Implementation Of CAN Based Intelligent Driver Alert System

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Abstract: This system is an attempt to analyze Intelligent Driver Alert System Using CAN Protocol. CAN (Controller Area Network) offer an efficient communication protocol among sensors, actuators, controllers, and other nodes in real-time applications, and is known for its simplicity, reliability, and high performance. It has given an effective way by which can increase the car and driver safety. This system presents the development and implementation of a digital driving system for a semi-autonomous vehicle to improve the driver-vehicle interface using microcontroller based data acquisition system that uses ADC to bring all control data from analog to digital format. In this system, the signal information like temperature (LM35 sensor) if the temperature increase above the 60 ^{o} C and ultrasonic sensor is adapted to measure the distance between the object and vehicle, if obstacle is detected within 75cm from the vehicle, the controller gives buzzer to the driver, speed measure using RPM sensor if revolution increase up to 1200 per minute controller act and to avoid the maximum revolution and to check the fuel level continuously and display in the percentage if fuel level below 20 percent the controller also gives buzzer to the driver and distance, fuel level and temperature continuously display on the LCD.

Keywords: CAN, Ultrasonic sensor, Fuel status, RPM sensor, LCD, Engine temperature, PIC18F458 microcontroller.

I. INTRODUCTION

This system helps in achieving effective communication between transmitter and receiver modules using CAN protocol with multiple sensors to monitor the various parameters and visualize them to the vehicle driver through a LCD display and alarm. The CAN modules interfaced with the sensors for this system are, temperature sensor capable of detecting engine heat, fuel level indicator using level detecting sensor, ultrasonic sensor for detecting the distance between obstacle and vehicle and RPM sensor to detect the speed of the engine. This is important that human drivers control over the vehicle and check the parameters in vehicle on LCD screen at the same time of driving, parameters like engine temperature, fuel level and obstacle's distance. CAN protocol (bus) are used for data transmission. A CPU is needed to manage the CAN protocol. The PIC18F458 microcontroller is used as the CPU that can manage bus arbitration, assigning priority for the message addressing and identification. The PIC18F458 microcontroller is chosen to control the altitude in this system and it is used in a CAN bus–based project. For the CAN bus–based designs it is easier to use a PIC microcontroller with a built-in CAN module, such devices include built-in CAN controller hardware on the chip. For implementation of this digital circuitry need a different component the main part for controlling all information to check working for this purpose use a processor for the sensing purpose use a temperature sensor, fuel level sensor, obstacle detection sensor, RPM sensor and power supply are main parts.

II. SYSTEM BLOCK DIAGRAM

In figure1, there are four parameters such as temperature sensor, fuel level indicator, speed sensor and obstacle sensor. These sensors are interface with the microcontroller and data transfer through the CAN bus. These sensors continuously sense the information and send the information to the microcontroller. If hazardous condition is occurred, then microcontroller gives buzzer to the user. This system consists of one master node and two slave nodes. Master controller controls the vehicle status with various sensors. Two slaves are used to receive the inputs of vehicle status. The communication between these sensors is done by using CAN controller. Slave controllers receive the signals from vehicles like temperature, fuel level, speed and obstacles etc., send to master controller with high speed rate. Master controls the status of vehicle and sends the feedback to operator panel by providing digital information's via LCD display and alarms.

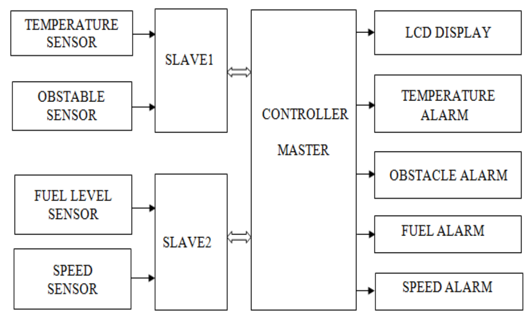

Figure.1. *Block diagram of the Intelligent Driver Alert System*

III. HARDWARE DESCRIPTION

A. CONTROLLER AREA NETWORK (CAN)

CAN is a Controller Area Network controller that can transfer the serial data one by one. CAN bus is a multi-channel transmission system, message broadcast system that specifies a maximum signaling rate of 1 megabit per second (Mbps). When a unit fails, it does not affect others. CAN is an International Standardization Organization (ISO) defined serial communications bus originally developed for the automotive industry to replace the complex wiring harness with a two-wire bus. The specification calls for high immunity to electrical interference and the ability to self-diagnose and repair data errors. These features have led to CAN's popularity in a variety of industries including building, medical, and manufacturing. CAN is a two-wire, half duplex, high-speed network system and is well suited for high-speed applications using short messages.

B. PIC MICROCONTROLLER

The PIC18F458 is a high performance 10-bit microcontroller with integrated CAN module. The CAN module uses port pins RB3/CANRX and CAN RB2/CANTX for CAN bus receive and transmit functions respectively. These pins are connected bus via an MCP2551-type CAN bus transceiver chip. CAN bus is a very popular bus system used mainly in automation applications. The PIC18F458 microcontrollers provide CAN interface capability.

Figure.2. *PIC18F458*

C. HIGH-SPEED CAN TRANSCEIVER

The MCP2551 is a high-speed CAN transceiver, fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. The MCP2551 provides differential transmit and receive capability for the CAN protocol controller and is fully compatible with the ISO-11898 standard, including 5V to 24V requirements. It will operate at speeds of up to 1 Mb/s. Up to 112 nodes can be connected. Temperature ranges in industrial (I): -40°C to +85°C and extended (E): -40°C to +125°C.

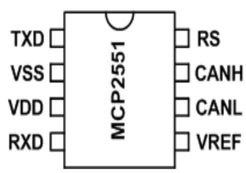

Figure.3. *MCP2551 CAN transceiver/receiver*

D. LM35 TEMPERATURE SENSOR

A temperature sensor LM35 is used for sensing the temperature of the environment and the system displays the temperature on an LCD in the range of –55°C to +150°C. The LM35 series are precision integrated-circuit temperature sensors. It draws only 60µA from its supply, so it has very low self-heating, less than 0.1°C in still air.

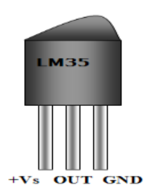

Figure.5. *LM35 pin configuration*

E. FUEL SENSOR

This was used to indicate the level of the fuel in the tank. A float sensor is attached to the fuel tank. The float sensor consists of a float which moves according to the fuel level in the tank. This float sensor sends the appropriate output signal according to the fuel level. When the output voltage from the sensor reaches a predetermined value, it is displayed on the LCD and alert to the driver.

F. ULTRASONIC SENSOR

For this research, using the ultrasonic module is more suitable than simple ultrasonic sensor. These sensors generate high frequency sound waves and calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. The sample diagram of HCSR-04 is given in Figure7.

Figure.7. *Ultrasonic ranging module HCSR-04*

G. DC MOTOR

It converts the electrical energy to mechanical movement. The main parts of DC motor as shown in figure 8 and there are rotor (armature), stator, commutator, field magnet (s), and brushes.

Figure.8.*The main part of DC motor*

H. SPEED SENSOR

Figure.7. *Speed sensor (IR rpm sensor ITR9813)*

ITR9813 is a photocoupler in which a high efficiency GaAs infrared light emitting diode is used as the light emitting element, and a high sensitivity phototransistor is used as the light detecting element. The two elements are arranged so as face each other, and objects passing between them are detected. The photosensor is not easily susceptible to output attenuation resulting from dust or particles. It is used to detect the revolution of the DC motor.

I. LIQUID CRYSTAL DISPLAY (LCD)

A liquid crystal display is special thin flat panel that can let light go through it, or can block the light. The 4x20 character LCD is used in this design. This LCD can shows 20 characters in each line and four lines in total. Thus, total 80 characters can be displayed. Figure 9 shows LCD display circuit.

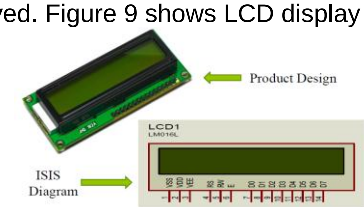

Figure.9. *LCD display*

IV. BLOCK DIAGRAM

Figure10 shows the block diagram of a simple three-node CAN bus–based system. The node1 reads the temperature and obstacle distance from each sensor and the node2 reads the fuel level from resistive fuel level sensor and the speed from speed sensor. The node3 receives the values which is sent from node1 and node2 at every second and displays it on an LCD.

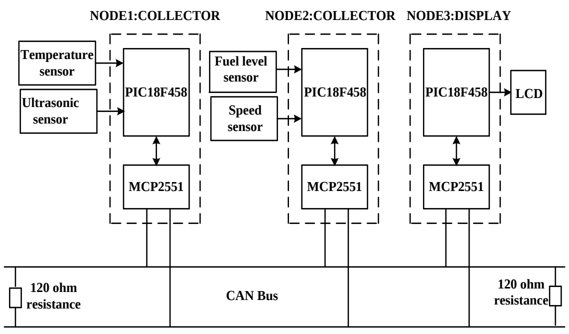

Figure.10. *Block diagram of the system*

V. SYSTEM PIN DIAGRAM

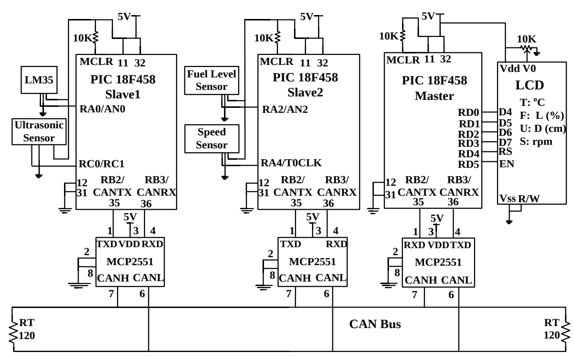

Figure.11. *Overall circuit diagram of Intelligent Driver Alert System*

Figure11 shows overall circuit diagram of the intelligent driver alert system which consists of transmitting and receiving section. Transmitting section consists of two slave controllers with built-in CAN module and MCP2551 transceiver chips. Analog input AN0 of the microcontroller is connected to a LM35DZ-type temperature sensor, RC0/RC1 is connected with ultrasonic sensor and AN2 is connected to fuel level sensor. The CAN outputs (RB2/CANTX) and (RB3/CANRX) of the microcontrollers are connected to the TXD and RXD inputs of MCP2551-type CAN transceiver chips. The CANH and CANL outputs of this chip are connected directly to a twisted cable terminating at the CAN bus. In the receiving section, LCD is connected to PORTD of the master controller to display the temperature values, speed, obstacle distance and fuel level.

VI. SYSTEM FLOWCHART

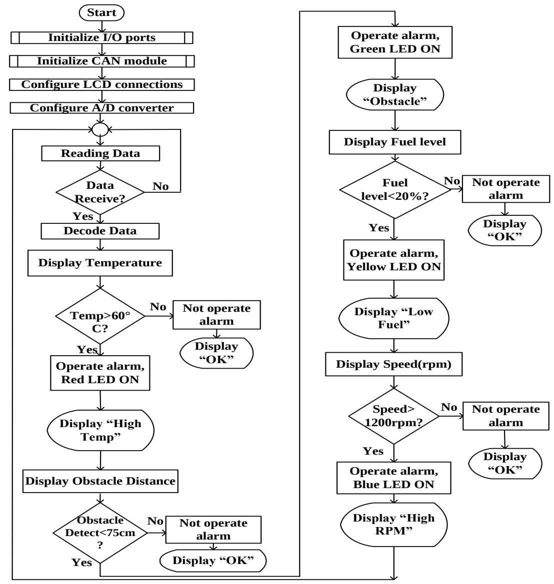

Figure.12. *Flowchart for intelligent driver alert system*

VII. TEST AND RESULT

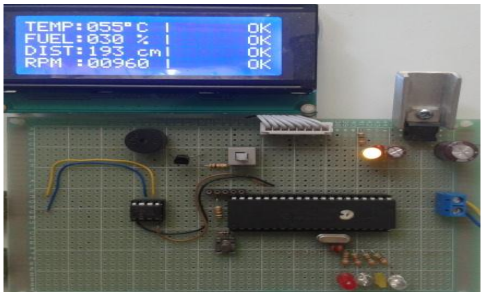

Figure.13. *Normal temperature condition (below 60 ° C)*

Figure13 shows the result of temperature sensor in ° Celsius (Centigrade) of normal condition. If the temperature of the engine is below 60° Celsius, the message "OK" is displayed on LCD and will not operated alarm.

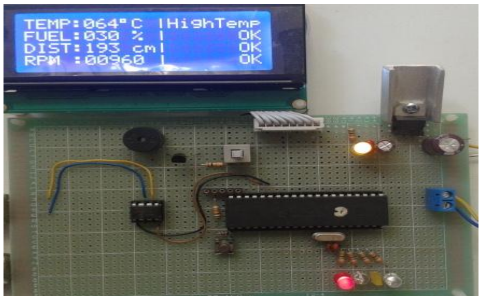

Figure.14. *High temperature condition (above 60 ° C, Red LED ON)*

If the temperature increases above the 60° Celsius, display it on LCD and alarm to user. Figure14 shows temperature increase above the 60° Celsius, display the message "High

Temp” on LCD and the driver will be given the instructions by the light signal to turn-on red LED.

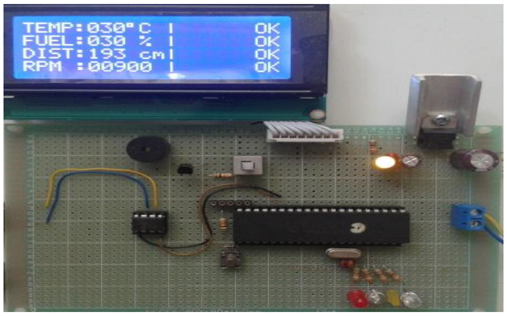

Figure.15. *Normal Fuel condition in Liters (fuel level above 20%)*

Aims at overcoming the drawbacks of this existing system by providing clear information to the user about the exact indication of fuel level digitally in liters and further distance to travel with the available fuel with respect to the different conditions of travelling such as in highways and heavy traffic roads there by removing the ambiguity to the user. Figure15 shows the status of fuel level above 20 percent in the fuel tank, display the message “OK” on LCD and will not operated alarm.

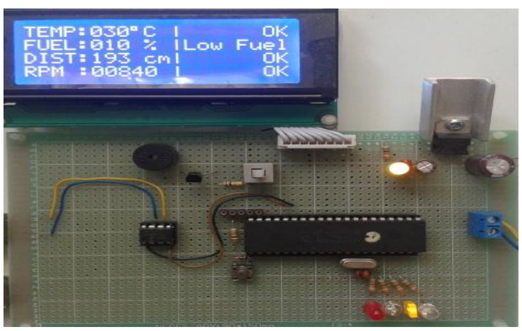

Figure.16. *Low fuel condition (below 20%, Yellow LED ON)*

Figure16 shows the fuel level continuously and display in the percentage if fuel level below 20 percent the controller gives buzzer to the driver and display the message “Low Fuel” on LCD, and turn-on yellow LED.

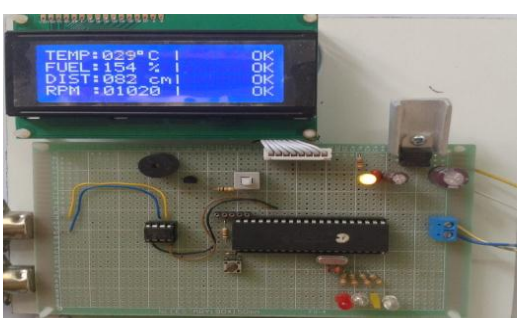

Figure.17. *Ultrasonic sensor in distance (centimeter) of normal condition*

Figure17 shows the result of ultrasonic sensor in distance (Centimeter) of normal condition. If an obstacle is not detected within 75cm near the vehicle, display the message “OK” on LCD and will not operated alarm.

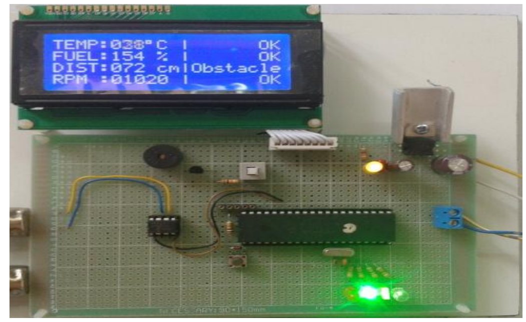

Figure.18. *Detection range within 75cm between obstacle and vehicle (Green LED ON)*

Figure18 shows the detection range of ultrasonic sensor. The distance measurement and warning messages will be displayed on LCD and alarm. When an obstacle is detected within 75cm from the vehicle, the status “Obstacle” is presented on LCD, and the driver will be given the instructions by the light signal to turn-on green LED.

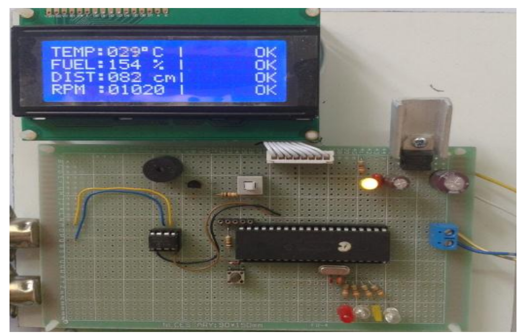

Figure.19. *Speed measure using RPM sensor (revolution below 1200 per minute)*

Figure19 shows the result of speed measure using RPM sensor (revolution below 1200 per minute) of normal condition. If the revolution is below 1200 per minute display the current values continuously and the message “OK” is also displayed on LCD and will not operated alarm.

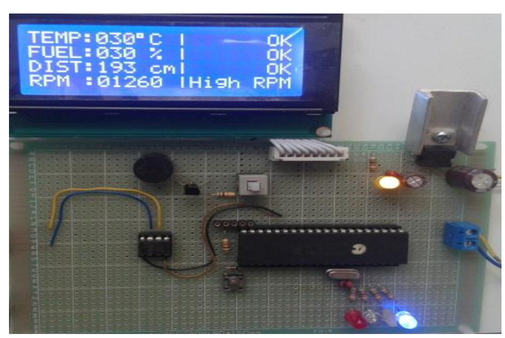

Figure.20. *Revolution increase up to 1200 per minute (Blue LED ON)*

Figure20 shows the result of speed measure using RPM sensor (revolution increase up to 1200 per minute). If the revolution increases up to 1200 per minute, display the current value of speed (rpm) and a message "High RPM" is also displayed on LCD, blue LED is turned ON and will operated alarm.

VIII. HARDWARE CONSTRUCTION OF INTELLIGENT DRIVER ALERT SYSTEM

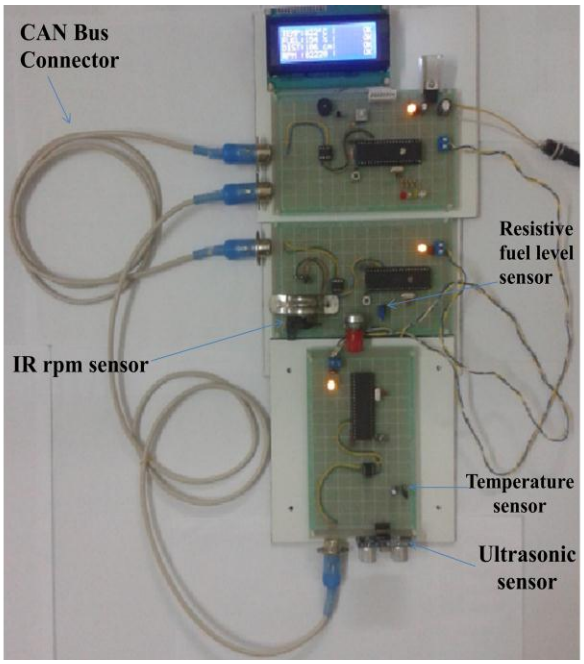

Figure.21. *Prototype of the intelligent driver alert system*

Figure21 shows the hardware construction of the intelligent driver alert system. In the intelligent driver alert system, the CAN is provide a high speed and the capacity is high it is capable for handling a large number of parameter with more efficiently. The status of vehicle like temperature (LM35 sensor) if the temperature increase above the 60 ^{o} C, if the revolution increase up to 1200 per minute, to check the fuel level continuously and display in the percentage if fuel level below 20 percent and the obstacle is detected within the vehicle 75cm from the vehicle controller gives buzzer to the driver and fuel level, obstacle distance, speed of the vehicle and temperature value continuously display on the LCD. The LCD provided at the driver's panel displays the alarm generated with different sensors. Alert during the various cases like high temperature of car engine and fuel level low, high speed and obstacle detect send the feedback to user by providing digital information's via LCD display and alarms.

IX. CONCLUSION

In this system, the CAN bus based communication system for intelligent driver alert system is designed. The status of car like fuel level indication, the speed of the vehicle, obstacle detection and temperature of car engine are displayed on LCD digitally, controller will send the signal information and alert to the user. The proposed high-speed CAN bus system solves the problem of automotive system applications. This system features efficient data transfer among different nodes and safety the driver and car in the practical applications.

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