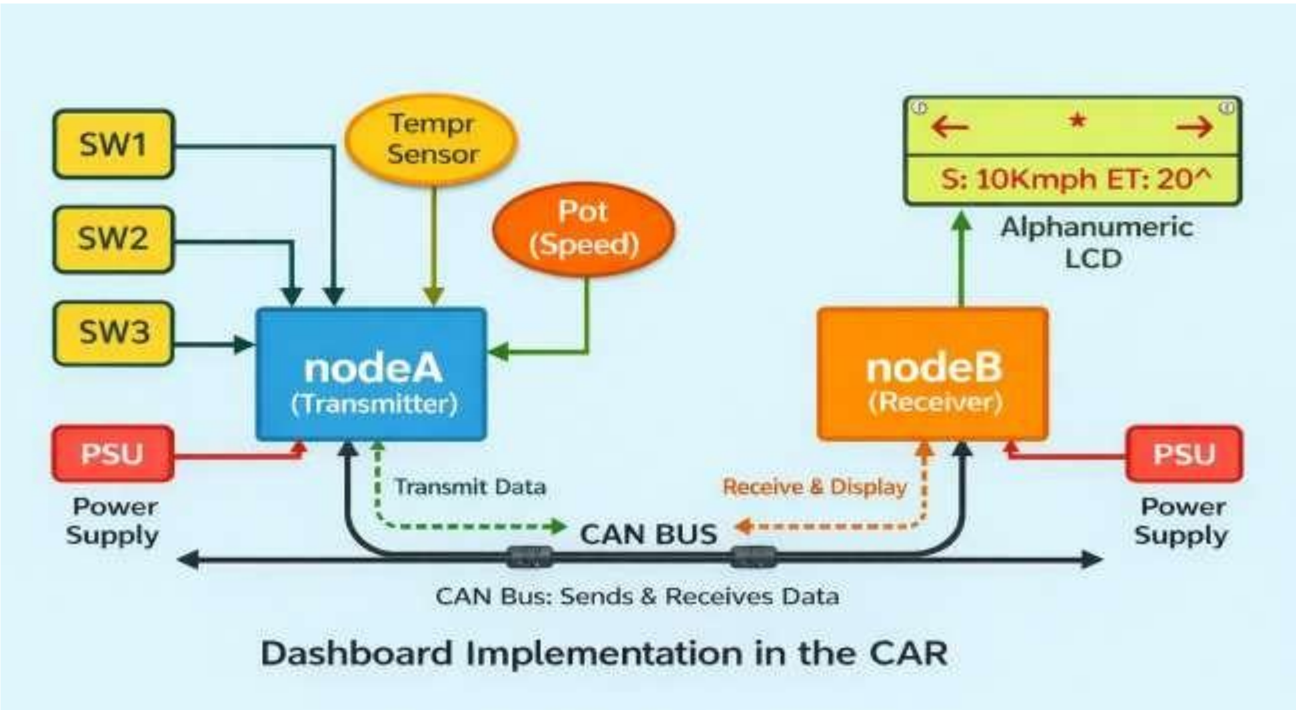

Fig 1 Block Diagram

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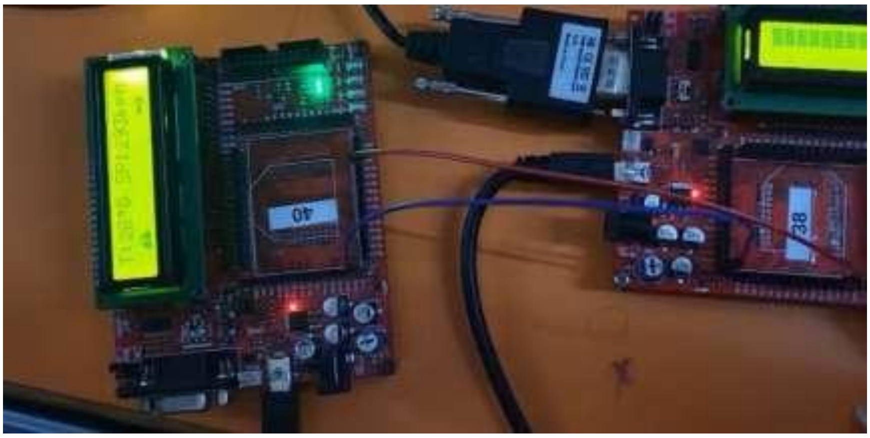

Figure 2: headlight indication

Figure 3:left indicator indication

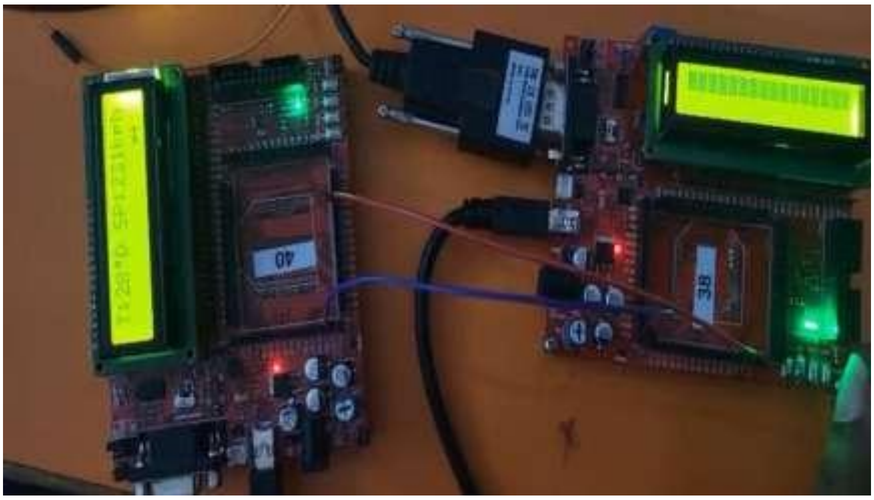

Figure 4: Right indicator indication

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Conclusion

This paper presented the design and validation of a real-time CAN-based automotive instrument cluster system using LPC2129 microcontrollers. The system successfully demonstrated reliable communication between two nodes, where sensor data was accurately transmitted and displayed in real time The use of the CAN protocol reduced wiring complexity and ensured high-speed, error-free data transfer. The system showed stable performance under different test conditions, confirming its reliability for automotive applications.

Overall, the proposed design is efficient, scalable, and suitable for modern vehicle dashboard systems, with potential for further expansion by integrating additional sensors and functionalities.

References:

Research Papers:

1. R. Bosch GmbH, "CAN Specification Version 2.0," 1991.
2. W. Voss, "A Comprehensible Guide to Controller Area Network," Copperhill Technologies, 2008.
3. K. Etschberger, "Controller Area Network: Basics, Protocols, Chips and Applications," IXXAT Press, 2001.
4. H. Kopetz, "Real-Time Systems: Design Principles for Distributed Embedded Applications," Springer, 2011.
5. M. Barr and A. Massa, "Programming Embedded Systems," O'Reilly Media, 2006.
6. NXP Semiconductors, "LPC2129 Microcontroller Datasheet," 2005.
7. Microchip Technology, "MCP9700 Temperature Sensor Datasheet," 2009.
8. B. Wilamowski and J. Irwin, "Industrial Communication Systems," CRC Press, 2011.
9. S. Mackay, "Practical Industrial Data Communications," Elsevier, 2004.
10. ISO 11898 Standard, "Road Vehicles – Controller Area Network (CAN)," International Organization for Standardization.