Simulator Design for Vehicle Application System Development Based on GMLAN

Taeyoung Lee, Youngjae Kim, Seonghun Lee, and Sungho Jin

Abstract—**Vehicle application system development consists of design, development, confirmation using vehicle CAN (Controller Area Network) signal. As to do this kind of process, very high costs and much time are required, further high risk is included. So, developers have designed and used simulation environment. But, vehicle application system developers are asking for methods of cost saving, few risks, and cut to development period. This paper introduces method of simulator design for vehicle application system development based on GMLAN (General Motor Local Area Network).**

Index Terms—**Vehicle application system, CANoe, GMLAN, CAN, simulator, embedded system.**

I. Introduction

Most of vehicle application system development be composed of design, development, verification using vehicle CAN signal such as engine on/off, accelerator / brake pedal position, vehicle speed, etc. As to do this kind of process, prohibitive costs and long haul are required, further high risk is included. So, each developer have designed and used simulation environment. But, vehicle application system developers are demanded for methods of cost reduction, low-risk, and cut to new product development period.

CANoe is multi-function software for development, test and analysis of entire network by Vector [1]. And CANoe is analysis tools with test environment for communication bus simulator, ECU and network. That is to say, it is easy to modification and error detected in the first stage by providing automated test. CANoe support the bus systems such as CAN, LIN (Local Interconnect Network), MOST (Media Oriented System Transport), FlexRay, Ethernet, WLAN (Wireless Local Area Network), and J1708 [5].

This paper introduces method of simulator design for vehicle application system development based on GMLAN. And this paper introduces development method of simulator for EPB (Electric Power Brake) system by development case study.

The concept of GMLAN simulator using CANoe is introduced in Section 2. The design procedure is explain in Section 3. And the simulator test result is explain in Section 4. Conclusion is given in the final section of the paper.

II. Concept of GMLAN Simulator Using CANoe

A. Design Concept

The CAN signal such as engine on/off, accelerator/brake pedal position, vehicle speed, etc. of vehicle need for ECU development and test [2], [3]. Developing ECU test are still the same problems and it is very high costs in the real car test. So, developing ECU test use CAN signal simulator.
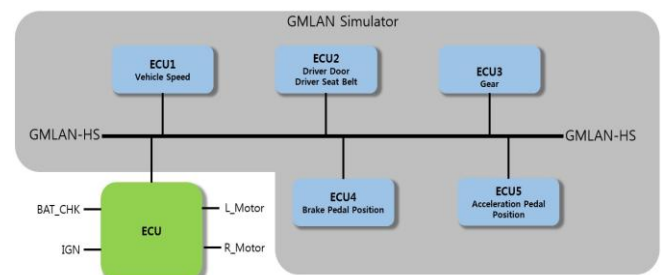

Fig. 1. Simulator design concept.

CAN simulator is composed of control panel, display panel, trace window as shown in Figure 2. Control panel controls transmission of CAN signal to ECU. Transmission of CAN signal use CAN signal based on GMLAN. Display panel receive CAN signal from ECU. Trace window can check the transmission and reception of CAN signal.
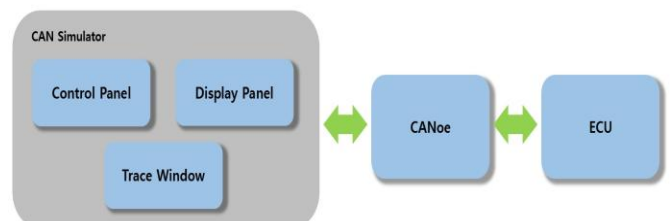

Fig. 2. Simulator structure chart.

B. Hardware Component [1]

The VN8970 FlexRay/CAN/LIN module is a slide-in module for the VN8910A and has a FlexRay channel as well as several CAN/LIN channels as shown in Figure 3. In addition, a ninth channel is available for dedicated digital-analog input/output tasks.

The slide-in module's greatest asset is its five plug-in locations for add-ons. Depending on requirements, electrically decoupled CAN High-Speed, CAN Low-Speed, CAN Single Wire, J1708 or LIN transceivers may be used [4]. In additions, four capacitively decoupled built-in CAN High-Speed transceivers are available. Channel 9 is reserved for dedicated IO Piggybacks.

Fig. 3. VN8970 FlexRay/CAN/LIN module.

C. Software Component [1]

The VN8900 interface family is a real-time hardware that is designed for using with CANoe. CANoe offers the option of executing real-time relevant simulations and test functions on the VN8900 separate from the graphic user interface. On the one hand, this increases overall system performance, and on the other it enables shorter latency times and more precise timers. Configuration of the simulation and evaluation are performed on a standard PC, while the simulation and test kernel are executed on the VN8900. Communication between the two computers is routed over a USB cable.
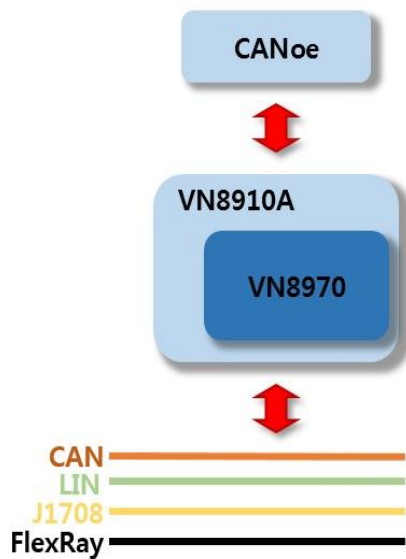

Fig. 4. System Description.

III. DESIGN PROCEDURE FOR EPB SIMULATOR

The CANoe Hardware Configuration can identify type, controller, baud rate, cab/piggy of information connected to the hardware. New nodes and database can set up at the Simulation Setup. Vector CAPL (CAN Access Programming Language) Browser can add CAN message used for simulator [1]. Also, Vector CAPL Browser can connect the environment variable to dbc files. Vector CANdb++ Editor can modify the dbc files.

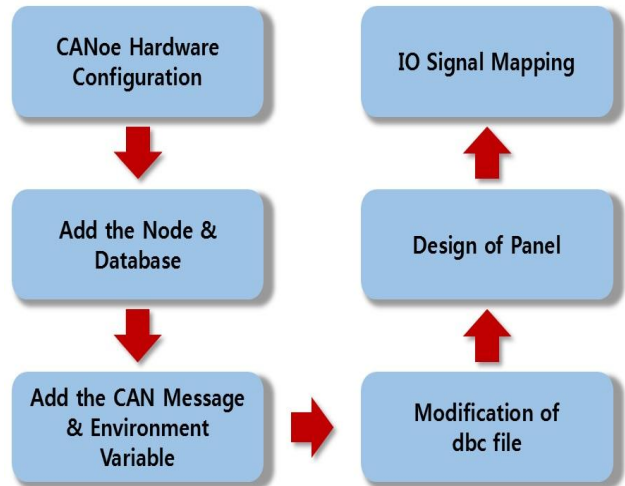In the process, we will develop simulator for EPB system as shown in Fig. 5.

Fig. 5. Simulator design procedure.

A. CANoe Hardware Configuration

500bps of baud rate, on board 1051cap set up for application of vehicle system EPB development.

B. Add the Node & Database

Simulation Setup of CANoe add the node to the number of panel and add the database.

C. Add the CAN Message & Environment Variable

Vector CAPL Browser of CANoe connect the CAN message to environment variable using GMLAN simulator.
The method is as in the following.

@(environment variable name) = this.(CAN message)
@ElectricParkBrakStatusDsp = this.ElecPrkBrkStat;

D. Modification of dbc file

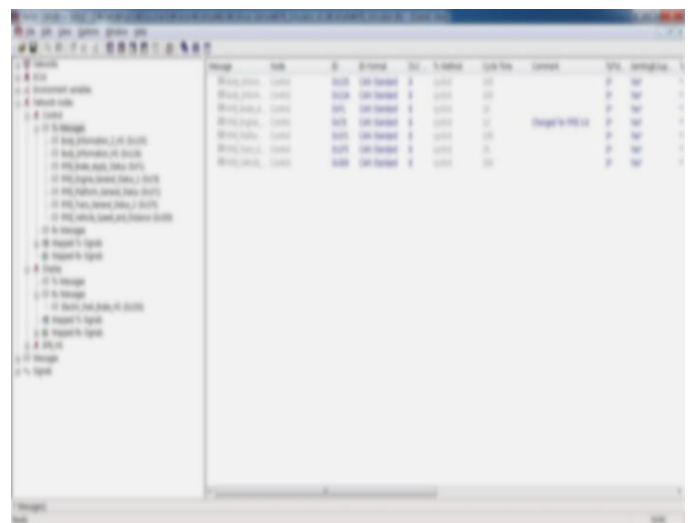Vector CANdb++ Editor of CANoe can modify compatible dbc for vehicle system EPB development [6].

Fig. 6. Vector CANdb++ Editor.

E. Design of Simulator Panel

The control panel is control screen for the transmission of CAN signal necessary for ECU test. Add the CAN signal to control panel. The CAN signal of control panel generate CAN signal of real-vehicle.
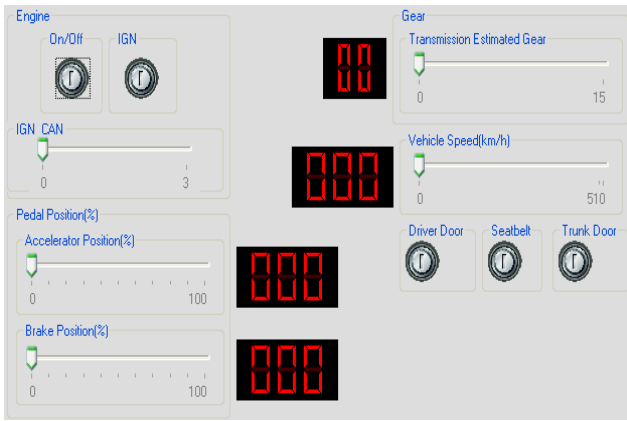
Fig. 7. Control panel.

The display panel receive a transmitting signal from the ECU. In other words, the display panel can identify condition of ECU.

Fig. 8. Display panel.

The trace window can identify a low data of transmitted / received signal. The trace window can identify ID, name, DLC (data link control) and data of signal.

Fig. 9. Trace Window.

IV. TEST RESULT OF EPB SIMULATOR

A. Result of transmitted / received CAN signal

The brake position and vehicle speed enter a value for 61% and 105km/h as shown in Figure 9. The CAN signal of transmitted control panel is the same form in the CAN signal of real-vehicle. So, developing ECU is obtainable test results from real-vehicle.

Fig. 10. Input of control panel.

The trace window can identify brake position value and vehicle speed value entered control panel as shown in Fig. 10. Furthermore, trace window can identify a transmitting signal from the ECU.
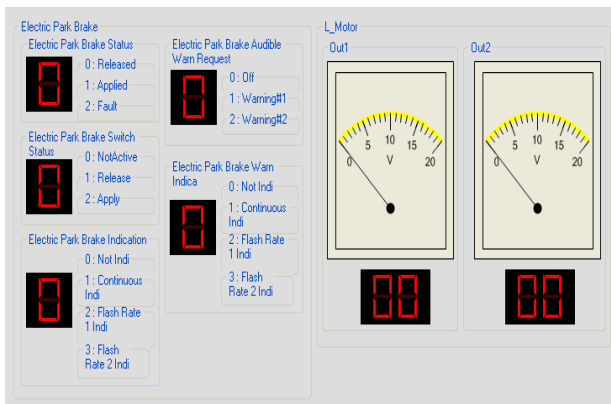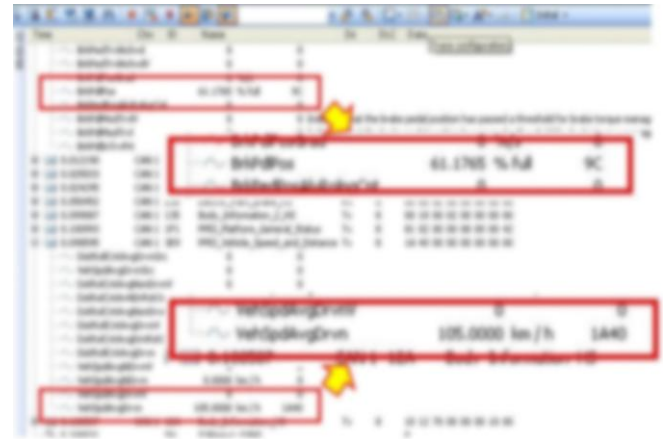

Fig. 11. Output of trace window.

B. Application of Vehicle System Development

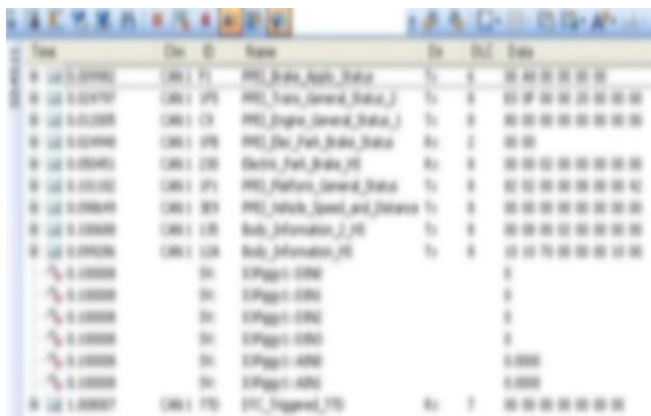The following figure is a result of vehicle system EPB development based on GMLAN simulator using CANoe.
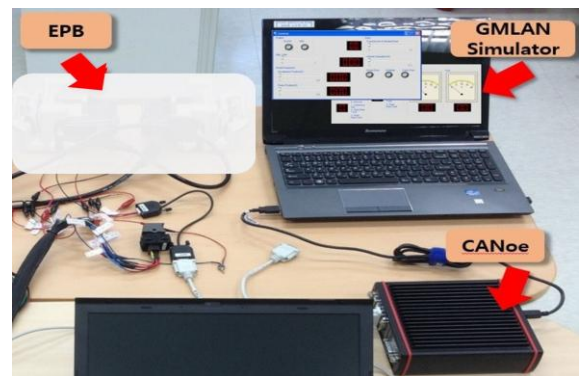

Fig. 12. Result of Development Application.

Operating sequence of EPB system is as follows. At first, this GMLAN simulator transfers CAN signals to the CANoe. And then, CANoe transfers the transmitted CAN signals from the GMLAN simulator to EPB ECU. Finally, EPB ECU actuates the EPB Calipper.

Display Panel of GMLAN simulator can identify condition of hardware of the EPB system.

V. Conclusion

This paper introduces method of simulator environment design for vehicle application system development based on GMLAN.

As a test result of GMLAN simulator using CANoe, GMLAN simulator was able to transmit CAN signal necessary for vehicle system EPB development. In other words, the GMLAN simulator was able to identify condition of EPB ECU.

In the future, we will renew improvements part of EPB development prototype.

Acknowledgment

References

[1] Vector. [Online]. Available: http://www.vector.com/vi_portfolio_en.html
[2] D. C. Pheanis and J. A. Tenney, "Data Collection with Vehicle-Bus Interface," presented at the ISCA International Conference on Computers and Their Applications (CATA-2001), Seattle, Washingtion, USA, March 28-30, 2001.
[3] D. C. Pheanis and J. A. Tenney, "Vehicle-Bus Interface with GMLAN for Data Collection," presented at the In Computers and Their Applications, Honolulu, Hawaii, USA, March 26-28, 2003.
[4] M. R. Stepper. J1939 high speed serial communications, the next generation network for heavy duty vehicles. [Online]. Available: http://www.sae.org/technical/papers/931809, August, 1993.
[5] CANoe Installation & Quick Start Guide, Vector, Germany, 2012.
[6] CANdb ++ Database Editor User Manual, Vector, Germany, 2005.

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