

Smart Vehicle Control System Design Using ARM7 and CAN Protocol

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ABSTRACT: A high speed network for the different vehicle parameter is a real time requirement. The network with high data transfer rate make a system smarter than conventional one. Higher the data rate faster the response. The devices are connected to a main controller called an Electronic Control Unit (ECU). The system is probably designed with two parameters. One is input information access. Another one is required output action. The input information is nothing but a sensor data. The sensor that converts physical information to an equivalent electrical signal. For the incoming electrical signal the controlling device should react with equivalent action. The time taken for the information access at the input and the equivalent action should be operated at very less margin of time. To make a act and react system there is a need of have a communication between them with high speed requirement. In this case the data transfer should not be loss, delayed due to noise or any other electrical signal. So an efficient communication protocol called Control Area Network (CAN) is established. The bus that has higher data rates makes a proper communication path between input and output with Control module. CAN in an automobile industry booming like a rocket. Each and every object in contact with a CAN will advanced with its operation. The high speed can have maximum speed up to 1Mbps. The critical sensor and action devices are utilises the high speed CAN. The factors that need medium attention from the system uses medium speed CAN. The parameters those are having low priority will be performed with low speed CAN. The CAN that offers high flexibility to the communication and provides enough reliability. The major directions are given by ARM7 LPC2129 microprocessor. CAN transceiver is responsible for the communication between the devices. The master part guides the slave for the system design.

KEYWORDS: LPC2129 ARM7, CAN, Vehicle Control Unit.

I. INTRODUCTION

As the requirement from the objectives of the control the vehicle system is more, the structural design become complex. The objectives are need to handle carefully with priority based scheme. In vehicle, critical parameters have higher priority as they have hard deadline. The normal parameters are at lower priority as they have soft deadline. The time requirement for the general constraints are not so critical. The factors such as Anti – lock Breaking System (ABS), air bags and engine temperature, vehicle speed control are usually having hard deadline that requires keen attention to handle at higher priority. The aspects such as wiper operation, head light mechanism, fuel level, tire pressure and door lock indicator have less priority as they give less threat to the human life. Both critical and normal constraints put together as an Electronic Control Unit (ECU). ECUs in a vehicle take responsibility of each and every parameter that is related to vehicle. The response time for each device varies as they have different priority with various deadlines. Modern Car at present scenario have maximum 70 ECUs. The constraints are needed to be monitor at the real time. This puts enormous amount of load to an ECU and the entire system in result may stop working. To avoid these kind of collapse in communication, a protocol called Control Area Network (CAN) has been implemented. The CAN is a protocol that communicates between modules on the basis of priority. The CAN also provides higher data speed between the measuring device and triggering device. The CAN helps to reduce the response time of an action device. The CAN bus provides maximum of 1 Mbps data speed so that the wiring load with the controller and I/O devices can be reduced. The communication protocol is asynchronous in nature. In CAN the wire requirements are very less. This makes the system work flexibly in real time environment with more number of vehicle control devices.+6

The paper is organised as follows. The section II elaborates the overall work has been carried with various factors that comes into picture with LPC2129 and CAN protocol. The CAN protocol embedded with the microprocessor provides enormous speed to an entire system design. The CAN bus between the microprocessor is the real time channel for the communication. The analysis on different parameters are done. The overall flow of the idea is described in the section

III. The relative experimental results are presented in section IV. Finally the conclusion tells that the advantages and applications in real time.

II. RELATED WORK

The work on the vehicle control system comprises the internal and external data analysis. The ARM7 LPC2129 variant responsible for the CAN communication in between different modules. The communication established when a data to be read from a sensor. The action taken against an input physical information using CAN channel. The vehicle speed control, engine temperature, tire pressure, fuel level, wiper control, ABS, location, door lock system, and headlight operation are main points to be considered while designing a vehicle control system. There are so many other microcontrollers such as LPC1768, LPC2148, and PIC microcontrollers are used to design a vehicle system. The CAN communication with LPC2129 make a system reliable as it consists less wiring. The real time connection between the modules can also be done with Bluetooth module. A real time system with Kernel will make the system work very efficiently.

III. METHODOLOGY

The methodology for a vehicle control system design is elaborated. Requirements analysis is the process of getting expected outcome as the action for an each and every sensor information. Specification analysis is the process of determining the feature, over all structure and details of each and every component. The block diagram includes all the requirements and information regarding the system. Hardware development will have a circuit design, selection of components and developing the overall system. The software development includes, programming, documenting, testing and debugging in creating and maintaining the application for vehicle control system. Integrate software and hardware so that the module will be designed.

IV. EXPERIMENTAL RESULTS

Figures shows an experimental results of vehicle control system. The sensor such as Temperature, Rain, LDR, Ultrasonic, Fuel level, IR sensors have been used to establish a system design. All the sensors takes the sensor information and provides a proper action against them as in array of results shown in Fig. 1.

Fig. 2 shows the actions take place against the input information. The float sensor position for full oil tank, engine cool fan, detection of rain, head light control, speed control, and door lock system are shown in the figure.

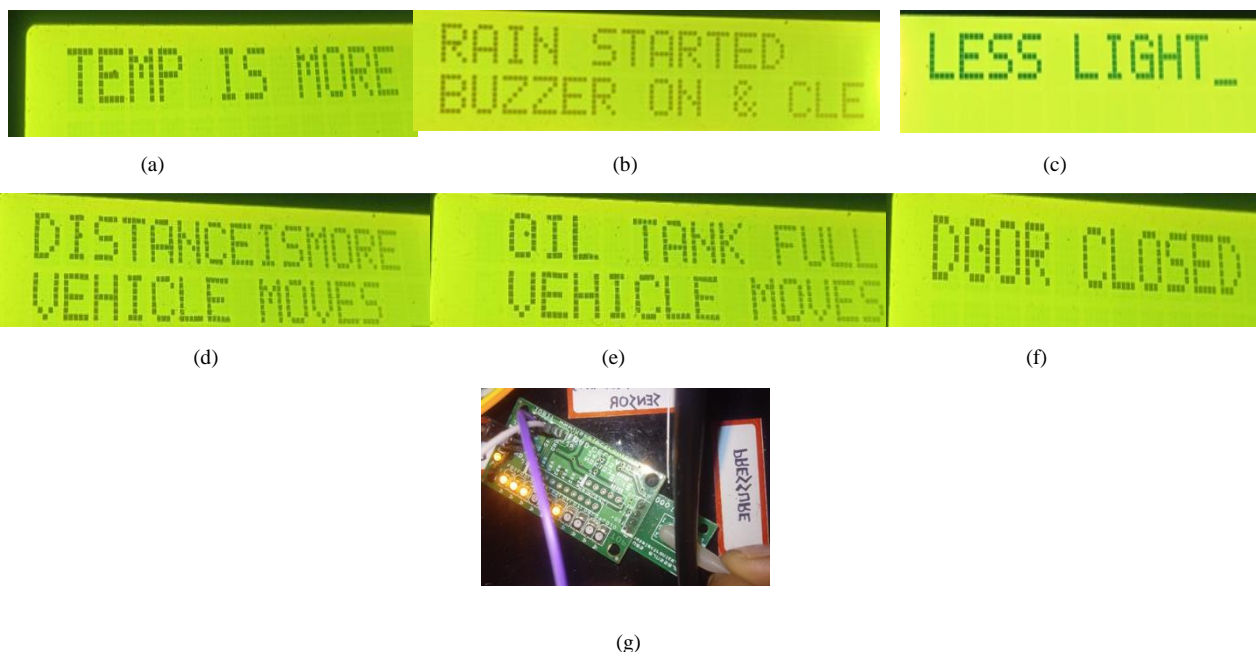


Fig. 1. The sensor and actuator data display (a) High Engine Temperature (b) Wiper Control System with rain detected message. (c) Head light Control System with less light message. (d) Vehicle Speed Control System with vehicle movement message (e) Fuel level Indication with oil tank is full message (f) The Door Lock System with Door closed message (g) The Tire Pressure Monitor System with Pressure Sensor.

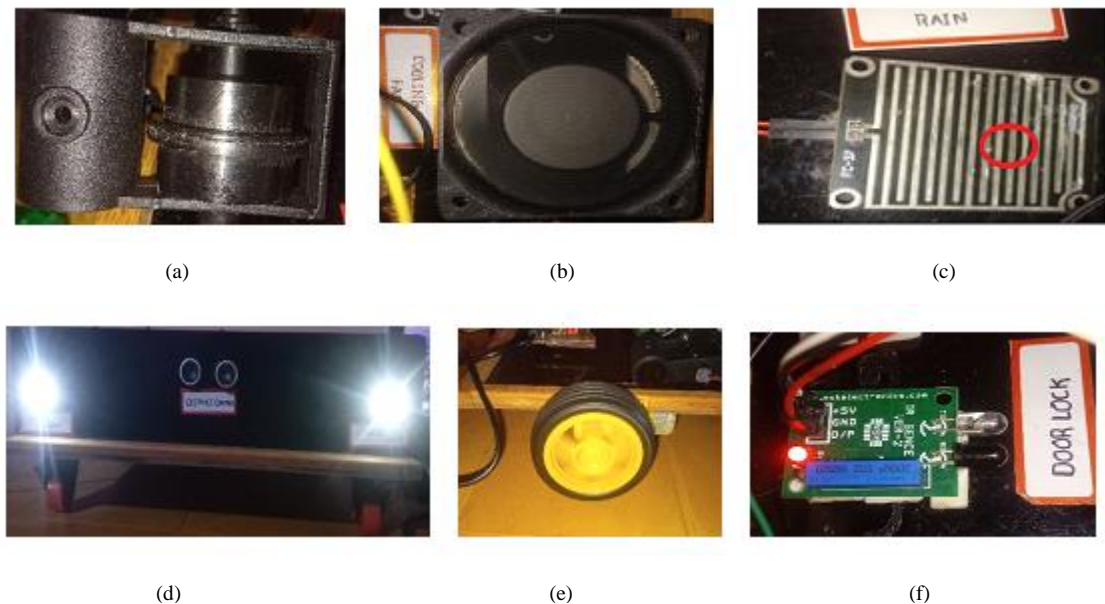


Fig. 2 Action over the input information (a) Float sensor Position (b) Coolant fan ON at high temperature (c) The rain sensor operation (d) Headlight ON at low light (e) vehicle wheel movement when there is a higher distance between vehicles. (f) IR Sensor for Door Lock System.

Figures Fig. 1 and Fig. 2 presents the experimental details of the project. The higher Priority objectives achieved first and followed by lower objectives. The lower objectives may/may not be performed.

VI. CONCLUSION

The different vehicle parameters are experimented. The GPS, IOT are the further future work that is to be analysed. The study of various CAN based vehicle system was carried and it is concluded that the CAN communication protocol provides higher data rate between physical information and output action. The various factors like engine temperature, tire pressure, door lock, wiper control, vehicle speed control, fuel level are diagnosed with various priority. The CAN bus implementation will enhance the system speed and reduces the wiring load to the system.

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