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Car Safety using CAN Module and Multi sensors

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Abstract-*In this paper we present the concepts and methods developed for the activities in communication systems for car-to-car communication to avoid Vehicle crash. From such communication systems, Controller area network (CAN) is a computer network protocol and bus standard designed to allow microcontrollers and devices to communicate with each other without a host computer. Modern automobiles are no longer mere mechanical devices; they are pervasively monitored and controlled by dozens of digital computers coordinated via internal vehicular networks. From a network-based systems the controller area network (CAN) to evaluate the feasibility of using such an in modern cars for a cooperative driving. The CAN module and multiple sensors have added in system for the passengers and vehicle safety. The cooperative and safe driving can be achieved by drivers by analysing another close vehicles data by drivers of car on their Dashboard.*

***Keywords*— Controller Area Network (CAN), Sensors, Automobiles, Microcontrollers, communication systems, Dashboard**

I. Introduction

Cooperative driving improves vehicle safety by exchanging vehicle data, so the driving status of neighboring vehicle can be observed in advance and thus the response time will be less. The vehicle gateway designs the information fusion of in-vehicle sensor data and wireless communication packets. The vehicle data is exchanged through vehicle-to vehicle communications and the GPP of vehicle gateway informs the SPP that the latest vehicle data were received. The information fusion engine in SPP will integrate local vehicle sensor data and the acquired neighboring vehicle information, and implement information fusion to generate several safety indexes and produce warning messages. First inspiration in this direction was our subject Automobile field and Embedded systems in which we studied the principles governing control systems. In this system multiple sensors are used to make driving safe and cooperative. In this system we are implementing cooperative driving system using CAN protocol. Here we will be measuring some parameters (temperature, pressure, Accelerator) using respective sensors. The sensor output will be transmitted through RF transceiver module (CC2500).

This data is received on PIC microcontroller (PIC 18F4680) acting as vehicle 1 of CAN transmission bus and then transmitted to the other vehicle of CAN through MCP2551. The transmission between vehicle 1 and vehicle 2 is done with the help of two wires, connecting them to TX and RX pins of MCP2551. This data is received on receiving section of communication system of CAN bus i.e., vehicle 2 which is second PIC microcontroller. This data is then displayed on graphics LCD.

II.MULTISENSOR INFORMATION FUSION

Each type of sensor has its own advantages and disadvantages to measure environmental parameters, while the similar type of sensors in different cars may have different kinds of precision or fault. In order to have full coverage to the detection of surrounding objects coming close to a host vehicle to prevent from collision.

Signal Processing

The input signals from accelerometer, LPG sensor, temperature sensor are processed or received by the microcontrollers of system or vehicle gateway, and the processed data is transmitted to nearby vehicle and own.

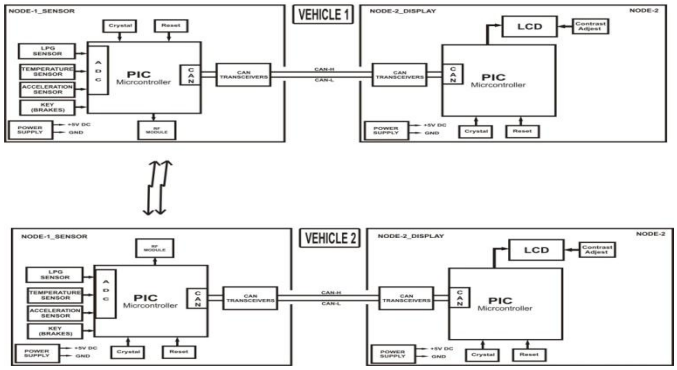

Fig.1-Block diagram of Car safety Warning System for Cooperative Driving.

Block Diagram Description

In this project there is the Wireless sensor Node and CAN Node. In this two vehicle system is designed and every vehicle has 2 nodes. The Sensor like LPG and temperature sensor would be connected to the Microcontroller PIC. The Sensor gives the analog output which is further given to the ADC which is inbuilt in the microcontroller. This data is processed and further given to the RF wireless module which will convert the digital data in RF waves. The RF module used is CC2500 from CIPCON Company. Further the data is transmitted to the

RF Receiver which will receive the data and Processed in the PIC microcontroller. The PIC microcontroller Used is 18F4685 which is has inbuilt CAN support. The PIC microcontroller Process the data further passed the data on the CAN bus through CAN Transceiver. The Data is received at the CAN display node where the LCD 128 X 64 is connected to the Microcontroller.

III. SYSTEM HARDWARE

The complete system consists of several modules and protocols, each of which is described in the following sub-sections

A. Accelerometer Module:

Small board size - Just 28mm X 23mm Simple 5 pin interface (VCC, GND, Xout, Yout, Zout) Selectable Sensitivity (1.5g/2g/4g/6g) and Sleep Mode Selectable through jumpers or microcontroller Needs no external components Easy to mount on General purpose PCB, Breadboards and special PCBs Low Current Consumption: 500 μA Low Voltage Operation: 3.6V to 5V High Sensitivity (800 mV/g @ 1.5g) for small movements Fast Turn On Time Integral Signal Conditioning with Low Pass Filter Robust Design, High Shocks Survivability.

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs .The product measures acceleration with a minimum full-scale range of • }3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. Small, low profile package 4 mm × 4 mm × 1.45 mm LFCSP Low power : 350 μA (typical) Single-supply operation: 1.8 V to 3.6 V 10,000 g shock survival Excellent temperature stability

B. MQ7: LPG Sensor

This sensor is very much sensitive to LPG. They are used in gas detecting equipments for LPG in domestic, industry and in car.

C. RF Module

RF Transceiver 2.4 GHz, SPI Interface, 30 meters range This is an FSK Transceiver module, which is designed using the Chipcon IC(CC2500). It is a high performance and low cost module it have 30 meters range with onboard antenna. This has High sensitivity (type -104dBm) this trans-receiver will be used together with a microcontroller. It provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication and wake on radio.

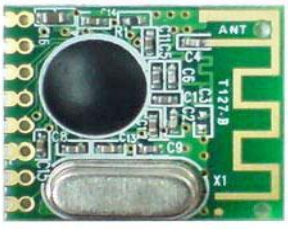

Fig2-RF Module

D. CAN Bus

It is used for vehicle monitoring system and fault diagnosis. It is a combination of hardware and software which can receive data, analyze data and display vehicle status and fault information on screen. CAN Protocol was designed specifically for automotive and home automation applications but is now also used in other areas. Controller-area network (CAN) is a computer network protocol and bus standard designed to allow microcontrollers and devices to communicate with each other without a host computer. The CAN bus may be used in to connect different sensor, display, PC etc., and can support 1 Mb/s operation. It implements ISO-11898 standard physical layer requirements. This module is Suitable for 12V and 24V systems. Externally-controlled slope for reduced RFI emissions with Low current standby operation and protection against damage due to short-circuit conditions (positive or negative battery voltage) also having Protection against high-voltage transients. It has Automatic thermal shutdown protection.

E. Microchip PIC18

PIC-18F4685 is an enhanced flash microcontroller with CAN. The PIC18, which includes a RISC CPU running up to 10 MIPS, with 16-bit wide instructions and 8-bit wide data path, is dedicated to the ECUs functioning as low-end I/O control or data acquisition. There are 4 timers, one capture/compare/ PWM module and up to 8 channels 10-bit ADC modules and a Master Synchronous Serial Port operating with SPI or I2C mode.

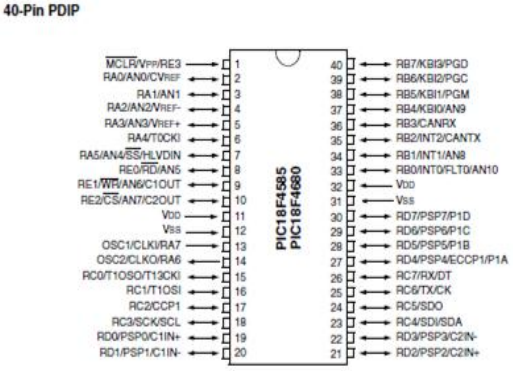

Fig3-PIC-18F4685

F. SENSORS

Different types of sensors are used for capturing vehicle data or driving status. The raw data are pre-processed by the control units and then mixed in the vehicle gateway. Some off the-shelf sensors, like GPS receivers, are manufactured as full Function modules, so the processor in the module processes the signals and output the measuring results with defined format through a standard interface.

G. Vehicle gateway

Because of the advance of integrated circuit technology, an ECU not only shrinks the size and reduces the power consumption, but provides more complicated functionality and data processing capability. Moreover, a multi-core processor is feasible for decreasing the amount of chip components eliminating the cable connection, and lowering down the cost.

H. Electronic control unit

The ECUs are used for acquiring vehicle sensor data, diagnostic information and human physiological signals, and transmit them to the vehicle gateway after some pre-processing computation.

Tire Pressure Monitoring Systems

Dashboard

TPMS systems measure the actual tire pressure using sensors which incorporate radio transmitters. The radio signals are picked up by a receiver unit which provides an alarm signal to the driver. Various types of information can be provided for the driver (alarm lamp, actual pressure, audible alarm, voice), and the sensors are either internally wheel mounted or may be externally fitted on the tire valve in place of the valve cap.

More advanced TPMS show the actual tire pressure on a display/receiver unit inside the vehicle. Actual tire pressure is measured by miniature sensors in each wheel which each transmit an encoded radio signal. The receiver/display is a digital back-lit display unit which recognizes your vehicles pre-coded radio signals and sounds an alarm at high or low pressure conditions. Some also indicate and monitor tire temperature.

The system has got a buzzer to indicate the abnormality for a lame user who cannot understand the display contents. The first passenger vehicle to adopt tire-pressure monitoring (TPM) was the Porsche 959 in 1986.

IV. Project Implementation

In this project there is the Wireless sensor Node and CAN Node. The Sensor like LPG and temperature sensor will be connected to the Microcontroller PIC. The Sensor gives the analog output which is then given to the ADC which is inbuilt in the microcontroller. This data is processed by microcontroller and further given to the RF wireless module which will convert the digital data into RF waves. The RF module used in system is CC2500 from CIPCON Company. Further the data is transmitted to the RF Receiver which will receive the data and Processed in the PIC microcontroller. The PIC microcontroller Used is 18F4685 which is has inbuilt CAN support. The PIC microcontroller Process the data further passed the data on the CAN bus through CAN Transceiver. The Data is received at the CAN display node where the LCD 128 X 64 is connected to the Microcontroller. In this there are two nodes. The one node is connected to the RF modules which receives the wireless data transmitted by the sensor network. The PIC microcontroller would be used for the Node 1 and Node 2. The MCP2551 transceiver would be used as CAN transceiver.

The two nodes would be connected on the CAN bus

The node 2 would be connected to the graphics LCD which displays the sensor data.

The Crystal would be used for the clock generation.

In modern Automotive there are around 20-50 ECU (Electronic Control Units) connected on CAN

How does an RF communication system work?

Imagine an RF transmitter wiggling an electron in one location. This wiggling electron causes a ripple effect, somewhat akin to dropping a pebble in a pond. The effect is an electromagnetic (EM) wave that travels out from the initial location resulting in electrons wiggling in remote locations. An RF receiver can detect this remote electron wiggling. The RF communication system then utilizes this phenomenon by wiggling electrons in a specific pattern to represent information. The receiver can make this same information available at a remote location; communicating with no wires.

In most wireless systems, a designer has two overriding constraints: it must operate over a certain distance (range) and transfer a certain amount of information within a time frame (data rate). Then the economics of the system must work out (price) along with acquiring government agency approvals (regulations and licensing).

V. Conclusions

The vehicle gateway and safety based on a heterogeneous multicore platform and use of sensors is establishing, and several ECUs are interconnected with the gateway through wired or wireless communications. The multi-sensor information merging is implemented for computing the particular position, velocity and acceleration to the host vehicle, so the potential crash risk can be assessed and the cooperative and safe driving feature is provided by exchanging vehicle data with surrounding vehicles through wireless communications. This design proposes the realization of cooperative driving to enhance the active safety.

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