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Vehicle Cluster Testing and Data Logging using Ni Compact-RIO

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Abstract

The instrument cluster contains various gauges and indicators that provide information about the current status of automobile when it is in motion. If this information is not accessible to driver, the condition of vehicle will not to be known to the driver this may even leads to accident. So it is necessary to test the cluster before assembling it inside the vehicle. In the proposed method the vehicle cluster is tested for several hours and the operating condition of cluster is continuously recorded using LabVIEW. The sensors and meters are continuously monitored. The status of these gauges and indicators are continuously recorded using NI-compact RIO (Reconfigurable Input Output) and report is generated in the form of excel sheet. This report will provide clear information about the status of cluster during its testing period, which included the date and time when the cluster shows faulty operation in terms of few microsecond accuracy. The proposed algorithm is verified and tested using LabVIEW software and implemented on the NI cRIO 9076 device on a laboratory prototype model to obtain the benefits of vehicle cluster testing and data logging.

Keywords: *Vehicle Cluster, LabVIEW, Sensors and Transducers, Virtual instrumentation.*

1. Introduction

1.1 Instrument Cluster

The instrument cluster contains various gauges and indicators that provide information about the current status of automobile. The instruments in the instrument cluster are gauges that are circular, and in most cases back lit. The instrument cluster allows you to monitor the vehicle and its performance. The function of the instrument cluster is to keep the driver informed with the most current information as he drives. Gauges provide the information for speed, distance, heat and fuel. Indicator lights provide warnings and updates like the check engine light and the low fuel light. Different vehicles have different warnings available.

The instrument cluster includes the speedometer, fuel gauge, tachometer and odometer; it is located on the driver's side on the dashboard, in front of the steering wheel. The speedometer tells you how fast the vehicle is moving. The fuel gauge tells you how much fuel is currently in your gas tank. The tachometer provides the driver with the rotation rate of the crankshaft in the engine. The odometer tells you how many miles the vehicle has travelled.

There are three types of instrument cluster these includes Standard instrument cluster, deluxe instrument and cluster electronic instrument cluster.

There are several existing studies on the design of instrument panel. Kim (1999) reported the driver's cognitive characteristics for the arrangement of instrument panel, Nam (2007) applied work domain analysis for the development of a vehicle control display, and Tanoue (1997) studied on the perceived images of vehicle interior. Also, studies are available on the application of Kansei engineering to car interior (Jindo and Hirasago, 1997). [1]

The Instrument Cluster (IC) Electronic Control Unit (ECU) is one of the most complex electronic embedded control systems in modern vehicles. The functionality is distributed among many ECUs providing the customers with information such as driving conditions, fault diagnostics, warning signals (messages) and infotainment. As more and more of the controls are performed automatically to increase driver convenience, these functionalities are becoming increasingly complicated. The Instrument Cluster software therefore requires a rigorous and thorough testing of its functionality. [2]

1.2 Methods Involved in Testing the Cluster

The proper working of vehicle cluster can be analyzed by testing it under various environmental conditions will be listed below,

1. Functional test
2. Operating voltage test
3. Short circuit test
4. Reverse polarity test
5. Electrical transient test
6. 12V protection test
7. Single line coupling transient test
8. Spike protection test
9. Insulation resistance test
10. Over voltage test
11. Start-up power supply test
12. Transient voltage withstand test
13. Electrical noise withstand test
14. Power supply interruption test
15. Set – Mode switches durability test
16. Low temperature test
17. High temperature test
18. Thermal cycle test
19. Thermal shock resistance test
20. Humidity test
21. Dust resistance test
22. Vibration test
23. Resistance to vehicle fluids test
24. High pressure water wash test
25. Water spray test
26. Static rain shower test
27. Corrosion resistant test
28. Ring endurance test
29. Vehicle Endurance test
30. Reliability Sequential test
31. Burn – In test
32. Water proof test

2. EXISTING METHOD

In industries the vehicle cluster is tested under the above mentioned techniques and monitoring of the status of cluster is done manually. Some of data loggers such as YOKOGAWA MX-100 shown in the Fig. 1. are used to record the testing status of cluster.

Fig. 1. Yokogawa Mx-100.

The demerits of YOKOGAWA MX-100 can be stated as,

1. This device cannot be used to measure multiple parameters.
2. Only voltage can be computed.
3. So additional calculations is needed to obtain the actual output.
4. 24 inputs can be processed at a time.
5. No extra modules can be added.

3. PROPOSED SYSTEM

3.1 Introduction

The proposed algorithm is based on LabVIEW technology. The LabVIEW is user friendly and graphical based software. The proposed method is to test the vehicle cluster and their associate sensors using this technology. Here, the vehicle cluster is tested for several hours and the operating condition of cluster is continuously recorded using NI cRIO is used for data logging purpose.

The NI cRIO possess reconfigurable input output modules and FPGA modules. In the proposed system NI 9219 universal module, NI 9227 analog current input module, NI 9225 analog voltage input module, NI 9263 analog voltage output module is used . The acquired data can be stored in excel sheet for permanent record and also it can be visualized as graphical format during testing itself. In case of any faulty operations the indicators will be in red showing that the device is operating out of specific limit. Here ACTIVA CLUSTER is tested.

3.2 Instrument Cluster – Activa

The instrument cluster activa contains various gauges and indicators that provide information about the current status of automobile as shown in the Fig.3.1. The instruments in the instrument cluster are gauges that are circular, and in most cases back lit. The instrument cluster allows you to monitor the vehicle and its performance.

The function of the instrument cluster is to keep the driver informed with the most current information as he drives. Gauges provide the information for speed, distance, heat and fuel. Indicator lights provide warnings and updates like the check engine light and the low fuel light. Different vehicles have different warnings available. The speedometer tells you how fast the vehicle is moving. The fuel gauge tells you how much fuel is currently in your fuel tank. The tachometer provides the driver with the rotation rate of the crankshaft in the engine. The odometer tells you how many miles the vehicle has travelled.

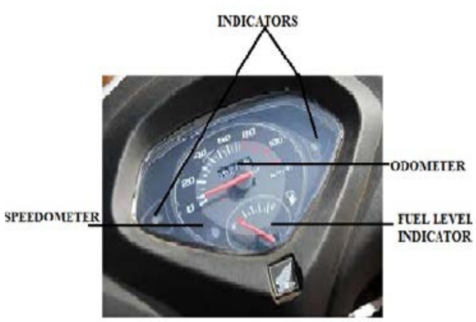

Fig. 2. Activa Cluster.

Indicator lights on the instrument cluster are differently placed for left and right, unlike all other scooters where there is a solitary indicator.

3.3 Block Diagram

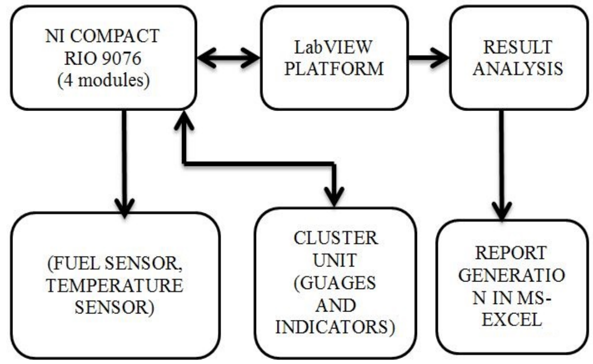

Fig. 3. Block diagram of proposed instrument cluster testing system.

3.4 Block Diagram Explanation

The above block diagram Fig. 3 explains how the activa cluster is tested by using proposed algorithm. In the proposed system fuel sensor, pt100, and cluster unit is tested. The fuel sensor provides resistance in correspondence to change in fuel level. NI UNIVERSAL MODULE 9219 is used to measure the changes in resistance of fuel sensor equivalent to fuel level.

The pt100 is used to measure the cluster temperature, it is three wire RTD type. It is connected to NI 9219 module where the output is in the form of temperature there is no any additional calculation needed to compute temperature. The speedometer, odometer, fuel level indicator, left and right indicators are connected to NI 9225 module. The input given to modules is recorded in excel sheet and also can be visualized as graphical format in front panel.

4. RESULTS AND DISCUSSION

4.1 Introduction

The vehicle cluster includes its fuel sensor, gauges, indicators are tested for several hours and the status of the instrument is recorded using LabVIEW technology. The LabVIEW simulation and result for entire testing process is discussed here.

4.2 Hardware Model

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The proposed method is implemented using cRIO as prototype model. All the sensors, indicators, and gauges are connected to LabVIEW through cRIO. The operating status of the instruments can be visualized in LabVIEW window. The proposed algorithm provides most efficient method of testing of vehicle cluster since the entire process is completely automated.

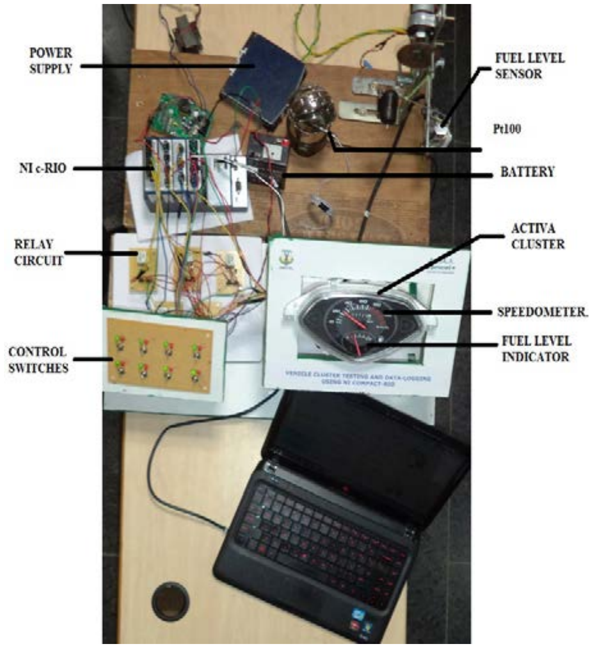

Fig. 4. Prototype model.

4.3 c-RIO Working Process

The NI cRIO-9076 consist of four modules, it has NI 9219 universal module, NI 9227 Analog input current module, NI 9225 Analog input voltage module, NI 9263 Analog output module. In NI 9219 module 4 channels are available in each channel four different parameters can be measured. Voltage, current, resistance and RTD are the parameters that can be measured. In the proposed method this module is used to measure the resistance of fuel level sensor and temperature of Pt100.

In NI 9227, the battery current of vehicle is measured. In NI 9225 the input voltage given to cluster is measured. NI 9263 is Analog output module; it is used to control the operation of the gauges, indicators, and sensors.

The parameters to be measured can be specified individually and their corresponding pin connections are displayed to the operator, and also the minimum and maximum range of measuring parameters can be set here for safety purpose. If the recorded data is not in range the indicators will be in red stating that there is some fault in the instrument under test.

4.3.1 Main Window

Fig. 5. Main window for vehicle cluster testing.

The main window will have three options PORT CONFIGURATIONS, PIN CONNECTIONS and RECORDING. PORT CONFIGURATION will provide information to configure the ports; PIN CONNECTIONS will give information about connection details, RECORDING will display output in the form of graphical, numeric indicator and also the acquired data will be stored in MS excel sheet.

4.3.2 Port Configuration and Pin Connections

In this process the module name, channel name will be displayed automatically, if you select the port based on the requirement the pre fixed parameter that can be measured in that port is automatically displayed to the user in parameter column.

After the above processes give connection name for each port so that the values obtained during testing are recorded in excel sheet under the specified name. In next column give the maximum and minimum range of output to be expected so that indication can be given to the operator in case of improper operation of the cluster placed inside the chamber. The next column will display the pin connections automatically based on the ports that you are selected in the previous process.

4.3.3 Recording

Recording is the option given in the main menu. Here the continuous test record can be visualized as graphical format and also can be stored as permanent record in excel sheet.

Step 1: When RECORDING option is selected in main menu the window shown in the following fig will be displayed. Enter the file name in the FILE NAME option. The recorded data will be stored in the file of respective name.

Step 2: Specify the Time Mode for recording, based on which the time delay for acquiring data will be allotted automatically. Once the SET button is pressed START RECORDING and STOP RECORDING options will appear.

Once START RECORDING is pressed the recording process starts. The acquired data will be displayed in graphical and numerical format. At the same time the acquired data will be recorded.

All the parameters such as current, voltage, temperature, resistance can be measured at a time and also no extra calculations is needed. The acquired data can be stored in excel sheet for permanent record. The acquiring time of input data is much faster in terms of milliseconds. The recorded file will provide information about the date and time when the particular data is acquired. So if any fault occurs it will be easy to compute the exact time of fault occurrence.

The output can be also visualized as graphical format during testing itself. Combined graph indication helps to make comparison study about the multiple parameters under test. In case of any faulty operations the indicators will be red showing that the device is operating out of specific limit.

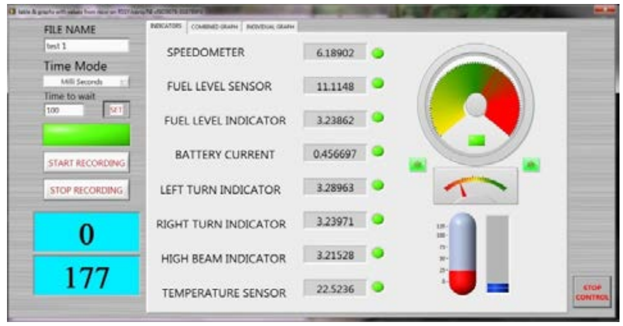

Fig. 6. O/P in the form of indicators.

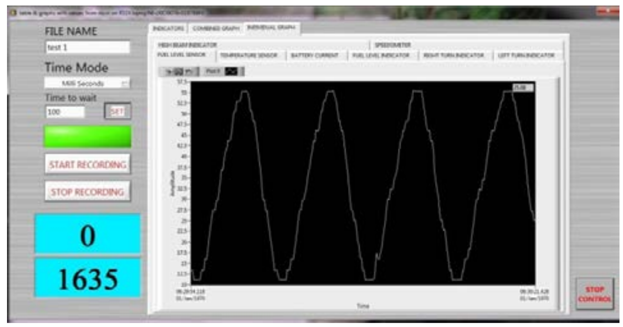

Fig. 7. O/P in the form of individual graph

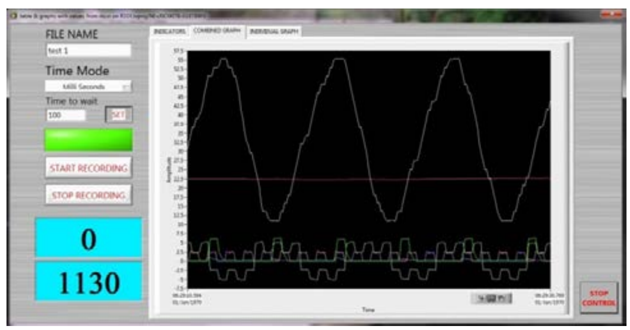

Fig. 8. O/P in the form of combined graph.

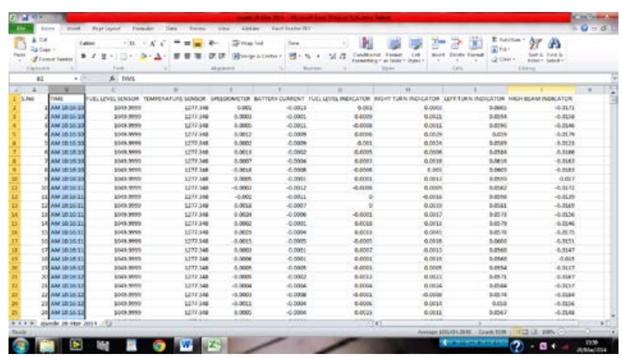

Fig. 9. MS Excel database

5. CONCLUSION

Through our proposed method the vehicle cluster is tested for several hours and the operating condition of cluster is continuously recorded using LabVIEW technology. The sensor such as fuel level sensor, gauges such as speedometer, odometer, fuel level indicator, and indicators such as left indicator, right indicator, high and low beam are continuously monitored using LabVIEW technology. The status of these gauges and indicators are continuously recorded using NI-compact RIO (Reconfigurable Input Output) and report is generated in the form of excel sheet. This report will provide clear information about the status of cluster during its testing period, which included the date and time when the cluster shows faulty operation in terms of few microsecond accuracy. The proposed algorithm is verified and tested using LabVIEW software and implemented on the NI cRIO 9076 (Embedded and FPGA based hardware) device on a laboratory prototype model to obtain the benefits of vehicle cluster testing and data logging to match with the simulation results. Since the entire operation is completely automated the manual intervention is reduced so parallax error is completely eliminated. The complete record of entire testing is recorded for future reference.

REFERENCES

[1] K.S. Cho, "*A Study on the Instrument Panel Design Trend for Automobile Interior*," Journal of Korean Society of Design Science,Vol. 18, No.4, 2005

[2] Davidsson, Ludvig, "*Integration Tests of the Driver Instruments. Institutionen för systemteknik. Luleå : Lu leå tekniska universitet*", ISSN 1402-1617, 2003.

[3] Amanjot Dhaliwal, Shreyas C. Nagaraj and Syed Ali, "*Hardware-In-The-Loop Simulation For Hybrid Electric Vehicles – An Overview, Lessons Learnt And Solutions Implemented*", SAE International, 2009.

[4] T. L. Narayana, S.Venkat Rao and K.Gnasen, "*Automated Instrument Cluster Testing Using Image Processing*" American Journal of Intelligent Systems, Vol.3 (1), pp.28-32, 2013.

[5] Jovitha Jerome (2011), "*Virtual Instrumentation Using LabVIEW*", PHI Learning Private Limited, Indian Edition.

[6] *"LabVIEW - Graphical Programming for Instruments, User Manual", National Instruments.*

[7] Lab VIEW CORE 1 Course Manual- October 2009 Edition- Part Number 325290A-01

[8] Lab VIEW CORE 2 Course Manual- October 2009 Edition- Part Number 325292A-01

BIOGRAPHIES

K. Sivakumar received his Bachelor's Degree in Electrical and Electronics Engineering from Sri Shakthi Institute of Engineering and Technology, Coimbatore in 2014. He is currently pursuing Master's Degree in Control and Instrumentation Engineering from Sri Ramakrishna Engineering College, Coimbatore. His research interests are Renewable Energy Resources, DC Machines and Industrial Automation.

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