# Canoe Simulation Framework for Software Testing in Automotive Industry

**CHETHAN S**
R V College of Engineering
Bangalore

**DR. RAMAKANTH KUMAR P**
R V College of Engineering
Bangalore

**Abstract**: Software testing is a very important and unavoidable phase in software development. Any software developed must go through several test phases several times; before it is ready to release. In automotive industries a software developed must be deployed to a specialized microcontroller to test its working in the automobile. Since it's not guaranteed that the software deployed will pass all the test cases the process is not one time. So, the microcontroller must be flashed and erased multiple times. It results in hardware damage. The idea of CANoe framework development will resolve this issue. It helps to test the software before deploying it to hardware and hence one can resolve all the issues and bugs before flashing it into the hardware.

**Key words-** Automotive-Industry, CANoe, Simulation, Software testing.

## INTRODUCTION

Technology has covered almost all the fields today. Hence the automotive industry is more intended to solve the problems using technology which results in development of software solutions. An automotive industry will have a specialized microcontroller to handle processes in ECU's. Any software developed to process any use case must be deployed to this specialized microcontroller.

Software testing is not a one-time process since the smooth working of any software is not guaranteed just after development. So, software testing is a recursive process. This recursive nature of software development and testing creates a problem in automotive industry since the software must be flashed for testing and must be erased if it's not working properly. If the software is flashed and erased multiple times in a single microcontroller it may damage the microcontroller or any part of it. If any damage caused to it disturbs the multiple functions of the car. The cost of these specialized microcontrollers is reasonably high and if they get damaged it will be huge loss for the company. So, the main motive to develop this framework is to protect the microcontroller and save money

So, the proposed idea to develop a framework for testing the software using a CANoe resolves this issue and help us to maintain the life of a hardware. The framework developed using CANoe will help us to test the software and debug the issues. It has many features to analyse and track the output of the software.

## LITERATURE REVIEW

The vector-based CANoe CAN analyser was used to simulate the real-time values from ECU to diagnose engine temperature, engine speed, vehicle speed etc. CANoe simulator was developed to implement the diagnosis system between two controller area network (CAN) nodes [1]. The approach proposed was well suited for diagnosing any automotive vehicle and the it made the debugging the problem in any vehicle interface easy. The method of simulating the real-time data is flexible and the same idea is used with some modifications.

The idea of automated navigation of car using the vector fields is something which shows us how we can send the signals to ECUs from vector [2]. They have developed an algorithm which calculate the direction in which the car should move and the same is stored in the vector fields developed by them and then the signal is sent to the control system to obey the direction law. The drawback is that it is not dynamic. It works only for a specific map that is trained in the model.

Good performance is only thing that a user expects from the software. Here the performance of CAN FD decides the performance of software. The approach to analyse the performance of CAN FD is based on a new automotive communication protocol that was officially proposed by Robert Bosch GmbH [3]. Considering the size of the data as an important source the speed of the data transfer is measured. It is again analysed using CANoe CAN analyser.

A design scheme of simulation and test system for vehicle body CAN bus network is brought forward, which mainly includes the topology of network, the hierarchical model of network and the selection of bus baud rate [4]. They have also shown how to use CANoe

to construct the simulation and test environment for vehicle body CAN bus system. Finally, the simulation and test system for vehicle body CAN bus is tested through experiment and the result was appreciable.

The idea to simulate through CANoe CAN analyser is a common thing identified in the research. This idea is derived to create a testing framework for software testing and to simulate the output using CANoe CAN analyser.

There are only few resources available to learn the CAPL programming. The programming techniques to create the handler between ECU node module and simulator for I/O interactions between the DLL and simulator is developed by understanding the CAPL programming using the text resource [5].

## METHODOLOGY

The generic methodology followed to develop the CANoe simulation framework is shown in the figure 1.1.

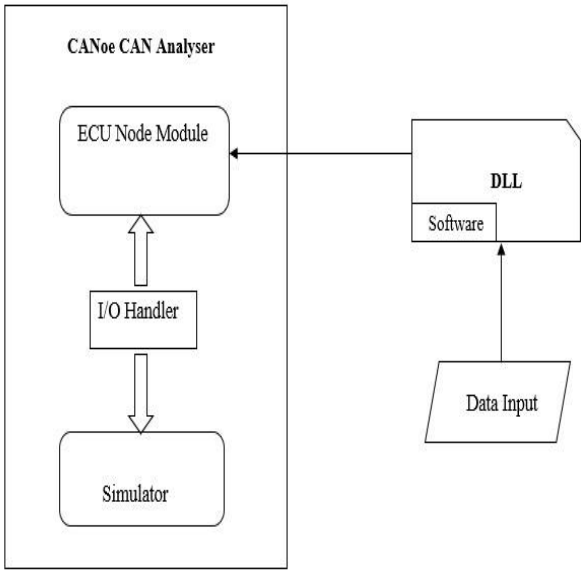


***Figure 1.1: Software design diagram***

Design a network module by adding the ECU node modules in the CANoe CAN Analyzer. Set the channel usage for the CAN BUS. Keep in mind that the hardware CAN case must be connected to your PC while doing all the configurations and also while simulating. Then the DLL of software to be tested must be loaded into the node module.

All automotive industries never use a single or same programming language to develop their software for their vehicles. The programming language is chosen based on the requirement. So, the software developed can't be tested directly using the canoe. A DLL (Dynamic link library) need to be created from the source code of the software. Then Need to create handlers or wrappers to communicate between DLL and CANoe. Then use CAPL programming techniques to get and set the values (input and output) from DLL to CANoe and vice-versa.

Once you capture the output from DLL using CANoe system variables you can just analyse them either in graphically or numerically. CANoe basically provides five kinds of analysis techniques. So, developer can choose any one which is convenient for him.

## RESULTS AND DISCUSSION

To analyse the quality of the framework, a sample software was developed which takes the sensor values as the input (hardcoded using c++; not read using any sensor) and gives the speed of the vehicle as output. The software is converted into an DLL and loaded to CANoe CAN analyser and simulated the output. The output given in the CANoe CAN analyser is compared with the real speed of the vehicle and the difference was NILL.

## CONCLUSION

The approach or idea of simulating the output of a software which is to developed for an automotive vehicle reduces the dependency on the hardware equipment. This general approach of developing a simulation framework using canoe can be cloned to any specific application. This approach is economical, time saving and helps in the testing the software before deploying it to microcontroller or ECU and hence everyone must make use of it.

## ACKNOWLEDGMENT

I am indebted to our guide, Dr. Ramakanth Kumar P., Professor and Head, Department of Computer Science and Engineering, for his wholehearted support, suggestions and invaluable advice throughout our project work and also helped in the preparation of this thesis. We would also like to extend our gratitude to Mr. Naresh Reddy Y M for his guidance in the mechanics of the project. We also express our gratitude to our panel members Dr. Ashok Kumar A. R, Associate professor and Prof. Manonmani S, Assistant Professor, Department of Computer Science and Engineering for their valuable comments and suggestions. We express sincere gratitude to our beloved Principal, Dr. K. N. Subramanya for his appreciation towards this project work. We thank all the

teaching staff and technical staff of Computer Science and Engineering department, RVCE for their help. Lastly, we take this opportunity to thank our family members and friends who provided all the backup support throughout the project work.

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