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Original Article

An Effective Method to Resolve The Message Parsing of CAN

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Abstract *- This paper studies the CAN message parsing problem (CPPP) with DBC protocol. The purpose of this problem is to parse the data of DBC protocols in the CAN message. To improve the efficiency of parsing CAN messages containing DBC protocol, it is necessary to consider parsing multiple DBC protocols simultaneously. According to this practical problem, a new method of parsing CAN message under a single DBC protocol is proposed. A multi DBC protocol parsing method based on single DBC protocol parsing is proposed. To adapt to the difficulty of parsing a large number of DBC protocols, a fast matching method is proposed. A comprehensive experiment of CAN message parsing based on a real vehicle controller proves the effectiveness of this method. This method can also be applied in some social areas, such as the governance system.*

Keywords — *CAN message parsing problem, multi DBC protocol, a fast matching method, governance system*

I. INTRODUCTION

CAN is the abbreviation of controller area network (CAN), researched and invented by BOSCH company, famous for R & D and the production of automotive electronics products. Today CAN has become the international standard (ISO 11898)[1], which is a kind of Fieldbus widely used in the world [2]. In Western Europe and North America, CAN bus protocol has become the standard bus of automobile computer control system and embedded industrial control LAN and has J1939 protocol designed for large trucks and heavy machinery vehicles with CAN as the underlying protocol. CAN bus adopts a multi-master competitive bus structure. It is characterized by multi-master operation, distributed arbitration serial bus, and broadcast communication. To realize the free communication between nodes, every node on the CAN bus can send information to other nodes in the network at any time, regardless of master and slave.

CAN is a continuous communication protocol widely recognized in the automotive and automation industry [3]. Can bus be a communication protocol, which is widely used in automotive distributed embedded systems? Its characteristics make it run reliably and efficiently in vehicle communication systems and industrial control systems. [4]. With the vehicle controller more and more widely used in the car, CAN bus is more and more used. Most of the vehicle controllers are purchased from manufacturers, and they do not have specific technology. Once the vehicle breaks down, whether the message read by CAN bus can be parsed quickly plays a vital role in finding the fault point quickly.

The database can (DBC) is the message content of CAN communication between electronic control unit (ECU), with which we can understand each other. At present, automobile manufacturers have different DBC transmission protocols for different models, which greatly increases the difficulty of CAN message parsing. In this way, it is very difficult to find the fault point of the automobile. In addition, most of the existing parsing tools are for a single DBC file to parse CAN message. For multi DBC protocol, parsing CAN message needs to be executed many times, which is inefficient and cumbersome.

This paper proposes a method to parse CAN message with multi DBC protocol to solve this problem above. The experimental simulation of the CAN bus message intercepted in practice proves the effectiveness of this method.

The rest of the paper is arranged as follows. In section 2, the literature about closely related problems is reviewed. In section 3, we formulate the problem. We introduce the proposed method of parsing the CAN message in section 4. In section 5, we show the simulation parsing. The remarks are concluded in section 6.

II. LITERATURE REVIEW

In this section, we focus on the CPPP. As we know, CPPP is a new problem. There are few studies on this problem, so we review it with the related CPPP problem. CAN protocol was originally developed for the automotive industry, with the advantage of using common buses and reducing the demand for wiring harnesses [5]. R[i]adul Islam et al. proposed a method to prevent multiple CAN bus monitoring attacks without changing the basic CAN protocol [6]. Chen et al. suggested studying the impact of such priority attacks based on DoS attacks [7]. Wu et al. proposed a WLAN CAN bus data test system. The test results show that when the message is transmitted, the error score of the system is about zero [9]. Gao et al. proposed and designed a control system of climbing welding robots based on the CAN bus.

The robot is used for autonomous welding in the manufacture and maintenance of large non-structural equipment [10]. According to the principle of dynamically changing priorities, Guo et al. designed the "bubble" of the dynamic priority scheduling algorithm to improve real-time performance. Through the simulation, the real-time performance of the bus has been greatly improved [13]. Li et al. designed a multifunctional CAN bus controller based on a single-chip STC12C5A60S2 microcomputer. The controller test shows that it has strong adaptability and flexibility and meets the different data acquisition and control requirements of the GSHP system [14]. Yu et al. proposed a multi-channel suspension bridge vibration acceleration data acquisition system based on stc12c5606ad single chip and analyzed the problems existing in the system design process [15]. To test the solution for signing messages and protecting CAN infrastructure from external attacks. It is a CAN bus simulation platform, especially simulating the real can network [16]. Shweta et al. used reliable two-wire control to realize the CAN bus lighting network, which is necessary to save energy or create an accurate lighting effect as a bas subunit [17]. Mansor et al. discussed threats and vulnerabilities in the CAN bus network， ， and the experimental setup of the CAN bus communication network is implemented and analyzed [19]. Zheng et al. put forward the design scheme of a wireless monitoring system based on con bus and ZigBee tower crane technology. It provides a new method for designing the wireless monitoring system of the tower crane [20]. Li et al. designed the program structure of communication status monitoring, set the ID of each node, and then sent the test data, finally realized the communication status of all nodes, and displayed the error node information through the upper computer, realized the rapid and reliable positioning of the error code. The results show that this method is an effective method for communication condition monitoring [21]. Luo et al. discussed the hardware-based CAN bus simulation system and realized the simulation kernel on PC, simulating multiple CAN buses online or offline. Simulation scripts can be assigned to each simulation node so that they can respond to bus events. In addition, other methods are used to ensure real-time performance throughout the simulation [22]. Lu et al. designed a set of industrial control networks with enterprise information network communication technology and introduced the network structure of the program into the CAN bus [23]. Zhang et al. built a queuing model based on CAN and considered its simulation and application [24]. Lu et al. built a two-way and multi station communication system based on the CAN bus data acquisition and storage module [25].

The research of CAN bus mainly focuses on the control and signal transmission of an automobile. Tong Chen et al. are the first to discuss, research, and build vehicle electronic and electric platforms [8]. Kovács et al. studied driver assistance systems with the goal of fully autonomous operation [11]. Peng et al. studied the tire pressure monitoring system of passenger cars and wireless sensor vehicles based on the tank. Through continuous research, a kind of pressure monitoring device that gives a warning in case of abnormal events plays a very active role in avoiding failure [12]. Zhang et al. introduced the vehicle fault diagnosis protocol ISO15765 and designed the fault diagnosis system based on CAN (controller area network) and electric vehicle diagnostic fault codes (DTCs). CAN communication network was tested by canoe software, and the results show that the network meets the requirements [18]. From the above literature review, we can see that the application of CAN bus is mainly in the vehicle controller; other aspects also have applications. CAN bus is so widely used, but there is little research on the parsing of the CAN bus. To solve the problem of CAN bus parsing, we propose a new parsing method.

III. Problem Definition

In this section, we mainly introduce the CAN message parsing problem (CPPP). Because this is a new problem, we will first introduce the basic knowledge points. First of all, we know that messages on the CAN bus transmit data through the DBC protocol. Therefore, to parse the CAN bus message, we must first learn to write the DBC protocol.

Here are some important keywords:

BO_: BO_ Is the definition of the message.

SG_: SG_ It's the definition of the signal.

VAL_: VAL_ Is the definition of the signal enumeration value.

The format of DBC has been described above. Next, how to use DBC to parse the physical value from the original message is introduced. Before that, we need to understand MSB (big end) and LSB (small end). MSB is high in front, LSB is low in front, most of them use MSB. We list a DBC protocol for the highest cell voltage signal below. In the

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DBC file, the beginning of Bo is the data frame ID of the corresponding CAN message. In this example, the corresponding CAN message ID is set as follows:

BO_ 2350847233 from VCU to BMS: 8 VCU

According to the generation process of the DBC protocol ID, we can deduce that the CAN message ID corresponding to this DBC is 0x0cef7d03. Table 1 shows a data frame corresponding to this signal.

Table 1. A data frame corresponding for Maximum cell voltage of battery

Serial number	Transmission direction	Time identification	Frame ID	Frame format	Frame type	Data length	Data (HEX)
0	Receive	16:33:46:737	0x0cef7d03	Data frame	Extended frame	8	0e 69 6f 93 0c 3f 66 0c

The maximum cell voltage of the battery in the DBC is selected as the verification example. The DBC communication setting of the maximum cell voltage of the battery is as follows:

SG_ Maximum cell voltage of battery_W : 24|16@1+(0.001,0)[0|0] "" Vector__XXX

From the above settings, we can see that the start bit of the highest cell voltage signal of the battery is 24, the data length is 16, the high and low bit is set to 1, the gain is 0.001, and the offset is 0. According to the data 0e 69 6F 93 0C 3F 66 0C of the data frame, the following information can be obtained by converting it into a binary system:

00001110 0110 1001 0110 1111 1001 0011 0000 1100 0011 1111 0110 0110 0000 1100.

From the starting bid of the highest cell voltage signal of the battery is 24 and the data length is 16, we can see that 1001 0011 0000 1100 is the corresponding data bit. By setting the high and low bits to 1, the gain is 0.001, and the offset is 0, we can see that the original data first increases by 1000 times and then increases by 0. The data bits are generated in the order of high bit first and then low bit. Therefore, we can get the corresponding maximum cell voltage of 37.644.

IV. The Proposed Method of Parsing CAN Message

The CAN message parsing method based on single or multiple DBC files provided by the invention can directly parse the required data information and store it in excel through the corresponding DBC format protocol, and the CAN message with the protocol to parse the CAN message into the actual value that can be read intuitively. This method can ignore the manual search and input for various DBC files and reduce the time cost caused by human factors. By searching the DBC file library, the invention parses the CAN message one by one, including various DBC files, and saves time searching the corresponding DBC files. For the CAN bus containing multiple DBC protocols and transmitting data to multiple targets simultaneously, the invention can parse all the required data frames only in the case of sequential operation.

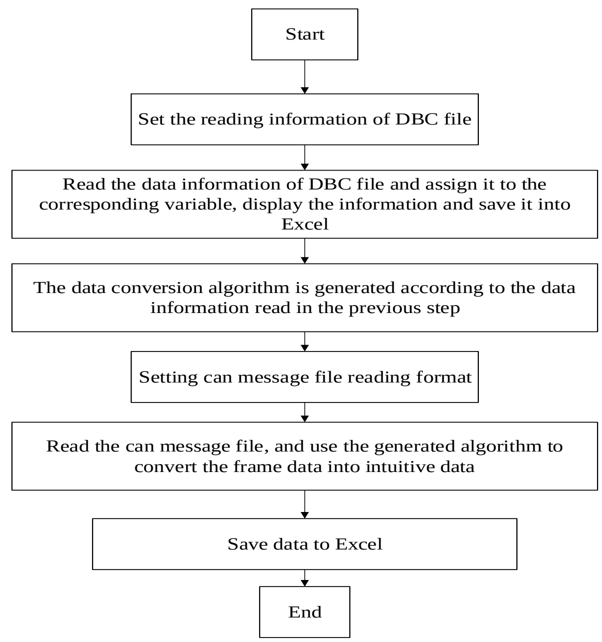

Fig. 1. The parsing process of the proposed method

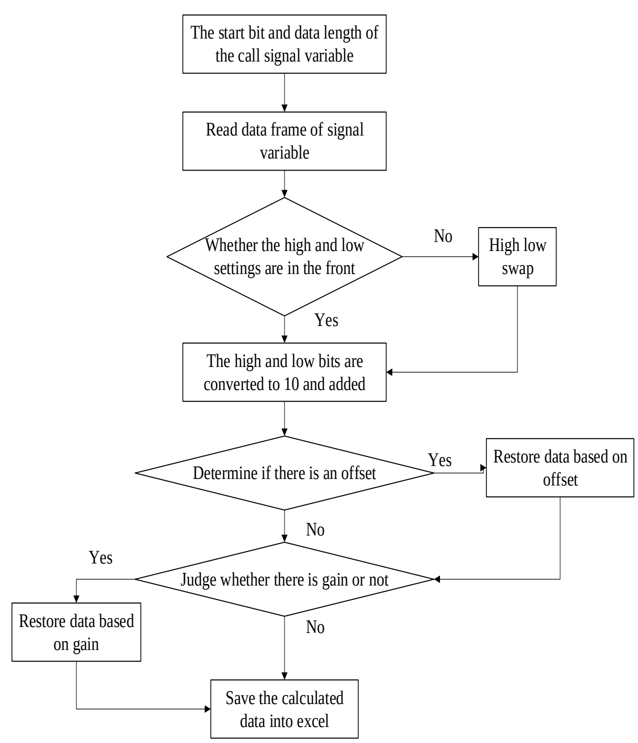

Fig. 2. The paring process of a single DBC protocol

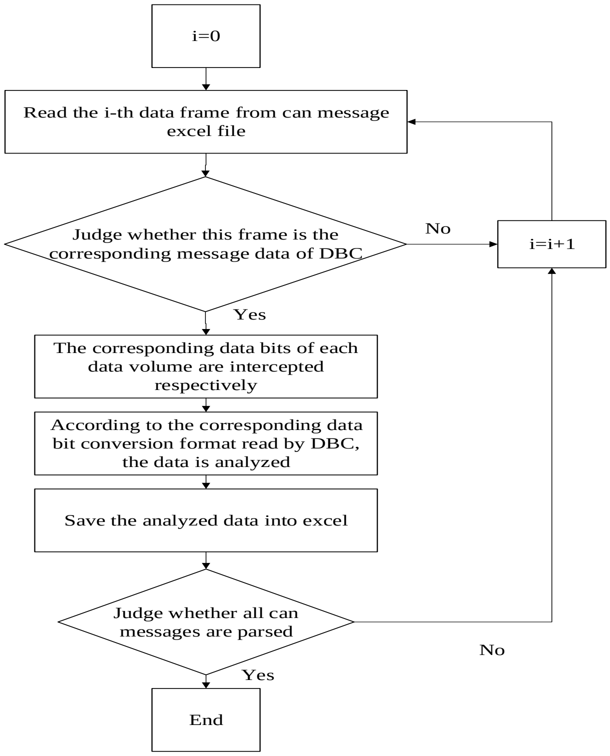

Fig. 3. The parsing process of multiple DBC protocol

As shown in Fig. 1-3, the specific implementation process of the CAN message parsing method based on single or multiple DBC files provided by the invention is as follows:

S1: read the required CAN message file and DBC file to the development platform.

S2: read the i-th line data frame of CAN message, record the data frame ID information of CAN message, and convert the data frame ID into the string format. When I > m, the parsing ends. Where I is defined as the number of rows of the data frame of the current CAN message, I ≤ m, and M is the maximum number of rows of the data frame of the current CAN message.

S3: read the data frame ID information of the j-th DBC file, and convert the DBC data frame ID into the string format. When J > N, define J = 1, I = I + 1, and return to step S2. Among them, j is defined as calling DBC files at present, and j is less than N. N is the number of all current DBC files.

S4: judge whether the current DBC file is the communication format of the current data frame, including the following event processing mechanism:

Event a: the data frame ID information of the DBC is the same as that of the current CAN message. Record the name, start bit, data length, high and low bit settings, gain and offset of the data amount of the data frame ID of the current DBC, assign them to the corresponding variables, and write them into Excel as the header of the data obtained by the corresponding parsing. The current CAN message searches the corresponding information according to the data frame ID reading the current DBC. The retrieved target data frame is parsed and calculated through data parsing, and the CAN message parsed into the actual value read intuitively. The corresponding header is stored in Excel under the corresponding data classification, and excel is saved. At this time, j = 1, I = I + 1 are defined, and step S2 is returned. Event B: the data frame ID information of DBC is different from that of the current CAN message. At this time, define J = j + 1 and return to step S3. Among them, in event a, the above data parsing is mainly realized through the following process:

1) Call the start bit and data length of the signal variable in the retrieved target data frame, and read the data frame of the signal variable.

2) To judge whether the high and low bits of the signal variable data frame are in front of the high bits, the ten-bit conversion is performed if yes, otherwise the high and low bits are exchanged.

3) Determine whether there is an offset and restore the data according to the offset.

4) Judge whether there is gain and restore the data according to the gain.

5) The actual value of the CAN message can be read directly.

V. The Simulation Analysis

Because of the single DBC protocol parsing tools on the market, we set the same CAN bus to contain only two kinds of DBC protocol communication data. When parsing CAN message data simultaneously, the parsing tool of a single DBC protocol needs to parse one protocol and then manually adjust to parse another protocol. The implementation needs to be considered auxiliary, and the data is saved in different files, which need to be merged manually. This paper proposes a method to parse multiple DBC protocols simultaneously, which can automatically filter DBC protocols for parsing without manual assistance. The generated parsing data are saved in the same file in order. Under the same workload, the proposed method is more efficient.

CPPP is widely used in real CAN bus check information and vehicle fault inquiry, but there are few studies on CPPP. The CPPP problem mainly contains the parsing of CAN messages, which has been introduced in detail. This paper mainly studies the problem of CPPP, takes parsing multiple DBC protocols at the same time as the goal, and takes a variety of measures. Firstly, we study the parsing method of a single DBC protocol. Then we propose a multi DBC protocol parsing method. This multi DBC protocol parsing method introduces a fast DBC matching method, which can effectively avoid manual matching and save labor and time costs. In addition, we compare with the current single DBC protocol parsing tools to verify the effectiveness of this multi DBC parsing method. In the future, we will study the fast location method of CAN bus fault alarm under vehicle controller. The CAN bus fault alarm is mainly by the car display simple alarm, and specific fault alarm information can't be displayed. In our opinion, the rapid location method of CAN bus fault alarm under the vehicle controller is of great significance in the actual process of vehicle maintenance.

At the same time, this method can also be applied in some social areas such as the governance system and economics. The governance system has a similar structure and relationship among its elements. Using the CPPP method can improve the efficiency of information transmission, especially in the warning mechanism of society. We hope this paper can provide new ideas for the research of the governance system.

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