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Design and Implementation of Co-operative Adaptive Cruise Control using CAN Protocol

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Abstract - *This paper presents the design, development, implementation, and testing of a CACC system. It comprises two controllers, one to manage the approaching to the leading vehicle and other to regulate car speed. Designing an ACC uses a PIC18F458 micro-controller. One as Main controller and another as the Low level controller. Using Controller area network (CAN) protocol, the slave module will transmit the data i.e. distance based on ultrasonic sensor. The data will be transmitted to the Master Controller for analyzing, and to control the motor. When threat switch is pressed, automatically camera will be on by taking video clips with all direction and these clips will be saved. Using android, the driver of the vehicle is informed about the presence of signboards and humps. MP lab IDE is used for coding and it will be done using Embedded C.*

Key Words: **Control Area Network (CAN), Global System for Mobile Communication (GSM), LCD, PIC Controller.**

1. INTRODUCTION

Significant developments in advanced driver assistance systems (ADAS) have been achieved during the last decade. Intelligent systems based on on-board perception/ detection devices have contributed to improving road safety. CAN or Controller Area Network is a propelled serial transport framework that proficiently bolsters appropriated control frameworks. It was at first created for the utilization in engine vehicles by Robert Bosch GmbH, Germany, in the late 1980s, likewise holding the CAN permit. CAN is globally institutionalized by the International Standardization Association (ISO) and the Society of Automotive Engineers (SAE).

CAN is a multi-master bus with an open, linear structure with one logic bus line and equal nodes. The number of nodes is not limited by the protocol. In the CAN protocol, the bus nodes do not have a specific address. Instead, the address information is contained in the identifiers of the transmitted messages, indicating the message content and the priority of the message. The number of nodes may be changed dynamically without disturbing the communication of the other nodes. Multicasting and Broadcasting is supported by CAN. To improve the behavior of the vehicle even further, it was necessary for the different control systems (and their sensors) to exchange information. This was usually done by discrete interconnection of the different systems (i.e. point to point wiring). The requirement for information exchange has then grown to such an extent that a cable network with a length of up to several miles and many connectors was required. This produced growing problems concerning material cost, production time and reliability.

1.1 Related Work

Today CAN have increased across the board use and is utilized as a part of mechanical computerization and additionally in automotives and portable machines. This protocol was produced going for car applications. The CAN convention is actualized in silicon. This makes it conceivable to consolidate the blunder taking care of and issue restriction offices of CAN with a high transmission speed [2]. The strategy utilized for circulating messages to the right collectors adds to picking up a decent utilize of the accessible data transfer capacity. This requires a basic transmission medium. A typical transmission medium is a curved pair of wires. The advancement of CAN started, when more electronic gadgets were actualized into current engine vehicles. In case of such gadgets incorporate motor administration frameworks, dynamic suspension, ABS, [3] gear control, lighting control, ventilating, airbags and focal locking. Along these lines, it is vital that human drivers still have a few controls over the vehicle. Progressed in-vehicle data frameworks furnish vehicles with various sorts and levels of insight to help the driver. The presentation into the vehicle outline has permitted a practically advantageous relationship between the driver and vehicle by giving a modern and safety driver-vehicle interface through the data system [5].

The CAN convention utilizes the Data Link Layer and the Physical Layer in the ISO - OSI model. There are likewise various more elevated amount conventions accessible for

CAN. CAN is most generally utilized as a part of the car and modern business sector sections. Run of the mill applications for CAN are engine vehicles, utility vehicles, and mechanical mechanization. Different applications for CAN are trains, restorative gear, building mechanization, family apparatuses, and office robotization [3]. Because of the high volume creation in the car and modern markets, minimal effort convention gadgets are accessible. There are around 20 million CAN hubs being used around the world. By the year 2000 the quantity of hubs is evaluated to be 140 million. Examples of vehicle transport frameworks, other than CAN, are A-BUS from Volkswagen, VAN or Vehicle Area Network, from Peugeot and Renault, J1850 from Chrysler, General Motors and Ford. CAN is obviously the main vehicle transport convention in Europe range-free schemes do not need additional hardware support, but can only provide coarse position estimates. Any CAN hub on the BUS can identify blunders in the message, and constrain the message to be pulverized and retransmitted… this element guarantees that the message a hub receives contains substantial information .The CAN Frame requires that each hub "recognize" the message before it can be handled by that hub. This recognizes can just come after different blunder condition checks; including a 15bit CRC on the message. In the event that one CAN hub finds a blunder with the message, the message is devastated and retransmitted [4]. The particular characterizes three distinctive mistake states for a CAN hub to be in; with every blunder state giving the CAN hub diverse levels of transport access. That was intended to constrain broken hubs from for all time bringing down the CAN transport.

2. OVERVIEW OF CAN PROTOCOL

CAN is a serial correspondence transport convention characterized in International Standards Organization (ISO). A serial correspondence transport is essentially used to exchange information starting with one system or point then onto the next point in duplex mode. It was produced for the car business as a substitute to the perplexing wiring with a two-wire transport. CAN is significantly diminish the electrical obstruction. Commotion impedance is the moved sign in the system. CAN present a blunder discovery and amendment component in the system which is extremely successful in exchanging the right information and validate information through the system. CAN is exceptionally prominent in commercial enterprises including building machines, medicinal, and producing. The CAN interchanges convention, ISO-11898: 2003 clarifies how data is passed between gadgets on a system. CAN takes after OSI model that is characterized regarding diverse layers.CAN utilizes just Physical and information join layer of OSI model as demonstrated Figure1. Physical layer of the CAN and OSI model clarifies the real correspondence between gadgets associated.

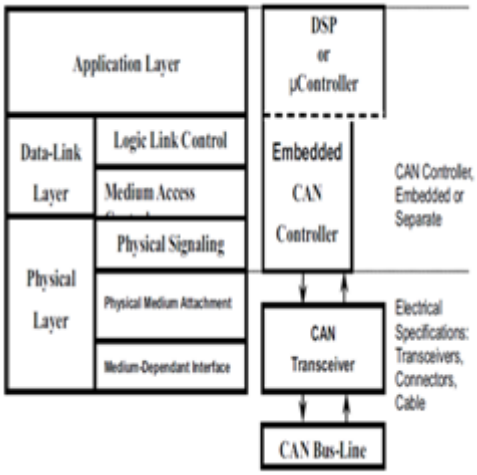

Fig-1: Hierarchical structure of CAN BUS

The ISO 11898 design characterizes the most minimal two layers of the seven layer OSI/ISO model as the information join layer and physical layer. Figure 1 shows in point of interest the use of DLL and Physical layer in CAN.

2.1 CAN Working

The interest for measure of information trade between ECUs keeps on climbing consistently. The routine information transmission framework can't deal with the expanding trade of information between electrical segments in the vehicle today. It is described by paired signs with its own singular conductors. Double flags must be transmitted by "one and zero". On/off proportions can't be utilized to transmit consistently changing parameters, for example, change of speeding up pedal, sensor for occasion.

2.2 Layout of electrical connections before CAN

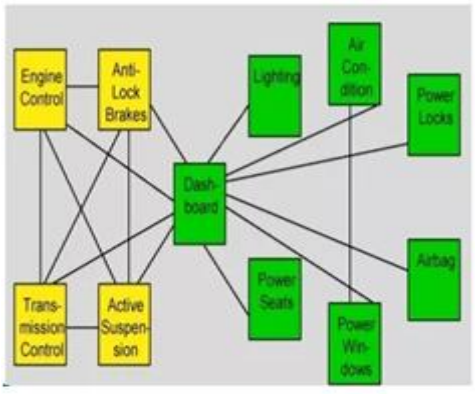

Fig -2: The Layout of Electrical Connections in a Car before Implementation of CAN.

Fig 2 shows the expanding trade of information between electrical segments in the vehicle today makes it hard to handle by means of traditional wiring tackle furthermore, module connectors. Additionally, the requests of the

measure of information trade between ECU's proceeds to climb consistently.

2.3 Layout of electrical connections after CAN

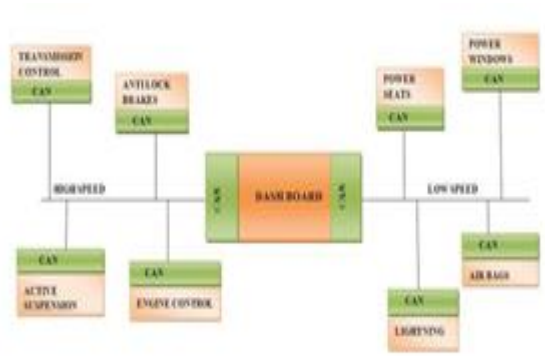

Fig-3: The layout of electrical connections in a car after the implementation of CAN.

CAN framework is particularly created for car application as a substitution for traditional information transmission framework. Here, the electronic frameworks, for example, motor administration framework EMS, TCS, ABS are coordinates with each other. From fig 3 the ECU's are allotted square with need and associated together utilizing straight transport structure. On the off chance that one of the station fizzles all the remaining station will keep on having full access in the system. The likelihood of the aggregate disappointment is particularly low. Rather than tending to individual stations the tending to conspire utilized by CAN doles out a mark to each message. Every message has its own particular exceptional 11 alternately 29 bit identifiers which distinguishes the substance of message. The given station forms just those messages whose identifiers are put away in its acknowledgment list disregarding all different messages.

3. PROPOSED WORK

Fig 4 shows the block diagram of Co-operative Adaptive Cruise Control using CAN protocol.

3.1 Microcontroller (PlC 18F458)

The small scale controller is the focal segment of a control unit and controls its agent grouping. Aside from the CPU, the small scale controller contains the information and yield channels as well as clock units, RAMs, ROMs and further fringe gatherings, all of which are incorporated on a solitary microchip.

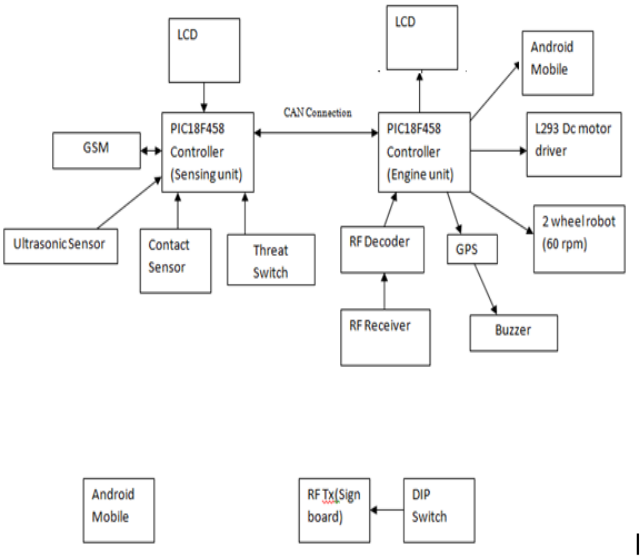

Fig-4: Block diagram of Co-operative Adaptive Cruise Control based on CAN protocol using Microchip.

3.2 CAN Transceiver/Receiver

Transreceiver: A unit beginning a message is called transreceiver of that message. The unit stays as handset until the transport is unmoving or the unit loses discretion. Receiver: A unit is called recipient of a message, on the off chance that it is not transmitting any message and the transport is definitely not unmoving.

3.3 Liquid crystal display

A liquid crystal display (LCD) is a flat panel level board; electronic visual showcase that uses the light balancing properties of fluid crystals.LCD is utilized to show any message. An average LCD show comprises of two lines with 8 characters in every line making an aggregate of 16 characters. The board is comprised of a few squares, and every piece can be binary shape. Every square is loaded with fluid precious stones that can be clarified or strong, by changing the electric current to that piece. Fluid precious stone presentations are frequently abridged LCDs. Fluid precious stone showcases are frequently utilized as a part of battery powered gadgets, for example, advanced watches, on the grounds that they utilize next to no power. They are additionally utilized for level screen TV's. They function admirably without anyone else when there is other light around (like in a lit room, or outside in sunshine). The LCD utilizes innovation called electro-optical tweak. This implies it utilizes power to change the amount of light goes through it.

3.4 Ultrasonic Sensors

Ultrasonic sensors (otherwise called handsets when they both send and get, yet all the more for the most part called transducers) chip away at a guideline like radar or sonar which assess characteristics of an objective by deciphering the echoes from radio or sound waves individually. Ultrasonic sensors create high recurrence sound waves and assess the reverberation which is gotten back by the sensor. Sensors compute the time interim between sending the sign and accepting the reverberation to decide the separation to an article.

3.5 GSM

A GSM modem is a specialized kind of modulator-demodulator in which a SIM card is accepted and it can be operated over a subscription to the mobile operator. GSM module is used when a communication between a computer and a GSM system is required**.** In many countries it is used as architecture for mobile communication. GSM module consists of a GSM modem and communication interfaces like RS-232, USB along with a power supply circuit for computer. GSM modem communicates over the mobile network when connected to a computer. GSM modems are also used to send and receive SMS and MMS messages. A GSM can be easily interfaced with the microcontroller system and uses serial communication for data transfer.

4. Design Flow

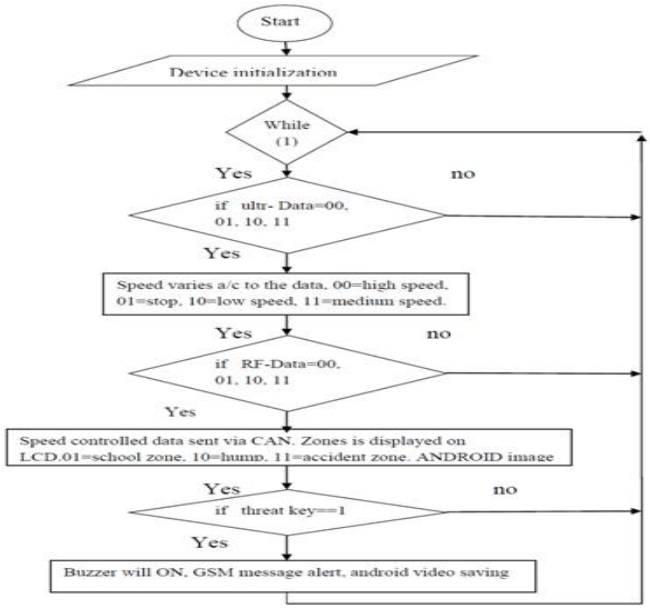

Fig -5: Design flow of overall system

The fig 5 shows the design flow of the overall system.

5. RESULTS AND DISCUSSION

Fig 6 shows the wire connections or the hardware model of the proposed system. It consists of LCD display, two PIC microcontrollers, RF Transmitter and RF receiver, Buzzer etc.

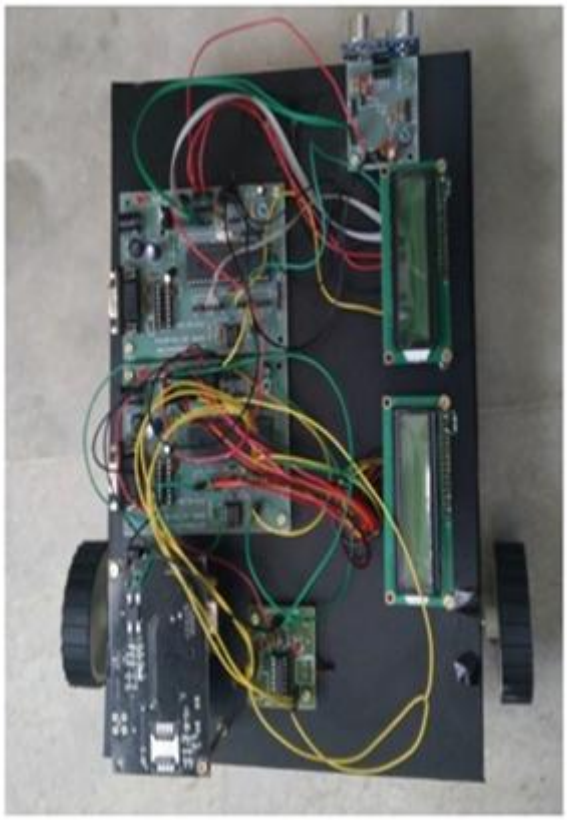

Fig- 6: Hardware Connections of overall proposed System.

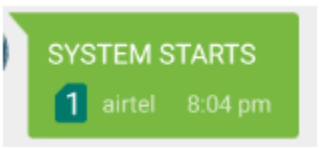

Fig-7: GSM output

Fig-7 specifies, in the wake of dumping the code to the equipment pack, check the instatement yield by switch ON the module. The yield will show in LCD show. In the wake of checking the instatement of modules, first it sends the test

message to required proprietor through GSM module as "SYSTEM STARTS".

Fig- 8: Speed Variation Output

At the point, when the front vehicle is in sure separation, the robot naturally controls speed utilizing ultrasonic sensor. In this manner the variety of speed will be shown in LCD show as appeared in figure 8.

Fig- 9: Cautions Output

While moving in roadways, the driver may not know about the sign sheets or he won't not have seen the sign board or protuberances before him. So keeping in mind the end goal to maintain a strategic distance from mischance the alert pictures will be shown in cell telephones like pictures in Figure 9.

Fig-10: Video capturing Output

After register the ten digits versatile numbers.The application is prepared to utilize when the risk assault inside the vehicle, in such cases if danger switch is squeezed then camera will be consequently ON through the android application. It begins to catch the video as appeared in figure 11.

6. CONCLUSION

The main paper demonstrates for safety purposes. Protocol forms a communication bridge between the controllers. Real-time, reliability and flexibility, all these characteristics make CAN an indispensable network communication technology applied in automobile network communication field. The CAN based communication system for vehicle automation is designed. Software system and hardware system are easily to be expanded and upgraded. This work can be further implemented by using android sending option through Email.

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