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Research of Hardware-In-The-Loop System of Monitor System of Marine Diesel Engines

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ABSTRACT: In order to improve the remote fault diagnosis and monitoring items of marine diesel engine, improve the development efficiency of monitor system of marine diesel engines. Hardware-in-the-loop simulation test has already been validated in developing monitor system of marine diesel engines. Build database of CAN application layer protocol .The information packet sends simulation process of diesel fuel injection. Infineon XC2765 is used to develop the simulation ECU. Sensor signals generated by the simulation ECU simulate the work of marine diesel engine in order to test the monitor system of marine diesel engines.

Keywords: the monitoring system of diesel engine, Hardware in the loop simulation technology, CAN-bus, simulation ECU

I. TNTRODUCTION

Hardware in the loop simulation(HILS) is a complex simulation system which mix physical model, mathematical model and entity. It's a real - time and dynamic simulation technology. Specifically, using the model on the computer instead of the controlled object of the closed - loop test system. Connect the physical with the simulation system in order to test the function of the object. HILS can make full use of the power of the computer, reducing the cost of research and improve the efficiency of development greatly. There is no need to build any model. Simulation of a single module can save a lot of time.

II. WORKING PRINCIPLE OF SYSTEM

The monitoring system of diesel engine of ship is mainly composed of engine ECU, monitoring and security system, remote monitoring system and abutment control system. It's used to control and monitor the marine diesel engines. Reasonable and reliable test environment is very important for the development of the monitoring system of diesel engine of ship. Each system of the monitoring system of diesel engine of ship works independent. CAN is used to communicate which can ensure the accuracy ,reliability and efficiency of transmission of data. The advantage of CAN bus is high speed, high reliability and convenient connection.
That makes high flexibility and reliability. Through the fault diagnosis system of CAN bus, fault diagnosis and acquisition of fault code information is quick and reliable. COMPUTER and emulation ECU instead of the actual working diesel engine connect with the monitoring ECU in the simulation system that save the cost of experiment. Through HILS the monitoring system of diesel engine can be tested.

III. OVERALL SYSTEM DESIGN

Working principle of Hardware in the loop simulation for the monitoring system of diesel engine is shown in Fig1.

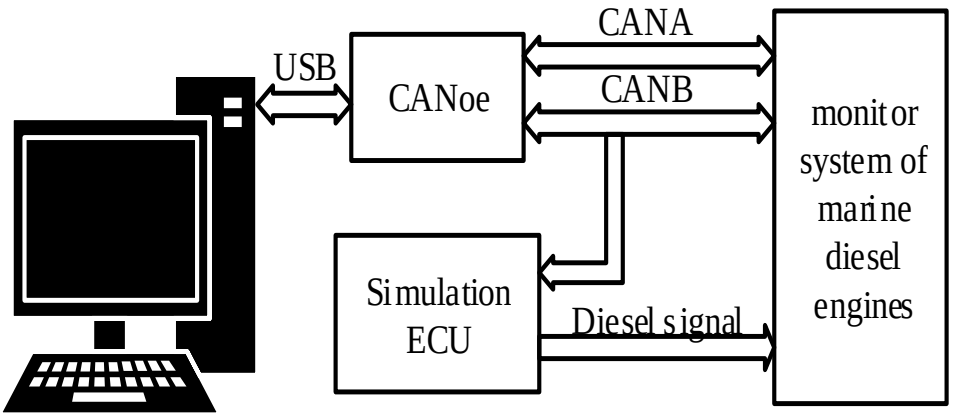

Fig1. Working process of HILSS of information system for marine diesel engine

3.1 Design of CAN bus network control system

In Hardware-in-the-loop simulation system, the internal communication between the subsystems based on the CAN bus.

Reasonable CAN bus can improve the reliability and stability of Hardware-in-the-loop simulation system for monitoring system of diesel engine. The main structure is shown in Fig2.

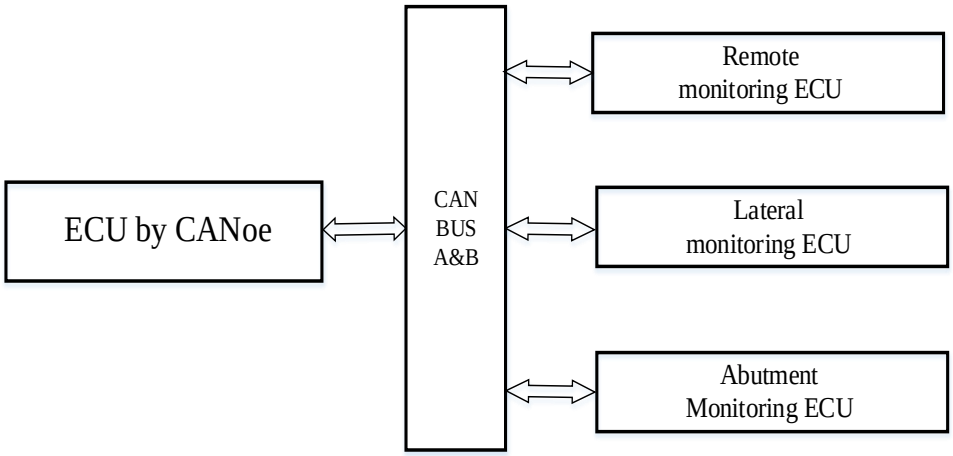

Fig2. Network topology of the CAN bus

The system consists of remote monitoring ECU, lateral monitoring ECU and abutment monitoring ECU.PC simulates the work process of diesel Engine ECU through CANoe and output the state parameters of marine electronic diesel engine which are sent to the monitoring ECU .CAN is used to exchange state parameters between different nodes.

3.2 Hardware design of Hardware in the loop simulation(HILS)

The function of simulation ECU is to simulate the condition parameters of engine which provides a virtual test environment for the marine diesel engine monitoring system. Working principle is shown in Fig3.

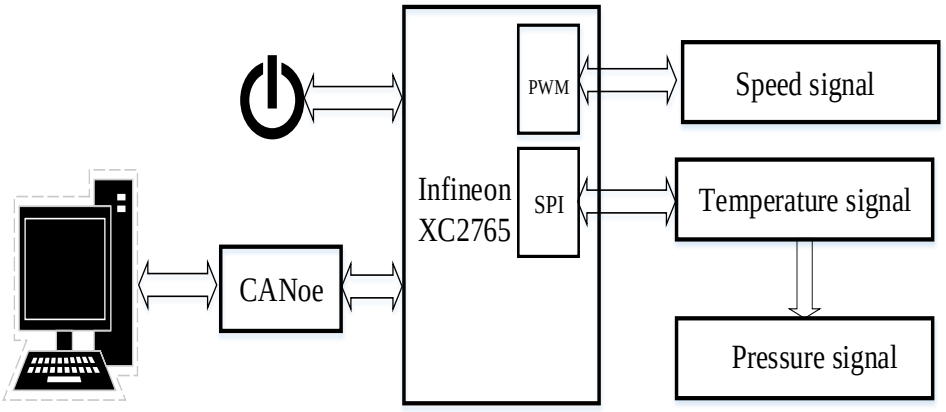

Fig3. Working principle of simulation ECU

Computer sends a digital signal to the simulation ECU. CANoe is used to connect them so that data can communicate with each other. Simulation ECU sent signal of sensor through D/A to the monitoring system of diesel engine in order to test the function of the system developed.

3.3 Software design of Hardware in the loop simulation(HILS)

The simulation ECU is developed based on Infineon XC2000 family XC2765. During the development of simulation ECU DAVE(Digital Application Virtual Engineer) and TASKING VX-toolset is used. The control program of simulation ECU includes initialization module, analog signal generation module, pulse signal generation module and communication module. Each module is designed, programmed and debugged separately and connected finally. Control process is shown in Fig4.

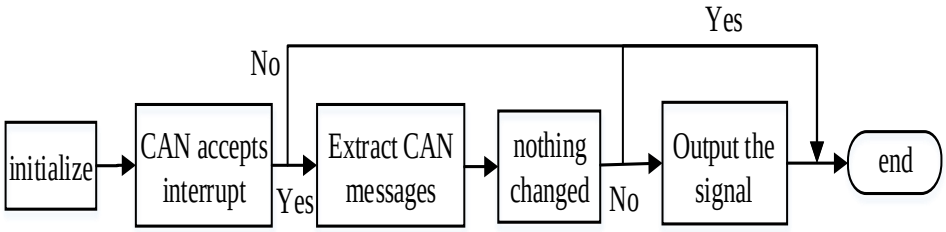

Fig4. Flow of ECU overall control simulation

Firstly we initialize the microcontroller driver. If there is an interrupt of CAN the simulation ECU extract message of CAN and compare with the data received last time to decide whether to update the data of sensor. If the data is different of the last time it'll output the new data.

IV. VERIFICATION AND CONCLUSION

We choose the simulation ECU as test object. The test window is developed by DAVE(Digital Application Virtual Engineer). After the Hardware in the loop simulation(HILS) system is established, we can test the function intuitionally . The data is shown in Fig5.

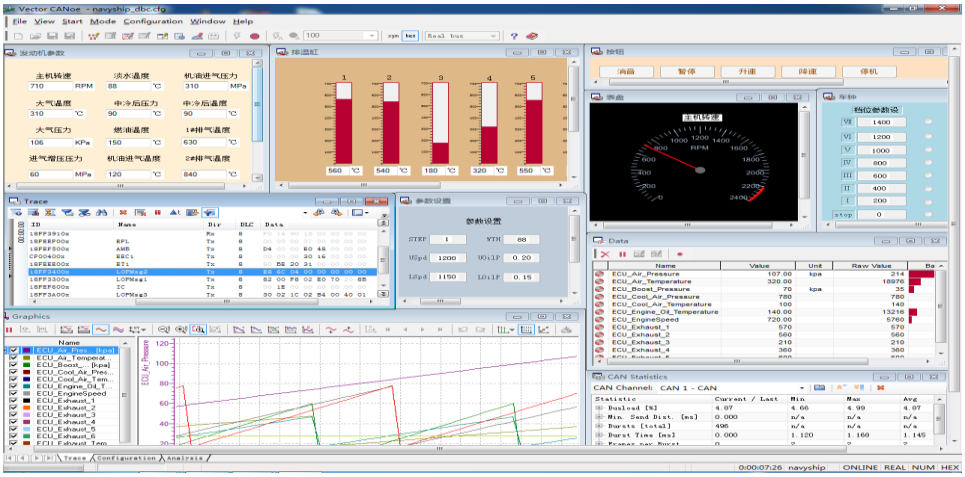

Fig5. Simulation test results of CANoe

The Trace window displays the ID, transmission direction, length, and content of the communication data on the bus. The message is sent cyclically. The curve changes from minimum to maximum constantly so that we can catch the test results visually. Through the window of CAN Statistics, we find that each message is sent in accordance with the regular scheduling time and there is no delay or error frame. The CAN message data simulated by CANoe is shown in Fig6.

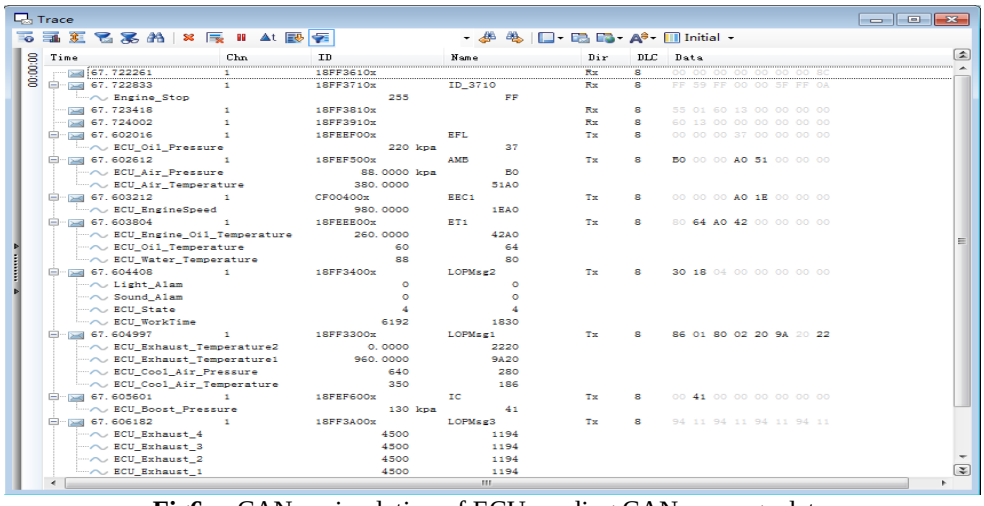

Fig6. CANoe simulation of ECU sending CAN message data

Through the analysis above we can see the CAN bus running in good condition. After testing, each function of the monitor system of marine diesel engines such as fault diagnosis and monitoring is good. In addition, the Hardware in the loop simulation technology can be used in development of system.

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