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Collision Avoidance of Vehicle System Using CAN Protocol

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Abstract— With rapidly changing computer and IT and much of the technology finding way into cars, cars are undergoing histrionic changes in their ability. Although some cars have provisions for deciding to either generate warnings for the human driver or control the car free, they usually must make these decisions in real time with only incomplete information. So, it is important that human drivers still have some manage over the car. So we design such System specially for car to avoid the accidents due to drunken driving,, due to low/high air in tyres or an accidental fire in car, due to high engine temperature, accident while parking & also system control the headlight & wiper of car as per the environment condition and take action over it.
Keywords— Control Area Network (CAN), GSM 900, PIC18F458, LCD.

I. Introduction

Nowadays accidents occur due to errors done by driver. An intelligent system needs to be developed to overcome these errors. This system is proposed where errors done by vehicle driver are prohibited. Lots of the intelligent car systems have monitoring system only. Intelligent brake and other automatic systems are present in sports cars and other luxury cars only. But these cars are not affordable to everyone.A car was generally build with an analogue driver car interface for showing various parameters of car status like temperature, pressure and IR obstacle detector, wiper (Rain detector), Alcohol sensor etc. Along with we use GSM modem. A PIC 18F458 microcontroller based data acquisition system that uses ADC to brought all control data from ADC format is used. Since the sense value are spread out all over the body of a practical car, a communication module that supports to implement a one stop control of the car through the master controller of the digital driving system. The proposed high-speed CAN bus system solves the difficulty of automotive system applications, also has a certain practical value and significance.

II. OVERVIEW OF CAN PROTOCOL

Controller area network (CAN) provide high reliability and good real-time performance with very low cost. Due to this, CAN is widely used in a wide range of applications, such as in-car communication, automated manufacturing and distributed process control environments.CAN bus is a serial data communication protocol invented by German BOSCH Corporation in 1983. CAN is a network protocol which is designed for the car industry [1].Since data communication in car often have many sensors transmitting small data packets, CAN supports data frames with sizes only up to 8 byte as shown in Figure 1. Meanwhile, the 8 bytes will not take the bus for a long time, so it ensures real-time communication. CAN use a large amount of overhead, which combined with a 15-bit CRC makes CAN very secure and reliable. CAN protocol use non-destructive bitwise arbitration process to access shared resource. CAN protocol define a logic bit 0 as a dominant bit and a logic bit 1 as a recessive bit, each transmitting node monitors the bus state and compares the received bit with the transmitted bit [2]. If a dominant bit is received when a recessive bit is transmitted then the node stops transmitting (i.e. it lost arbitration). Arbitration is performed during the transmission of the identifier field. There are two message formats: Base frame format with 11 identifier bits and extended frame format with 29 identifier bits [3].

Figure 1. CAN Data Frame

A. *CAN Bus Electrical Characteristics*

CAN transmission medium formed by the two, One is called high-level transmission line CANH and another is called low-level transmission line CANL, connected to CANH and CANL pins of MCP2551 CAN transceiver. V_{CANH} and V_{CANL} be the voltage level of CANH and CANL lines with respect to ground. The d i f f e r e n c e between them is called difference voltage V_{diff}

B. *Scheduling of CAN BUS*

CAN protocol implements fixed priority scheduling of CAN messages. Higher priority node has lower node ID. If available bandwidth is scarce, difficulties come with traditional fixed-priority based scheduling [5]. It is possible that low priority control loops cannot access the network all the time, then, messages in different loops will be transmitted.

C. *Reliability*

Reliability is defined as the probability of no failures in an operational interval. High error handling capability of CAN improves system reliability. If any message transmitting node has detected an error, the node forcibly aborts transmission. Then it attempts to retransmit again until its message is transmitted successfully. This functionality may let the CAN bus be hogged, if the node of high priority is unsuccessful. It is the designer's responsibility to ensure that no any message node hogs the bus. To avoid such crises, the faculty of the transmit error counter (TEC) and the receive error counter (REC) are started to diagnose the conditions of CAN controller [7]. MCP2515 CAN controller has TEC and REC which enhances reliability of CAN bus system.

D. *Hierarchical structure of CAN BUS*

Architecture of CAN protocol based on OSI reference model is as shown in Figure 2. CAN protocol contain three layers, physical layer, data link layer, application layer. Application layer has different protocols such as SAE J1939, CAN open, Device Net, etc [4].

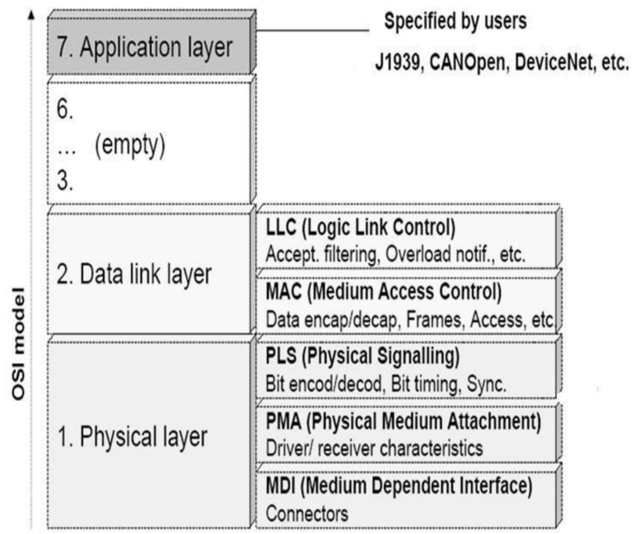

Figure 2. Hierarchical structure of CAN BUS

A CAN controller can be in one of three states: error active, error passive or bus off state. The operating state of the controller is controlled by two error counters – TEC and REC. The CAN controller is in error active state if TEC less than 127 and REC less than 127 [8]. Passive state is used if and TEC less than 255. Bus off state is entered if TEC is greater than 255. Once the CAN controller has entered bus off state, it must be reset by the host microcontroller in order to be able to continue operation. In accordance with the newly assigned priorities[6].A new mixed traffic schedule (MTS) is based on the communication principle of controller area network, network scheduling and analysis of schedule.

The core idea of MTS is set the relative deadline information into the identifier. Use the earliest deadline first (EDF) message scheduling algorithm for high priority information as well as the RMS message scheduling algorithm for low priority information scheduler.

Upon invocation, the scheduler calculates the urgency of each control loop based on the set points and current system outputs. According to the MUF algorithm, the scheduler produces new priorities based on these urgency values. And overcome using direct feedback scheduling algorithm, namely MUF (maximum urgency first) is integrated in the network.

III. HARDWARE STRUCTURE

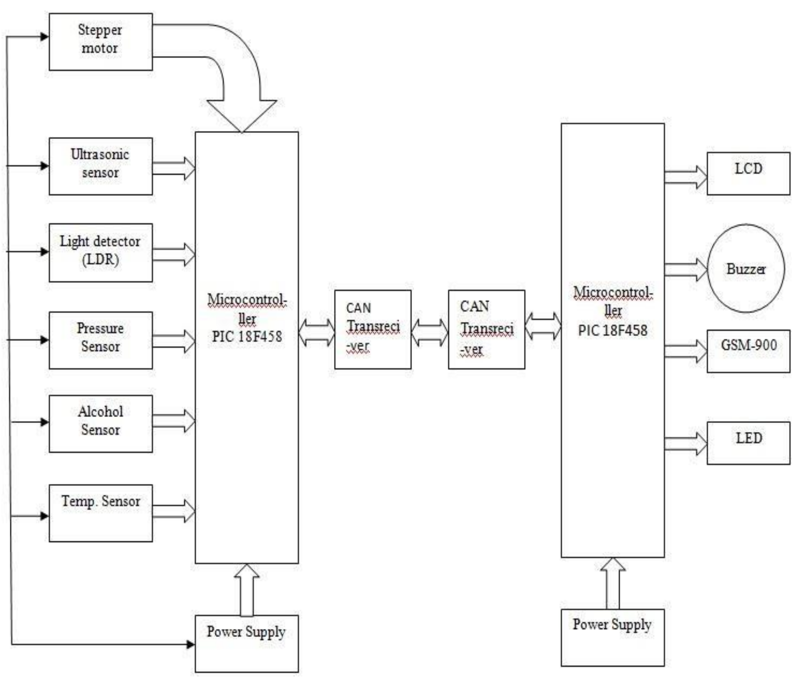

Figure 3. Block Diagram

In hardware structure the sensors will communicate with the output devices using CAN (Control Area Network) protocol which will be implemented in the PIC controller.

A. Ultrasonic sensor

Ultrasonic sensor is adapted to measure the distance with respect to the previous obstacle OR car. While the car is in motion the distance of another car is measured and accordingly warning signals are given to the driver.

B. Alcoholic sensor

Alcoholic sensors in it to monitor the person in the car. If the person appears to be drunk the transmission will be automatically switched off. The information of car and details of driver is send to the police and block that car.

C. Temperature sensor

Temperature sensor monitor the temperature of engine. Accordingly warming signal are given to the driver.

D. Pressure sensor

Pressure sensor monitor the air pressure of tyre. If pressure of tyre is low OR high then it send the signal to the driver and buzzer is ON.

E. Light detector (LDR)

LDR detect the brightness of light in the environment. If the brightness of light is low then automatically the car light is ON otherwise it remain off.

F. Rain drop detector

Rain drop detector detect the rain if rain falls on the glass. After detecting the rain drop the stepper motor is rotate in 180^0 and the wiper turns ON.

G.GSM Modem

The uplink frequency range specified for GSM 900 is
933 - 960MHz and for downlink frequency is 890 - 915MHz. The GSM-900 is used for sending the message to the police using the above frequency.

H. Peripheral interface controller (PIC)

The controller will take input from the sensors and depending on the various sensor inputs output devices will be driven using the other microcontroller. The controller PIC 18F458 has in-build CAN controller .The two microcontroller will communicate with one another using can communication protocol. PIC is a family of Harvard architecture microcontrollers made by microchip technology of control peripheral devices, load from main cpu.PIC is equivalent to the automatic nervous system. PIC is very cost effective, and many types of PIC is available for low cost. There is a chance to choose the PIC for suitable application.PIC execute most of instruction in 0.2 micro seconds (or) 5-instructions per microseconds. It has up to 12 independent interferences.

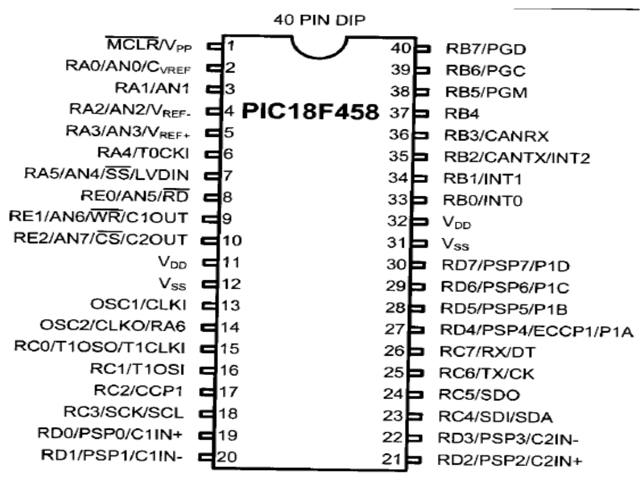

Figure 4. Pin Diagram of PIC18F458.

I. Transceiver

CAN transceiver MCP2551 adapts signal level from the bus to level that the CAN controller expects and has protective circuitry that protects the CAN controller. It converts the transmit-bit signal received from the CAN controller into a signal that is sent onto the bus.

IV. SOFTWARE STRUCTURE

The car control system is programmed using the Embedded C and debugged with PROTEUS simulation. MP Lab IDE PICkit-2 is used for fusing embedded-c coding with CAN IC-18f458.

A. Flowchart

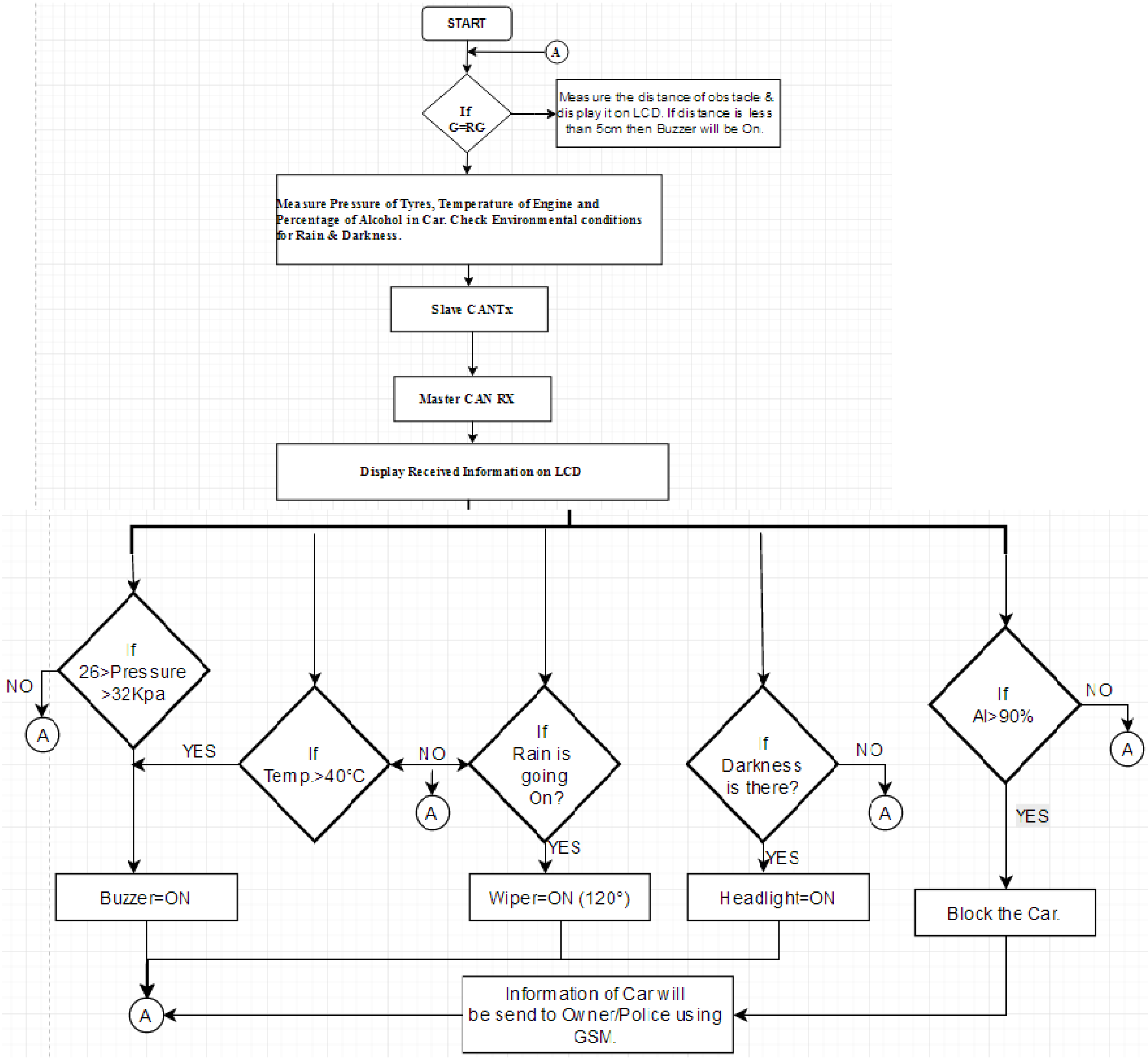

Figure 5. Flowchart.

V. DESIGN SCHEME OF COMMUNICATION PROTOCOL

The design scheme of communication protocol is explained in this section. Identifier of the message is the unique character for the application program to distinguish messages. In this communication system, when a node receives a message correctly (until the last bit of the EOF area is right), the configured filter box message, and then save the messages with matched ID in receiving box. By using this feature, communication protocol can be made. Different identifiers are set for every data type or control command in this system, then distinguish the received messages conveniently, and choose corresponding processing mode. The standard format of identifier is used in this system as shown in fig. 6. Its length is 11 bit long. Use of standard identifier can reduce the data length and improve data transmission efficiency. In this system, the 11 bit identifier is designed for the "Address Code + Type Code" format. Bits D7 to D4 of identifier is the address field, providing at most 16 address codes, and every address code corresponds to a individual node.

Bits D3 to D0 is the type field, which can also provide 16 type codes. And the bots D10 to D8 is the backup field which is used for system expansion. By configuring the value of the filter ID, each node would only receive the messages with the matched address code.

D10 D9 D8	D7	D6	D5	D4	D3	D2	D1	D0
000	0	0	0	1	0	0	1	0
backup	address code				type code			

Figure 6. Identifier format

VI. RESULT AND CONCLUSION

This is concerned about implementation of CAN nodes for monitoring parameters and taking action over it. The monitoring parameters are temperature, tyre pressure, alcohol, distance from the obstacle, light in the environment. For monitoring the above parameters, LM35 sensor, LDR and MQ6 sensors, HCSR04, SPD005G are used. For implementing this, the programming of LED, buzzer, stepper motor, ADC and LCD interfacing with microcontroller is done using Embedded C. Then the Simulation results are obtained using Proteus professional schematic software. The programming of microcontroller interfacing using CAN Protocol is verified using a general purpose board. Hardware schematic is drawn using Diptrace. Implemented hardware and software is ported to it. The temperature of the engine, environment condition of light, distance from obstacle, tyre pressure, alcohol in the car are transferred from engine to dashboard via CAN Protocol and these readings are displayed through LCD on the dashboard. The complete hardware setup is shown in Fig.

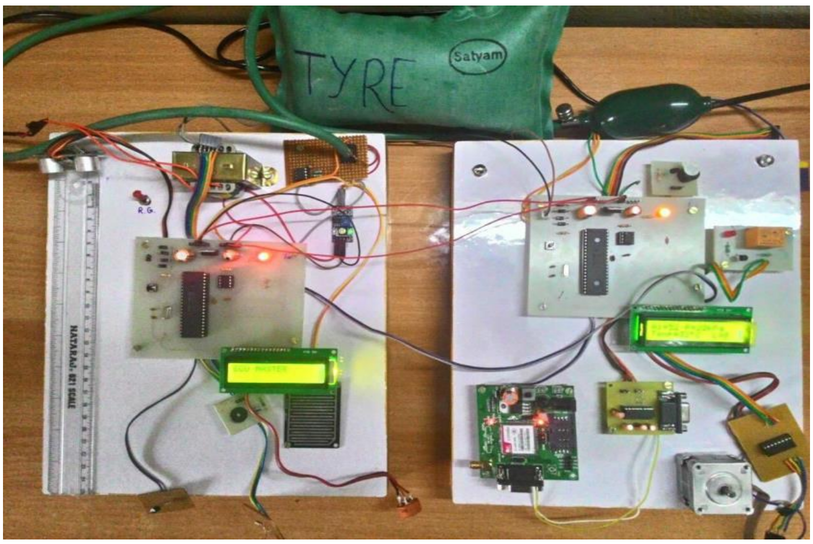

Figure 7. Collision avoidance system.

Figure 8. Car get blocked as alcohol sensor detects alcohol in car.

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