A REVIEW ON AUTOMOTIVE SAFETY SYSTEM USING CAN PROTOCOL

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Abstract

Driver and passenger safety is one of the prime concerns in modern day vehicle. Automotive electronics is a rapidly expanding area with an increasing number of safety, driver assistance, and infotainment devices becoming standard in new vehicles. In existing system the main clogs are cost along with many things. For invulnerability seven sensors are used. Temperature sensor is used to give the higher temperature notification on engine to retard faults about it. For gas leakage accident faults, gas sensor and exhaust gas control is used. Luminance sensors are useful for Glaring effect accidents by reason of opposite vehicle headlight illumination at night driving. Current sensor is used for short circuit in automotive wiring. Due to inaccurate fuel level monitoring in analogue meter faults may occur so we prevent it through fuel level sensor. Indeterminately higher sound horn is also one of the major concerns for accidents due to disturbance in restricted surroundings. The proposed system has two Master and Slave modules they are communicating through CAN (Controller Area Network).The First three sensors are interfaced to master and remaining four are to the slave. The proposed system will be in cost effective safety system, reliability and hardware size will be small.

Keywords: Adaptive headlights ,Automatic dim/bright, Controller Area Network , CAN trans-receiver ,Fuel level monitoring, wheel pressure, , Automatic dim/bright, Temperature, Gas leakage prevention, Horn adjustment,.

I. INTRODUCTION

According to today's upcoming technologies vehicle is one of the important necessity of human being. A vehicle dynamics, economy and comfort are improved by traditional electronic control but some problems comp up and they are very dangerous. Hence in-vehicle networking protocol gives benefits to many faults so we can inhibit problems such as the body wiring complexity, space constraints and some reliability issues. Therefore Alarming statistics of accidents and increased number of vehicles on road demands for an intelligent safety mechanism that helps the driver in handling immediate precarious situations [4]. In this proposed system there are seven safety measures are included in this system. These safety measures are the most common reasons for road accidents during day and night time driving. The Main motivation of this proposed system is to reduce driving accidents for automotive [2].

Controller area network (CAN) has been widely used for in-vehicle network. The demand of data rate of in-vehicle network has risen sharply, while traditional CAN communication cannot support this demand of data rate with limited bandwidth around DC [5]. CAN which connects the ECUs (Electrical

Control Units) embedded in the automobiles [4]. To reduce night time driving accidents, short circuit faults at the vehicle wiring connections, gas leakage, higher temperature in an Automotive engine location, disturbance of louder horn sound, increased pressure on wheel is measures in proposed system [1].

II. LITERATURE SURVEY

Accidents are a major cause of death and disability. There's one death every four minute in India due to road accident. Car network has been introduced into China for several years. The development is fast. Vehicle safety enters into a new era of main safety through the car networking technology.

Che Soh et al. [1] presents the design of a Carbon Monoxide (CO) gas leakage detector in vehicles. They told four accident cases in different countries due to gas leakage in car cabin .Carbon Monoxide is a colourless, odourless, and tasteless gas that is poisonous and lethal. CO is a by-product of incomplete combustion. The modified exhaust systems are usually a bit shorter so CO manages to seep into the car's inner chamber through its extractor exhaust system more easily compared to a standard exhaust, due to air conditioning also CO gas will come into car cabin are reasons of gas leakage accidents. Hardware used to design the system of this paper is Gas sensor, microcontroller, logic detector circuit, green LED, red LED and alarm system to give alertness to people. IN the presence of CO, gas sensor NAP-11A will sense the gas and send the signal to microcontroller. At critical voltage of 1.2V, green LED will immediately turns off and the red LED with the buzzer will operate simultaneously. The buzzer from the logic detector circuit will also operate as well both devices (red LED and buzzer) operate continuously. They thoroughly explained logic detector circuit and various voltage reading for four conditions like during source, normal condition, in presence of CO and during cleaning process of CO. Voltage at the normal condition is 0.02 V. Increase gradually up to maximum and constant value of 5.10V in the duration of 1 minute at presence of CO condition.Voltage of 5.10V decrease gradually and slowly to 0.02~ approaches 0V, duration of 1 minute during heat cleaning process.

Ashwini S. Shinde et al. [2] designed controller area network for vehicle automation. This paper describes the ARM7 based design and implementation of CAN Bus prototype for vehicle automation. It based on hardware and software design of intelligent node. Hardware same as above paper but the sensors are increasing. Here LIN protocol is also used for controlling the LED lights of a car. Hardware interface circuit mainly consists of MCP2515 standalone CAN-Controller, LPC2148 microcontroller based on 32-bit ARM7 and MCP2551 high speed CAN Transceiver. MCP2551 CAN Transceiver works only in the physical layer.

Jaimon Chacko Varghese et al.[3] designed low Cost intelligent real time fuel mileage indicator for motorbikes .They manufactured a low cost device can actively display the fuel mileage of a motorbike and display it in real time onto a display which is attached to vehicle along with other driver information system. The device works on carburetor and even on bikes with fuel injection technology. Distance travelled and the estimation of the fuel tank can be done by speed sensor and flow meter. This sensor data has given to microcontroller and computed numerical value through control unit is displayed. They compared the mileage obtained at different speeds under various load conditions. Mileage obtained during load condition of a single person is slightly higher than the Mileage obtained during load condition of two persons.

Beying Deng ei al. [4] discussed the car networking application in vehicle in which they car connecting the car to the network and making iot (Internet of Things) based car. It focuses on how to prevent the collision and accidents and look on the human condition, road condition monitoring, aided scheduling, prevention of traffic accidents through the car networking means. Firstly they noted the problem of accidents due to driver. Then they had explained engine operating condition, engine temperature, tire pressure and other conditions sensors which we can say as the ECU (Electronic Control Unit) data send to vehicle terminal equipment through CAN bus and send the data to the cloud by cloud computing and give indication to the driver so we can retard every accident and save lives

.lastly they given significance of the information security of car networking.

Shane Tuohy et al. [5] reviewed intra vehicle networks. Now days, number of vehicles are employing different networking protocols. Vehicles internal performance and dynamics is monitor by Antilock braking system (ABS) and electronic stability control are examples of systems ; whereas camera, radar, and ultrasonic sensors are being acclimated to sense the environment around the vehicle and provide drivers with more information about their surroundings. For a number of years, technologies such as Flex Ray, CAN, local interconnect network (LIN) , media oriented systems transport (MOST) , low-voltage differential signaling (LVDS) , and IEEE 1394 Firewire have been used in vehicles and their comparison is explained in this paper. Physical layer technologies, non-automotive specific standards, automotive network traffic, Ethernet and link layer topologies are also explained in this paper. IEEE 802.1Q VLAN Tagging, AVB and TTEthernet are discussed in the link layer protocol.

Thanima Thulaseedharan et al. [6] designed real time intelligent driver assistance system in which ARM 7 microcontroller is used in which they monitor the vehicle in two parts as engine control and driver assistance. In engine control they had monitored temperature detector, CO level detector, Fire detector, fuel status and road surface nature .Simulation had done on the Keil µVision in which UART1 and UART2 give simulation results on engine control and driver assistance. A vehicle health report that enables to know about the current condition of vehicle so as to provide a safe drive.

Jaromir Skuta et al.[7] explained Control of car LED lights by CAN/LIN bus. This paper was focused to verification of communication algorithm and possibilities with use of PCAN-LAIN interface. The car lights are connected to LIN interface through separate controllers. The LIN frames are 8 bytes length. Data frame according to CAN 2.0A and data frame of LIN bus is explained thoroughly. They are controlling lights through the LIN bus. Firstly USB is connected to the CAN then CAN bus of vehicle is connected to the LIN bus and we can their simulation results through PCAN-LIN software. In this way we can control intensity of lights.

Donghyuk Jang et al. [8] explained communication channel modelling of controller area network (CAN). The demand of data rate of in vehicle network has risen sharply, while traditional CAN communication cannot support this demand of data rate with limited bandwidth around DC. CAN with PLC and VDSL system, CAN communication systems use bus topology structure, where the bridge tap length and the main line length are limited below I m and 33m, respectively. Traditional CAN bus and bridge taps use AW G 24 twisted pair for transmission since it has a characteristic of cancelling out electromagnetic interference (EMI) from external sources. Destructive interference is generated at the intersection between a main line and a bridge tap because signal reflection occurs at the bridge tap. After that channel model is briefly explained in this paper. Based on the proposed method, we can obtain the channel frequency response which can be used for decision of suggested tap length and bandwidth without real measurements. So this channel modelling method is quiet accurate.

Pradhan suvendu kedareshvar et al. [9] designed CAN protocol based embedded system to avoid rear-end collision of vehicles. Human errors amount to 93% of all accidents, rear end collision are 30% out of it. Global positioning system , vehicle to vehicle communication , Zigbee module, fuzzy logy based controllers implement different collision warning system .This paper proposed ARM Cortex m0 controller based collision avoidance system. Alert collision warning system, evaluation of deceleration levels, braking display LED array ,control system, CAS-ECU Can communication and ECU controlled DC motor are main sub points of this paper. Alert collision warning system algorithm calculates slope of response of accelerometer and transmits the level of deceleration corresponding to a sudden break to collision avoidance system to take necessary action. They had done graphical analysis of accelerometer where the slopes in the graph give intensity of brakes differentiating gradual braking from sudden change.

Vikash Kumar Singh et al. [10] designed implementation of 'CAN' protocol in automobiles using advance embedded system. In this paper control system with network

architecture have benefit over the traditional method. Two sensors that is temperature sensor and IR sensor are monitor through two different microcontroller and CAN controller but these two can connected to the CAN bus. They also explain CAN protocol in brief with its format. CAN controller MCP2510 and CAN transceiver (MCP2551) are used as Transmitter and receiver respectively .They also explained the flow chat if transmitter section as well as receiver section. Fault confinement is also a major benefit of CAN. Faulty nodes are automatically dropped from the bus that prevents any single node from bringing a network down, and gives guarantee that bandwidth is always available for critical message transmission.

Ashutosh U. Jadhav et al.[11] done work on review of control Area Network (CAN) based intelligent vehicle system using advanced RISC machines (ARM) for driver assistance. Road accidents are tremendously happening and to prevent it they designed the system that is Intelligent vehicle (IV) system aims to assist drivers in any dangerous situations and save human lives. In introduction they explained the factors contributing to the the fatal accidents and its bar graph. Failure to stay in lane caused the high rate accidents than other problem issues of the accidents. In the proposed work slave ARM processor has alcohol sensors, eye blink sensors to the master, car ignition, GPS module, GSM module parameters are sensed so they made the intelligent vehicle system. Therefore these sensors are used to monitor and detect driver's behaviour to ensure road safety.

Jianqun Wang et al. [12] explained the requirement of accuracy of communication is continuously increasing in rapid development of science technology. In this paper they briefly explained the algorithms that will used to prevent the accidents occurred due to collision of vehicles. Reliability and real-time ability of communication guarantee methods and drawbacks of conventional CAN. Synchronous acquisition is first algorithm which is explained for a user is in queue that is each code is able to receive the information others send, and moreover, once a node in bus has the requirement of bus usage, it can compete to apply. Cyber Storm is conceived if all nodes send data to bus which damages the reliability of in-vehicle network. Therefore when the number of nodes is large, the collisions of frames are severe and therefore the acquisition errors caused by arbitration are hard to calculate and control, in a word, the synchronous acquisition can hardly be achieved. Hence to overcome all these errors they used a dynamic autonomous synchronization method based on IDs of frames. A dynamic autonomous synchronization method based on IDs of frames is proposed here. The core of which is to build a sending queue in the memory of the CPU, and every node sends its data after the successful sending of its former node in the queue. In this method contains the formation of ID's and time slot of sending frames and approaches to add and delete an ID of frames queue explained briefly. So they conclude an autonomous dynamic synchronization method for CAN communication based on the queue of IDs of frames is proposed to realize a quasi-synchronous communication result is best.

Mr.K.Kalaiyarasu et al [13] designed an automotive safety system using Controller Area Network. In this paper there are two modules master and slave but both are connected to each other . Action for the night time driving accidents due to glaring effect of headlight luminance, short-circuit fault line detection, Gas leakage detection cum prevention action, to provide clear vision for vehicle driver and monitoring the engine area temperature by an analog and digital sensor is explained in this paper. Overall they explained five sensors .Master and slave both have different CAN bus connected through 8-bit PIC16F84 microcontroller .Master and slave modules have CAN communication, USB, and Serial port communication. The coding will developed and burn through ICSP.

M. Santhosh Kumar et al. [14] have reviewed self - propelled safety system using CAN protocol . They have taken seven sensors and connected to the 8-bit PIC16F84 microcontroller on-board system .There are two modules master and slave and first four sensors are interfaced to the master and three to the slave and display values on LCD and if the conditions are extreme then buzzer will give indication to the human. They explained CAN protocol thoroughly and given its working according to OSI model .Anti-skid braking, automatic manual transmission, gearbox

control, traction control and door control also can be control told in the future scope.

Table: Analysis of Automotive Safety System.

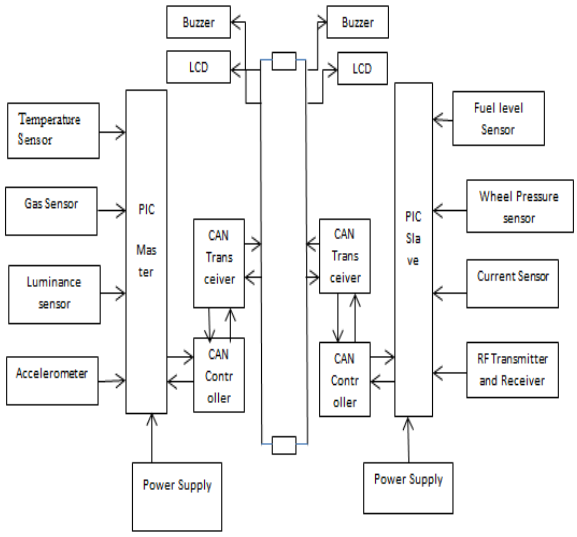
Ref. No	OBJECTIVE	AUTHORS	YEAR	MAJOR CONTRIBUTIONS
1	Vehicle Gas Leakage Detector	A.CheSoh, M.K.Hassan and A.J.Ishak	2010	Discussion On to avoid accidents due to Possible Situations of Leakage Carbon Monoxide Gas in a Car.
2	Controller Area Network for Vehicle automation	Ashwini S. Shinde , Prof. vidhyadharand B. Dharmadhikari	2012	Mechanism of CAN bus to see sensors value but sensors are not specified in this paper
3	Low Cost Intelligent Real Time Fuel Mileage Indicator for Motorbikes	JaimonChacko Varghese, BineshEllupurayil Balachandran	2012	Discussed fuel injection system and its working to find out automatic fuel mileage
4	Car networking application in vehicle safety	Beying Deng and Xufeng Zhang	2014	Explained way to overcome traditional problems with new car networking application through CAN.
5	Intra-Vehicle Networks: A Review	Shane Tuohy, Martin Glavin, Ciarán Hughes, Edward Jones, Mohan Trivedi, and Liam Kilmartin	2014	Discussed different protocols at different layers of OSI model of communication between cars.
6	Real Time Intelligent Driver Assistance System	Thanima Thulaseedharan, Vijayakumar. K, Nishitha Geri	2015	Explained five different sensors for driver safety. Engine control and driver assistance these two blocks are mainly

		son		important for communication between sensors and controller.
7	Control of car LED lights by CAN/LIN bus	JaromirSkuta and JifiKulhanek	2015	Control of LED lights of car through LIN bus. Briefly explained LIN and CAN bus communication.
8	Communication Channel Modelling of Controller Area Network (CAN)	Donghyuk Jang, Sungmin Han, Suwon Kang, and Ji-Woong Choi	2015	End-end channel modelling with the help of transmission matrix. Channel model of two port network is discussed.
9	A CAN Protocol Based Embedded System to Avoid Rear-End Collision of Vehicles	Pradhansuvendukedareswar and Venkatasubramanian krishnamoort	2015	Methodology of collision avoidance system.
		hy		
10	Implementation of CAN Protocol in Automobiles Using Advanced Embedded System	Vikash Kumar Singh and KumariArchana	2015	Explained temperature sensor mechanism and node to node communication.
11	A Review: Control Area Network (CAN) based Intelligent Vehicle System for Driver Assistance using Advanced RISC Machines (ARM).	Ashutosh U. Jadhav and N.M. Wagdarikar	2015	Discussion about Eye-blink sensor and alcohol sensor connected to master module. Car ignition system, GSM module and GPS module are connected to the slave.
12	A Method to Improve the Stability and Real-time Ability	Jianqun Wang, Jingxuan Chen and Ning	2015	Discussed method to increase data rate A dynamic autonomous synchronization based on ids of

	of CAN	Cao		frames.
13	Automotive safety system using Controller Area Network	Jianqun Wang, Jingxuan Chen and Ning Cao	2015	Window ,gas sensor, temperature and motor and their automation is explained in this paper.
14	Self - Propelled Safety System Using CAN Protocol- A Review	M. Santhosh Kumar, PG Scholar and Dr.C.R.Balamurugan	2016	Safety automotive systems by using seven sensors are connected to master and slave module combine to avoid accidents.

III. PROPOSED SYSTEM

In proposed system, there are two modules master and slave of PIC16F778A .There are seven sensors through which they analyzed car so we can prevent accidents. LPG gas leakage sensor, exhaust gas control unit LPG gas leakage sensor, temperature monitoring unit and automatic front headlight adjustment system sensors are interfaced with master module and digital fuel level sensor, short-circuit identification unit, wheel pressure monitoring sensor, digital fuel level sensor, Radio Frequency transmitter and receiver for horn volume automatic adjustment sensors are connected to the slave module. The communication between the master and slave is has done through CAN (Controller Area Network). The block diagram of the proposed system is given below [1].



In the future work we can monitor road condition, fuel mileage according to persons, front and rear window operating. Also addition to this proposed work of given sensors we can do take prevention by doing automation on the car like if temperature in car engine will increase then radiator fan will automatically turn ON, if distance between the two respective car is less automatically speed of car will reduce so that with indication on lcd we can tackle the situation.

IV. CAN PROTOCOL

CAN is controller area network which is used in a vehicle bus standard .CAN bus communicate with different ECUs (Electronic Control Units) like anti-braking system, cruise control and many other. ECU consists of microcontroller and SPI bus interface to communicate another ECU's controller. Every ECU of CAN has one CAN controller like MCP2515 and CAN transceiver.CAN Bus has recessive bit '0' and dominant bit '1'.The CAN protocol node representation is shown in below figure.

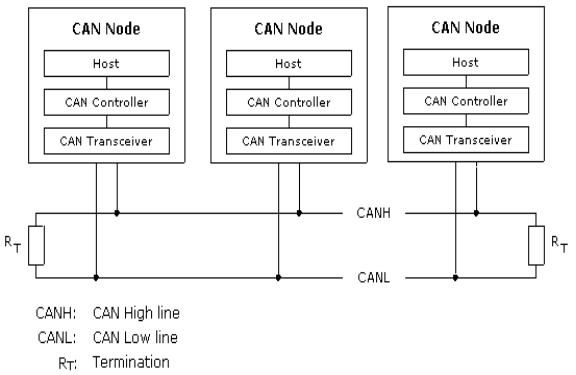


Fig.1: CAN bus representation

There are two parts of specification based on identifier. First one is CAN 2.0 A (11 bit identifier) and another one is CAN 2.0 B (29 bit identifier).ISO released the CAN standard which has reconstructed into two parts 1) ISO 11898 -1covers data-link layer.2) ISO 11898 -2 covers Physical layer for High speed. It is Multi-drop; Multi-master serial bus provides communication between controllers, sensors, actuators. It is Very reliable and robust, well proven technology and uses SPI interface for communication.CAN devices send data across the CAN Network on packets called frames.

A typical CAN frame contains an arbitration ID, a data field, a remote frame, an error frame, and an overload frame.

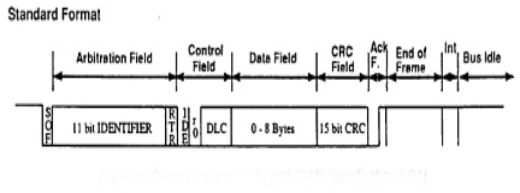


Fig. 3: Standard Frame Format of Can Bus.

V. CONCLUSIONS

According to review of we can prevent the accidents caused by above problems at night time driving also because number of accidents occurred during night time are more than day. We observed that in previous paper they first monitor only two parameters but now they are increasing .We can monitor approximately 120 parameters of car through CAN (Controller Area Network). Through these sensors we can make the car automatic like GOOGLE car. Communication protocol has been implemented and it precedes required actions, values displayed in dashboard for driver assistance. With this we can see car condition on LCD for precaution purpose.

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