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AUTOMOBILE ON BOARD DIAGNOSTIC SYSTEMS

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ABSTRACT

The system proposed in this paper is an embedded on board diagnostics system which continuously monitors the system parameters and generates and debugs the Diagnostics Trouble Codes (DTCs). The system consists of master slave communication implemented through CAN protocol. The system contains two hardware sections, one is the Electronic Control Unit (ECU) with sensors for monitoring various system parameters and the other is the Diagnostic Scanner Unit with a CAN controller and user interfaces. The Electronic Control Unit keep on monitoring the system issues and reports to the controller in the Electronic Control Unit (ECU). The controller in this section generates Diagnostic Trouble Codes and send them to the CAN Bus. The Diagnostic Scanner Unit is responsible for obtaining the codes from Electronic Control Unit and performs the debugging operation and also indicates to the user about any system violations through electronics display interfaces while the scanner section in connection with the Electronic Control Unit(ECU).

Keywords: *Vehicle diagnostics, CAN, OBD II, Automobile diagnostics.*

1. INTRODUCTION

On-board diagnostics is a mechanism used in the field of automobiles and robotics which referring to a vehicle's or robot's self diagnostic and reporting capability. OBD systems allow the vehicle owner or repair technician to access the status of the various vehicle subsystems. In earlier OBD's the system response is not a problem specific information about the faults occurred in the vehicle. Those systems give only the indication through an indication light with certain patterns. After obd-ii standard arrived the development in the diagnostic systems becomes much more advanced. The later systems equipped with a device called obd scanner which has the compatibility to interface with the vehicle in one end and with the super computer at the other end. The faults which are identified via the scanning tool will be described with specifications on a dedicated software application running on the computer. The importance of fault identification is realized and as a result of that factor most of the small vehicles comes within built the on board diagnostics systems. So the on-board diagnostics plays a vital role in other areas like embedded systems, robotics and medical equipment, flight control systems.

2. SYSTEM ARCHITECTURE

The proposed system consists of two sections which can be separated and interfaced easily. The two sections are Electronic Control Unit(ECU) which replicates the ECU in the vehicles and the diagnostic scanner section which performs the operation of the scanning tool in workstations. The requirement of computer an a dedicative software application is replaced with the help of microcontroller and electronic display interfaces. The vehicle parameters which are going to be monitored are categorized into three sections and each section experimented with sensors.

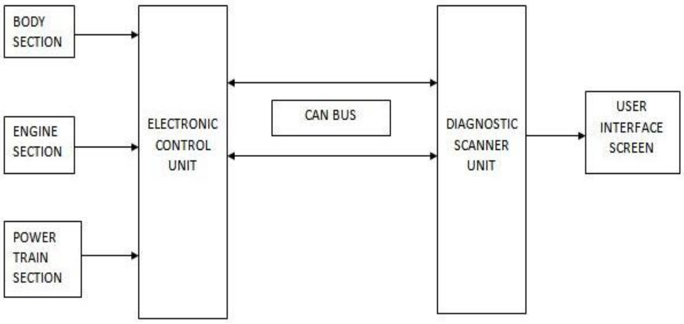

Fig1: SYSTEM ARCHITECTURE

3. SYSTEM TECHNOLOGIES:

3.1 CAN

CAN stands for Controller Area Network. It is a serial communications protocol which proficiently supports distributed real time control with a very high level of security. Its domain of application varies from high speed networks to low cost multiplex wiring. In automotive electronics multiple engine control units are connected

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using CAN with bitrates up to 1 Mbit/s. CAN has been subdivided into different layers for achieving design transparency and implementation flexibility.

- The (CAN-) object layer
- The (CAN-) transfer layer
- The physical layer

The object layer and the transfer layer include all services and functions of the data link layer understandable by the ISO/OSI model. The purpose of the object layer includes

- Finding which messages are to be transmitted
- Deciding which messages estimated by the transfer layer are actually to be used,
- Providing periphery to the application layer related hardware.

3.2 HARDWARE REQUIREMENTS

3.2.1 NXP LPC1768

The LPC1768 is a micro controller from ARM Cortex-M3 version core for embedded applications requiring a high level of integration and low power indulgence. The ARM Cortex-M3 is a next generation core that provides system enhancements such as modernized debug features and a higher level of prolong block integration. High speed versions (LPC1769 and LPC1759) operate at up to a 120 MHz CPU frequency. Other versions function up to an 100 MHz CPU frequency. The ARM Cortex-M3 CPU incorporates a 3-stage pipeline and it is made of Harvard architecture with individual local instruction and data buses as well as a third bus for peripherals. The ARM Cortex-M3 CPU also contains an internal pre fetch unit that supports speculative branches. Most important feature of LPC1768 that makes it a better selection for this project is that the controller has two inbuilt CAN modules and lot of I/O pins that makes the designing work easier.

3.2.2 MCP2551

The MCP2551 is a high-speed CAN transceiver from microchip. It is fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. The MCP2551 allows differential transmit and receive capability for the CAN protocol controller and is well-suited with the ISO-11898 standard, with 24V requirements. It will operate at speeds of up to 1 Mb/s.

3.3.3 SENSORS AND DISPLAYS

The sensor section categorized as one sensor for each section of the vehicle given in the block diagram. A temperature sensor, an IR module and a flow sensor are used for engine, body and power train sections respectively. In the scanner side a 16x2 LCD display is placed to view the diagnostic report from the scanner part.

3.3 SOFTWARE FLOW

The programming part of the prototype is done with mbed online compiler. The online programming environment gives us a flawless programming experience with large number of predefined library functions. The program flow is also divided into two sections likewise the hardware part. Micro controllers in each section are coded separately with separate program flow. The code for Electronic Control Unit(ECU) associated with sensor and CAN transceiver interfaces and the programs for scanner section carried out with the details of transceiver and display interfaces.

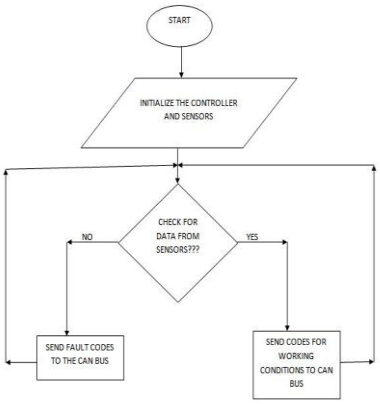

Fig.2 Flow chart for ECU

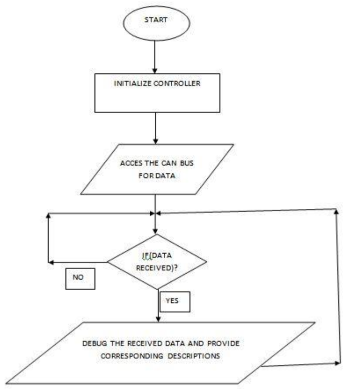

Fig.3 Flow chart for OBD Scanner

4. EXPERIMENTAL RESULTS:

The whole set up is tested in laboratory with the help of python scripts for serial interface. The Electronic Control Unit successfully diagnose the status of sensors using their input values and generates the trouble codes. This section also fulfilled the need of transmitting DTC to the CAN bus. The scanner section also performing

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the operations of obtaining the trouble codes from the CAN bus and produce corresponding descriptions to the users.

Fig.4 Experimental Set up

5. CONCLUSION AND FUTURE WORK

The proposed system can be an optimum solution for diagnostic requirements in non-obd vehicles with fewer mechanical design changes. The scanner part of this prototype can be an better alternative for computer and dedicative software dependent existing workstation diagnostic scanners. The system can be improved by increasing the number of parameters. This can be done with the help of increased number of controllers in the Electronic Control Unit(ECU) side, were all those controllers interconnected with the master controller. The communication protocol supports this without compromising the system performance.

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