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LabVIEW Based Instrument Cluster Tester

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Abstract: Instrument cluster is the Human Machine Interface (HMI) in vehicle which ensures the safety and comfort of the driver by showing the prevailing condition of the vehicle. These days instrument clusters are getting more and more complex. So the testing of instrument cluster for proper functioning i.e. HMI, indicators and warning signals has to be conducted. This paper presents the cost effective and efficient method of testing the instrument cluster using the software developed in LabVIEW and CAN protocol. CAN controller interfaces the PC and instrument cluster, it sends signals through CAN bus to test the tell-tale, dials, fuel gauges and display's in the cluster.

Keywords: LabVIEW, CAN communication, Instrument cluster, TOMLine.

I. INTRODUCTION

In the recent years the automotive segments has become sophisticated, the instrument cluster which assist the driver with information of driving condition has become more complex, so in the process of manufacturing it should be tested to ensure its proper functioning. In some automobile company unit testing is performed manually, using traditional instruments. This is tedious as the number of functions in the cluster increases.

These days people search for ways to reduce their time and effort to do any job. Automatic testing is more efficient and reliable, and less prone to human errors due to negligence and fatigue. Hardware parts increase the risk of errors during the production, thus the testing of the system has to be carefully performed. For that reason, automated testing in production lines is important to reduce the risk of hardware fault. This has led to the implementation of this project.

The software for automated instrument cluster testing is developed in LabVIEW. LabVIEW platform has the capability of data acquiring, monitoring, processing and controlling. CAN is one of the widely used communication interface in the automobile. It reduces the complexity of wiring and improves data transfer reliability. CAN controller is a vital device in the system to process the message received from PC. It provides dynamic signals to the system under test.

An automated test based on LabVIEW application, for units testing of MIKME advanced microphone in a serial production is proposed, which is 20 times faster than manual test [1]. Currently, automated design validation testing of a vehicle instrument cluster using dSPACE mid-size simulator is presented [2]. An automated test system for various systems using LabVIEW is implemented over last few years [3, 4]. Automotive instrument network design and data transmission using CAN bus [5], characteristics and message transmission rules of CAN bus using different processors and controllers [6] are proposed in recent years.

The proposed work in this paper explains the validation test of vehicle instrument clusters in real-time using LabVIEW application, on successfully performing the test, the series production of the cluster is started.

II. APPLICATION DESIGN

The designed LabVIEW application for cluster testing mainly has four panels. First panel we see when we open the application is shown in Fig. 1. It is the main panel or front panel, where we can select the required subpanel by pressing the respective buttons on the main panel. The buttons in main panel are Test, Parameter, Settings, About, Exit. The table in the main panel shows the information about the tasks performed in the application with date and time and exit button will close the application. The necessary parameters for interface are given in settings panel Fig. 2. It includes selecting the type of test to be performed either End of Line Test (EOL) or Endurance Test, Number of test cycles to be performed and number of cycles to be skipped which are applicable for endurance test, and CAN port, TOMLine file paths also should be entered. TOMLine is the Vision software of Goepel electronics for analysing the cluster image.

In the parameter panel shown in Fig. 3. we give the name of the test in test step table (eg: Ignition, Right indicator) and by pressing add button we add the test case. The conditions for the test cases should be given in subsequence table (eg: on or off). A test case can have any number of subsequence. For every subsequence the

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general setting, CAN setting and TOMLine setting has to be entered and saved. The selected test case or subsequence can be deleted by pressing delete button, on pressing execute button test page will open, and the back button will take us to the front panel.

When the test button in main panel is pressed it will take us to test panel which is shown in Fig. 4. Here we perform the test for the test cases entered in the parameter panel by pressing start button. The test is conducted in the order given in parameter page. Cluster image for every case is displayed in the picture box, and the same image is analysed by TOMLine and the test result is displayed in the table of test panel. Current cycle, number of cycle and skip cycle are indicators, which show the values entered in the settings panel if endurance test is performed, and it will be zero for EOL test. Refresh and cancel button will start the test from beginning and stop the test respectively. On pressing the report button, html report as shown in Fig. 5. is generated for the test results displayed in the table of Test panel and the generated report is saved for the future reference.

Fig. 1. Main Panel

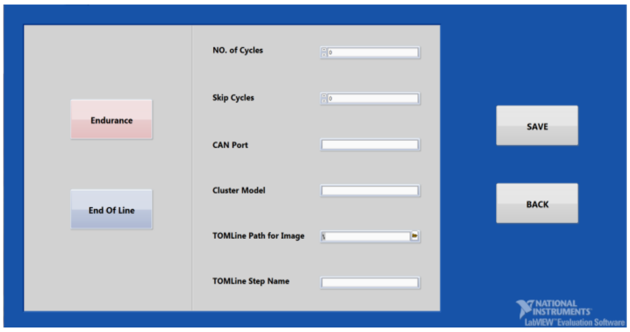

Fig. 2. Settings panel

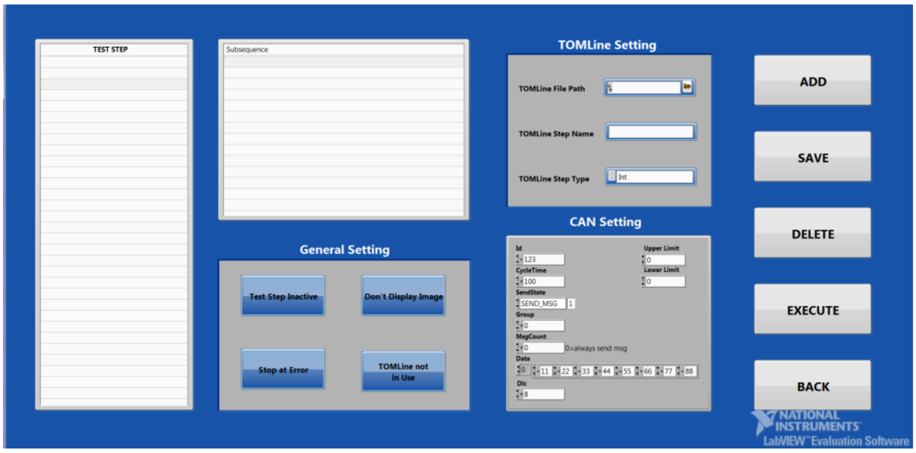

Fig. 3. Parameter panel

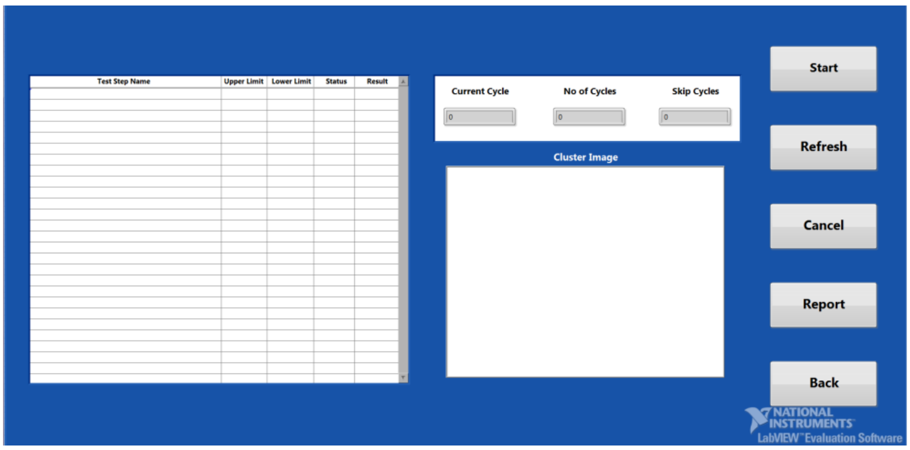

Fig. 4. Test panel

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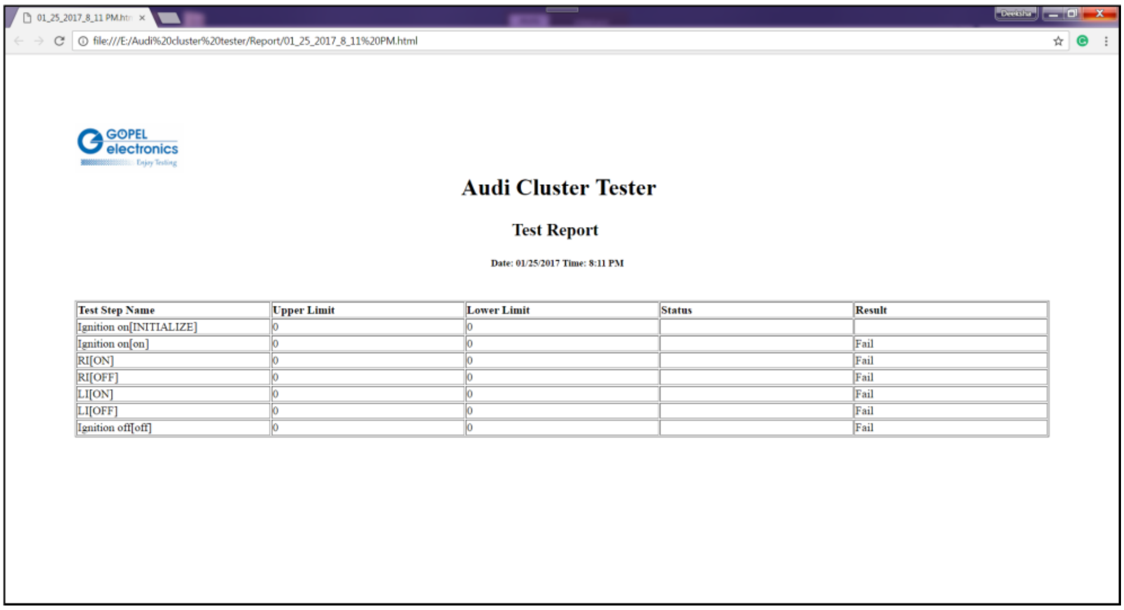

Audi Cluster Tester

Test Report

Date: 01/25/2017 Time: 8:11 PM

Test Step Name	Upper Limit	Lower Limit	Status	Result
Ignition on[INITIALIZE]	0	0		
Ignition on[on]	0	0		Fail
RI[ON]	0	0		Fail
RI[OFF]	0	0		Fail
LI[ON]	0	0		Fail
LI[OFF]	0	0		Fail
Ignition off[off]	0	0		Fail

Fig. 5. Generated html report

III. TEST SETUP AND WORKING PRINCIPLE

The test system for testing the instrument cluster is shown in Fig.6, it consists of host PC with LabVIEW application, unit under test and communication interfaces.

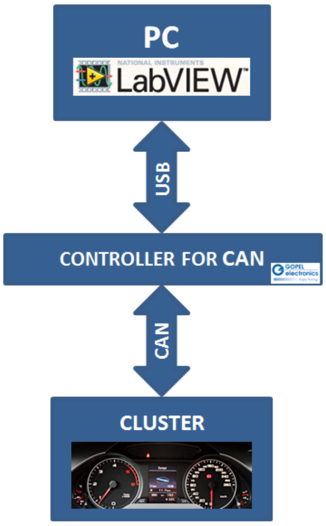

Fig. 6. Automated control of Instrument cluster using LabVIEW application

A. LabVIEW

The main controller of the system is designed LabVIEW application. LabVIEW is a graphical programming language. So we can develop better programs in LabVIEW since graphical programs are easier to maintain, edit and understand. We can reuse the code in different operations hence it is simpler to program and easy to understand just by looking at the code.

B. Device Under Test

The device under test is the instrument cluster shown in Fig. 7. it is one of the most complex electronic embedded systems in vehicles. Its functionality is distributed among many ECUs. The cluster consists of tell-tale, warning indicators, fuel gauge, speedometer, tachometer, and LCD display.

The major components of instrument cluster which are tested include Ignition, Right and Left Indicators, Parking Light, Door Open Warning, Bonnet and Boot Lid Open Warning, Low Fuel Level Warning, Tyre Pressure Monitoring, Power Steering System, Speedometer gauge, Fuel gauge.

C. CAN

CAN protocol is used for communication between PC and instrument cluster. CAN frame which carry CAN messages consist of an ID, a varying number of data bytes, and data length specified by DLC. The particular function in instrument cluster will have unique ID number and it can have any number of data bytes. The size of different fields in CAN frame is given below.

- ID: Identifier: 11 or 29 bits
- Data Bytes: 0 - 8 bytes
- DLC: Data Length Code: 4 bits – 8 bits

CAN information given by user is automatically handled by the CAN controller i.e. forming CAN frames for the given CAN details and gets the message on the bus.

LabVIEW application acts as front end interface in testing the device under test. The designed application is generic since the user has got the freedom to add, modify or delete the test cases.

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Source: Internet
Fig. 7. Instrument cluster

The CAN message of the respective test cases are sent to the DUT using CAN API (Application Program Interface) in LabVIEW. The basic CAN API function block consists of an initialization, start, read or write data and clear.

When the test is performed respective CAN message of the test cases are passed through USB cable to CAN controller, where the message is converted to CAN frames and sent to Instrument cluster through CAN bus. The instrument cluster on receiving the signal performs the respective functions. The result of the test observed in cluster is as shown in Fig. 8. Once the test is successfully performed; the series production of the same is started.

Fig. 8. Instrument cluster showing various indicators

IV. CONCLUSION AND FUTURE WORK

The instrument cluster test system acts as virtual vehicle to test the clusters behavior and to test the functionality.

LabVIEW application is successfully applied for testing the instrument cluster. Using this system, we can saves time, reduces complexity and error in testing. This will save time and money.

The machine vision system to read and analyze the test result will be done as future work.

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BIOGRAPHIES

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K. Vasudeva Shettigar, received his B.E. (E& E) degree from SJCE, Mysore University, Mysore, India in 1986, and M.Tech. (Power Systems) degree in 1992 from National Institute of Engineering affiliated to Mysore University. Presently Mr. Vasudeva Shettigar is serving as Associate Professor, Dept. of Electrical & Electronics Engineering, Nitte Mahalinga Adyanthaya Memorial Institute of Technology, Nitte, Karkala, India. He is Life member of ISTE. He has published 11 technical research papers in various National and International conferences. He has chaired International conference held at NMAMIT Nitte during May 2011, 2013 and 2015. Mr. Shettigar has organized several National Conferences and National Workshops and Short term training programes (STTP) in the college for the benefit of faculty (NMAMIT) and faculty of neighboring Institutes. His areas of interest include power system & protection, power quality and High Voltage Engineering. He has a teaching experience of over 27 Years, and guided over 50 U.G & 24 P.G. Technical Project works.