Soft Tools to Investigate Faults In Automobiles- A Review

Anil Kumar, Lecturer, Pusa Institute of Technology, New Delhi, akumar14916@gmail.com

Dr. Neeraj Kumar, Professor, Suresh Gyan Vihar University, Jaipur, neeraj.kumar1@gmail.com

Abstract: In the field of automobile servicing and maintenance lot of advancement taken place in last decade. Earlier the faults were detected using conventional method of physical inspection and manual reading circuits then checking all the components one by one till the fault is pointed out. This method was very much time consuming and the output of service stations was also very low. To overcome this problem the automotive manufacturing and servicing companies replaced their conventional automobile control systems with interactive component based intelligent control systems. This paved the way for use of smart fault finding tools and increases the output of service stations making it possible to find and repair the faults in a speedy way based on automotive mechatronics systems. This method of monitoring is based on exchange of messages through communication system of automobiles e.g. the CAN bus. The transmitted sensors and control units messages are different depending on vehicle condition. This paper will explain the details of development and working of these smart fault finding techniques.

Keywords – Onboard Diagnosis, Off-board Diagnosis, Self diagnosis, Measured value, Threshold value, Control units etc.

INTRODUCTION

There are two different diagnostic methods, the off-board and onboard (OBD) diagnosis. The control units are in self diagnosis mode and continuously checking the condition of controller and their own. This is done when a problem has appeared, a corresponding boundary condition is exceeded or periodically in a program loop. The OBD is a example of the self diagnosis system, which originated in the U.S. The cars' emission data is continuously analyzed by OBD. All measured values are compared with their specific threshold values. The specification and the operating condition define the threshold values. If the measured value exceeds the thresholds limit it is indicated in the dashboard via a warning lamp (MIL). The malfunctions are permanently stored in control units, so that the problem can be investigated by the company technician. A tester is used to access the trouble code stored in control units, which is an off-board diagnosis example [1]. Onboard failure diagnosis is necessary to maintain the safe operation of the vehicle while the vehicle is in working mode., as well as the off-board failure diagnosis is suitable for in workshop maintenance of the vehicle. Off-board diagnosis system is analyzing the control unit's trouble codes. The early diagnostic systems used a warning lamp e.g. the engine control unit lamp in dashboard of the vehicle, or as an external device. The Blinking codes indicate the abnormal function and isolated the fault location. Latest automobiles with different actuators, sensors and several control units need a more sagacious diagnostic approach. The fault isolation method is no more very effective and an approach with a better fault detailing is needed. Because of this reason the entry of a trouble code in the fault memory is defined by symptoms and explicit rules. For example a high voltage condition on the controllers' signal input. The trouble code is specified in the tester. The safety- and comfort systems using multiple control units which are divided into sub-networks, are spread over the entire vehicle. In order to communicate with each other , the control units use different bus systems, e.g. CAN,LIN, FlexRay or MOST to communicate with each other. The sub-networks 'Power-train', 'Comfort' and 'Infotainment' is an example of the in-vehicle cross-linking which is shown in Fig.1.

Different functions are spread over several control units and these systems are developed and produced by different companies as per their products. Because of this an accurate diagnosis is in high demand. Due to the in-vehicle cross-linking a single fault can affect several control units, which can be explained through the following theoretical example: A particular fault in sensor is detected by a control unit. The trouble code is generated by the monitor program of the sensor in the fault memory. Simultaneously further controllers depend on the concerned control unit messages. But the message of this particular controller is no longer transmitted or correct on the bus. Resulting, other control units in their fault memory will generate different trouble codes or will get into fall back mode. The off-board diagnostic tool will read further trouble code beside the actual fault, generated by different monitoring procedures. These procedures neither correlate in time nor in content.

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The diagnostic tool performs the function of inference of the actual fault from the trouble codes [1].

During regular driving due to safety requirements only a limited part of the controllers' diagnostic services can be accessed. In term of diagnostic requirements this is a disadvantage of the current approach. During the driving of vehicle accessing the fault memory of the control units is either not possible or is very limited.[2]. This means if a malfunction appears the driver does not get explicit information about the condition of car and, the fault information available is very limited .The safeness of driving is restricted if driver evaluate the seriousness of the present fault. Hence during this applied diagnostic approach each single control unit detects the faults of their own and that of integrated sensors.

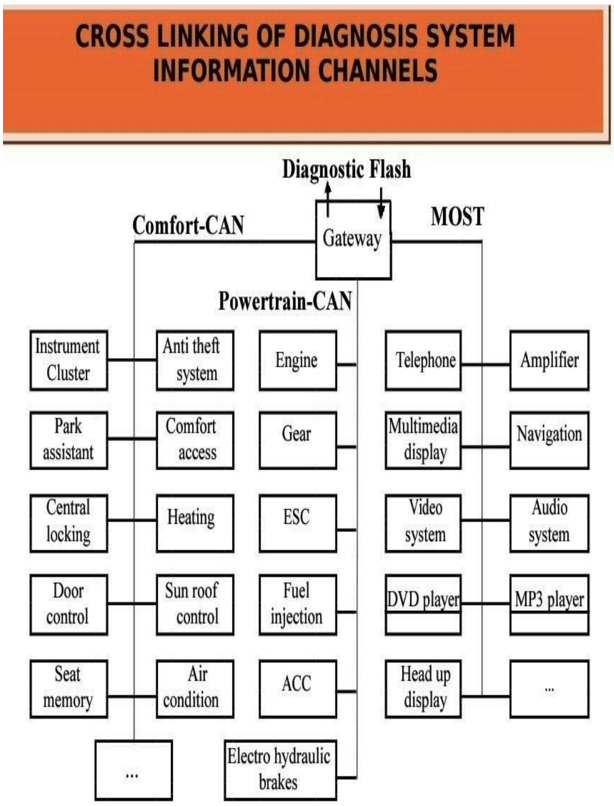

Figure 1. Automotive cross-linking.

Due to addition of new functions in past years the quantity of control units are steadily increasing and several controllers share these new functions [3]. This diagnosis approach has some disadvantages as only limited diagnostic services are available when the vehicle is in driving mode. Over the past years different standards has been used. The network affected by a single fault can affect different control units.

II. NEW ONBOARD FAULT DIAGNOSIS TECHNIQUE

In the technique detailed in introduction section of this paper the messages exchange between different control units were not considered to find out abnormal working of any part in the automobile. In new technique of diagnosis these messages on the bus are used to find out fault. These sensor's messages changes as the status of vehicle changes from faultless to faulty vehicle. The messages transmitted from sensors and control units are not same for different conditions of vehicle. The new onboard diagnosis technique is now capable of analyzing the bus level and hence faulty component can be pin pointed. The new fault detection technique uses the transmitted bus messages as fault indicator. The new onboard diagnostic technique is capable of communicating with each bus member in the vehicle. Hence complete Smart sensor data of transmitted messages on the in-vehicle bus network are checked for plausibility by continuous monitoring. By sending status messages over the in-vehicle bus network the controller and actuator condition can easily be enquired. By monitoring the transmitted messages on the in-vehicle bus network Incorrect commands from the control units for actuator or other control units can be easily detected. A fault so detected can be displayed as trouble code on a display by the new diagnostic technique. [4].The new onboard technique is quite advantageous to off-board technique. The new onboard diagnostic technique is capable of generating more helpful and accurate fault code information about the fault. The more accurate fault information is available to the driver at his own convenience. Faults are indicated real time soon as a fault occurs. Hence driver knows well about condition of his vehicle if it faulty or faultless. A fault detected by this technique is readily shown as a fault code on the display of vehicle. As the faulty component can be pin pointed through fault code, so there is hardly any chance that a good working component is replaced while repairing the fault resulting increasing cost of repair. Only faulty component is replaced or repaired, which reduces replacement/repairing costs and time. As the fault identification is improved with onboard diagnosis unit therefore the dependency on off board diagnosis unit is reduced, which is very costly and put a heavy burden on the pocket of service stations.

III. THE CONSTRUCTION DETAILS OF NEW ONBOARD FAULT DIAGNOSIS SYSTEM

The interface is necessary for this diagnosis system to function. The data flow chart is shown below in figure no.2.

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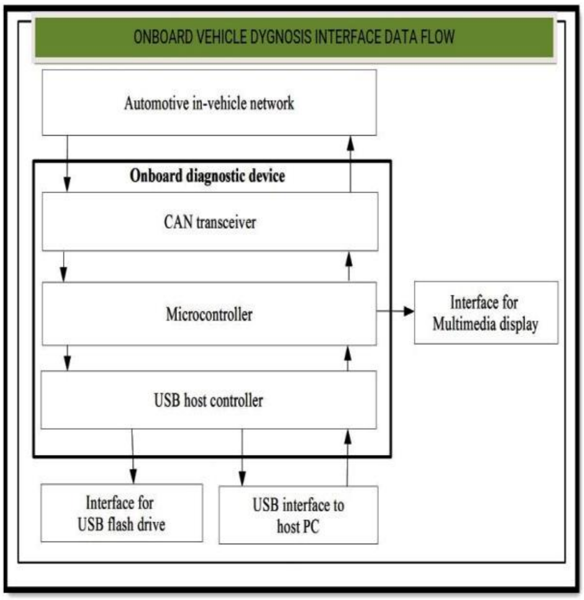

Figure 2. Diagnostic tool data flow.

The List of components used in this system is as detailed below:

1. The Atmel AT90CAN128 is an 8-bit low power microcontroller and includes a CAN controller.
2. The port 'C' is used as display interface to indicate detected faults.
3. To provides an interface between the physical bus and the CAN protocol controller, Philips CAN transceiver PCA82C251 is used. It can be implemented in trucks, buses and cars for applications
4. An embedded single chip FTDI USB host controller VNC1L is used in which there are two USB ports wired. One port serves as USB host and the other one as USB slave. The USB slave provides an interface, between the diagnostic device and a personal computer to monitor the CAN bus in real time. Thereby, the data are transmitted over the parallel FIFO interface. The USB host allows connecting the diagnostic device to USB flash drive so that the trouble codes can be stored on a memory stick .Thereby; the data are transmitted over the SPI interface of the microcontroller AT90CAN128.
5. The designed hardware gets power supply from the cars' battery. As the hardware components need 5V supply voltage, a voltage regulator is used for voltage regulation.

IV. CONCLUSION

From the above it can be concluded that the new diagnostic tool is very helpful to monitor the status of vehicle and reduce the unexpected vehicle breakdown during its operations. Further due to readily available fault messages it help the technician to remove the fault quickly and without any hit and trial technique. Reducing cost & ideal time taken to get the vehicle back in service after repair. It also increases the output of technicians and the service stations as well. Moreover the dependency on off- board diagnostic tools is also reduced which are very expensive as compared to On-board display system.

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