IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

CAN configuration management for the Electric vehicles using AUTOSAR and OEM architectures

[1]ULLAS.S, [2]NIRMALA KUMARI .K,

[1]PG Student, [2]Associate Professor
[1]VLSI and Embedded Systems,
[1]Bangalore Institute of Technology, Bengaluru, INDIA

Abstract: Network, as a component, plays a very important role in automotive. The main concept of this project involves the communication between different ECU's within the vehicle through the CAN Protocol. There are different components configured in an ECU. Here, in this project NET component plays an important role. The development of the software includes three stages. The developing of the software is based on the customer expectation which is provided in the form of CAN-matrix. First stage involves Implementation or Configuration. The configuration of software is built by the reference of the base software provided by the customer by the use of AEEE tool base. The different layers of AUTOSAR and Bosch specific layers are configured, DBC is created and the application container is generated which contains the final configured software. Second stage is of testing the software. Testing is done on the LABCAR, where the generated application container is flashed and the logs are measured. Third stage involves the reviewing part, where the derived test logs are reviewed in the offline mode using MM6 and Canalyzer tool. Thus the message is communicated to different ECU's through CAN communication protocol.

***Index Terms* - CAN. AUTOSAR, Electric Vehicles.**

I. INTRODUCTION

Automotive Engineering has become predominant in the present scenario due to its service to mankind. Essentially, it is to come out of the use of fossil fuels, which is a burning problem caused by acute pollution, endangering the pristine environment and human existence. It incorporates several components that provide assistance in the operation of the vehicle. Safety is a state that requires to be shielded from any hazard, peril, harm or reason for damage. In the car business, safety implies that clients, administrators or producers don't confront any hazard or threat originating from the engine vehicle or during driving. Safety for the autos themselves, suggests that there is no danger of harm. Currently, automotive have been equipped with both Active Safety and Passive Safety systems. Active safety systems are those systems which provide safety to people before accidents happens (preventing) and minimize the effects of the crash. Passive Safety systems are those systems which help to reduce the effects of an accident. Sensor based systems like advanced driver assistance systems together with adaptive cruise control and collision mitigation/warning are also included in the active safety systems. Electronic Stability Program (ESP) is designed for active and passive safety systems. ESP of Passive Safety systems consists of air bags, seat belts etc. ESP of Active Safety systems consists of ABS, Traction Control Systems (TCS), Dynamic Stability Control (DSC), Power Train (PT), and many Value Added Functions (VAF's) like Hill Hold Control (HHC), Hill Descent Control (HDC), All Terrain Progress Control (ATPC) and many other.

II. LITERATURE REVIEW

- The authors [1] proposed an event trigger design for vehicle control is proposed in this paper for vehicle control by using the protocol of Controller Area Network (CAN). The proposed design covers the development of CAN communication node, which is developed by using microprocessor chip Microchip PIC18F4585 and MCP2551 CAN transceiver. In addition, an alternative GUI-based utility program developer is also built up for user to easily develop the required function call to cope with the design specification. A wireless electric-driven control vehicle is served as a platform to verify the design of drive-by-wire and brake-by-wire operations. Experimental results demonstrate the success of the proposed design.

- The authors [2] the motivation to design such CAN module is try to ease the development of CAN-BUS based embedded applications. With the CAN module, the engineers do not have to understand all aspects of CAN protocol, CAN controllers and CAN transceivers, therefore an industry automation application can be built conveniently. The CAN module provides simple hardware interface and highly abstracted software communication protocol, due to the abstraction and integration of all CAN related communication functions in an embedded module, and therefore can be easily embedded into any MCU based systems. The CAN module can send/receive data following the pipe based communication model. With the help of the software package, the CAN-BUS communication would be transparent to the micro-controllers of the nodes in the system.

- The authors [3] in which authors describe how to build a Controller Area Network communications test environment for Unmanned Aerial Vehicle that uses NVIDIA TX2 board and AUVIDEA J90 carrier board to reduce wiring costs, hardware complexity, and weight.
- The authors [4] in which examines the security risks within the CAN protocol and proposes a feasible solution.it also investigate the problems with implementing certain security features in the CAN protocol, such as message authentication and protections against replay and denial-of-service (DoS) attacks.
- The authors [5] feasible solution. In this research, we investigate the problems with implementing certain security features in the CAN protocol, such as message authentication and protections against replay and denial-of-service (DoS) attacks. We identify the restrictions of the CAN bus, and we demonstrate how our proposed implementation meets these restrictions. The solution proposed in this research is tested with a simulative CAN environment. This paper proposes an alteration to the standard CAN bus nodes and the CAN protocol to better protect automobiles and other CAN-related systems from attacks
- The authors [6] propose a novel identification method, which works in the physical layer of the in-vehicle CAN network. Our method identifies electronic control units (ECUs) using inimitable characteristics of electrical CAN signals enabling detection of a malicious ECU. Unlike previous attempts to address the security problem in the in-vehicle CAN network, our method works by simply adding a monitoring unit to the existing network, making it deployable in current systems and compliant with required CAN standards. Our experimental results show that our method is able to correctly identify ECUs. In case of misclassification rate for ECU identification, our method yields 0.36% in average which is approximate four times lower than the method proposed by P.-S.
- The authors [7] propose a novel identification method, which works in the physical layer of the in-vehicle CAN network. Our method identifies electronic control units (ECUs) using inimitable characteristics of electrical CAN signals enabling detection of a malicious ECU. Unlike previous attempts to address the security problem in the in-vehicle CAN network, our method works by simply adding a monitoring unit to the existing network, making it deployable in current systems and compliant with required CAN standards. Our experimental results show that our method is able to correctly identify ECUs. In case of misclassification rate for ECU identification, our method yields 0.36% in average which is approximate four times lower than the method proposed by P.-S.
- The authors [8] proposes a novel tree-based IC fault diagnosis method to identify the various IC fault locations in the CAN network. First, the error event pairs for network nodes are defined by analysing the data-link layer information upon each error. Then, the domains of studies are conducted to demonstrate the performance of the proposed method. The results show that IC fault identified by the proposed method agree well with the case study setups.
- The authors [9] presents the bus structure of a CAN-FD is investigated and a transfer function of ringing is modelled by considering the physical bus configuration and features of a controller area network transceiver. The effects of the main parameters of the physical bus, such as the stub line length and number of stub lines connected to a joint connector, are then quantitatively analysed using the presented model. When a practical bus structure is considered, additional signal distortion owing to a neighbouring connector in a physical bus is modelled and analysed. These analytical results are confirmed experimentally. Their comparison shows that the presented model-based analysis can closely approximate the size and time response of ringing and the extent of bit time distortion. The presented model-based analysis facilitates reliable communication performance by estimating the ringing and resulting asymmetry of the propagation delay for a given physical bus design and, necessary, adjusting the design.
- The authors [10] propose literal multi-dimensional anomaly detection approach using the distributed long-short-term-memory (LSTM) framework for in vehicle network, especially the Control Area Network (CAN). The proposed approach only needs the literal binary CAN message instead of revealing the semantics of CAN message. To enhance the accuracy and efficiency of detection, it detects anomaly from both time and data dimension simultaneously by exploiting multi-task LSTM neural network on mobile edge. The extensive evaluation results show that the proposed anomaly detection achieves a satisfying accuracy of 90%. The detection speed is as fast as 0.61 ms on mobile edge

III. INSIGHTS ON AUTOSAR, CAN, ECU

3.1 AUTOSAR

It is an open and standardized automotive software architecture jointly developed by automobile manufacturers, suppliers and tool developers. AUTOSAR is a common platform across the whole automotive industry which will enhance the scope of applications of vehicle functionalities without disturbing the existing model. The sole objective of AUTOSAR is to establish a common standard among the manufacturers, software suppliers and tool developers, retaining the competition so that the end outcome of business is not altered in the process.

- The **AUTOSAR** consortium standardizes an Automotive **Open System Architecture** software planform for car electronic and software systems.
- It aims to reduce the ever increasing complexity in vehicle software development by standardizing a common software platform.
- AUTOSAR partners can utilize the platform, modify it, and to design the software based on their needs.
- The re-use of standardized software components and the integration of third party solutions based on the AUTOSAR standard, make the design process highly cost-efficient.
- AUTOSAR is a partnership program, consisting of core partner, premium partner, development partner, and associate partner.

- Core Partners are responsible for defining the main activities of the project.
- Premium partners are allowed to participate actively in the standardization process, including access to all necessary documentation
- Development partners are provided with limited access to development documents, but allowed to participate.

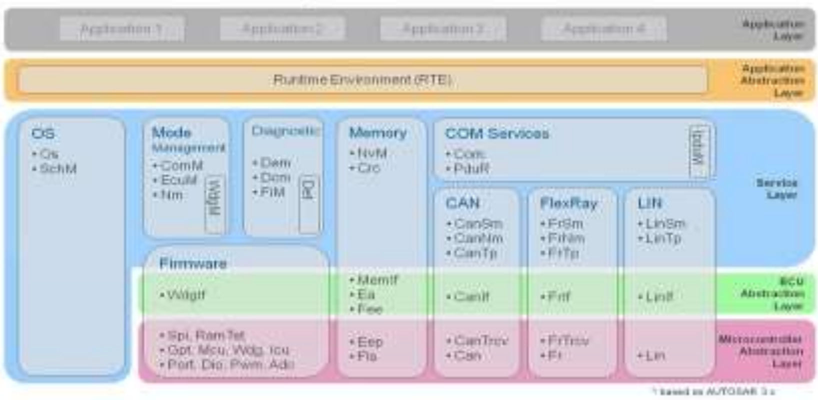

Fig 3.1 AUTOSAR Layered Architecture

3.2 CONTROLLER AREA NETWORK(CAN)

The Controller Area Network (CAN) is a serial asynchronous multi-master communication bus defined by ISO and SAE standards. Developed by Bosch in the 80's for the automobile industry CAN protocol can handle data rates up to 1 Mbit/s. It is largely immune to electrical faults and can detect errors. The CAN protocol describes how information is exchanged between individual nodes of the network. Every CAN node always sends a message to all systems on the bus.

The Physical Layer defines how signals are actually transmitted. Within this specification the physical layer is not defined so as to allow transmission medium and signal level implementations to be optimized for their application The Transfer Layer represents the kernel of the CAN protocol. It presents messages received to the object layer and accepts messages to be transmitted from the object layer. The transfer layer is responsible for bit timing and synchronization, message framing, arbitration, acknowledgment, error detection and signaling, and fault confinement.

The Object Layer is concerned with message filtering as well as status and message handling.

3.2.1 CAN PROPERTIES

- Prioritization of messages
- Guarantee of latency times
- Configuration flexibility
- Multicast reception with time synchronization
- System wide data consistency
- Multi-master
- Error detection

3.2.2 CAN MESSAGE STRUCTURE

- SOF (Start of Frame) - Marks the beginning of data and remote Frames
- Arbitration Field – Includes the message ID and RTR (Remote Transmission Request) bit, which distinguishes data and remote frames
- Control Field – Used to determine data size and message ID length
- Data Field – The actual data (Applies only to a data frame, not a remote frame)
- CRC Field – Checksum, ACK Field – Acknowledgement of checksum check
- EOF (End of Frame) – Marks the end of data and remote frames

- IFS – Interframe Space

3.3 ELECTRONIC CONTROL UNIT (ECU)

The electronic control unit (ECU) is the intelligent heart of the Servo electric power steering system. Based on the steering signal from the torque sensor, the ECU calculates the optimal assistance and sends this information to the electric motor. In addition, the ECU processes various vehicle parameters and calculates the necessary steering corrections in milliseconds. An Electronic Control Unit (ECU) is an embedded system that controls electrical subsystems in a transport vehicle. Modern motor vehicles have up to 80 ECUs.

IV. PROPOSED METHODOLOGY

4.1 FLOW CHART

For implementation of network communication, each container is configured individually for different conditions specified by the BOSCH customer. Upon completion of the compilation, all these implementations are then checked by performing the test suite which is static analysis of the code to find the code coverage. Once the compilation is successfully, the code is then simulated in the LABCAR by flashing the software on to the ECU. If all these testing are successful, the software is then flashed directly on to the actual ECU of the car.

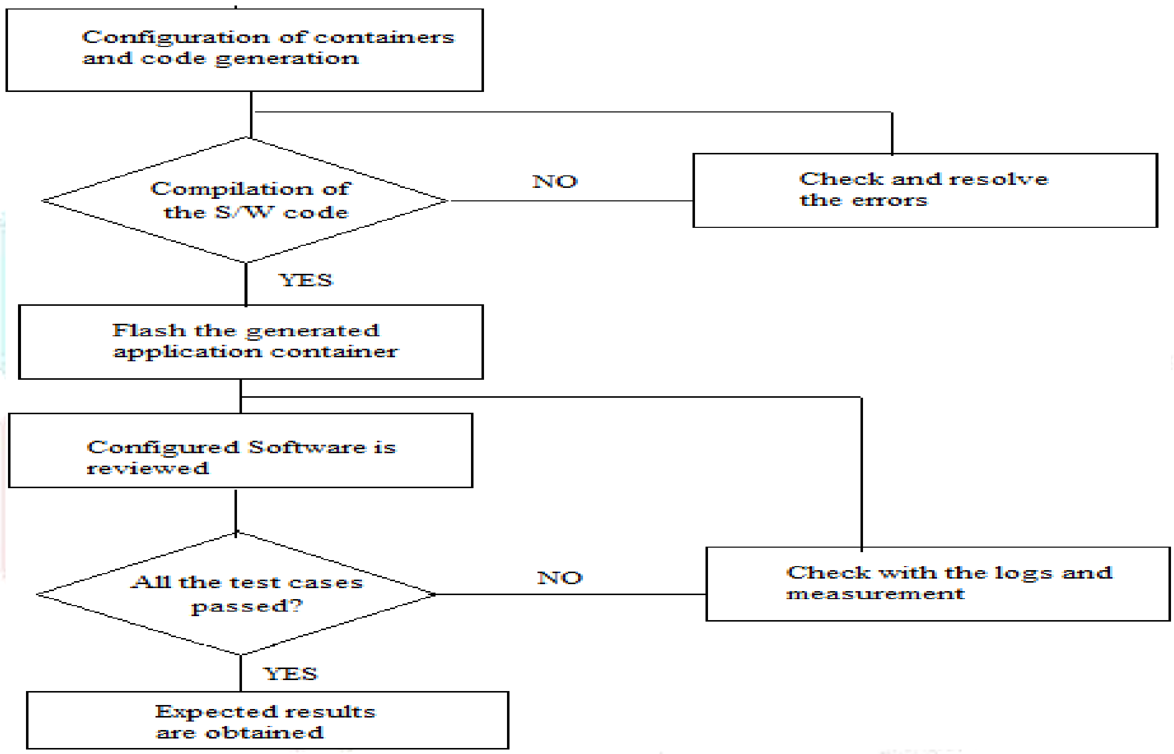

FIG.4.1 FLOW CHART OF THE EXECUTION

4.2 OPERATIONAL BLOCK DIAGRAM

Fig.4.2 represents the block diagram of can architecture and the significance of each module or container that are configured as NET-PR

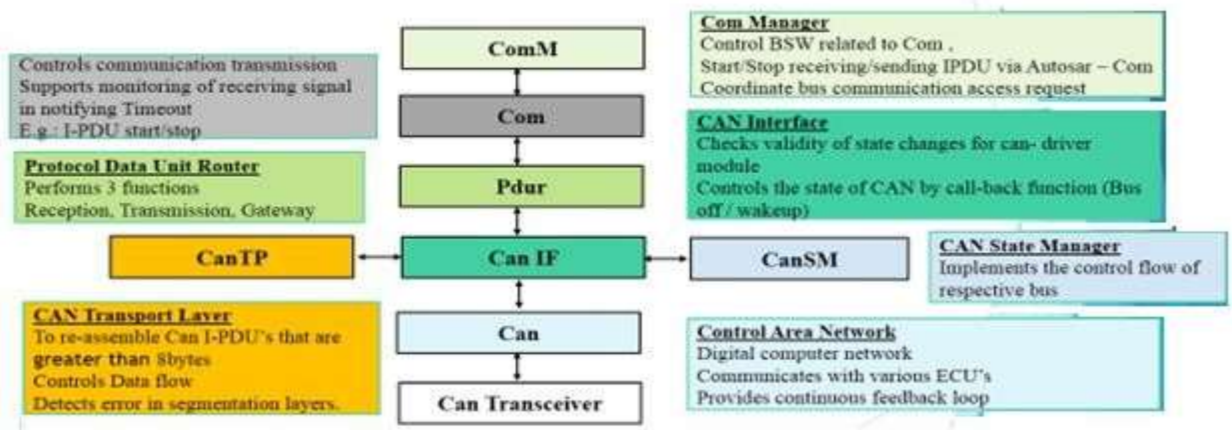

FIG 4.2 BLOCK DIAGRAM

V. OUTCOMES OF PROJECT

Testing is an essential phase to be carried out to guarantee that the created software/program works right and meets the prerequisites of client.

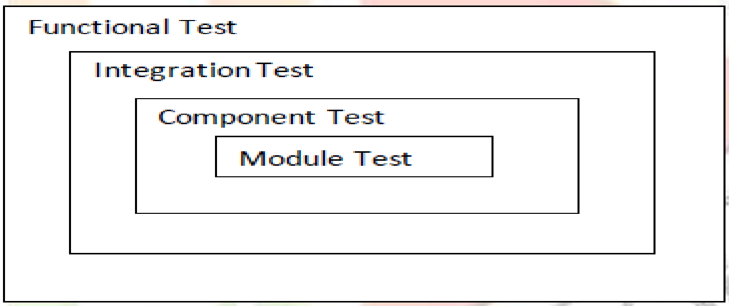

Fig 5.1 Several stages involved in testing

5.1 INTEGRATION TEST:

Integration test is carried out for complete project. All the components are incorporated into the project and are usually tested in LABCAR.

5.2 TEST RESULTS

Using the online mode in the Canalyzer tool , the measurement logs are taken that are saved in the logfile as shown in Fig.5.2. For the different test cases to be performed the can logs are viewed in the Trace window as in Fig.5.6 andare saved in the file location given. These can logs are saved in the .asc files that are used for reviewing the test cases in the offline mode.In the Fig.5.3, the trace window showing the CAN or CANFD messages with the CAN ID, DLC, Checksum, Type of the message, CAN channel. This trace window is helpful in analyzing some of the test case in the reviewing process. Once the application container is flashed through X Flash in the LABCAR in online mode the project files are loaded and the measurement logs are recorded and are saved as zip files in the location provided by us. These zip files contains the plots where they are loaded in the offline mode and the representation of the signals are viewed in the Uniview window as shown in Fig.5.4

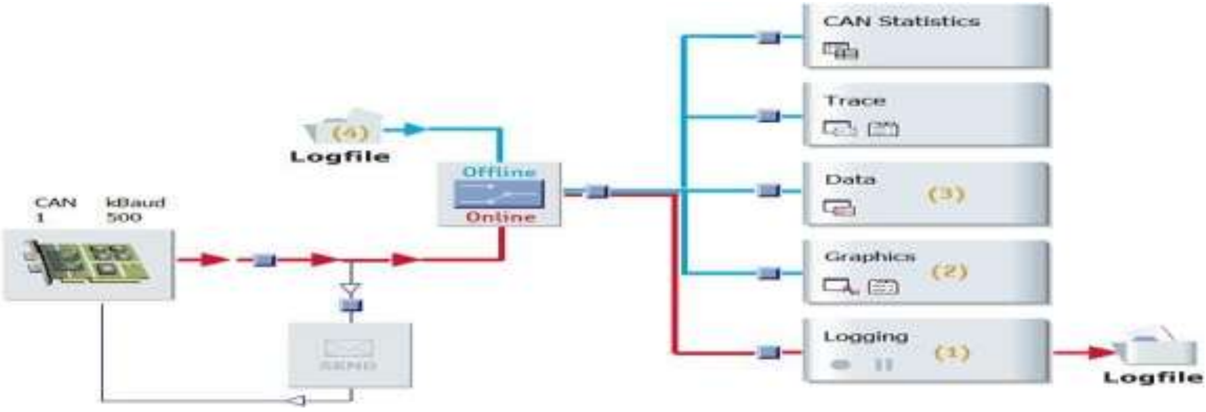

Fig.5.2 Logging File

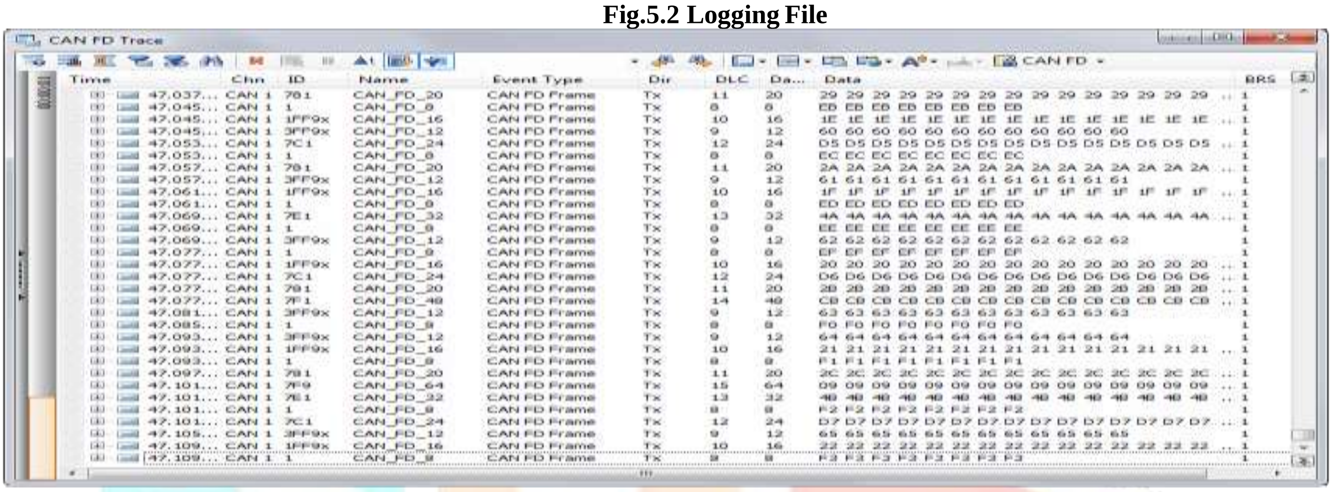

FIG.5.3 CAN LOGS

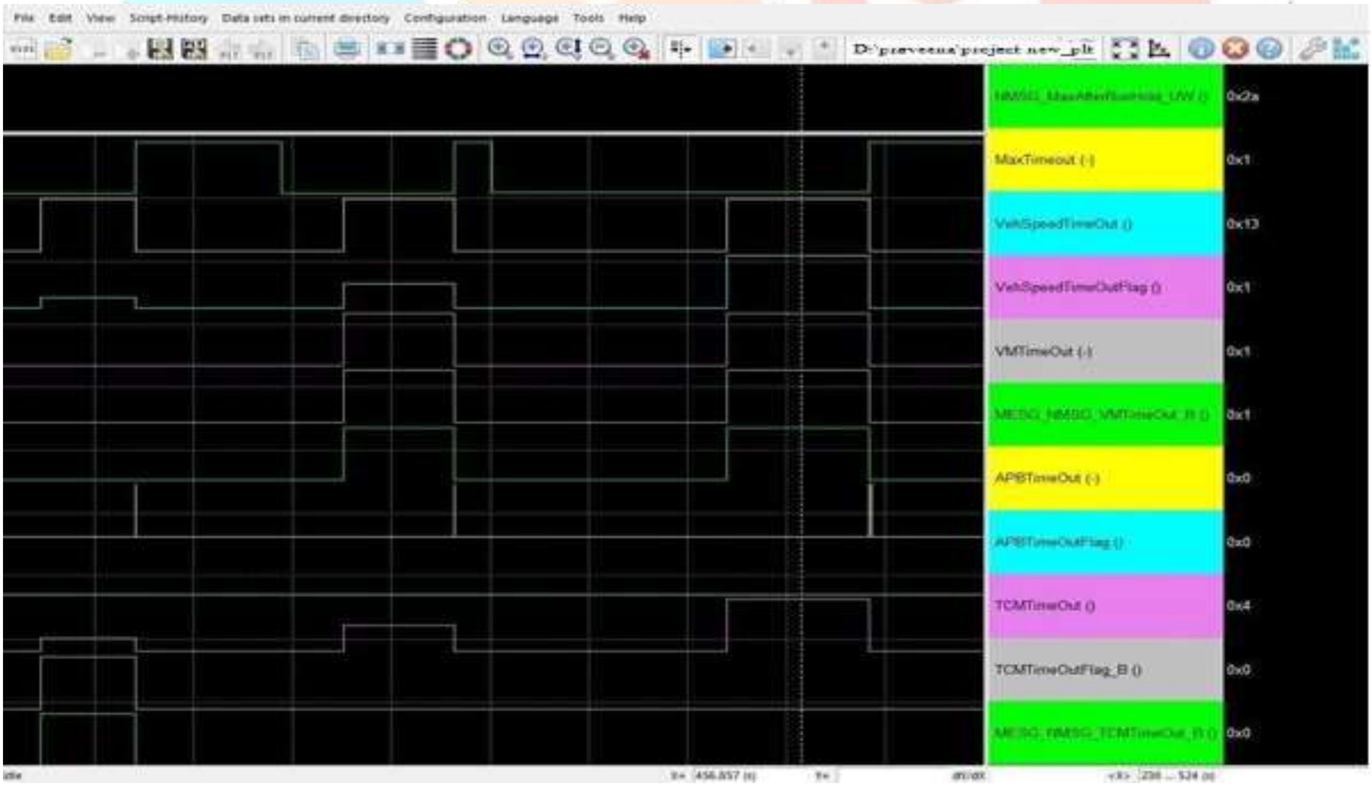

Fig.5.7 Test logs measurement on LABCAR – Uniview window of the activation of brake according to speed of vehicle

VI. CONCLUSIONS AND FUTURE SCOPE

6.1 CONCLUSION

Network, as a component, plays a very important role in automotive. Of allthe things considered, the technician will utilize a diagnostic device to check whether there are any recorded issues. Thus the work was carried out to detect the fault and degradation strategy for ESP in a car. The new software is thus configured for the existence of communication between ECU's provided by the BOSCH customerwere developed. A method for performing the test suite for checking the code coverage of the NET component was also discussed and successfully tested and 100% expectations was met.

6.2 FUTURE SCOPE

The future of CAN is bright. The lifetime of CAN technology might have been prolonged by 10 to 20 years with the introduction of the CAN FD protocol. The automotive industry has already started to adopt the CAN FD protocol for the next generation of in-vehicle networks. It can be expected that all future applications will make use of the CAN FD protocol. It doesn't matter if they require higher bandwidth or not. You can still use CAN FD with a single bit-timing setting. The payload length is configurable from 0 to 64 byte anyway.

REFERENCES

1) Der-Cherng LIaw ,Cheng-Yu Yu and Kuo-Chen Wu " A CAN-Based Design for the Control of Electric Vehicle" 2014 14th International Conference on Control, Automation and Systems (ICCAS 2014) Oct. 22-25, 2014 in KINTEX, Gyeonggi-do, Korea.

2) Xiaoming Li, Mingxiong Li "An Embedded CAN-BUS Communication Module for Measurement and Control System" Metric based Evaluation of Powertrain Architecture, no. SAE International, 2017. IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 68, NO. 9, SEPTEMBER 2019.

3) Jeong-Hwan Lee, Jaekyung Lee and Jihun Cha proposed"How to build Controller Area Network Communication Test Environment using NVIDIA TX2 for Unmanned Aerial Vehicle" IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 68, NO. 9, SEPTEMBER 2019.

4) Zachary King proposed "Investigating and Securing Communications in the Controller Area Network (CAN)" 2017 International Conference on Computing, Networking and Communications (ICNC): Workshop.

5) Alpha Tamrakar, Adasrh S., K.I. Ramachandran" Fuzzy logic based Fault detection of Controller AreaNetwork using MicroAutoBox – II" IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 68, NO. 9, SEPTEMBER 2019

6) Wonsuk Choi, Hyo Jin Jo , Samuel Woo, Ji Young Chun, Jooyoung Park , and Dong Hoon Lee" Identifying ECUs Using Inimitable Characteristics of Signals in Controller Area Networks" IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 67, NO. 6, JUNE 2018

7) Sukhwan Kang , Jewoo Seong , and Myunghee Lee " Controller Area Network With Flexible Data Rate Transmitter Design With LowElectromagnetic Emission" IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 67, NO. 8, AUGUST 2018

8) Leiming Zhang , Fan Yang, and Yong Lei" Tree-Based Intermittent Connection Fault Diagnosis for Controller Area Network" IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 68, NO. 9, SEPTEMBER 2019.

9) Hansang Lim , Gyunha Kim , Seungsu Kim, and Dongok Kim" Quantitative Analysis of Ringing in a Controller Area Network With Flexible Data Rate for Reliable
Physical Layer Designs". IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 68, NO. 9, SEPTEMBER 2019

10) Konglin Zhu , Zhicheng Chen, Yuyang Peng , and Lin Zhang "Mobile Edge Assisted Literal Multi-Dimensional Anomaly Detection of In-Vehicle Network Using LSTM"
IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 68, NO. 5, MAY 2019