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A Review: Implementation of Intelligent Features in Vehicle using CAN Protocol

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Abstract: Automotive electronics sector is dominant in vehicle automation. To automate different features in vehicle, there are several Electronic Control Units (ECUs). To link up these ECUs there are traditionally used point to point communication which causes to increase in wiring harness. So data transmission is not efficient. To overcome this drawback, Controller Area Network protocol widely used. This CAN protocol implemented through CAN integrated PIC controller ICs. The propose system aims to develop board which contain multiple interface facility which become compact in size and cost. In the proposed system, two UART and CAN bus interface on single board. This reduces the drawback of traditionally used approaches for vehicle automation.

Keywords: CAN (Controller Area Network), ECU, PIC Controller, Point to point communication, Rain sensor.

I. INTRODUCTION

Modern vehicle are equipped with different electronic control units (ECUs) for entertainment and infotainment purpose. These ECUs are connected through wire connectivity or may be wireless. Information about final paper submission is available from the conference website. There is traditional approach to link up these ECUs known as point to point communication [1]. In this point to point communication every ECUs are connected through each other as shown in Fig.1.

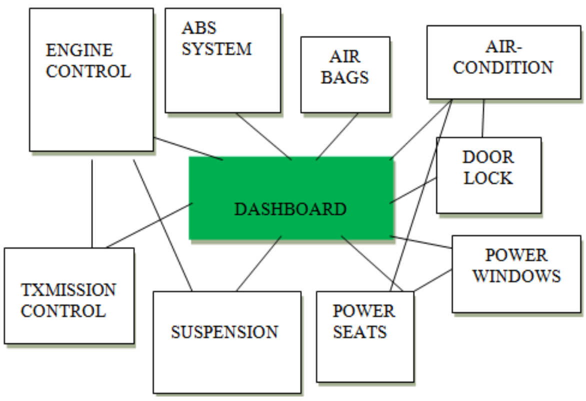

Fig.1ECUs point to point communication

With such the point to point communication different ECUs are connected, but causes to increase in wiring harness. This wiring connection causes to data transmission complex. There are different communication protocols to connect these ECUs such as LIN, CAN and Flex ray and so on [3]. But it will choose CAN protocol due to following advantages. In following table there is comparison between these protocols. Due to real time communication and high reliability the propose system selecting CAN protocol for vehicle application.
There is some existing system having master and slave module [4]. For implementing CAN bus requires CAN Controller & CAN transceiver separately MCP2551. Master module has gas leakage detection and slave module has automatic headlight adjustment system.

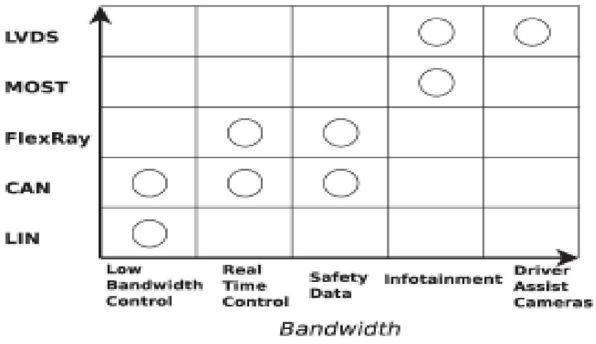

Fig.2 Comparisons of several vehicle networks [3]

Another system has development of BCM (Car Body Module) with features providing automatic control of windshield wiper, automatic headlamp and smart window regulators [5]. In this LDR is used to detect the light intensity and control the headlight of vehicle. With the several controlling parameter there may be data collision occurs. So data transmission through wiring is not suitable. The main objective of this paper is comparisons of different automotive protocol and overview on CAN protocol.
The rest of the paper organized : overview of CAN protocol is given section II, proposed work is explain in section III and lastly conclusion and future enhancement is provided in section IV.

II. CONTROLLER AREA NETWORK

Controller area network originally developed by Robert Bosch (Germany, 1986). This protocol intentionally invented for only vehicle applications [2]. CAN protocol is a multi-master and multicast protocol. CAN protocol overcome the disadvantage of point to point

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communication of wiring harness and data transmission complexity. It has following properties:

- Priority of incoming sensing message
- Perfect latency times
- Configuration flexibility
- Multicast reception with time synchronization
- Error detection and error signalling.

With the properties of CAN is not limited to only vehicle applications. Its port is a two wire, half duplex, high speed network system that can achieve 1 Mbps data transmission speed. It is capable of upgrading any node.

A. Architecture of CAN Protocol

Controller area network is an International Standardization Organization (ISO) defined as serial communication bus [2]. The CAN communications protocol, ISO - 11898:2003, describes how information is passed between devices on a network and conforms to OSI layer model. The ISO 11898 architecture defines two layer of seven layer of OSI model as the data link layer and physical layer as shown following fig.3.

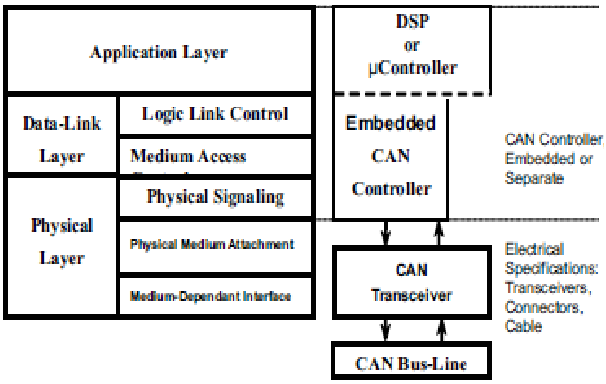

Fig.3 ISO 11898 layered standard CAN architecture [6]

In these architecture three layers has different functionality which will discuss in next section.

B. Standards of CAN

Controller area network (CAN) protocol uses a carrier-sense, multiple-access with collision detection and priority on message [7]. CSMA technique able to wait each node must wait for prescribed period of inactivity before sending message. Collision detection and message priority resolved collision between messages through bit-wise arbitration, based on preprogrammed priority of each message in identifier field of message. The higher priority always wins bus access.

There are two version of CAN standard:

- Standard CAN(11 Bit Identifier)
- Extended CAN(29 bit identifier)

I. Standard CAN

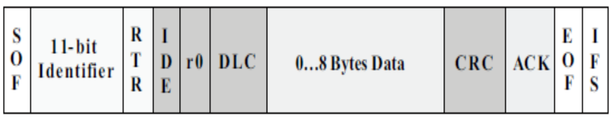

Fig.4 Standard CAN [4]

The content of data field is as follows:

- SOF-Start of frame marks the start of message and used to synchronize the nodes on bus after being idle.
- IDE-The standard has 11 bit identifier establishes the priority of the message. The lower binary value having high priority
- RTR- The single remote transmission request (RTR) bit is dominant when information is required for another node. All node received request but identifier determines the specified node.
- IDE- A dominant single identifier extension (IDE) bit means that standard CAN identifier with no extension is being transmitted.
- R0- reserved bit
- DLC- the 4 bit data length code contains number of bytes of data being transmitted.
- Data- up to 64 bits of application data may be transmitted.
- CRC- the 16 bit cyclic redundancy check (CRC) contains the checksum of transmitted bits
- ACK- every node receiving an accurate message overwrites the recessive bit in the original message with dominant bit, which shows error free message sent.
- EOF- this is end of frame marks end of the frame and disables bit stuffing.
- IFS-this is 7 bit interframe space (IFS) contain the time required by controller to move a correctly received frame to its proper position in a message buffer area.

II. Extended CAN

Standard CAN amended to next version of CAN known as extended CAN. It has 29 bit identifier as shown in fig.5.

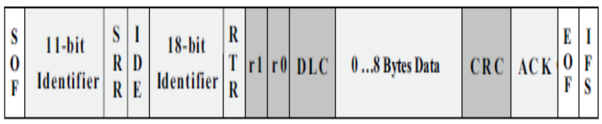

Fig.5 Extended CAN [4]

The extended CAN is the same as the standard message with the addition of:

- SRR- the substitute remote request bit replaces the RTR bit in the standard message location.
- IDE- a recessive bit in the identifier extension indicate that more identifier bits follow.
- R1- this bit is additional reserved bit along with r0 bit in standard CAN.

The ISO 11898:2003 Standard has 11 bit identifier, which provides for signaling rate from 125 kbps to 1 Mbps. The standard was later amended with "extended" 29 bit identifier. The standard 11bit identifier field provides 211 nodes and standard 29 bit identifier provides 229 nodes upgraded.

C. Functioning of CAN Layer

Basically there are three layers in CAN protocol which is as follows:

1. Physical layer
2. Data link layer
3. Application layer.

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The functionality of CAN mainly integrated in physical and data link layer which is shown in following fig 6.

Data Link Layer	**LLC (Logic Link Layer)** Acceptance filtering Overload notification Recovery management **MAC (Medium Access Control)** Data encapsulation/decapsulation Stuffing/de-stuffing Bus arbitration Error detection Error signaling Fault confinement Acknowledgement
Physical Layer	**PLS (Physical Signaling)** Bit encoding/decoding Bit timing Synchronization **MDI (Medium Dependent Interface)**

Fig.6 Functioning of CAN layer [7].

The physical layer defines the actual communication between different nodes in a network [6]. It also defines how data is transmitted and how it deals with encoding, timing and synchronization of the bit stream. Data link layer mainly functioning for message transmission. In data link layer data frames are building to hold data and control bits. It also provides other services such as frame identification, bus arbitration, bit stuffing, error detection, error signaling, fault confinement and automatic retransmission of erroneous frames. Finally application layer defines the two layers on which platform such as DSP, MCU etc. With the help of this it can control the operation on CAN bus.

III. THE PROPOSED SYSTEM

The proposed system consist of implementation of CAN bus on Peripheral Controller Interface (PIC) microcontroller. Generally system requires additional CAN controller and transceiver.

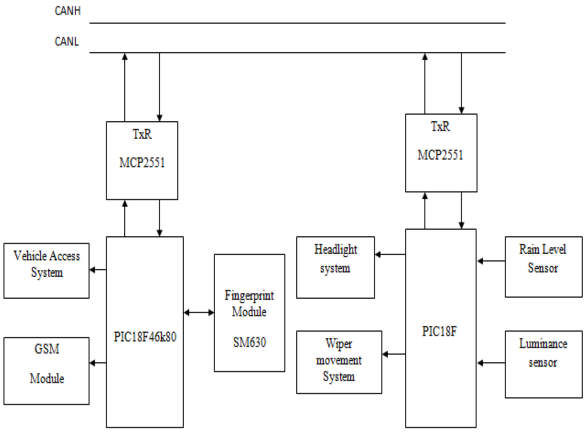

Fig.7 The Proposed System Block Diagram.

The proposed work covers some intelligent features like biometric access for vehicle owner, rain sensing wiper movement etc as shown in fig.7.

But in the proposed work selects integrated CAN microcontroller which is PIC18F46K80. So it does require additional CAN controller ICs. The PIC18F series some of controller having in built CAN controller interface facility. The proposed work provides the biometric security for vehicle to avoid vehicle theft. For implementing the security vehicle owner thumbprint will take as a database. If thumb match to system then vehicle access to user. Otherwise car will not get the access. If unauthorized person trying to access the system the message send through GSM module to vehicle owner. As this way it provides high security to vehicle.

Due to CAN bus upgrading features like rain sensing wiper and headlight glare effect easily possible. With the rain level sensor we can detect the rain level according to that it can control wiper speed in intermittent speed. As rain level goes on increases then wiper speed become in full automatic mode. If rain drop sensor used in proposed approach then it detect only presence of water drop so wiper does not move in intermittent speed.

In the night time drivers may get eye glare effect of opposite vehicle, so due to such effect accident may cause. To avoid such glare effect, here luminance sensor used to take opposite vehicle headlight brightness then automatically reduce our vehicle headlight reduces. So this technique can avoid glare effect. For luminance sensor we here used BH17 series. According to these two feature we can provide them priority so we can select which operation performed 1st. So no collision occurs between these messages. So data transmission efficient and no wiring harness. Due to CAN bus upgrade the system without changing original hardware. That means device upgradability easily available.

IV. CONCLUSION

The implementation of intelligent features using CAN protocol has been proposed. The proposed work eliminates the drawback of traditionally used approach like wiring harness and data transmission complexity. This system develops the board which has two UART and one CAN interface facility. Also reduces the system space as required in traditional approach. Using CAN bus network it is possible to upgrade the system without modifying original hardware.

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