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A Real Time Implementation of an IOT based Vehicle Health Monitoring System

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Abstract: ***This paper approaches an IoT based vehicle health monitoring system that is embedded for detecting the condition of a vehicle by monitoring the internal parameters such as heating rate, engine oil level and status of the CO of the vehicle. It is a real time vehicle health monitoring system is designed and developed to detect and identify the actuator and sensor faults created by automatically or manually by the user of the vehicle. Actually, Vehicles need repair after a certain interval of time and if are not repaired at fixed intervals, it can lead to loss of life of the persons travelling on it and there are many key issues which can affect the vehicle. So, the primary objective of this system is developing an IoT based embedded system that can detect the internal condition of a vehicle by evaluating the various parameters that are used to examine in the vehicle's current health condition. In fact, this is a real time evaluation system that can be used for rapid condition screening. As a result, it provides all reliable information about the vehicle conditions. This IoT based system claims that it can detect and identify actuator and sensor faults with almost minimal detection latency even after lots of disturbances and uncertainties.***

Index Terms: Sensor, IoT, Vehicle Health Monitoring, Real Time, Actuator Faults.

I.INTRODUCTION

This approach defines a real time system for detecting the vehicle condition by monitoring the various inner parameters of a vehicle such as Heating Rate, Fuel Level and status of the CO of the vehicle that are used in evaluating the actuator and sensor faults of the vehicles i.e. current health condition. The objective of the system is to notify the users about the excessive heating of the engine, fuel level and status of Carbon Monoxide (CO). A temperature sensor is connected in the engine that gives an alarm the user about overheating of engine. Besides, a voltage divider is used to measure the fuel level while a MQ7 based sensor is also employed in the engine that can identify the status of CO. This helps in proper monitoring and evaluating the performance of the vehicle [2]. If the vehicles are monitored, the reliability of vehicles is increased.

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As a result, service capacity, efficiency of maintenance and operations of vehicles are also improved. Besides, the operating and maintenance cost of the vehicle are reduced and minimize the troubleshooting by almost half. This model can be implemented to identify and report he faults in a vehicle to the authorized service centre through wireless communication which is a concept of remote diagnostics.

II.SYSTEM ARCHITECHTURE

This system comprises of both the hardware design and the software implementation as a package. Software part is a web based application that is used for notifying the user and manufacturer about the fault in the vehicle that needs to be repaired.

A. Hardware Module

As per the hardware part is concerned, the SST89E516RD2 Microcontroller enables working of the entire circuit through DC power supply. For detecting the temperature and continuously sends the readings to the Microcontroller in real time, a temperature sensor is employed in the hardware interface of the monitoring system,

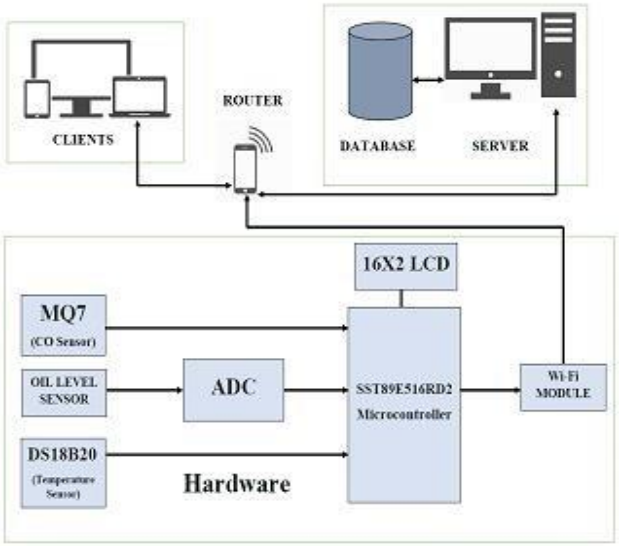

Fig. 1. Block Diagram of Hardware Interface of the Vehicle Health Monitoring System

Other then, two sensors are engaged in the engine. The fuel level sensor detects the engine oil level and its functionality is like a voltage divider mechanism which is used to measure the engine oil level in real time. A MQ7 based CO sensor is applied in the engine to detect whether CO level is high or Normal.

The information is continuously being updated on the internet through an ESP8266 Wi-Fi module that is attached to the Microcontroller and can monitor the data on LCD display. The Wi-Fi module uses a network of IoT to send the data to the server and also to access the data from the server. An update notification is also sent to the webpage by the web server whenever temperature rises, engine oil level and CO status is observed using Wi-Fi module through a network of IoT.

B. Server Module

The cloud module present in this system provides a graphical user interface designed for user services and maintenance of data received by the web server. This cloud module will function in two ways, the first one is front end application of a webpage and the other one is database for storing and retrieving the data in real time.

At front end, the system will take the responsibility for creating user's profile in database with unique user key. This module is all about the web server that is configured to handle responses from the ESP8266 Wi-Fi module and requests sent by the user through a server site programming written in PhP. The programming is responsible for collecting the data that is transmitted through a router over Wi-Fi communication and fetch into the database present in the server. The ESP8266 module has to be configured with the router to connect with the server. When the ESP8266 receives valid information from microcontroller by a serial communication, it will transmit the data to the web server that is configured by the configuration of ESP8266 Attention (AT) command. This data can be used for further use like online monitoring, performance analysis etc.

Later on, the system will create and maintain the details of devices and the operations performed on it according to the user's specification. At back end, the data received from gateway is stored according to the user's specific instruction and their devices and the data is visualized under device data in user profiles.

III. IMPLEMENTATION

The primary objective of the system is to identify or detect various parameters associated with a conventional vehicle or electrical vehicle. In this system, a special focus has given on three vital parameter i.e. temperature of the engine, oil level and carbon monoxide. The system will keep monitoring these parameters and transmit the data to the web server using Wi-Fi communication, so that this information can be used by different group of people or user Primarily this information can be need by or helpful or useful for the user of the vehicle, the automobile industry as well as government organization like District Transport Office. The primary objectives or the features of the system are microcontroller based designing for flexibility and upgradability. It enables transmission of data over secured Wi-Fi communications. Cloud based server or a web server can be used to implement the system. The system Implements of free work and widely used software in web technology for higher acceptance.

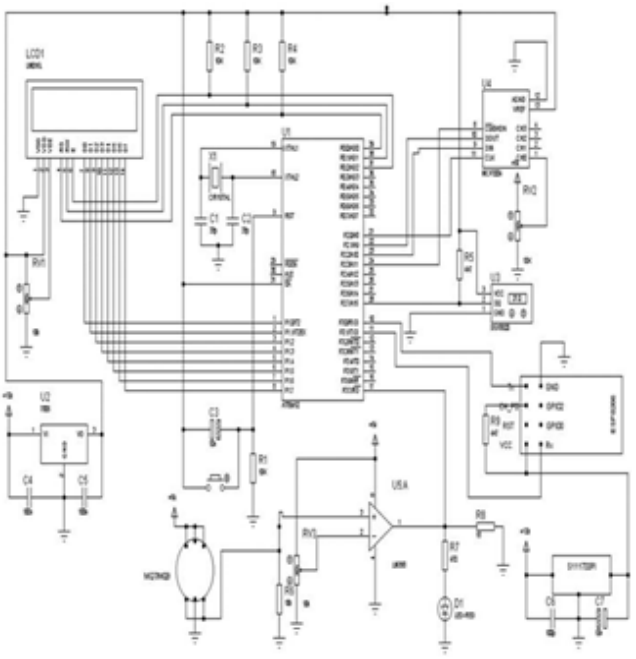

Fig. 2. Circuit Diagram

A. Circuit Design

The circuit is designed and simulate by proteus simulation software that has a popular 8052 family microcontroller SST89E516RD2 having 40 pin DIP package. To reduce any noise or ripple we are using two 200 nF ceramic capacitor across pin no. 1 & 2 and 2& 3. Any micro-controller or micro-processor require clock source to fetch instructions and execute if few micro-controller has internal oscillator but SST89E516RD2 is not having any internal oscillator. Hence this circuit must have to use external oscillator circuit. To provide clock source the switching circuit can use crystal oscillator, resonator, function generator or even another micro-controller. The crystals are most commonly used oscillator for micro-controller pin 18 & 19 of SST89E516RD2 are XTAL1 &XTAL2 respectively.

As per the capacity SST89E516RD2 can operate from 0 MHz to 33 MHz. i.e. we can use a crystal oscillator of value (0-33) MHz. In this circuit, systems are using 11.0592 MHz crystal.

This odd no. is very important in case of serial communication if there is noneed to do serial communication then system can go with any crystal frequency (0-33) MHz, but if serial communication is needed then, system must have to use 11.0592 MHz crystal otherwise there will be error in serial communication and it will not communicate with the external device properly. In this work, system must have to implement serial communication, as the Wi-Fi module ESP8266 communicate with micro-controller through serial communication only. Parallel to the crystal i.e at pin no. 18 & 19 to ceramic capacitor C1 & C2 of value 33PF is connected to ground.

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To measure the temperature, system uses digital temperature sensor DS18B20, it is having internal ADC and provide data in digital form and hence we don't need any external ADC, DS18B20 communicate with the micro-controller using 1 wire communication protocol i.e only one I/O pin is used to send command from micro-controller to DSB18B20 and read the data through the same pin. To measure the fuel level system uses the mechanism of voltage divider. As the voltage divider circuit follows Vout= (R1/R1+R2)*Vin. Where, R1 & R2 change the output voltage where Vin is fixed. The center terminal is connected to the MSP3204 which is a 12 bit analog to digital convertor because the voltage is analog signal and that's why it cannot directly measure by micro-controller. It communicates with the micro-controller or host with a SPI protocol that need four signal line i.e. MISO, MOSI, CLK and RST[5]. To identify the status of CO i.e. high or low we are using MQ7 based sensor built on SNO2 and sensitive to CO.

B. Data Acquisition

In order to achieve a communication between client and server, a user interface web page is built to take request from clients i.e. the user of the vehicle. The user interface and the internet front end are connected to a backend database server. The users can send request to the server through the web page to interact with the system. The request sent by the client is received by the server and similarly the server acknowledges the client through a router over Wi-Fi communication. The database is the main back end present in the web server as a special focus is given for designing the database as a common integrated platform to store the instructions sent by the user through web page. Basically, the database is integrating the platform between the storage of data from the sensors connected with the circuit and acquisition of data from the web server. The database is connected to MySQL server by using a data source name (DSN). The programming burnt into the microcontroller is also such way designed that it can trigger the data collected from the vehicle in real time to the database. The data are consumed by the sensors that are transferred to the server by a microcontroller AT89S52 through a router over WiFi communication after a fixed amount of time repeatedly and stored into the database simultaneously. If any exception is happened on data, then it will be sent to the owner of the vehicle [6]. The CO level is identified by the system as high or low and when it is high, a buzzer will be rung until the CO becomes low.

IV.RESULT AND ANALYSIS

A few experimental results have been found during the execution of the system by which user can evaluate and analysis the performance of the vehicle as mentioned in the objective of the proposed system, the aim of this work is to monitor different parameters of vehicle i.e. temperature, oil level and CO status of a vehicle through IoT connectivity. The result of this system that is outcome finally can be visualized with the help of the graphical user interfaces of present in the server locally and at the client side remotely.

Fig. 3. The Entire System

Once the server machine is started after connecting and switching the all components required in the system, the data triggering process also is also started from the sensors present with the vehicle to the database by the microcontroller over Wi-Fi communication. The data are stored in the database in the following form of table of different another fields along with parameters to be observed.

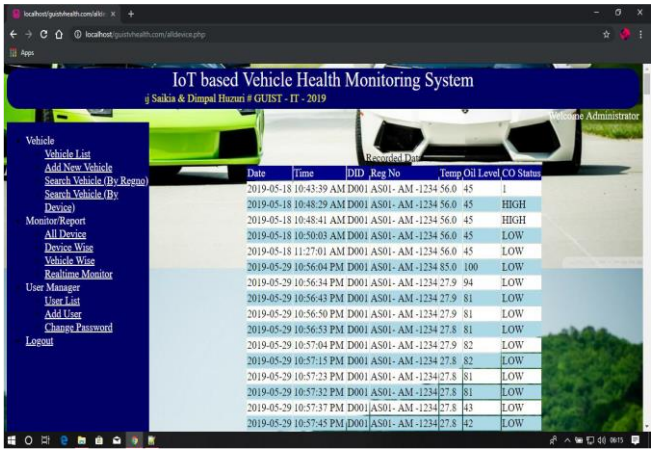

Fig. 3. Details of Data received from server

The entire system is designed for collecting and retrieving the real-time data of Temperature, Engine Oil Level and CO status of the vehicle. So, Administrator and users can access the data in real time using the Real time Monitor option present in the graphical user interface designed for the client. The real time data for a particular vehicle can be visualized in fig. 4.

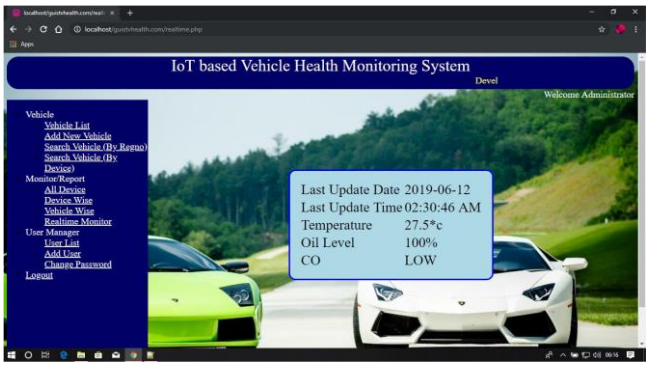

Fig. 4. Real Time data acquired from a vehicle

V. CONCLUSION

The project is initiated by collecting and gathering the information required for evaluating various parameters of the vehicle health condition. This information includes the of vehicles performance on various parameters of car subsystems. Also different methods for health monitoring, which differ by the way of extraction of parameter values, are observed regarding their feasibility and economic factors.

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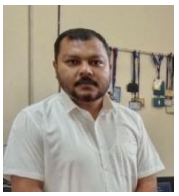

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