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DESIGNING AND AUTOMATED TESTING OF AGRICULTURAL MACHINE SYSTEM USING NI LABVIEW TESTER

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ABSTRACT

Automated Testing gives an improved testability in terms of time than manual testing. An automated testing is a cost effective technology that can avoid manual errors while testing. Most of the time or the effort is needed at the time of initial development of scripts which are the inputs for the automated testing. This technology is used for "Agricultural Machine System".

A proprietary scripting language is used for automated testing. Scripts are developed using commands that are well defined. Control signals which includes inputs, outputs and CAN are specified in map files which are in excel format. The result of the automated testing for a particular test case run is generated in a report in excel format.

With the automated testing one can reduce manual errors in testing, improved testability in time and cost of test repeatability.

KEYWORDS: Agricultural Machine System, Automated Testing, Control Area Network, Hardware-In-The-Loop (HIL), Electronic Control Units (ECU).

INTRODUCTION

Testing is a major requirement in today's automotive industry. Testing of each functionalities directly on the physical vehicle system is not possible as it is time consuming, risky and costly. It is easy and reliable to test each functionalities on model before it goes to the actual system.Hardware-In-The-Loop(HIL) is one of the testing methodologies used by automotive industry to test Electronic Control Units(ECU) which runs on real time. HIL involves interaction between hardware and software. HIL is preferable testing method to test an automotive system which embeds more than one ECU's.

Software-In-The-Loop and Model-In-The-Loop are two other testing methods which can be used to test the ECU. Compare to HIL these two techniques are less costly and no external hardware is required. For these two techniques testing runs on normal Personal Computer(PC). The advantages of HIL over these two techniques are gives more accurate result and testing of real time functionality is possible. In this work HIL technique is applied for Agricultural Machine. This consists of XX microcontrollers out of which X Controllers plays a vital role in the Harvester. One Control Unit controls the major features like feedroll, header, lighting etc.

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The other control unit controls the On Board Diagnostics part and display. The other one controls temperature and other physical quantities. A typical HIL system consists of load boxes that are connected with ECUs which consists of analog, digital, frequency inputs and outputs. All the ECUs along with respective load boxes are connected in CAN network. Functional testing of the controllers is carried away by processing required inputs and monitoring expected outputs. The other controllers are simulated using a tool. All the CAN messages that are to be transferred by the other X controllers which are not present are simulated using the tool depending on the functionality. Objective of this project is to make functional testing of Agricultural Machine automatically. To carry the automated testing the load box is replaced with a tester which is controlled by LABVIEW software.

ESIGN FLOW OF HARDWARE-IN-THE-LOOP

BLOCK DIAGRAM OF HIL

As shown in the below figure the major component of HIL are ECU under test, Load Box, host computer and CAN communication network.

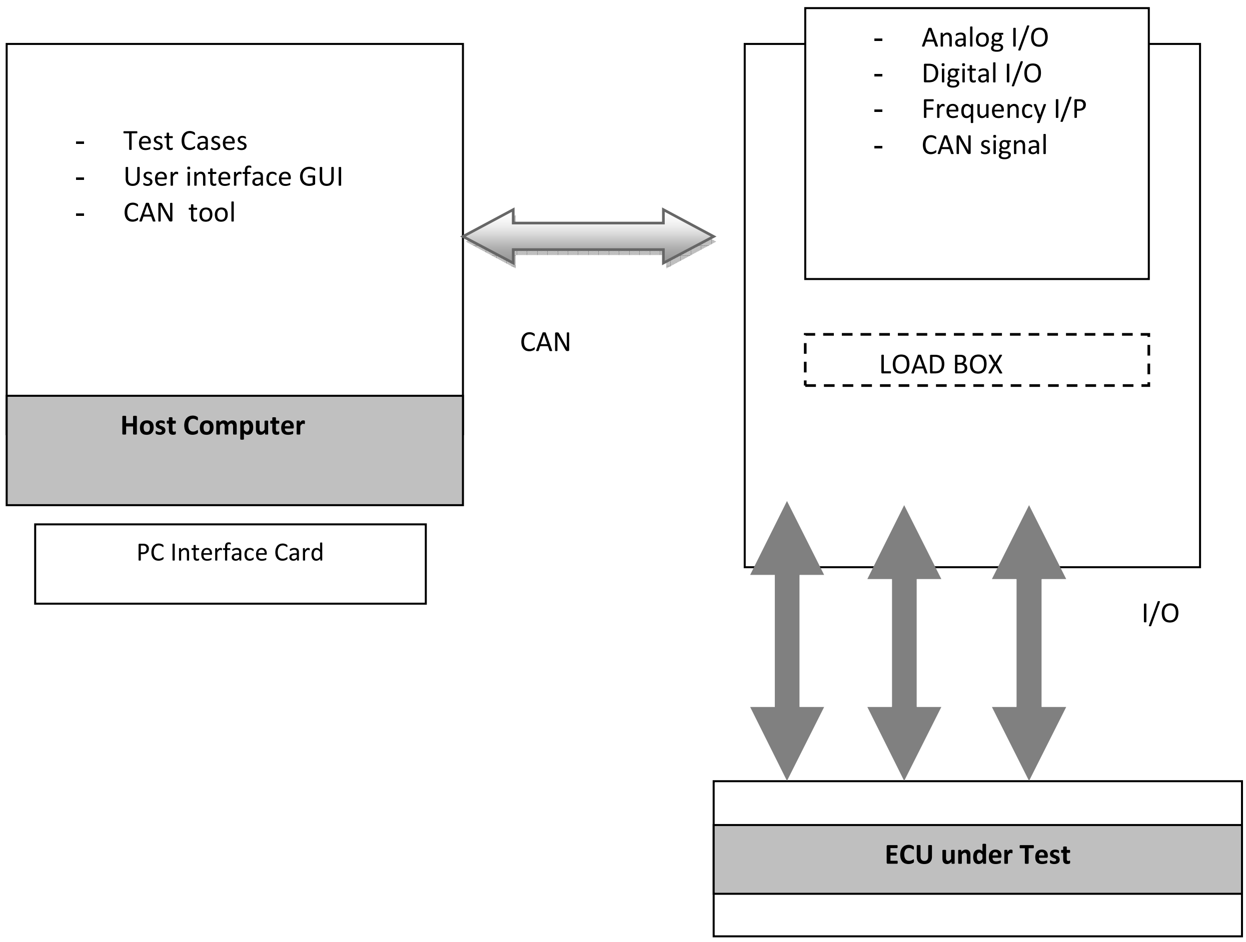

Figure 1.HIL block diagram

HOST COMPUTER

The host computer is loaded with the tool which is used to simulate the required CAN signals and to check that data on the bus. The test cases of the functional testing that are to be tested are also saved in the host PC. The test cases are taken from original software functional test document. The host PC is connected to the loadbox through an interface card which is known as CAN driver. Using the CAN driver the tool that is loaded in the host PC is able to communicate with the controller on the CAN network. The tool is configured with the provided CAN diver details. The required CAN message from Engine controller like Engine Speed are configured initially in the tool.

LOAD BOX

The other major component in HIL is the load box which is shown in the Figure1. The load is connected to the host PC using the CAN network. The load box is connected to the target controller using general input output lines. The load box is provided with several inputs or loads and the outputs. The inputs and outputs include analog, digital and frequency. The inputs that are required by the controller can be processed by setting the voltage at the load box. The output from the controller can be monitored on the load box by monitoring the output voltage. The sensor signals can be processed at the frequency inputs on the load box. These signals are connected to ADC channels of the controllers. All the analog inputs are processed using analog pots. The required pull-up and pull-down resistors at the input output pins of the controller are equipped with the load box.

CAN NETWORK

The host PC is connected to the target controller using CAN communication network. The CAN signals that are transmitted by the controller are monitored in the tool loaded in host PC. These signals are transmitted via the CAN communication network provided. The CAN signals that are needed to be simulated are also transmitted via the same CAN communication network provided.

TARGET CONTROLLER

The other major component in HIL is the unit under test which is the target controller. It is connected to the load box through general input output lines. The power input required by the controller is also processed from the load box. The target controller can be programmed by using a tool that is loaded in host PC.

DESIGN OF CAN NETWORK

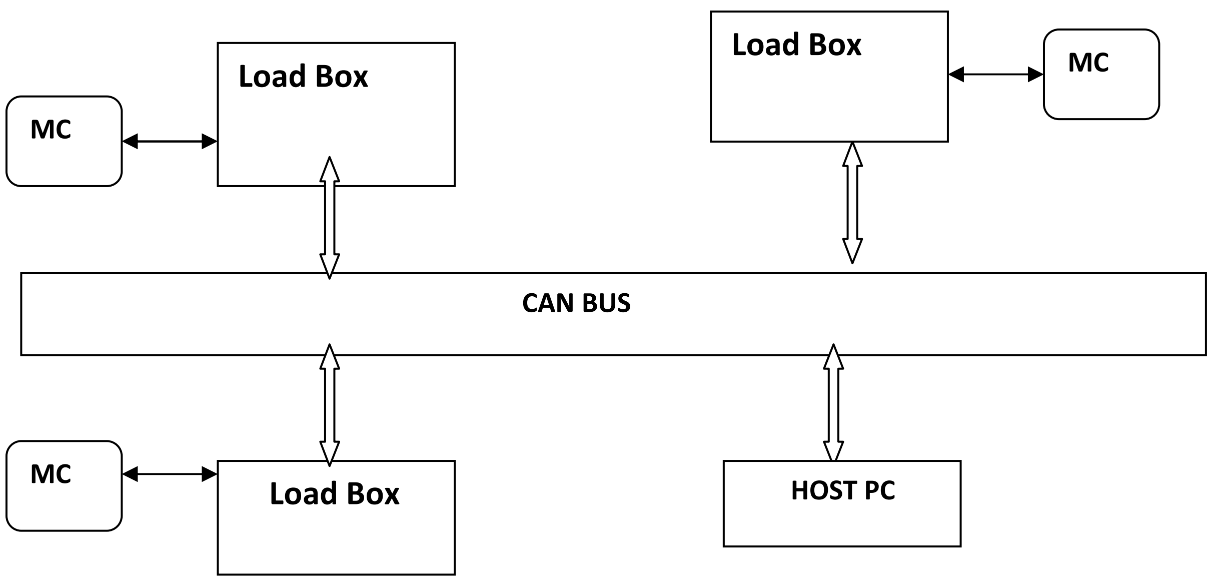

Figure 2.CAN Network

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As shown in the Figure 2 the three controllers are connected in CAN network. The communication between the controllers is implemented using the CAN network. The communication between the controllers and the host PC is also implemented using the CAN network.

To run a test case the required inputs and CAN signals are processed accordingly from the load box. The CAN signals that are required to be transmitted from the controllers which are not present in the network are simulated using the tool loaded in host PC.

AUTOMATED TESTING

The principle objective in automated testing is to enhance the testability. The main considerations that can be enhanced are test time and test repeatability. The other primary objective of automated testing is to avoid manual errors. All the required inputs analog, digital and frequency can be processed automatically without any manual intervention.

Even CAN signals that are required by the unit under test can also be processed automatically.

The functional testing includes processing of all kinds of inputs and monitoring expected outputs at the output pins of the unit under test. Even some functions require time critical operations which may prone to errors in manual testing. For example if an input is expected to be high for three seconds and then low for two seconds, the progression of input voltage should be taken care of. Manual testing of this functionality may cause several errors and the expected output may not be obtained at the output pin of the unit under test.

ADVANTAGES OF AUTOMATED TESTING

The major advantages with Automated Testing are:

- Test Reliability
- Test Quality Assurance
- Improved Testability
- Reduced Man Power
- Test Reusability Due To Maintained Standards
- No Manual Errors

INPUTS REQUIRED FOR AUTOMATED TESTING

- Scripts
- Tester Input Output File
- Map File

SCRIPTING

Commands are well defined for input output operations, CAN message transmission and reception, etc. To perform basic input output operations commands are developed in such a way that pin id and the respective voltage minimum and maximum range should be given. For CAN based operations commands require CAN parameter name and the data associated with the message.

The script also makes use of mapfiles which will be explained in the sub sequent section. The scripting should be done in such a way that certain syntax is to be followed like no space between the names. The command inputs are separated by a back slash character.

TESTER INPUT OUTPUT FILE

The tester input output file consists of all the pin details of the tester. The test script compiler makes use of this file while mapping the pins that are mentioned in scripts for input output operations.

MAP FILES

There are four map files that are to be developed for automated testing.

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- CAN mapfile
- Input Output mapfile
- Dialog mapfile
- Memory Access mapfile

The design flow of automated testing is started with the preparation of harness for the connection of unit under test with the tester. Then the development of map files as shown in the above sections. Initial power testing should be done after the harness preparation and make sure that tester should meet all the power requirements by the connected unit under test.

The scripting should be taken care of without any syntax errors in using the keywords and the arguments. The script developed should be saved in required file format.

WORKING FLOW OF AUTOMATED TESTER

As explained in the previous sections the working flow of the automated testing starts with the following tasks.

- Harness Preparation
- Script Development
- Map File Development
- Generation of test executable File
- Test Run
- Report or Result Generation

CONCLUSION

The automated testing is more advantageous over manual testing that improves all the important factors like test time, test reusability, test reliability. Using automated testing manual power can be reduced and the manual errors while testing can also be avoided. Using automated testing one can check the boundary conditions of a particular application with maximum and minimum limits in limited time. The net result is that 80 to 90 percent of the functional testing can be achieved using automated testing. Initial effort in automation testing is needed in the preparation of harness, development of scripts and the mapfiles that required for the interpreter.

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