On Board Diagnostics and Troubleshooting for Two Wheelers

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***Abstract*—[Font: Today every new car has an OBD-II (On Board Diagnostics II) port that can be used to retrieve vehicle diagnostics data using an chip. This microcontroller can be used to determine currently measured parameters of the vehicle, such as speed, engine and water temperature, battery charge level, and error codes for fault detection. Our research aimed at modifying and installing this module in a two-wheeler and using an application and an algorithm that perform the relevant analysis of the collected data and produces statistics on whether the currently measured value is within the suitable range. By examining the different readings (if they are alarming several times in a row) it would be possible to warn the user that there may be a problem with the vehicle. By monitoring the data, it would be possible to reduce the probability of major faults occurring and provide information about the occurrence of the fault.**

I. INTRODUCTION

We all are using different types of vehicles for different purposes. Now vehicle is a machine and in order to run this machine as per our consideration and expectations they need to be control. Now to control vehicle there is a control unit which we called ECU (engine control unit) or VCU (vehicle control unit). This control unit has processor and memory. This unit receive signals from sensors then after processing this data VCU operate different relays and other electronic components.

When there is any problem occurs in vehicle VCU get triggered by its sensors and other electronics components. That problem gets stored in VCU memory.

But most of the peoples in society doesn't know technical information about their own vehicle. So, when any problem occurs in our vehicle we go to the garage or service center and they solve our problem and then we pay them for solving our vehicle issues. but there is also dark side of market. When we go to the garage sometimes, we get cheated or even technician fails to address the issue in our vehicle so they try to change whole related assembly or change unnecessary parts which might cost us extra money.

So, if we are able to address an accurate issues and problems then it will save our time as well as money. But to do this we must have detail and professional knowledge about our vehicle which sounds quite impossible for all of the vehicle owners. But if there is someone who can give us the accurate current status info about our vehicle on which we can trust.

So, this problem can be resolve by using on board diagnostic tools (OBD). OBD tool is a device which can interfere and communicate with VCU. After connecting this device to VCU we can communicate with VCU. We can get access to vehicle real time data stored in VCU memory. And by monitoring this data we can resolve problems that occurs in our vehicle.

II. RELATED WORK

J V Moniaga, S R Manalu, D A Hadipurnawan and F Sahidi :- Transportation accident rate are still being a major challenge in many countries. There are many factors that could be cause transportation accident, especially in vehicle's internal system problem. To overcome this problem, OBD-II technology has been created to diagnostics vehicle's condition. OBD-II scanner plugged to OBD-II port or usually called Data Link microcontrollers, Arduino, Raspberry Pi are chosen because it sustains the application to receive real-time diagnostics, process the diagnostics and send command to automobiles at the same time, rather than Arduino that must wait for another process finished to run another process. Outcome from this application is to enable automobile's user to diagnostics their own vehicles. If there is found something unusual or a problem, the application can told the problem to user, so they could know what to fix before they use their vehicle safely.

DimitriosRimpas, AndreasPapadakis, MariaSamarakoua :- Road vehicles operations are continuously monitored through physical parameters (temperature, air flow, rotation rate); such measurements are retrieved by electronic sensors and communicated, over the internal vehicle communications protocol, towards the Main Control Unit for further processing. In this paper we present our selection of parameters for monitoring key vehicle operations and briefly describe the sensors employed for the retrieval of these parameter values. The values are retrieved through the OBD-II diagnostics protocol and they are related with the vehicle operation and with the fuel consumption. As proof of concept, focused experimentation has taken place, through a 5 km trip with low and heavy traffic. Values retrieved from the OBD-II scanner are presented and discussed. In terms of evaluation, the raw values as well as the calculated measurements related to fuel consumption are compared with manufacturer standards and the user driving behaviour has been identified as the key factor influencing the fuel consumption for a given model.

Lueckenbach, S., Moser, U., Haake, B., and Frank, J :- The decision to leapfrog from the Bharat Stage (BS) IV emission standards directly to the BS VI standards not only effects passenger and commercial vehicles but also India’s by far largest vehicle class, with regards to sales and production, the two-wheelers. The BS VI norm will not only tighten the emission standards, but it will also increase the required emission mileage level and upgrade the On-Board Diagnostic (OBD) requirements, also by introducing In-Use Monitor Performance Ratio (IUMPR) standards. While OBD was already introduced for passenger and commercial vehicles with BS IV in 2010, OBD will be then newly introduced for two-wheelers. The OBD system monitors the vehicle’s in-use emission performance, informs the driver via the malfunction indication light (MIL) on the dashboard in case of an emission relevant failure, standardises the diagnostic code handling and regulates a standardised access to the electronic control units (ECUs) for maintenance and inspection purposes. To comply with the proposed BS VI standards, the twowheelers must undergo profound modifications and updates on the hardware and the software side. This paper highlights the main proposed regulation changes for twowheelers and discusses the related challenges associated with the OBD Stage II system

III. PROJECT PLAN AND IMPLEMENTATION

Identifying the Problem: Sensors and other electronics components of a vehicle trigger the VCU to alert the vehicle controller when there's a problem. That problem is stored in the VCU's memory. But most people in society aren't aware of the technical information about their own vehicles. As a result, when a problem occurs in our vehicle, we go to a service center or garage, where they solve the issue and then we pay them for their service. However, there is a dark side to the market. Our garage technicians may fail to address our vehicle's issue or even change the whole related assembly or change unnecessary parts, which might cost us more money. Sometimes, we get cheated at the garage or our technician might fail to address every issue in our vehicle.

Possible Solution: Due to the higher costs of vehicle diagnostic systems used by garages and service centers and unavailability of such system in two-wheelers which allows the rider/driver to personally monitor the vehicle performance, we choose to modify and install a device for diagnostics and monitoring of two-wheeler vehicles making it easier and cost efficient by using a programmed microcontroller which has self-diagnostic and reporting capability.

IV. OBJECTIVE OF THE PROJECT

Using programmed microcontroller for two-wheelers which translates this on-board diagnostics information and sends this data to the connected device makes it easier to monitor the vehicle’s real-time data such as acceleration, engine revs, speed, throttle position/displacement, coolant temperature, etc from the sensors and identify the problems and fault codes. This microcontroller transmits data at high speed and with precision. And it being compatible with programs such as Torque, SCAN TOOL, Modiag, among others, give it the first preference.

V. ON-BOARD DIAGNOSTICS (OBD)

Comparing to the other technologies that are used in our day-to-day life, automotive engines have not changed a lot. The same basic principles that drove the first car engines are still used today. However, modern automotive engines have evolved to meet today’s power, efficiency and emission standards. To achieve that, sensors are being used in each sub-system of the vehicle, which continuously monitor the states and are used as feedback to control the inputs for the engine to gain the maximum in means of power, efficiency and emission standards. All the sensors are connected to the Powertrain Control Module (PCM); an electronic control unit which is considered as the "brain" of a modern vehicle. There is a special circuit integrated to the PCM, which is designed to monitor emission control systems and key engine components. It is called On-Board Diagnostics (OBD) which refers to a vehicle's self-diagnostic and reporting capability.

On-board diagnostics (OBD) is an automotive term that refers to the self-diagnosis and reporting capability. In the development of OBD, the problems caused by periodic emission monitoring played an important role. CARB (California Air Resources Board) has recognized this and made continuous monitoring compulsory for manufacturers. The Onboard Diagnostic System (called OBDI) became obligatory in the USA in 1988. The technical specifications were defined by SAE (Society of Automobile Engineers) standards and recommendations. In 1994 OBDI was replaced by OBDII, and from 1996 it was also mandatory for diesel vehicles. EOBD is the European equivalent of OBDII, which had to be introduced in the member states of the European Union by Directive 98/69/ EC. A large amount of diagnostic information about the car can be obtained via OBD. To analyze this information, a simple and cheap ELM327 chip was used based on OBD interfaces, which is powered by the Microchip Technology PIC18F2480 Micro Controller. Newer devices use the STN1110 chip, which is fully compatible with ELM. ELM is a preprogrammed microcontroller, and the ELM327 Command Protocol is one of the most popular PC -OBD interfaces.

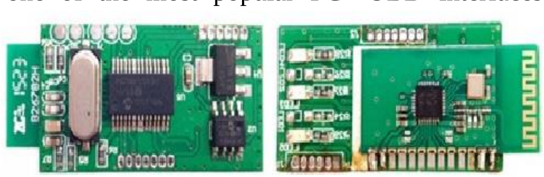


Fig: Microcontroller Chip

Many applications process OBD signals and have used Android mobile phones for that. Many applications display basic information for the car owner, and there are many experiments to process this data for its original purpose. For example, some developers try to retrieve information that is specific to the driver, or the vehicle state. Some researchers are also working on automatic error detection. Most of them look at a single data series. In particular, cases when data that are outside the expected values are reported to the user as fail. Another new feature is that changes in the linear relationship between certain parameters are detected. If these values change, that indicates a message. This can also be used for special features based on preliminary tests where they have had good results In contrast, our research aimed at the development of a fully automatic failure detection system. The detection was based on rare data. The good vehicle works with typical values for a long time. During this time the correct working values were recorded, but a failed vehicle usually showed values that were not usual. Our algorithm tries to find automatically the rare data and the parameters indicating the failure.

The OBD2 connector:

The OBD2 connector lets you access data from your car easily. The standard SAE J1962 specifies two female OBD2 16-pin connector types (A & B). In the illustration is an example of a Type A OBD2 pin connector (also sometimes referred to as the Data Link Connector, DLC).

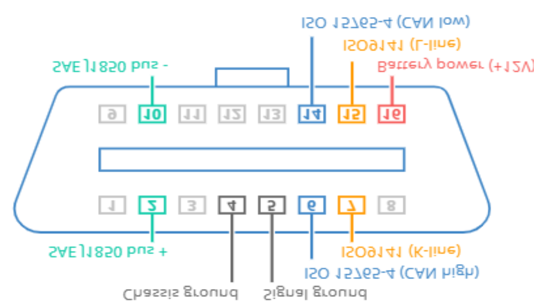
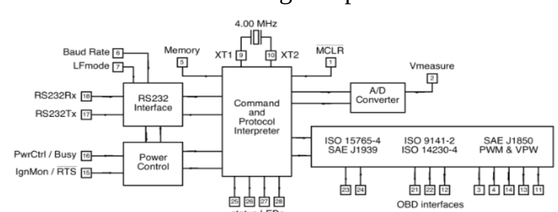


Fig: OBD II Diagram

CONSTRUCTION:

OBD-II has main following components: -



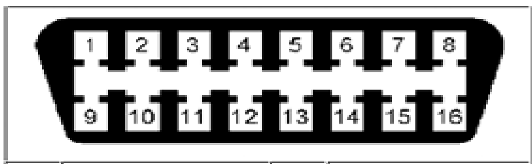
OBD interfaces: - this is a socked which has 16 pins. This socket used to connect to the VCU.

Command and protocol interpreter: - this is a small chip. this receives protocol from OBD interfaces and then process it. Then this chip transfer signals to RS232 interface chip.

RS232 interface: - this is also a chip which take electronic signals from Command and protocol interpreter and then convert it into wireless or Bluetooth signals.

Power controller: - this is also a chip which take power from VCU and then convert it to required voltage for OBD-II.

OBDII has 16 pins.
After connecting OBD to VCU , it received different types of protocols from VCU. Then it converts those protocols into wireless or Bluetooth signals. These signals can be received on mobile cellphone and computer on which we can read the VCU data.



PIN	DESCRIPTION	PIN	DESCRIPTION
1	Vendor Option	9	Vendor Option
2	J1850 Bus +	10	J1850 Bus –
3	Vendor Option	11	Vendor Option
4	Chassis Ground	12	Vendor Option
5	Signal Ground	13	Vendor Option
6	CAN (J-2234) High	14	CAN (J-2234) Low
7	ISO 9141-2 K-Line	15	ISO 9141-2 L-Line
8	Vendor Option	16	Battery Power

The communication between VCU and OBD can be happened by following protocols:

SAE J1850 : The SAE J1850 bus is used for diagnostics and data sharing applications in vehicles. The J1850 bus takes two forms:

A 41.6Kbps Pulse Width Modulated (PWM) two wire differential approach, or a 10.4Kbps Variable Pulse Width (VPW) single wire approach.

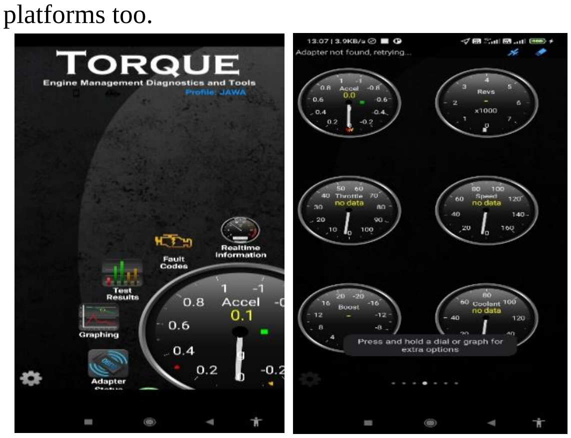
CAN (ISO15765 OR J2234 OR ISO11898): The ISO 11898 standard refers to The Controller Area Network (CAN) data communication protocol

CAN High Voltage: Value should normally be in between 2.5 and 3.5 Volts. Measured on a machine that is running, it will usually range between 2.7 and 3.3 Volts.

CAN Low Voltage: Value should normally be in between 1.5 and 2.5 Volts. Measured on a machine that is running, it will usually range between 1.7 and 2.3 Volts.

ISO 9141: This protocol has an asynchronous serial data rate of 10.4 kbps. It is somewhat similar to RS-232; however, the signal levels are different, and communications happen on a single, bidirectional line without additional handshake signals.

OBD-II RELATABLE APPS:
For Android, there are several third-party apps like Torque and ELM327 Terminal. The Terminal app is very primitive and is limited only to interactively test various AT and OBD2 commands via ELM327 adaptor and it does not do any further processing. Torque app comes along with an attractive GUI which is capable of showing OBD2 PID values in real time using its GUI components like graphs and digital/dial meters. It is also capable of viewing DTCs and clear them. Similar apps are available for iOS and Windows platforms too.



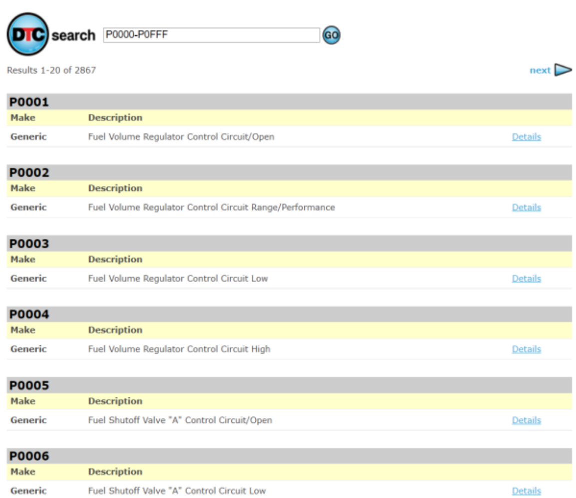
There are also PC-based software such as ProScan [26] and OBD GPS Logger [27]. Both are more focused on improving fuel efficiency. Moreover, ProScan tool supports real-time plotting of data, data logging, clearing DTCs, performing fuel system and emission tests.

Main features that are lacking in the above apps are:

- Mobile apps are easier to connect and drive with but lack of computational power and capacity to do comprehensive tests on sensors.
- PC apps do have that capability, but it is not always viable for a driver to take a PC (or a laptop) with the vehicle.
- Do not have the capability to identify impending sensor failures.

FAULT CODES:

Fault codes help to diagnose the problem with the vehicle. Searching for these fault codes on the internet provides the details about the problem including causes and solutions. After getting solutions we can troubleshoot any problem in vehicle.



VI. CONCLUSION AND FUTURE WORK

We implemented a system for vehicle diagnostics and troubleshooting which integrates OBD2 and mobile application. The system is also capable of detecting possible sensor failures earlier and alert the driver via the mobile phone which saves the cost of fuel and maintenance due to running the vehicle with a poor performance for a long time.

The main drawback of the proposed solution is its dependency on the data communication of the mobile phone to the backend. If the driver has not allowed data transmission on the mobile phone the system will not be useful for backend processing related use cases. The system assumes that a driver possesses a smart phone which is capable of running an Android app. In order to overcome this problem, a dedicated hardware device can be built, where, once the device is plugged into the OBD2 port, data will be uploaded to the remote servers autonomously. The current set of functionalities only consists of a limited number of features which were identified as crucial. The architecture is built in such a way that new functionalities can be added whenever needed.

REFERENCE

[1] *J V Moniaga, S R Manalu, D A Hadipurnawan and F Sahidi:* Diagnostics vehicle's condition using obd-ii and raspberry pi technology: study literature.

[2] *DimitriosRimpas, AndreasPapadakis, MariaSamarakoua* OBD-II sensor diagnostics for monitoring vehicle operation and consumption

[3] *Lueckenbach, S., Moser, U., Haake, B., and Frank, J.,* "On-Board Diagnostic Related Challenges on Two-Wheelers Related to the Upcoming Bharat Stage VI Emission Standards," SAE Technical Paper 2017-26-0147, 2017, https://doi.org/10.4271/2017-26-0147.

[4] *OBD-II*, http://www.obdii.com OBDII PIDs, https://en.wikipedia.org/wiki/OBD-II_PIDs

[5] *Posada, F & Bandivadekar*, "Global overview of on-board diagnostic (OBD) systems for heavy-duty vehicles". The International council on Clean air transportation, on line.

[6] W.D. Huang, Y. Zhang and J. H. Liu, "Research and Design of the Automobile OBD Data State Monitoring System Based on the Android Phones," in Advance Materials Research, vols. 605-607(2013), 2301-2305, 2013.

[7] OBDII: Past, Present & Future. [Online] Available:http://www.autotap.com/techlibrary/obdii_past_present_future.asp

[8] OBD-II Background Information [Online]. Available:http://www.obdii.com/background.html

[9] Diagnostic Trouble Code Definitions, SAE J2012, 2002