The Parameter Analysis System of CAN Bus for Electric Vehicle Based on LabVIEW

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Abstract. In order to get a real-time, comprehensive and convenient monitoring of the state parameters of the electric vehicle, this paper develops a CAN bus parameters analysis system based on LabVIEW. The system, consisting of P-CAN and PC host computer software, is able to collect CAN message which simultaneously and automatically is converted into intuitive data that users need for display and realize the real-time, visual monitoring and fault alarm function of the electric vehicle. The tests carried on at electric EV platform of Hebei University of Engineering shows that the system is convenient, reliable and stable, therefore it provides a new tool for the study of EV platform.

Introduction

Under the enormous pressure of environmental issues, new energy automobile is becoming more and more important, the United States, Europe and Japan have introduced measures to stimulate the development and market of electric vehicles, encourage and support the development of electric vehicle technology, such as the United States famous PNGV plan and freedom car plan [1]. The European Union has allocated 1430 million euros to support the development of electric vehicles. Japan has always insisted on the development of new energy automotive technology as an important strategy. Because of environmental problems, China has also put the electric car technology research as an important development direction, and give a lot of financial support, in accordance with the mileage of vehicles as a standard to give subsidies.

In response to the national energy conservation and emission reduction policies to promote the development of pure electric vehicle technology, training related personnel, Hebei University of Engineering set up EV platform for teachers and students to study the exchange of learning. The EV platform uses a variety of electronic control system, a large amount of data needs through the exchange and monitoring of these systems, the traditional distributed routing occupies a lot of space, cumbersome and complex, while the platform built by CAN bus communication, whose wiring is simple, is a reliable way of communication. Can bus transfer binary message through differential voltage. For logic verification of each control unit of the vehicle, electronic appliances, function test, message monitoring, real-time direct reading comprehension is very important, the traditional automobile instrument is difficult for all messages to be listed one by one, so the use of LabVIEW to develop a set of data monitoring system, is convenient to carry out a full range of line of the total observations, and to realize the high-efficient human-computer interaction.

Platform Hardware Structure

The EV platform of Hebei University of Engineering, using lithium-ion batteries, its' software, hardware, structural design are all in accordance with the automotive standards. The products are designed and tested in the aspects of system function test, high and low voltage withstand voltage, protection level, redundancy backup and anti abuse. Electric vehicle is a distributed architecture, the detection unit can support up to 30, and 1-300 arbitrary series battery pack. The EV platform sets up

2 CAN bus network and a number of LIN network

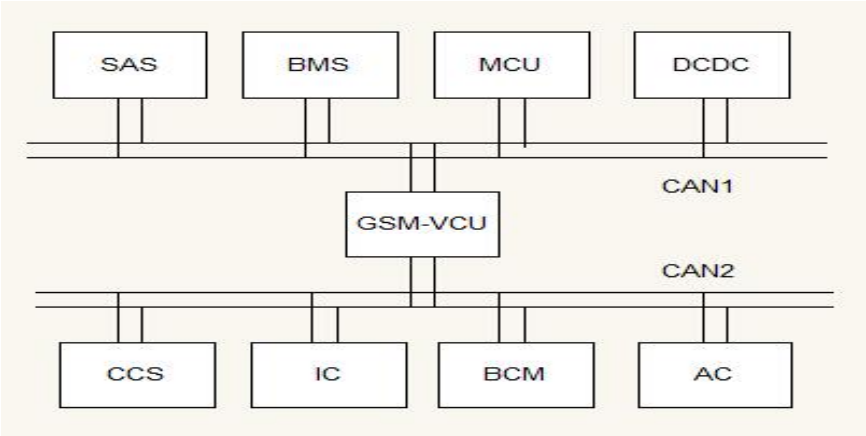

Fig. 1 CAN topology

The motor controller, vehicle controller, air conditioning controller are connected to the CAN1, while the baud rate is 500kpb/s. Battery management system, on-board charger and liquid crystal display received 250kpb/s can2.Each node through the twisted pair bus access, two segments are connected by a gateway communication. Main control system element topology as shown in Figure 1:Due to the advantages of high reliability, real time and high performance, CAN has been widely used in all kinds of fields, such as testing, industry, transportation and so on [2]. The biggest difference between the CAN protocol and the traditional communication is not to use the station address code, but to encode the transmitted message.

The EV platform of Hebei University of Engineering follows the SAE J1939 protocol, each sensor node address is defined in the protocol, with multiple functions of ECU using multiple addresses. The platform uses custom address 208 ~ 231 as the reservation address [3]. The message format is for Motorola format.

Monitoring System Design

Implementation of Hardware Connection. The system is composed of a CAN acquisition card with a USB interface, a computer and PC monitoring software developed by LabVIEW. The structure is shown in Figure 2.

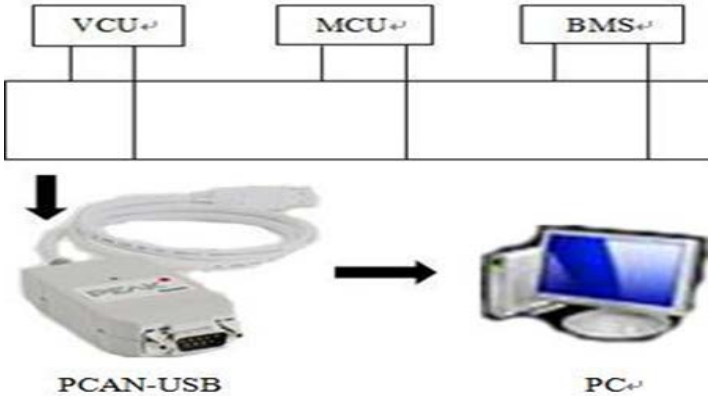

Fig. 2 Hardware components

We choose Pcan-USB card which is realization of the vehicle can bus and PC connection and then carry out the message through the data monitoring system and converted into an intuitive data or chart, to facilitate the monitoring of the state of the vehicle running.

Collecting Pcan-USB card is manufactured by the German company PEAK-system, which meets the demang of ISO 11898-2 standard, high speed can bus interface, support 11 (can2.0a) and 29 (CAN2.0B active identifier, error handling are reliable, excellent EMC performance.

Software Design Ideas. LabVIEW(Laboratory Virtual Instrument Engineering) is a graphical programming language [4] with a strong ability to simulate hardware. It has the advantages of rapid development, expansion, change convenient.

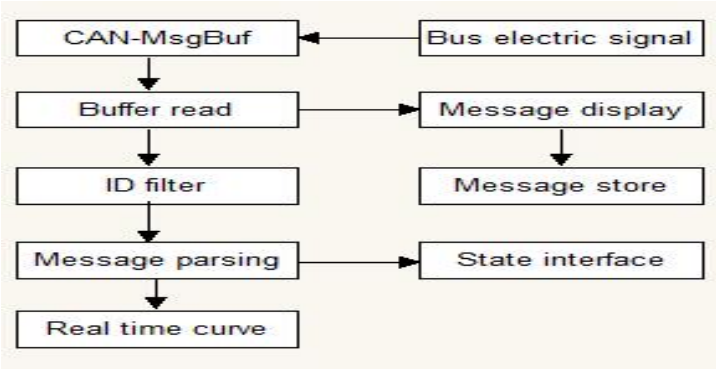

Fig. 3 software design

According to the experimental requirements, EV data monitoring system function is divided into data acquisition, data real-time display, data storage, data conversion, real-time curve function. data acquisition: Acquisition of differential voltage message from each controller to bus. data real-time display: The collected message information is displayed in a binary format, and display relevant information, such as DLC, ID, etc..data storage: According to the needs of users, the packet information storage is for future access analysis. data conversion: The data field of message in different byte or bytes are converted to visual data display in accordance with the relevant agreement. real-time curve function: The data and time are connected to generate real-time curve diagram for research and analysis.

Library Function Call. EV platform bus communications need to call the virtual CAN interface function (VCI). The virtual CAN interface function is derived from [5] Pcan-USB.dll. LabVIEW can directly call DLL, in the interconnect interface options in the selection of the library and the executable function, select the function call.

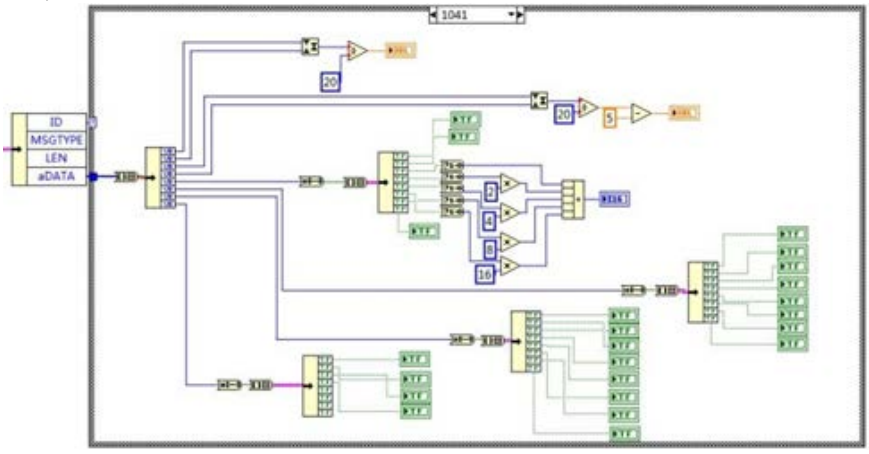

Fig.4 translation process

In the library function call configuration interface, click the Browse button to add the path of the library function or in the program block diagram of the specified path. Users need to understand the prototype of the target function. After selection of Call function to configure parameters and types of function returns the data type, the function and application of the argument type to objective function and virtual reference types match through parameter options. In the call specification, you can choose WinAPI or C function [6]. At the parameter interface, configure the parameters by adding and deleting buttons, and setting the parameter name and type of the parameter. In LabVIEW, you should use the Cluster to create the data structure of these functions before the use of VCI function [7]. The element can be either an arbitrary control or a display control. They are placed in the sequence of the cluster which determines the logical order of the elements [8].

Host Computer Program. Can bus is opened by calling CAN_Open Device function and can initialized by CAN_Init function, according to the agreement, we set can channels, baud rate and frame format throuth CAN_Init, success will return 1. Failure will return 0. Function to be called and the basis of the application package into a sub VI and add the terminal to facilitate the procedures in the call to simplify the program panel. Create a new VI, will contain the to read the

function such as initialization of the sub - VI to add to the panel, connecting terminal. Create a new VI, add the sub VI to the program panel and connect to the terminal. We separate message by message ID Because the bus is a serial communication. According to the different baud rate, it's divided into 2 front panel interfaces .the message From USBCAN card is still the data frame, a frame of data may contain multiple signals of different meanings. In the application, the CAN message from each controller is required to be resolved. LabVIEW can edit complex logic conversion formula, as shown in Figure 4, a process of translating message.

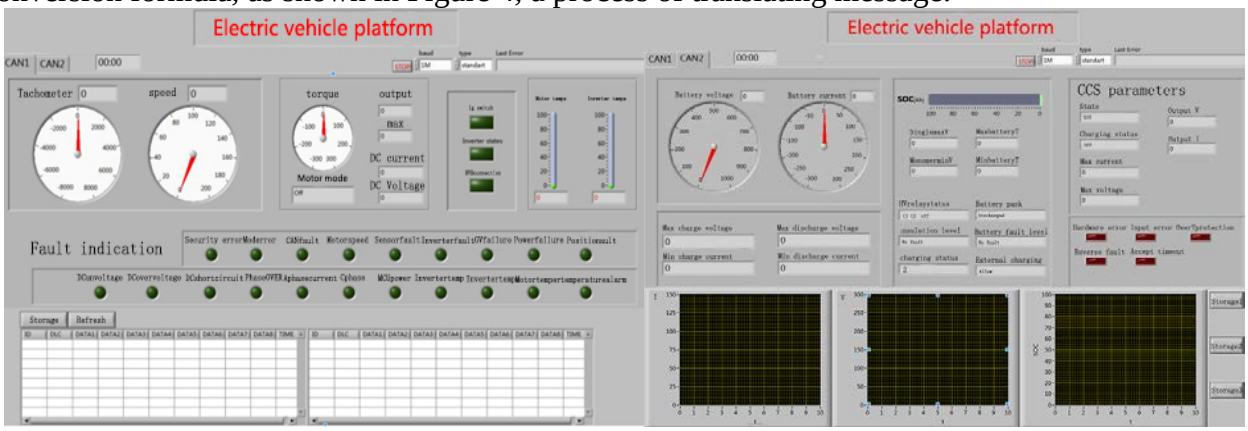

Fig.5 Program panel

According to the protocol of message, The binary message is converted into an intuitive decimal information through the logical operation of scaling factor and offset and sent to the monitoring interface. The monitoring interface is divided into 2 parts, corresponding to different baud rate, and switch from different tap. Display panel is mainly divided into three plates of data display, fault detection and real-time curve. Data display shows the current work status of the EV platform which can real-time display all the parameters of monitored control unit. Fault detection have the alarm function with triggers, when the system detects when the system detected an error signal, it will trigger a buzzing alarm function, and the corresponding error indicator will light up. The chart shows the curve of the data measured, which is convenient to compare the relationship between time and data. The front panel is shown in Figure 5 and Figure 6.

Real Vehicle Test

In order to verify the reliability of the system, the PCAN-USB is connected to the computer and the EV platform. After the platform is started, the CAN bus analysis system based on LabVIEW realizes the real-time data display. Battery voltage, current, temperature, torque,speed values and other parameter can display through indicator light, graph, data table, etc. When the test is completed, you can store the data you need. Through test, it can be seen that the system can ensure the stability and reliability of the data in the range of error tolerance.

ID	DLC	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8	TIME
0C0AF4D0	8	E6	01	00	00	00	00	00	00	100
14015010	8	91	36	07	00	00	00	3E	43	100
14015011	8	0B	BA	0C	DD	00	00	00	33	100
140310FF	8	1C	0A	00	00	02	1A	00	00	20
1801D0F4	8	E6	0B	BA	0C	DD	91	35	36	100
1802DOF4	8	81	00	01	4A	01	48	00	00	100
1803D0F4	8	0E	42	A6	B8	09	C4	14	3C	100
1806E5F4	8	0E	42	01	F4	02	00	00	00	500
18CE28F4	8	10	00	10	00	10	00	10	00	250

Fig.6 Message display

The running state parameters of the automobile are collected by each sensor and sent to the CAN bus network by the differential voltage. The bus parameters analysis system is developed based on LabVIEW to monitor the vehicle state parameters. Related tests we carried out on the EV platform of Hebei University of Engineering.The Results shows that the system hardware structure is simple,

easy to set up and operate. The system software is stable and reliable, the operation is simple and practical, which can achieve the desired goals and can quickly expand the interface of different test designs. The system is applicable to equipment which support bus communication and have the corresponding communication interface,so it has good application prospect.

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References

[1] ZHANG Jing-yan.Optimization Design of Charging Services Bassed on Charging Device Overall Efficiency[D].Beijing: Beijing Jiaotong University,2014:7-9.

[2] LI Hao, LI Sheng-kun. The Design of Digital Signal Transmitter Based on CAN Bus[J]. Journal of Test and Measurement Technology, 2010, 24(6):527-530.

[3] LI Fang,ZHANG Jun-zhi,WANG Li-fang,et al.Controllor Area network for Powertrain System of Electric Vehicles[J]. Journal of Mechanical Engineering, 2008,44（5）:102-107.

[4] TIAN Lin, BAI Feng-e, GUO Jian-wei. Design of Virtuals Pectrum Analyzer Based On LabVIEW[J]. Electronic Technology, 2009,5: 26-28.

[5] LIU Xiang,WU Guang-qiang. The Automotive Data Acquisition and Monitoring System Based on LabVIEW and CAN Interface[J]. College of Automotive Engineering,2011,30(8):34-37.

[6] ZHAO Jiong,LIU Li-ping. LabVIEW-based Dynamic Link Library Call[J]. Chinese Journal of Construction Machinery, 2007,5（1）:122-126.

[7] LIU Hong-xian, HUANG Wen-mei. External Code Interfaces in LabVIEW[J]. Journal of Hunan University(Natural Sciences),2002,29(3):41-45.157-160

[8] WANG Jia－shun, ZOU Hong－xia, GAO Yong－ming. Research on Communication Protocol Integrated about SpaceRobot Based on LabVIEW[J]. Computer Technology and Development, 2012.22(3):157-160.