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Analysis of Advanced Safety and Diagnostics System for Electrical Vehicles

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Abstract:

As electric vehicles become more common, there is an increasing need for advanced safety and diagnostic systems to ensure their reliable operation. One approach to achieving this is to use a Controller Area Network (CAN) protocol to facilitate communication between the various systems and sensors in the vehicle. This research paper presents the development of an advanced safety and diagnostic system for electric vehicles using the CAN protocol. The system includes a CAN based sensor hub that broadcasts the data on CAN Bus of various sensors such as load cells, temperature sensors, and ultrasonic sensors. The proposed system offers a reliable and robust approach to advanced safety and diagnostics for electric vehicles, with the CAN protocol facilitating efficient communication and enabling quick detection of faults and effective remedial actions.

Keywords — **Electric Vehicles, CAN Protocol, On-Board Diagnostics (OBD) system.**

I. INTRODUCTION

In the era of electric vehicles (EVs), advanced technologies play a pivotal role in powering these clean and efficient machines. One such technology that forms the nervous system of an EV is the CAN Bus. The CAN Bus, short for Controller Area Network Bus, is a vital communication system that enables various components within an EV to exchange information seamlessly.

The Controller Area Network (CAN) bus is a communication protocol specifically designed for real-time applications in automotive and industrial systems. It serves as the backbone for transmitting and receiving data between various electronic components within a vehicle. The CAN bus allows these components to communicate with each other efficiently and effectively. CAN was introduced as a centralized solution that requires two wires, i.e., CAN high and CAN low. The solution of using CAN protocol is quite efficient due to its message prioritization, and flexible as a node can be inserted or removed without affecting the network.

As we know that, the OSI model partitions the communication system into seven different layers. However, the CAN layered architecture consists of two layers, i.e., data-link layer and physical layer as shown in figure 1.

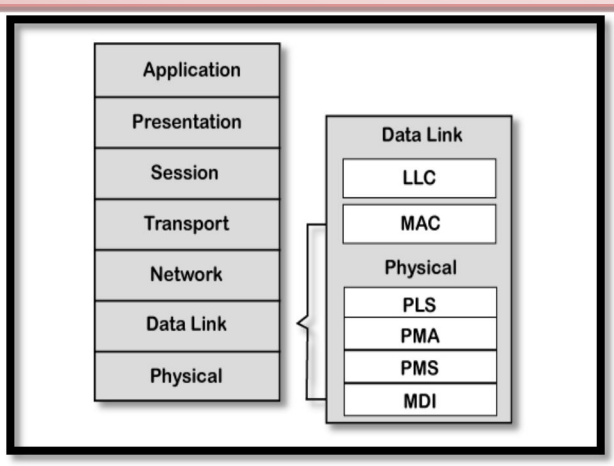

Fig.1Architecture of CAN Protocol

The number of ECUs is increasing in electric vehicles to integrate the sensors to get real-time data of running vehicles. Data from all the sensors is transmitted to the primary system that runs the algorithm and decides the condition without any errors and losses. Automotive standards will allow for data transmission over long distances with minimum hardware complexity to avoid external interferences like EMI, EMC, vibrations and noise.

This work presents the development of an advanced safety and diagnostic system for electric vehicles using the CAN protocol. The system includes a CAN based sensor hub that broadcasts the data on CAN Bus of various sensors such as load cells, temperature sensors, and ultrasonic

sensors. The system also includes an On-Board Diagnostics (OBD) system that continuously monitors the health of the vehicle's components and alerts the driver if a fault is detected. The OBD system can also take remedial actions to avoid system failures.

II. Results and Conclusion

The CAN system of the electric/hybrid power automobile comprises a CAN bus structure and a plurality of electric control units (ECU) of the electric/hybrid power automobile, wherein the CAN bus structure adopts a CAN bus type topological structure and is connected with the plurality of ECUs through a high-speed CAN to form a high-speed CAN communication network, and the plurality of ECUs realize data information sharing through the CAN bus, so that the number of wiring harnesses and the number of pins of a controller interface are reduced, the wiring harnesses are reduced, and cost is reduced.

TABLE I

CAN BUS Length	Specification	Difference (msec.)	Time1	Time2
CAN BUS Length_ 1 meter	Baud Rate 50 KBPS	133	18:33:37:77	18:33:37:90
	Baud Rate 125 KBPS	119	18:33:39:47	18:33:39:59
	Baud Rate 250 KBPS	100	18:33:41:37	18:33:41:47
	Baud Rate 500KBPS	73	21:43:55:31	21:43:55:39
	Baud Rate 1000KBPS	32	21:44:10:85	21:44:10:89
CAN BUS Length_ 2 meter	Baud Rate 50 KBPS	140	11:34:45:40	11:34:45:54
	Baud Rate 125 KBPS	125	11:36:40:38	11:36:40:50
	Baud Rate 250 KBPS	60	11:38:40:83	11:38:40:93
	Baud Rate 500KBPS	50	11:39:49:48	11:39:49:53
	Baud Rate 1000KBPS	33	11:42:49:5	11:42:49:5

A distributed (integrated) network type control system is implemented; reliability and instantaneity of communication are guaranteed; new functions of on-line programming, on-line diagnosis, combined action of a plurality of controllers and the like can be realized simply and quickly; functional expansibility and control reliability of the automobile are improved; development cost is reduced; development period is shortened; and failure rate of the automobile is reduced.

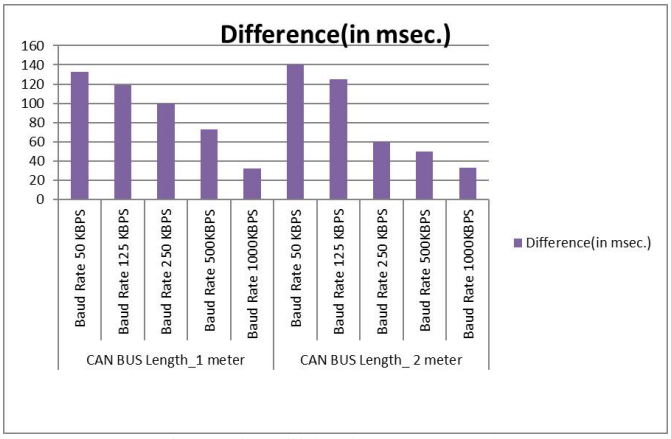

Fig. 2 Delay with baud rate representation

Depending on the signal propagation times of the line, the achievable total line length of a CAN network increases with a decreasing bit rate.

From the table and figure 2, it can be concluded that data transmission using CAN bus –

As the Bit rate increases the time delay between two frames decreases. Time delay is observed on the Bit rate 50KBPS, 125KBPS, 250KBPS, 500KBPS and 1000KBPS. It is also observed that as length of CAN bus is increases the time delay also increase. Time delay for 1-meter length and 2-meter length of CAN bus is observed. Figure 3 and figure 4 shows system circuit diagram.

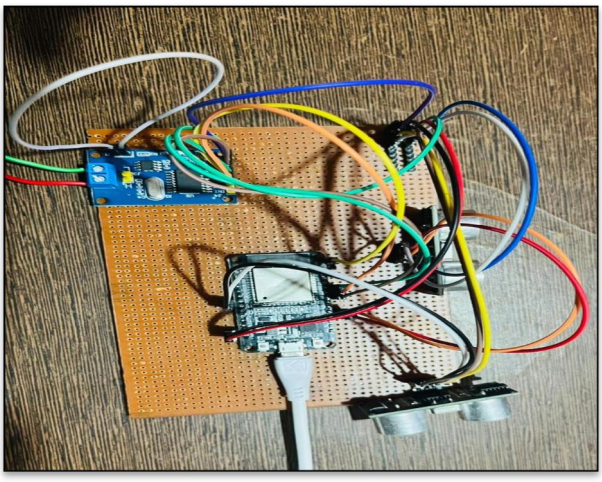

Fig. 3 Transmitter Part

From the well known facts that the other data transmission protocol having more time delay between two frames. However, Data Transmission

using CAN protocol having less time delay. It is advance safety feature of CAN protocol because transmission of data between different nodes with less time delay increases the safety. Arrival of critical data at central node will processed early and safety action will be taken before hazards.

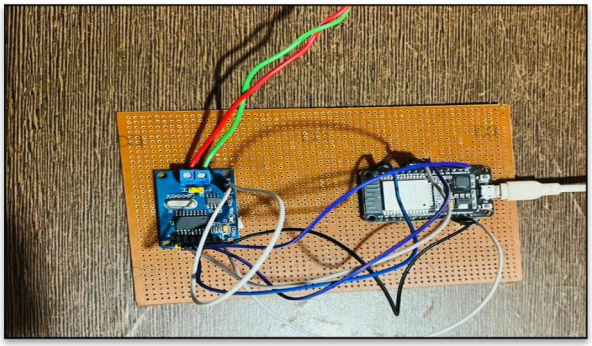

Fig. 4 Receiver part

REFERENCES

1. *Palak Bagga , Ashok Kumar Das, Mohammad Wazid, Joel J. P. C. Rodrigues, On the Design of Mutual Authentication and Key Agreement Protocol in Internet of Vehicles-Enabled Intelligent Transportation System, IEEE Transactions On Vehicular Technology, Vol. 70, No. 2, February 2021.*
2. *Ahmed Al-Areqi and Tamás Szakács, Can Bus Communication Demonstration Tool for Education, EasyChair Preprint № 5562.*
3. *Reza Alaei, Payman Moallem And Ali Bohlooli, Statistical Based Algorithm for Reducing Residual Error in Embedded Systems Implemented Using the Controller Area Network, Digital Object Identifier 10.1109/ACCESS.2020.3008872.*
4. *Clinton Young, Joseph Zambren, Habeeb Olufowobi, Gedare Bloom, Survey of Automotive Controller Area Network Intrusion Detection Systems, DOI 10.1109/MDAT.2019.2899062, IEEE Design and Test.*
5. *Qian Wang ,Yiming Qian, Zhaojun Luy, Yasser Shoukry and Gang Qu, A Delay based Plug-in-Monitor for Intrusion Detection in Controller Area Network, 978-1-5386-7471-0/18/$31.00 © 2018 IEEE.*
6. *Robert Buttigieg, Mario Farrugia and Clyde Meli, Security Issues in Controller Area Networks in Automobiles. 978-1-5386-1084-8/17/$31.00 ©2017 IEEE.*
7. *Ki-Dong Kang, Youngmi Baek, Seonghun Lee, Sang H. Son, Poster Abstract: Lightweight Authentication Method for Controller Area Network, DOI 10.1109/RTCSA.2016.58.*
8. *Md Moniruzzaman and Abu Asaduzzaman, Muhammad F. Mridha, Optimizing Controller Area Network System for Vehicular Automation, 978-1-5090-1269-5/16/$31.00 ©2016 IEEE.*
9. *J. N. D. O. Fernandes, A Real-Time Embedded System for Monitoring of Cargo Vehicles Using Controller Area Network. IEEE LATIN AMERICA TRANSACTIONS, VOL. 14, NO. 3, MARCH 2016.*
10. *Manish Parihar, M.K. Bhaskar "Review of Power System Blackout" International Journal of Research and Innovation in Applied Science -IJRIAS vol.3 issue 6 June 2018, pp.08-13 URL: https://www.rsisinternational.org/journals/ijrias/DigitalLibrary/Vol.3&Issue6/08-13.pdf.*
11. *Yujing Wu, Yeon-Jin Kim, Zheyan Piao and Yong-EnKim, Security Protocol for Controller Area Network Using ECANDC Compression Algorithm, 978-1-5090-2708-8/16/$31.00 ©2016 IEEE,*
12. *Juri Ranieri, Alessandro Vincenzi, Amina Chebira, David Atienza and Martin Vetterli, Near-Optimal Thermal Monitoring Framework for Many-Core Systems-on-Chip, IEEE Transactions On Computers, Vol. 64, No. 11, November 2015.*
13. *Kristian Ismail, Aam Muharam and Mulia Pratama, Design of CAN bus for research applications purpose hybrid electric vehicle using ARM microcontroller, doi: 10.1016/j.egypro.2015.03.258.*
14. *Swati Sharma, Review on CAN based Intercommunication between Microcontrollers, JETIR (ISSN-2349-5162).*
15. *SAAD MUBEEN, JUKKA MÄKI-TURJA and MIKAEL SJÖDIN Extending Worst Case Response-Time Analysis for Mixed Messages in Controller Area Network With Priority and FIFO Queues , Digital Object Identifier 10.1109/ACCESS.2014.2319255.*
16. *Manish Parihar, M.K. Bhaskar, Dharmendra Jain, Digvijay Sarvate, Deepak Bohra."Voltage Stability Analysis of Power System using Power World Simulator", Volume 5, Issue XI, International Journal for Research in Applied Science and Engineering Technology (IJRASET) Page No: 2508-2515, ISSN : 2321-9653, http://doi.org/10.22214/ijraset.2018.11371.*
17. *Umamahe swaran and Santosh Nagendra, Microcontroller based Multi-Star Simulator using Controller Area Network (CAN), 978-1-4244-4495-3/09/$25.00 ©2009 IEEED. Swagatam, and P.N. Suganthan, "Problem definition and evaluation criteria for CEC 2011 competition on testing evolutionary algorithms on real world optimization problems," Technical report, Dec 2010.*