

## Automobile Design and Implementation of CAN bus Protocol- A Review

S. N. Chikhale

**Abstract-** Controller area network (CAN) most researched communication protocol used for automotive industries. Now we are heading towards the automotive world of autonomous AI based or semiautonomous vehicle system which is capable of delivering the best in class driverless experience around the world. We need an effective implementation of vehicle and computer convergence along with a very fast communication protocol. CAN helps us to design and implement such kind of system with single on board computer which control vehicle parameters remotely. Researchers are looking forward for Wireless Controller Area Network (WCAN) which eventually can even prospect into the IOT field and flourishes the smooth transportation system. This paper reviews such kind of design and implementation setups to acquire a secured and effective CAN bus protocol.

**Keywords-** Controller area network, Internet of Things, Raspberry Pi, Embedded system, Engine Control Unit

**Introduction-** ControllerArea Network is basically a message based protocol which is used for communicating automobile applications. Microcontrollers and devices communicates with each other through these standards designed specifically for automobile industries. It helps us to reduce complex wiring to a simple and robust structure to communicate effectively throughout vehicle. We know that we are in an era where computer technologies are used widely in controlling vehicle applications at a large scale. Simple park assist, V2V communication protocol, Tesla's AI based automation, Pop-up display, etc. are some of the technologies which completely rely on computer technologies. When we deal with computer networks we often face some difficulties in speed and security which is most concerned parameter. To deal with such kind of situation we needed an effective implementation of communication protocol which is fulfilled by Controller Area Network.

CAN was developed in 1986 by the scientist named Robert Bosch GmbH. While working on vehicle technology and that too in this computer technology world we must process our data on board for speed and accuracy. The nodes which brings information to the microcontroller like speed, temperature, break status, air pressure must transmit the sensed data over the CAN bus effectively to OBD. OBD is On Board Diagnostic system which consist of single board computer which is Raspberry Pi in our system. This will process and actuate the control system of all the ECU (Electronic Control Unit) parameters through the processor. Also, we have to make sure that our System is secured and not affected by any external parameters. For security concern we can even use various compression algorithms like ECANDC (effective CAN data compression).

**System Design-** Vehicles now contain wireless interfaces for many purposes such as tyre pressure monitoring system, Smartphone connectivity, Web and GPS data connectivity and many more. Also, there are emerging wireless technologies for vehicle-to-vehicle(V2V) and vehicle-to-road (V2R) communications such as DSRC (Dedicated Short Range Communication) which is capable of communicating other vehicle present on road. A Vehicular Collision Warning Communication (VCWC) protocol required much more reliable, speedy and secured communication protocol which is delivered by CAN.

Network structure will consist of CAN transceiver, CAN controller and SBC (Single Board Computer). The Wireless module is connected to the SBC which communicates internally and externally with effect of ECANDC algorithm. This system gathers all the necessary information from various applied nodes and send it to the server or remote monitoring system via wireless module. All the system nodes are connected to the CAN bus with effective hardware system. They share all the necessary information over the same channel. With MCP2515 as a CAN Controller and MCP2551 as a CAN transceiver we can effectively implement the CAN protocol.

**Controller Area Network (ISO 11898 Standard)** - CAN bus originally developed for automotive industry to reduce complex structure of wiring for various subsystem which operates electronic control unit (ECU). Modern automobile uses automatic transmissions, airbags, antilock braking/ABS, cruise control, electronic power steering semi-hybrid vehicle, audio systems, GPS, power windows, auto climate control, electronic mirror adjustment, etc. CAN is one of the protocol which uses on-board diagnostics (OBD) standard and also reduces multiple wiring systems. CAN was developed for automobile but now researchers are developing applications for Internet of Things (IOT) using CAN.

Using this system we can also interconnect two vehicles effectively to monitor and control traffic management. This allows us safety, economy and convenience which would cut additional costing and complexity. CAN is a multi-master serial bus standard for interconnecting Electronic Control Unit i.e. ECU. Two or more node which communicates using CAN interface through computer over a USB or Ethernet port. Each node requires a CPU, CAN controller, Transceiver for effective communication. CAN network is typically connected to sensors, actuators and other control devices. Most effective arbitration method is used in CAN data transmission which requires a network to be in synchronized manner to sample every bit on CAN network at the same time.

CAN is an important automotive protocol supports the following layer- CAN only standardizes the lower layers. Other high level protocols are used for application layer.

1. Physical layer- built on bit dominance
2. Protocol layer- binary countdown
3. Message filtering layer

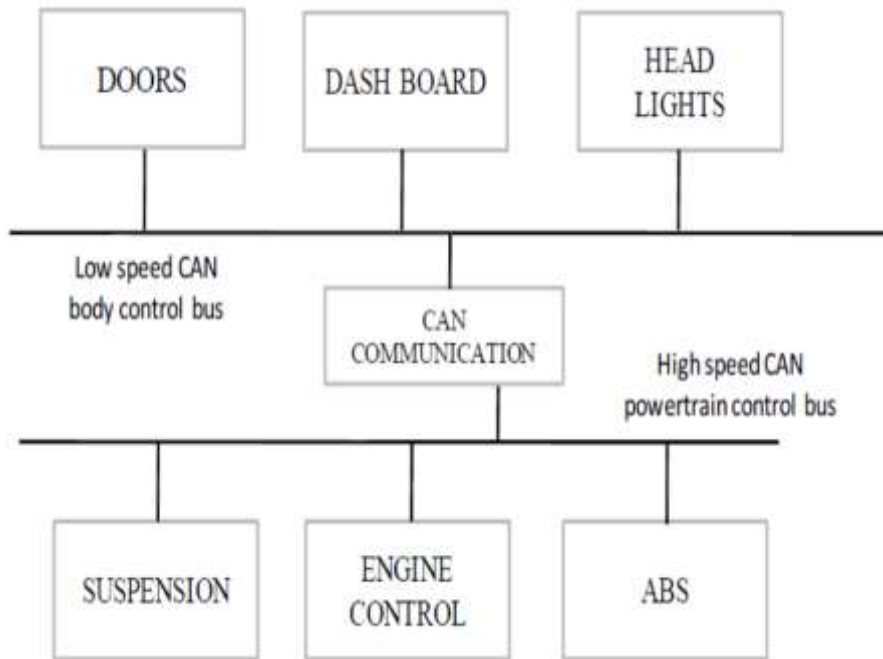


Figure- CAN Bus System

Driver vehicle interface is most important when we deal with semi-hybrid vehicle automation. It is mandatory to improve the driver's comfort which leads us to the development and implementation of a digital driving system using CAN bus. CAN bus is connected to various node like detailed in above figure. CAN which has effective data transfer rate also takes a feedback of vehicle conditions like vehicle speed, engine temperature, etc.

**Raspberry Pi Module-** Raspberry Pi was developed by raspberry pi foundation in UK to teach basic computer science programming. This is very powerful credit-card size computer which is capable to handle various processing activities. Single Board Computer is capable of controlling & processing activities which is carried out according to the fundamentals provided by the inputs for the vehicle driven techniques. Hence eventually all the necessary inputs are provided to the raspberry pi 3 and all the processing activities are maintained through the super-board having the capacity of small intelligent computer. It is having around 40 low-level peripheral pins, called GPIO interface which are connected to the on-board BCM2386 chip's GPIO pins.

Without using any high costing computer system, we can use low cost, affordable and efficient one raspberry pi module to develop such kind of applications in the organizations. This raspberry pi 3 B is capable of on-board Wi-Fi 802.11n and Bluetooth capabilities in recent design whereas, Broadcom provides its SoC (system on a chip) with an integrated ARM compatible to central processing unit (CPU) and on chip graphics processing unit (GPU). Processor speed is 1.2 GHz and 1 GB RAM as an on-board memory. Also it consists of 4 USB inputs and a power and HDMI cable with audio/video output and SD card is operated as a basic memory storage of raspbian OS.



Figure- Raspberry Pi 3 Model B

Using the above two distinguish elements we will require some sorts of IR sensor, Alarm, Temperature sensor, level sensor, LCD display, Motor speed sensor, etc. for complete environment.

**System Operations-** Interfacing the Raspberry pi with CAN controller and transceiver system, we check the system with initial message transfer and acknowledge the successful transmission and interrupt. Now most important parameter among the communication of CAN bus is the communication of nodes. The two nodes sense the particular sensor which measures speed and brake status. Here, Hall Effect sensor is used for speed measurement and the simple switch which is placed below the breaks is used to measure the brake status. The switch gives high output when the force is applied on the brake pedal and gives low output when the brake pedal gets released. Also particular priority is assigned to the nodes.

The third node makes some interactions with CAN bus which collects the data according to the speed and brake status. It means the third node will be acting as a server which incorporates all the necessary information which is collected on the first two nodes and deliver it to the single on board chip processor. Raspberry pi works accurately provide the necessary processing to deliver the effective results amongst the CAN bus and deliver the results to the LCD display. Also secured algorithm which is effective CAN data compression gets applied over the communication channel which provides one sort of shield to the database.

**Conclusion-** This vehicle control system works really well among the ECU parameters. Raspberry pi provides on board computing with effective cost cutting technology and CAN bus interface which connects automobile nodes efficiently with secured system. This system is totally getting effective implementation among the automotive industries. Also researchers are working among the IOT applications to use this CAN system effectively at industry and home applications.

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