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Automation of Accident Avoidance System Using Control Area Network

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Abstract:

Based on requirements of modern vehicle, in-vehicle Controller Area Network (CAN) architecture has been implemented. In order to reduce point to point wiring harness in vehicle automation, CAN is suggested as a means for data communication within the vehicle environment. The benefits of CAN bus based network over traditional point to point schemes will offer increased flexibility and expandability for future technology insertions. This proposed system presents an idea to develop a accident avoidance system with onboard sensors and microcontroller. A CAN-bus based communication system for accident avoidance system is developed. The system can be upgraded easily and use of CAN reduces wiring to a great extent. Also, use of ARM 7 processor ensures high efficiency, fast operation, and low power, low cost and higher performance. The proposed system which uses sensors to measure various parameters of the vehicle like obstacle detection, accidental lane change, and driver alcoholic status as well as road conditions. If any value goes out of range the system sends a warning signal to the driver to avoid accidents. In addition to this if accident occurs in any remote area then using MEMS sensor accident is detected and SMS is send immediately using GSM.

Keywords: ARM7, CAN, sensors

1. INTRODUCTION

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-vehicle 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 bytes 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 nondestructive 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).This project is implemented in two sections. First one known runs with ARM as master node and another one as normal ARM data acquisition as slave node to those sensors are temperature, gas, LDR, ultrasonic, IR, and MEMS accelerometer sensors are connected. The first one is automatic front head light adjustment system, the headlight cause glaring effect to the vehicle driver at that time vehicle are not controlling due to opponent vehicle, so here using LDR sensor it has resistor internally it has 1,00,000 ohm resistor, a light falls in to this sensor, its resistance will be reduces for automotive. Second one is temperature monitoring system in an automotive engine location. So approximately the engine heat produces from 100 to 135 degree Celsius, then the continuous of engine heat will damage the fuel tubes, power supply wires and control signal wires. Third one is gas leakage detection and protection, In India local four wheelers are used LPG as fuel for better millage purpose but they don't know the risk in LPG arrangements at tank locations, so some conditions fuel tubes are damaged then the accidents are occurred. Fourth one is obstacle detection and collision avoidance for automotive. When the obstacle is near suddenly then accidents are occurring. So, to avoid this accidents for automotive.

RPM counter by using IR sensor is vehicle controlling purpose and MEMS accelerometer sensor is the purpose of vehicle position level. So, the communications between two nodes are accomplished through high speed CAN communication. This proposed system has hardware and software. Surface mount device (SMD) hardware used in this proposed system. Both master and slave nodes are communicating through vehicle communication bus

controller area network (CAN) protocol. CAN protocol was developed in the year 1980 by Robert BOSCH. CAN is a message based serial communication protocol which transfers 8 bit data. The CAN bus is special purpose for only developed for vehicle communication it can transfers data up to 1Mega byte per second speed. CAN protocol needs CAN transceivers to exchange the data from one node to another node, in this proposed system has MCP2551 CAN transceiver. Sensors are connected are Gas, Ultrasonic, Temperature, IR, MEMS, and LDR. The master node will collects all these information through CAN network and stores in three sessions. To acquire the results, respective session switches are provided at the master node. These results can be monitoring section.

Block diagram:

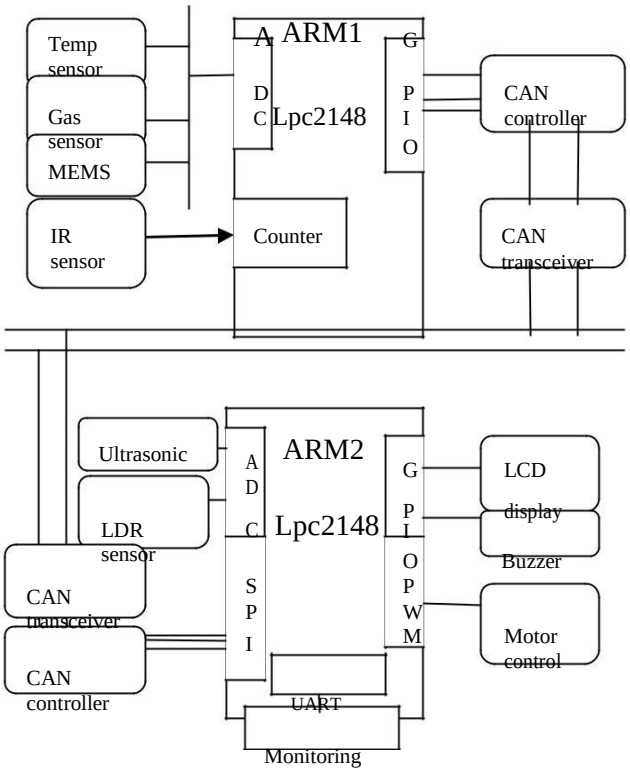

Figure1: Block Diagram

II. Designing and implementation

An intelligent of vehicles system that works by collecting and sending actual, real-time data directly from the vehicle, whenever it is being driven and upload in a serial communication. MEMS sensor is an electronic device which provides voltage analogue of the temperature of the surface on which it is mounted. The voltage variation in the MEMS is produced from a G-cell sensor in the module. Which generate voltage output depend on the tilting angle. This voltage will be passed to the ARM processor ADC channel 0. Then the ADC converter will give a digital value and it will be transferred through the CAN protocol and it reaches the serial communication.

The smoke level in the automobile we are using gas sensor. In this proposed system, MQ5 sensor uses which pick up heat changes in the sensor element and quick response to the change in the gas parameter like liquefied petroleum gas and methane. This sensor has excellent sensitivity, fast response.Ultra sonic is used to find the obstacle detection. Which can be broken down in to three functional units, there are namely the receiving, transmitting circuit, and the MCU circuit. The receiver and transmitter circuit can work independently of the MCU, and it has own clock & own generate pulses. IR sensor is used to find the RPM (Revolutions Per Minute) of the motor. An IR will pass an invisible light to the photodiode. Due to this the photodiode will conduct. If any objects interrupt to the transmission, then the photodiode will stop the conduction. This conduction and non-conduction condition of the photodiode will pass high and low signal to the controller. These signals will be counted through capture input of the controller and will be calculated as the RPM. The finalized value will be transmitted through the RS232 to the personal computer.

III. System Hardware

LPC2148 Processor:

Due to their tiny size and low power consumption. LPC2148 are ideal for applications such as access control and point of sale. It has 8-32kb of on chip SRAM and 32-512kb of on chip flash program memory.

This controller has 64 pins and 2 ports. Port1 is mentioned port 0.0 to port 0.15 and port 0.16 to port0.31, port 1.0 to port 1.15 has debugging pins and port 1.16 to port 1.31 is available. This controller requires oscillations, Then clock is provided by crystal oscillator. 12MHZ external crystal oscillator we are interfacing to the micro controller. But the controller operating frequency is 60 MHZ. so, 12MHZ to 60 MHZ why we are achieving means by using PLL concept. PLL nothing but an oscillator followed by a multiplier circuit. So, by using multiplier circuit we are introducing the operating frequency of the controller. And by using this microcontroller we want to interface are communicate some other peripherals. So, 128 bit wide interface enables high speed 60 MHZ operation. Serial communication interface at ranging from a

USB2.0 full speed device, multiple UARTs, SPI, SSP to I2C bus and on-chip SRAM of 8kb up to 40 kb.

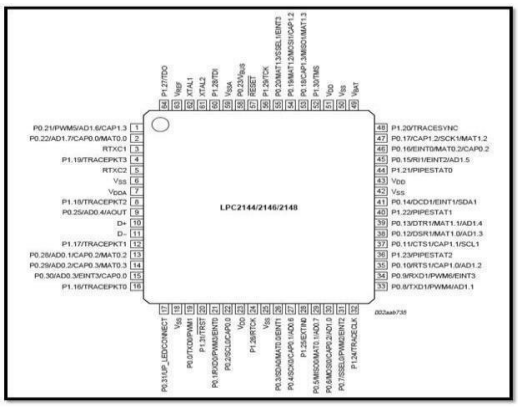

Figure2: LPC2148 microcontroller

MEMS sensor:

MEMS accelerometer is one of the simplest but also most applicable micro-electromechanical systems. They became indispensable in automobile industry. It cans measures acceleration forces. These forces like the constant force of gravity pulling at our feet, or vibrating the accelerometer. MEMS is used for mainly depends on tilt angle. For example, vehicle is moving any wheel is problem then in normal position any small changes will access. So that why we are using means controlling purpose. We are taking that what is the position level of that vehicle for monitoring purpose.

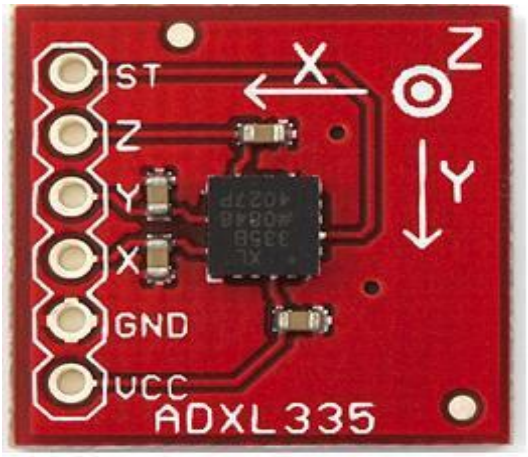

Figure3: MEMS Accelerometer Sensor

RPM Controller By Using IR Sensor:

IR transmitter and receiver can be obtained at low cost. This sensor shape is looks like the same as LED. The transmitter always comes in clear LED while receiver is in black color. Specific frequency 38KHZ is used in remote control, IR transmitter will emit infra-red when power is in ON. You can connect the IR transmitter like a LED together with a current limiting resistor. I am using 330 ohms resistor for the IR transmitter. The current limiting resistor is used to avoid too much of current passing through the transmitter and it will remove.

Figure4. IR sensor

Temperature sensor:

The LM35 pin diagram is shown in figure5. As a temperature sensor, the circuit will read the temperature of the surrounding environment and relay temperature to us back in degrees Celsius. It has +5vDC power supply.

This is ideal because the arduino's power pin gives out 5 of power. This sensor has just 3 pins, 2 for power supply and one for analog output. The output pin provides an analog voltage output that is linearly proportional to the Celsius (centigrade) temperature. Pin 2 gives an output of 1mv per 0.1degree centigrade (10mv per degree). So get the degree value in Celsius.

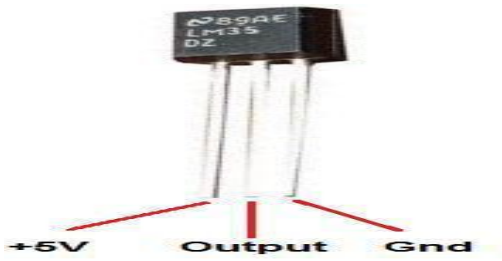

Figure5.TemperatureSensor LM35

Gas sensor:

Gas sensor has 4pins. Here we are using 3 pins only. 2 for power supply, 1 for linear output, 1 for digital output. Linear output means analog output; digital output is 0 and 1. If we want when the gas is leaked are not it is connected to digital. If you want how much quantity of gas is leaked must connect analog pin. If you are connected analog pin, So that you can convert analog to digital we can measure the data, otherwise the gas is detected are not means we can simply connect digital data. Here we are not connected digital pin so here we use as linear pin only. This sensor is used to detect the presence of a dangerous LPG leak in your car or in a environment. This can be easily incorporated in to an alarm unit to sound an alarm or give a visual indication of the LPG concentration.

Figure6. Gas Sensor

Ultrasonic Sensor:

The ultrasonic sensor is to find the distance through an echo pulse. The sensor provides precise, stable and non-contact measurements from 2cm to 4meters with very high accuracy. Ultrasonic sensor has 4pins.There are 2 power supply, Trig, and Echo. Here transmitter and receiver is mentioned, so transmitter whenever trigger is enabled, transmitter will send the clock pulses it will send 8 clock pulses and then it wait for the echo.When there is an obstacle, these emitted pulses reflected back to the receiver. When the receiver receives echo pin response with high. Then echo becomes high we have a obstacle here. And it is using 16MHZ crystal oscillator, it is having its own clock generate pulses from own.

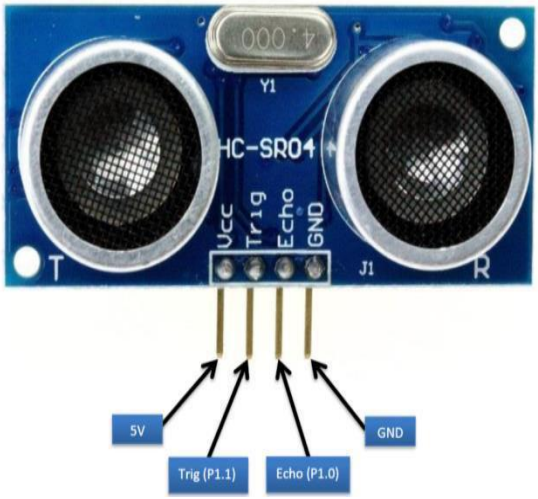

Figure7. Ultrasonic Sensor

Light Dependent Resistor (LDR) Sensor:

The cell resistance falls with increasing light intensity, two cadmium sulphide, and photo conductive cells with spectral responses similar to that of the human eye. Applications include smoke detection, automatic lighting control, and batch counting and burglar alarm systems

In LDR sensor, internally it has 100,000 ohm resistor, a light falls in to this sensor its resistance will be reduces. So here we are one more resistor for the purpose of giving less voltage to the sensor.

So, this LDR sensor light source on then its resistance will reduces. The more current is low from one end to other end; when more current will flow get the LED indication. If you want light when the light focus is less at that time also it will glow.

Figure8. LDR sensor

Wired communication: CAN overview

The development of CAN began when more and electronic devices were implemented in to modern motor vehicles. Examples of such devices include under protocol such as engine management system and lighting system, gear control. All this means more safety and comfort travel for the driver and of course a reduction of fuel consumption and exhaust emissions. To improve the behavior of vehicle even further, it was necessary for the different and their sensors to exchange information. This was usually done by 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. The solution to this problem was the connection of the sensors via serial bus system. This bus had to fulfill some special requirements due to its usage in a vehicle. With the use of CAN means all sensors wiring complexity increases. So, it is replaced by one serial bus connecting all sensors. So, this means CAN is used for to reduce wiring complexity. This is accomplished by adding some CAN specific hardware to each sensor that provides the protocol for transmitting and receiving information via the bus.

LCD display:

Liquid crystal display (LCD), have materials is combination of both properties of liquids and crystals. Other than having a melting point, they have a temperature range which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered from similar to a crystal. This LCD is uses for display the results with the help of master node.

DC motor:

Motors are converting from electrical energy in to mechanical motion; motors are powered by a source of electricity–either AC or DC. It uses direct current sources of electricity such as batteries and DC power supply. The principle of how motor works means the electrical current flowing in a loop of wire. It will produce a magnetic field across the loop, when this loop is surrounded by the field of another magnet of the loop will turn producing a force such as the rate of change of rotation is called torque. That result is in mechanical motion. These are includes in AC motor types such as single phase and multiphase motors, universal, servo motors, induction, gear motor as well as linear, stepper, air motors, motor contactors and starters.

Figure9: DC motor

Relay:

We are using motor it is required 5V and 9V, so operating voltage is 9V to 12V. Motor having two control pins, if two control pins are directly to the board then it cannot execute. Why because it is not required output voltage. If we are connected to external power supply, when it is not connected to the board. So that purpose we are using the relay circuit. By using the relay circuit we can interface board, motor and external power supply to the controller. Then Relay is connected to the motor. When a condition is exceeded like gas is leaked, it will be detected. Whenever obstacle is needed then it will be detected. Whenever condition is exceeded at that time it will go ON/OFF condition.

IV. Experimental results

The prototype figure is as shown in below.

Figure10. Prototype

In this project, the monitoring section is Serial port to USB cable is connected from master node to personal computer by using RS232 cable through hyper terminal software as shown in below figure.

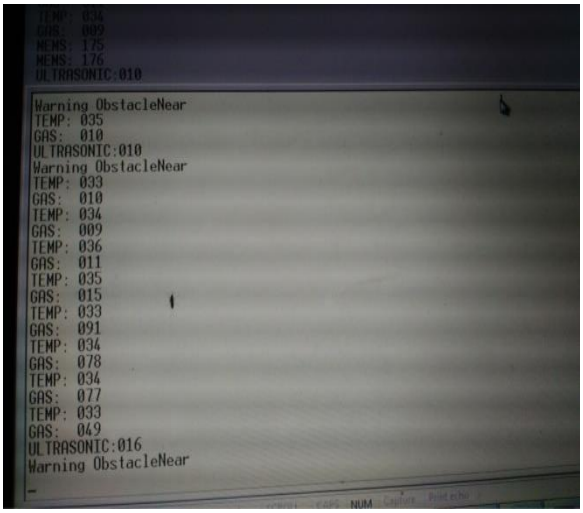

Figure11. Monitoring Section

V. Conclusion

Using the intelligent of vehicles, A system that works by collecting and sending actual, real-time data from the car whenever it is being driven to a CAN network is implemented in this paper. The acquisition node collects the sensor information to the processing node through CAN network and will be transmitted to the monitoring section. This project will bring an efficient improvement in the vehicular network.

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