NETWORK-BASED IN-VEHICLE BODY BUS CONTROL SYSTEM WITH FAULT DETECTION

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ABSTRACT

It is a tremendous requirement that more things will be possible to connect to the Network and there will be a great advantage that combines the Internet and in-vehicle bus control network. In this paper, we propose the design and implementation of a network-based in-vehicle body bus control system with fault detection. Then fault-detection methods for single signals without models like limit and trend checking and with harmonic and stochastic models, like Fourier analysis, correlation and wavelets are treated. This is followed by fault detection with process models using the relationships between signals like parameter estimation, parity equations, observers and principal component analysis.

Key Words: Network-based Control System, Embedded C, keil compiler

I. MOTIVATION

With recent advantages in processor miniaturization and wireless technology, as well as the decreasing manufactur- ing cost of the devices, there is a tremendous requirement that more things will be possible to connect to the Network . Automobiles, which are embed-ded dozens or hundreds of electronic control units, are no exception to this trend. Connecting automobile to the Network allows to transmit all information on the automo- bile, not only the information brought by some people vis-iting the web site, but also the information of automobiles themselves, such as velocity, position, lamp status, water temperature, throttle opening and so on. On the other hand, vehicle bus network technology has been generated to solve problems as the body wiring complexity, space constraints and some reliability problems which traditional electronic control system brought, although it can improve a ve- hicle's dynamics, economy and comfort. Vehicle bus net- work is in the integration of computer networks and mod- ern control technology and has many advantages, such as a significant reduction of wiring harness, reducing body weight and costs, improving the efficiency of fault diagno- sis and enhancing the level of intelligent control. There will be a great advantage that combine the GPS, GSM and in-vehicle bus control network, and will be amount of functional applications on this combining base.

II. INTRODUCTIONS

In this paper, we propose the design and implementation of a network-based in-vehicle body bus control system with fault detection in which Network based control system already completed

2.1 Introduction to Network-Based In-Vehicle Body Bus Control System with Fault Detection

The project which has supported network-based in-vehicle body bus control system with fault detection, is a research project to investigate applications, data structures, software architectures and network technologies about networked vehicles. From an application point of view, a network- based vehicle control system need to collect vehicle's data, i.e. velocity, wiper status, lamp status, water temperature etc., and gather statistics to generate executer's status ac- cording to the result of controlling commands. In this sec- tion, there is an overview of network-based in-vehicle body bus control system with fault detection. Then fault-detection methods for single signals without models like limit and trend checking and with harmonic and stochastic models, like Fourier analysis, correlation and wavelets are treated. This is followed by fault detection with process models using the relationships between signals like parameter estimation, parity equations, observers and principal component analysis. Along with designing the system, we consider an informa- tion model, and section 3 introduces it. We introduce de- sign and implementation around network-based in-vehicle body bus control system with fault detection in section 4. Section 5 describes details and results of controlling testing and section 6 dis- cusses the problems of the system and how to improve.

Figure 1: Network-Based Vehicle Body Bus Control System with Fault Detection

In this system, the vehicle detect by using GPS position of that vehicle. This position consist of latitude and longitude position of the satellite, this different place position is save in controller and due to continuously tracking, the necessary matched position is then transmit on user mobile by using GSM model. This information consist of detecting position of vehicle and detecting faults which is sense by different connecting sensors.

III. INFORMATION ABOUT DIFFERENT SPECIFICATION

Almost all network-based in-vehicle body bus control sys- tem use information from a vehicle like geographical lo- cation information, water temperature, vehicle velocity, wiper status, lock status, etc.. This is the most important characteristic of vehicle control system.

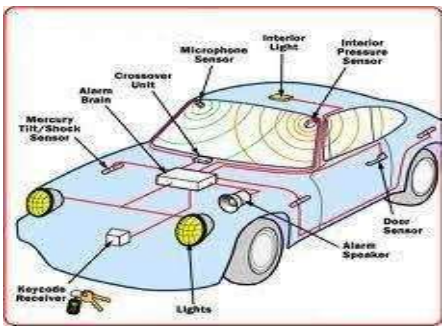

Figure 2: Information Specification

Vehicle information could be used both from inside of the vehicle and outside of the vehicle. Remote query and diagnosis applications fetch the information from outside, on the other hand, in-vehicle gateway application use them in-side. Information specification of network-based in-vehicle body bus control system provides information to both of them. If vehicle information are used outside application of a vehicle, the information have to be formalized. For example, vehicle water temperature is represented as short range of voltage value, however it cannot be used outside of the automobile because the coefficient to convert it to more
formal values like deg. C. To solve the problem, network- based in-vehicle body bus control system introduces infor- mation mapping shown in figure 2. It defines how the infor- mation must be stored. For example, vehicle water temperature has to be stored in centigrade using hex. Also this specification is useful for in-vehicle gateway applications. Another Carbon Sensor (Gas Sensor) MQ6 is used for gas leakage detecting purpose equipments in family and industry, are suitable for detecting of LPG, iso-butane, propane, LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke. Sensitive material of MQ-3 gas sensor is SnO2 be used to detect alcohol with different concentration; it is with low cost and suitable for different application.

IV IMPLEMENTATION OF NETWORK-BASED IN-VEHICLE BODY BUS CON-TROL SYSTEM

The implementation of in-vehicle gateway of network- based in-vehicle body bus control system has been vali- dated on six modules: network gateway, display center, LIN bus, CAN bus, GPS module and CDMA module. Fig- ure 3 shows the in-vehicle gateway structure.

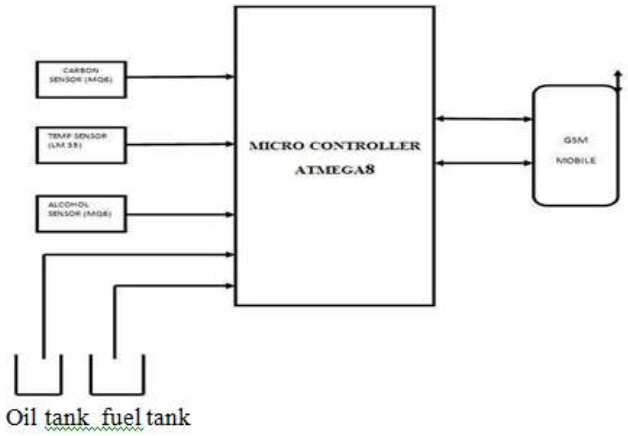

Figure 3: Topology of In-vehicle body.

4.1 Hardware of Network-Based In-Vehicle Body Bus Control System

Network gate- way gets the navigation information from GPS module via a serial port, and the navigation information is collected once a second. In-vehicle body bus is including a sensors and controller, both of them are connected to the controller, and each of them has respective interfacing circuit. Network gateway collects vehicle's faults from the sensors , as well as controls on the different parts of the vehicle. GSM module is connected to the network, and it is linked to the controller via an UART port, shown in figure 4.

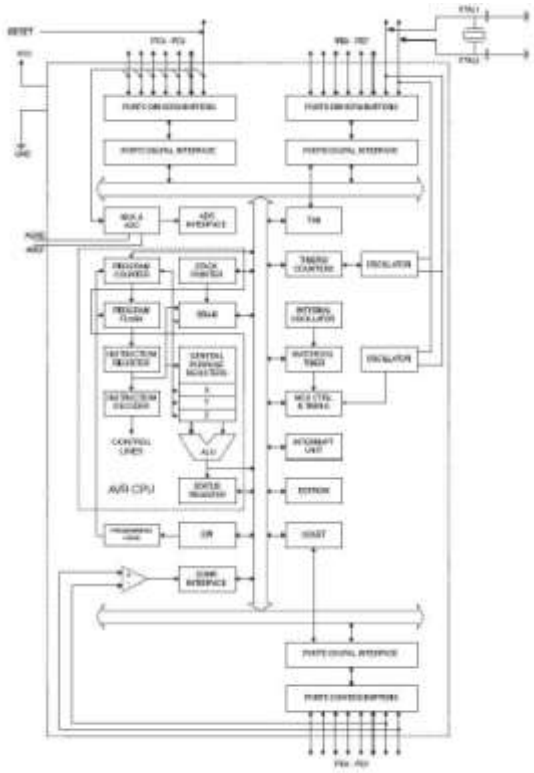

Figure 4: Structure of Hardware

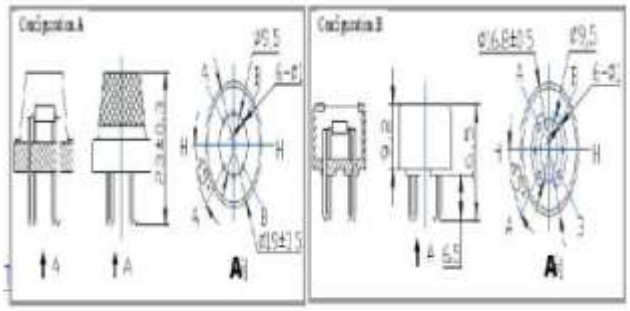

Figure 6: Configuration of Carbon Sensor

Network gateway is based on ATMega 8 microcontroller GPS module is based on u-blox LEA-4H and links network gate- way via a serial port. GSM module is connects network gateway via a UART port. MQ-3 gas sensor is SnO2, which with lower conductivity in clean air. When the target alcohol gas exist, the sensor's conductivity is higher along with the gas concentration rising.

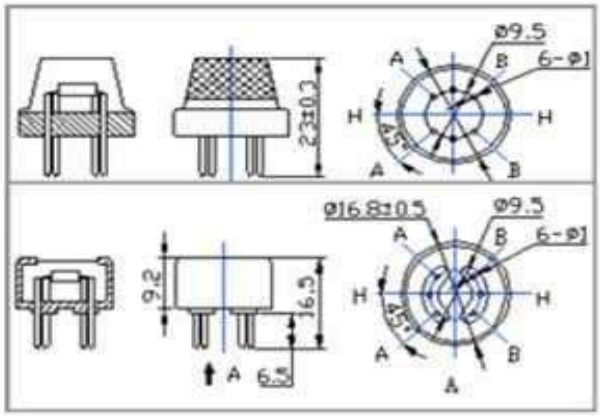

Figure 5: Configuration of Semiconductor Sensor

Carbon sensor is used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, iso-butane, propane, LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke. The implement module of water temperature unit uses two-terminal IC temperature transducer(AD590) and 8-bit A/D converters(ADC0804).

In the low speed and cost applications, controller using single-wire communication and decreases the weight and wires greatly. The network gateway acts the master unit, and there are four types executive units in the in-vehicle body , rearview mirror, door locks, windows and wiper.

4.2 Protocol Implementation

Work flow of system can be briefly described as figure 7:

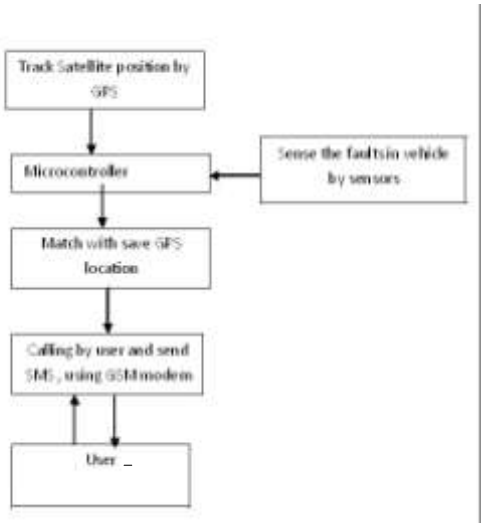

Figure 7: System work flow.

In network-based in-vehicle body bus control system with fault detection , information are transmitted through wireless communications to the center controller by the application of in-vehicle gateway. The large number of timely and effective information will play an important role in automobile online monitoring and fault diagnosis. Client monitor can not only access the information, but also send some commands. For instance, check the door lock status of vehicles. Center controller maintains and operates instruction error table, as well as receives instructions from the client and sends to in-vehicle gateway. Work flow of system can be briefly described as above: client creates a act, and sends an implementation; controller receives the information first, an- alyzes and sends service request to the right car. When the GPS received the satellite position og the vehicle then it continuously transmit to controller and match with the save location. Simultaneously sensors sense the faults and transfer to user by sms system when he call the resp. GSM number.this information consist of satellite position and detecting faults The ATMEGH8 is in build with 6 channels 10 bit ADC. The GSM modem is operated with command i.e. AT + (Message) = (Mobile No.) and the all message is giving to the modem and there is one transmission variable z^ which terminates the message and send over mobile and service station.. And controller tri to solve some problems by using alternative options.

V. DEMONSTRATION VEHICLE

Experiment prototype includes in-vehicle gateway of network-based in-vehicle body bus control system with fault detection, controller, GPS, GSM, different sensors used for this system. Some applications are tested using the vehicle. This section introduces some applications, and the major is about network-based controlling.

One application is vehicle body status diagnosis. In-vehicle gateway collects information from the body units via in-sensors , and packs the information using information specification. In-vehicle gateway sends the information to the controller , then controller saves the information to the memory . When a client terminal wants to know automobile's status, the controller will provide the all information to users using sms by GSM modem. Another application is network-based controlling. Another application is in Transportation industries.

VI. FUTURE WORK

This paper describes a network-based in-vehicle body bus control system with fault detection , and we implement at this notion by a prototype vehicle. In the future work, communication performance is very important for safety applications, and to tri to solved more faults which is detected by sensors. And design IP-based network node

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