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Vehicle Health Monitoring System Using CAN

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Abstract: This paper is implemented for Vehicle Health Monitoring System Using CAN. Now a days, the focus is on vehicle interior network application and the wireless data transmission technology. This system is based on the widely used CAN bus technology. CAN bus is used to extract the vehicle's status or fault information. When the vehicle breaks down, the status of vehicle will be sent as SMS to the control system using GSM technology and position of the vehicle with the help of the GPS. In automotive electronics the important parameters such as battery level detect, brake fluid level detect, speed sensing system, fuel level detect system etc. are obtained using CAN.

Keywords- **Vehicle Network; CAN topology; Sensors; GSM and GPS technology.**

I. INTRODUCTION:

With the advent of development of electronics technology, the automotive field has undergone drastic changes in terms of customer comfort and safety. The structure of vehicles has become more complex. Increased degree of automation has been incorporated in the design of the vehicle. Significant safety features have been added at lower costs.

This system is based on the widely used CAN bus technology, to extract the vehicle's status or fault information. The increasing complexity of automotive electronic control system makes automotive fault diagnosis and maintenance work more difficult. Transfer of large amount of data and exchange of different signals between electronic control systems on the bus vehicle is essential. Therefore vehicle interior network came into existence. CAN (Controller Area Network, CAN); relying on its stability performance, low price and high reliability and real-time, has now been widely used in automotive internal network. GSM and GPS technology are used for sending information of vehicle status when it faults are detected**.** The GPS system will provide location and time. GPS provides accurate location and time information for an unlimited number of users in all weather, day and night, anywhere in the world. It has the advantages of a wide coverage, high accessing speed, charging according to the flow rate.

II. RELATED WORK:

CAN: The Controller Area Network (the CAN bus) is a serial communications bus for real-time control applications; operates at data rates of up to 1 Megabits per second, and has excellent error detection and confinement capabilities. CAN was originally developed by the German company, Robert Bosch, for use in cars, to provide a cost-effective communications bus for in-car electronics and as alternative to expensive, cumbersome and unreliable wiring looms and connectors. The car industry continues to use CAN for an increasing number of applications, but because of its proven reliability and robustness, CAN is now also being used in many other control applications. CAN or Controller Area Network is a robust industrial strength hardware and software protocol used to communicate between microcontrollers. It is very popular in modern automotive applications and is gaining popularity in industrial and home automation applications.

Working Principle:

Data messages transmitted from any node on a CAN bus do not contain addresses of either the transmitting node, or of any intended receiving node.

Instead, the content of the message (e.g. Revolutions Per Minute, Hopper Full, X-ray Dosage, etc.) is labeled by an identifier that is unique throughout the network. All other nodes on the network receive the message and each performs an acceptance test on the identifier to determine if the message, and thus its content, is relevant to that particular node. If the message is relevant, it will be processed; otherwise it is ignored. The unique identifier also determines the priority of the message. The lower the numerical value of the identifier, the higher the priority. In situations where two or more nodes attempt to transmit at the same time, a non-destructive arbitration technique guarantees that messages are sent in order of priority and that no messages are lost.

Bit encoding:

CAN uses Non Return to Zero (NRZ) encoding (with bit-stuffing) for data communication on a differential two wire bus. The use of NRZ encoding ensures compact messages with a minimum number of transitions and high resilience to external disturbance.

The physical bus

The two wire bus is usually a twisted pair (shielded or unshielded). Flat pair (telephone type) cable also performs well but generates more noise itself, and may be more susceptible to external sources of noise.

Robustness

CAN will operate in extremely harsh environments and the extensive error checking mechanisms ensure that the transmission errors are detected. See the 'Error Handling' section of this site for more details.

http://www.kvaser.com/zh/about-can/the-can-protocol/23.html

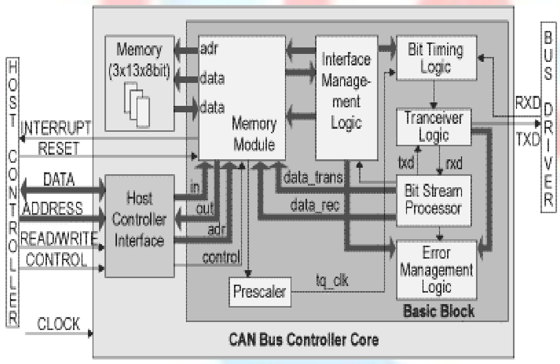

Fig.1:Block diagram of CAN protocol

Types of CAN:

There are two types of CAN implementations depending in the size of the identifier field. 1) STANDARD: 11-bit wide identifier field. 2) EXTENDED: 29-bit wide identifier field. The Standard CAN protocol (version 2.0A) also now known as Base Frame Format supports messages with 11 bit identifiers.

The Extended CAN protocol (version 2.0B), also now known as Extended Frame Format, supports both 11 bit and 29 bit identifiers.

Most 2.0A controllers transmit and receive only Standard format messages, although some (known as 2.0B passive) will receive extended format messages –which can be ignored. 2.0B controllers can send and receive messages in both formats.

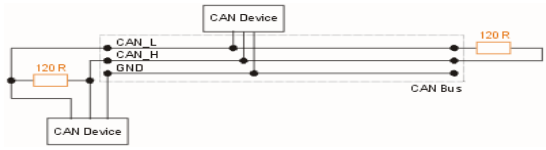

Fig.3: Implementation of CAN protocol

GSM MODEM:

GSM stands for Global System for Mobile Communication. It is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz

The GSM modem basically consists:

- SIM card holder to hold the activated SIM card for sending and receiving SMS.
- 5V AC power supply header to which the 5v ac adapter is connected.
- Power led which gives the indication of modem status that is on or off.
- 9 pin female to which the GSM antenna is connected.

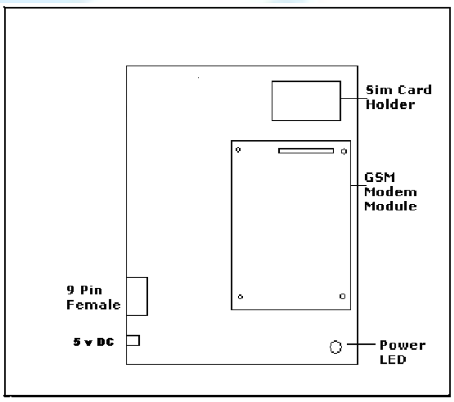

Fig.4. GSM Modem Block Diagram.

Through the mobile equipment the network messages are sent and received. These messages are sent to the terminal adapter which is

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also known as GSM data card. Now if some data is to be sent to the mobile equipment then the terminal equipment (basically a computer or processor) sends out AT commands to the terminal adapter which in turn sends the mobile equipment the required data. The GSM modem being a serial communication device is connected to the serial port or a serial device through a serial connector. The power input to the modem is given through a 9V ac adapter.

The LED will indicate different status of the modem:

- OFF (Modem Switched off)

- ON (Modem is connecting to the network)

- Flashing Slowly (Modem is in idle mode)

- Flashing rapidly (Modem is in communication mode)

GSM Specifications:

Bandwidth: The broader the bandwidth, the faster the data can be sent.

Bits per second (BPS): A single on-off pulse of data. Eight bits are equivalent to one byte.

Frequency: The number of cycles per unit of time. It is measured in Hertz between uplink and downlink. A channel has two frequencies,80 MHz a part.

Channel Separation: The separation between adjacent carrier frequencies is 200 KHz.

Transmission rate: GSM is a digital system with the over the air bit rate of 270 kbps.

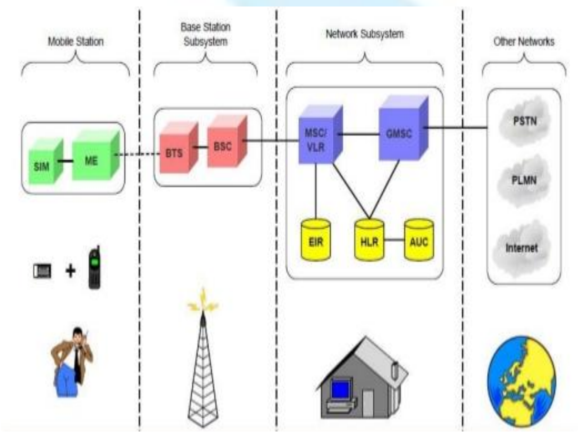
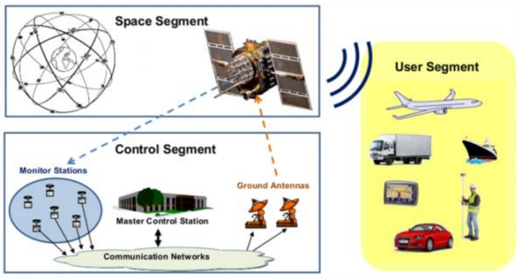


Fig.5:Architecture of GSM network

GPS:

The **Global Positioning System** (**GPS**) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.



A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth. Each satellite continually transmits messages that include

- the time the message was transmitted
- satellite position at time of message transmission

The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite using the speed of propagation of electromagnetic waves. Each of these distances and satellites' locations define a sphere. The receiver is on the surface of each of these spheres when the distances and the satellites' locations are correct. These distances and satellites' locations are used to compute the location of the receiver using the navigation equations. This location is then displayed, perhaps with a moving map display or latitude and longitude; elevation or altitude information may be included. Many GPS units show derived information such as direction and speed, calculated from position changes.

The current GPS consists of three major segments. These are the space segment (SS), a control segment (CS), and a user segment (US). The U.S. Air Force develops, maintains, and operates the space and control segments. GPS satellites broadcast signals from space, and each GPS receiver uses these signals to calculate its three-dimensional location (latitude, longitude, and altitude) and the current time.

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The space segment is composed of 24 to 32 satellites in medium Earth orbit and also includes the payload adapters to the boosters required to launch them into orbit. The control segment is composed of a master control station, an alternate master control station, and a host of dedicated and shared ground antennas and monitor stations. The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service and tens of millions of civil, commercial, and scientific users of the Standard Positioning Service (see GPS navigation devices).

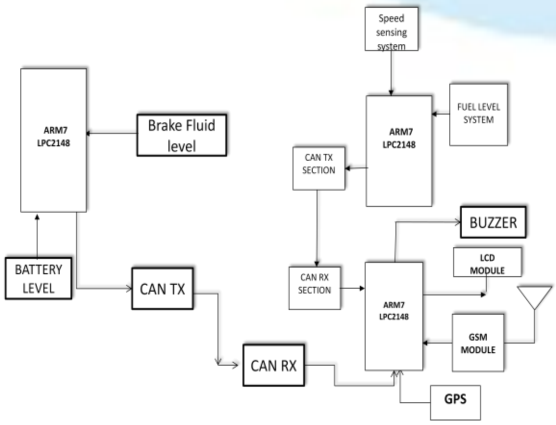
In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly stable clock (often a crystal oscillator). They may also include a display for providing location and speed information to the user.

GPS receivers may include an input for differential corrections, using the RTCM SC-104 format. This is typically in the form of an RS-232 port at 4,800 bit/s speed. Data is actually sent at a much lower rate, which limits the accuracy of the signal sent using RTCM.

The navigational signals transmitted by GPS satellites encode a variety of information including satellite positions, the state of the internal clocks, and the health of the network. These signals are transmitted on two separate carrier frequencies that are common to all satellites in the network.

Implementation:

In the implementation of our prototype system, vehicle interior network structure can use topology bus network. All the electrical systems nodes inside the bus vehicle are attached to the CAN bus through their own respective CAN communication module. Here we have used two slaves and one master.



CAN/SMS Wireless Gateway not only be used to organize and coordinate all the interior electrical systems nodes, but also can be used as internal and external communications data interface. It gathers the information from all the interior electrical systems nodes sent to the remote monitoring service center computer via SMS wireless module. This paper focuses on vehicle health monitoring system based on CAN bus and SMS, which can be used to improve the efficiency of monitoring, to maintain the system security, to lower the maintenance costs as well as the operating costs. With the development of the mobile technology, the design will be made better; the data transmission based on wireless communication will be used more widely. The communication network designed is able to stay stable in a long run in the experiment and meets the expected target and also we can locate the target.

Here, Keil cross compiler will be used for building the applications. LPC2148 development board has been used to test the built application. Flash magic software is used to dump the Hex file in to the Microcontroller.

V. CONCLUSION:

The paper focuses on vehicle health monitoring system based on CAN bus, which can be used to improve the efficiency of monitoring, to maintain the system security, to lower the maintenance costs as well as the operating expensed. With the development of the mobile technology, the design will be made better; the data transmission based on wireless communication will be used more widely. The communication network designed is able to stay stable in a long run in the experiment and meets the expected target. In future we can extend this project further by connecting more devices to make configuration of a vehicle health monitoring system more effective.

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