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IoT Based IC Engine Temperature AND Lubricating Oil Condition Monitoring System

[1]Preety Pradhan, [2]Sridhar N
[1]PG Scholar, Department of ECE, CMR Institute of Technology, Bengaluru, India
[2]Associate Professor, Department of ECE, CMR Institute of Technology, Bengaluru, India

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ABSTRACT
There is a high demand for Internet of Things (IoT) in the industrial sector since it can be used for many practical purposes, including smart machines and reliable transportation. An overwhelming amount of different sensing data is being produced by numerous sensory devices in the IoT space as a result of industrialization. IoT for industry. Industry 4.0, smart industries, and smart machines are terms we use today. It is quite essential for the system of an automobile to be monitored in real time. Implementing IoT applications in the automotive sector helps with design, which improves performance, lowers costs, and allows for quality control. It is necessary to monitor the engine in order to improve the performance of the cars. Similar to the brain of an automobile, the engine. It has all the energy required to keep your car running. Owning a vehicle comes with some responsibilities. We need to make your car payments and keep your insurance up to date, for starters. In order to get along with and operate the vehicle before moving on, also need to take care of it. Therefore, keeping an eye on oil consumption and engine temperature is a smart first step in maintaining the engine. The work describes the design and development of engine temperature and oil condition monitoring system. Here IoT based smart system is developed where the user can monitor the engine temperature and oil condition through mobile app in real time.
Keywords: Engine Oil monitoring, Engine Temperature monitoring, Color Sensing, Blynk IoT

I. INTRODUCTION

"Things" and "internet" are the building blocks of the phrase "Internet of Things" (IoT). IoT devices may remotely sense, act upon, and continuously monitor certain sorts of data. They can also communicate data in real time, either directly or indirectly, with other connected devices and apps. IoT devices are distinctive from one another and have unique identities. They are also capable of collecting data from other gadgets, processing it, and sending it to other servers. The term "internet" can also refer to a global network of computers that facilitates the exchange of information. Consequently, the Internet of Things is defined as "a dynamic Global Network Infrastructure with self configuring capabilities based on standard and inter operable communication to protocol where physical and virtual things have identities, physical attributes, and virtual personalities and use intelligent interfaces and are seamlessly integrated into the information network, often communicating data associated with user and their environment."An ideal Internet of Things device includes a number of wired and wireless interfaces for connecting to other devices.

The way you use and interact with your cars is likely to be completely transformed by IoT connection, intelligent sensors and devices, mobile apps, edge computing and cloud services. Implementing IoT applications in the automotive sector helps with design, which improves performance, lowers costs, and enables quality control. IoT applications in the automobile industry are countless thanks to Industry 4.0's foresight. According to unbiased market study by Globe Newswire titled "Automotive IoT Market by Platform-Global Forecast to 2025," the automotive IoT business is projected to reach $541.73 billion by 2025. The automotive industry is working to make the most of the Internet of Things as we transition from the age of products to the age of services and experiences, from functionality to information as the primary object of value generation, and from warehouses to highly networked systems.

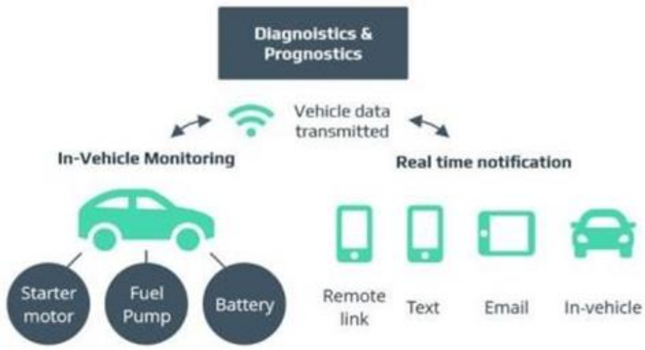

Fig. 1 Use of IoT in Automotive Industry

Owning a vehicle comes with some responsibilities. We need to make your car payments and keep your insurance up to date, for starters. We also need to care for the vehicle if you hope to get along and useful life from it before moving on. So monitoring engine temperature and oil consumption is a good step toward keeping the engine healthy. Unaware of the deterioration of the oil in the car, it may result in future severe damage to the engine or other parts, resulting in a high repair cost. Using the old oil may also produce black smoke, which contributes to air pollution[1]. For a variety of internal moving parts of combustion engines in a vehicle, engine oil is utilized as lubrication[2]. Additionally, it aids in cleaning, performance, and engine protection. The engine has a limited lifespan and oil must be changed[3][4]. The cooling system's main responsibility is to keep the engine functioning at its ideal temperature[5]. So real time monitoring of engine temperature and oil consumption through Internet of Things(IoT) is an approach to make vehicle owners life easier. So that they can monitor the engine health in real time and take the necessary steps to avoid the wear and tear of engine[6].

II. EXISTING SYSTEM

In vehicles, we don't have see-through glass; instead, we have a dipstick that measures the amount of oil. See-through glass is used in two- wheelers to show the oil level. But certain luxury vehicles, such as high-end Audi, BWM, and others, include specific oil level indicators, oil pressure indicators, or warning lights.In India, vehicle technicians still supervise engine lubricant using traditional methods[7].

This method simply measures the engine oil level, not the oil's quality or condition. Occasionally, when the crankcase pressure is too high, the dipstick will pop out.

III. PROPOSED SYSTEM

The work's goal is to monitor the engine temperature and analyse the quality and quantity of lubricating oil in real time. It helps the owner to when the oil is degraded and also eliminates the replacing the engine oil during maintenance whether it has been fully used or not. The owner will be able to take desire actions such as slow down or stop the car if the temperature crosses the limit. Here IoT based micro-controller Arduino Uno is used which is drived by 12 V DC supply. The characteristics of engine is monitored using smart sensors. The oil consumption is indicated by the ultrasonic sensor which estimates the amount of the oil is present in the cylinder[9]. The oil degradation is monitored by using a color sensor which demonstrates the color level of the oil because as the oil degrades the color of the oil changes. A temperature sensor that detects the engine's operational temperature levels is used to monitor the engine temperature[8]. The data obtain by these sensors are deployed by the program in C on Arduino Uno, the Arduino connected to the Wi-Fi module that is Node Mcu through Blynk app which is open source Internet of Things application where the real time data is visualized.

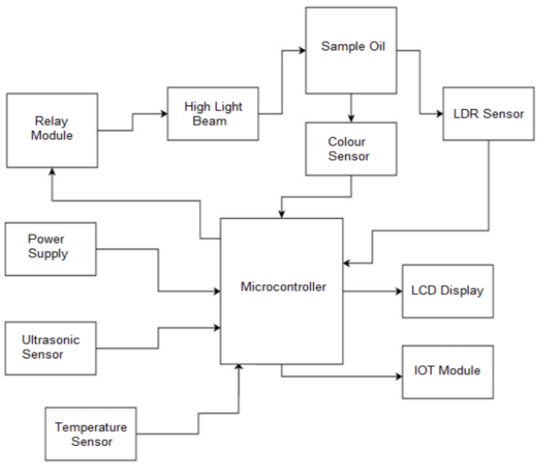

Fig. 2 Block diagram of the engine temperautre and oil monitoring system

3.1 Hardware Requirements

3.1.1 Arduino uno : One of Arduino's standard boards is the UNO. The Italian word UNO here is for "one." To identify the initial release of the Arduino Software, it was given the name UNO. It was also the first USB board that Arduino has ever released. It is regarded as a strong board that is employed in many projects. The Arduino UNO board was created by Arduino.cc[10].

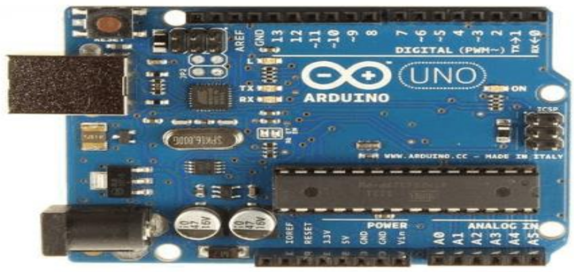

Fig. 3 Arduino Uno

3.1.2 Color sensor (TCS320) : A number of photodetectors make up the Color Sensor (TCS230), each of which has a red, green, or blue filter or none at all (clear). To prevent color location bias, the filters for each and every color are dispersed equally over the array. An oscillator within the device generates a square-wave output whose frequency is inversely proportionate to the selected color's intensity.

Fig. 4 Color Sensor

3.1.3 Ultrasonic Sensor (HC-SR04) : The transducer also known as ultrasonic sensor, functions same as a radar system. An ultrasonic sensor may convert electrical energy into sound waves and the other way around. The acoustic wave signal is an ultrasonic wave with a frequency greater than 18 kHz. Ultrasonic waves are generated using the well-known HC SR04 sensor at a frequency of 40 kHz.

Fig. 5 Ultrasonic Sensor

3.1.4 Temperature Sensor (LM35) : The LM35 is a device for measuring temperature with an analogue output voltage that varies with temperature. The output voltage is given in centigrade. No additional calibrating circuitry is needed. The LM35 has a 10mV/degree Celsius sensitivity.

Fig. 6 Ultrasonic Sensor

3.1.5 LDR : An LDR is made by covering an insulating substrate, such as ceramic, with a light-sensitive substance. The material is laid out in a zigzag pattern to attain the requisite resistance and power rating. The resistances of the contacts must be as low as practical to guarantee that the resistance changes are mostly brought on by the light action alone. An LDR works on the principle of photo-conductivity, an optical phenomenon[11].

Fig. 7 LDR

3.1.6 LCD Display : LCD stands for liquid crystal display. It is a specific kind of electronic display module that is used in many different circuits and gadgets, such as cell phones, calculators, computers, TVs, and other electronics. The majority of seven segment and multi segment light-emitting diodes are used for these displays. The main benefits of using this module are its affordability, programming simplicity, and animations, and lack of any restrictions on the display of customisable characters, unique and animations, etc.

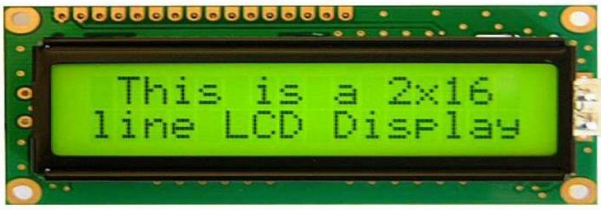

Fig. 8 16x2 LCD Display

3.1.7 Relay : Relays are the most common switching mechanism in electronics. The voltage required to activate the relay and change the contact from Common NC to Common NO is known as the trigger voltage, is the first of two crucial relay characteristics. The load voltage and current, that in the case for DC is a maximum of 30V and 10A, is the other parameter. It speaks about the maximum voltage or current that the relay's NC, NO, or Common terminals can support.

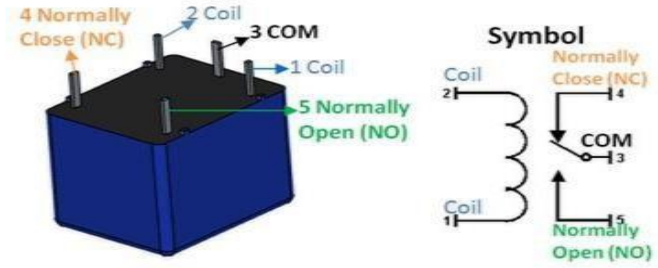

Fig. 9 16x2 LCD Display

3.1.8 Voltage Regulator (LM7805) : Voltage regulators are designed to stabilize or maintain a consistent voltage in the circuit. There are two series presented: 78xx and 79xx. In this, xx represents output voltage, and 78 represents a positive.

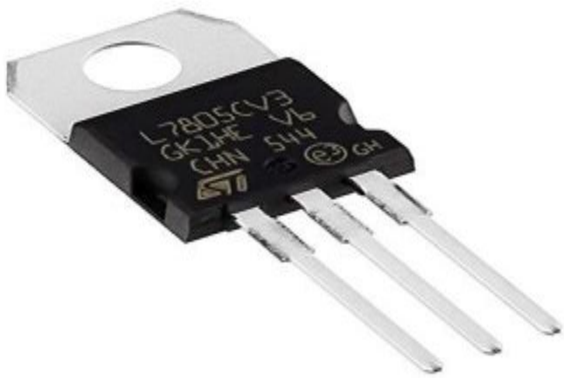

Fig. 10 Voltage Regulator

3.1.9 12V DC Power Supply : The 12V (or 12VDC) supply is one of the most frequently utilised power sources in use today. To change a 120VAC or 240VAC input into a 12VDC output, a transformer, diode, and transistor combination is frequently employed.

Fig. 11 12V 2A DC Power Adapter

3.1.10 Node MCU : The ESP8266 System-on-a-Chip (SoC) is a low-cost SoC that is the foundation of the NodeMCU, an open-source platform for creating both hardware and software. The ESP8266 was developed and manufactured by Espressif Systems and includes all necessary computer components, such as a CPU, RAM, WiFi, and even a modern operating system and SDK.

Fig. 12 Node MCU

3.2 Software Requirements

3.2.1 Arduino IDE : The well-known AVR microcontrollers are supported by the open-source Arduino breakout board in addition to its software library. The tool used to develop code for Arduino boards is called the IDE (Integrated Development Environment), and it is available as a downloaded file from the Arduino website.

3.2.2 Embedded C : A C language extension is embedded C. Programming for Arduino boards is done in "C." In compared to other high-level programming languages, the widely used system programming language C executes quickly on hardware. Because of this, several programming languages and the majority of operating systems are constructed in C.

3.2.3 Blynk IoT App : The Blynk application's main goal is to support the Internet of Things. Blynk is a platform that allows users to operate devices like Arduino, Raspberry Pi, and others remotely using IOS and Android applications. On a digital dashboard, widgets may be easily moved around to create a prototype's graphical user interface. It had a lot more capability, including the ability to save and view data, show sensor data, and remotely operate devices.

IV. WORKING OF PROPOSED SYSTEM

The pushbutton switch has been wired to the Arduino Uno. The LED will glow for three seconds after the switch has been pressed. The top of the blue container has a connection for the colour sensor TS2300. The output is attached to the D12 of the Arduino uno, while the four data ports S0, S1, S2, S3 are connected to pins 8, 9, and 10 of the Arduino. The sensor is used to assess the oil's quality. LDR is used to measure oil quality as well. On each of the two sides of the blue container, the light source is placed axially placed with LDR[4]. The Arduino Uno's A0 and Vcc are linked to the first and second terminals of the LDR, respectively. The high beam of light is driven by the relay. The Arduino's pin 18 is connected to the relay pin. The HC-SR04 ultrasonic sensor, which is positioned on the top of the white container, is used to measure the oil level. The echo and trigger pins of the sensor are linked, respectively, to pins 17 and 16 of the Arduino. Engine temperature is measured with the LM 35 temperature sensor. The micro-controller's analog pin A1 receives the sensor output. All sensor output is displayed on a 16x2 LCD screen. The D2, D3, D4, and D5 are connected to the LCD's four data ports. The micro-RS controller's pin is linked to D7, while the enable pin is connected to D6. In order to lower a greater voltage to a smaller one and maintain its stability, the voltage regulator LM7805 is used with the Arduino Uno and node mcu. The LM7805's pin is attached to the mcu's 5V supply. After the Arduino Uno has completed its analysis, the data is sent through serial communication to the Wi-Fi module. The D5 and D6 of the esp8266 are wired to the RX and TX of the Arduino. The micro-controller is powered by a 12 volt DC power supply.

A. Advantages of the Proposed System

- Cost effective
- Continues feedback to help optimize oil- drain intervals
- Early problem indication
- Monitor the engine temperature in real time

B. Applications of the proposed system

- Used in vehicles
- Used in industries
- Used in generators

V. RESULTS AND DISCUSSIONS

The Fig. 13 shows the final prototype of IoT based smart ic engine temperature and lubricating oil condition monitoring system. It is temporarily attached to a ply-board to easy the handling during the experiments.

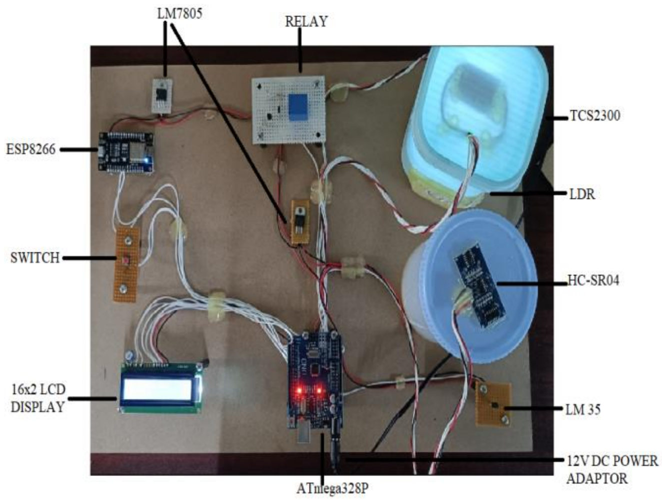

Fig. 13 Final prototype of the engine temperature and oil monitoring system

The Fig. 14 shows the different quality of engine oil used for the experiment to analyse the quality of lubricating oil .

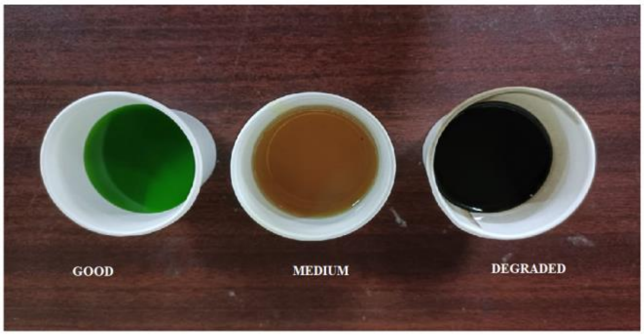

Fig. 14 Different Engine oil Quality taken

Three different kinds of engine oils are used in the experiment. Running a 4-stroke motorcycle engine for 0 km, 197 km, and 550 km caused the oil to degrade. All of the oil samples used for testing were maintained at room temperature in the organizer.

A motorbike engine may have several issues at once. India's subtropical monsoon environment, which is typified by high temperatures, has an impact on the motorcycle engine's condition and can lead to overheating. Additionally, travelling a motorcycle for an extended period of time without stopping to rest might cause the engine to overheat. The system that has been deployed has the ability to track engine temperature and cloud-store the corresponding values. The temperature data sheet of Table 1 shows that the overheating detection threshold is 38°C.

Table 1- Experimental data of LM 35 Temperature Sensor

SI.	Temperature (°C)	Response
1	35°C	Normal
2	26°C	Normal
3	53°C	Overheating
4	31°C	Normal
5	48°C	Overheating

When the motorcycle is run for a long duration the engine oil quality degrades. Here oil quality was tested at 0 km, 197 km, 550 km. The quality of oil tested for the experiment are Good, Medium, Degraded based on the distance travelled.The deployed system can monitor the quality of oil and the cloud stores the corresponding values. Table 2 shows a oil quality data sheet.

Table 2- Experimental data of TCS230 Color Sensor

SI.	Distance Travelled (km)	Quality(%)	Response
1.	0 km	1%	Good
2.	197 km	4%	Medium
3.	452 km	6%	Degraded
4.	550 km	9%	Degraded

When the motorcycle is run for a long duration with the engine oil quantity decreases along with the degradation of oil quality. The levels of oil tested in this experiment are Full, Medium, Low. The deployed system can monitor the quantity of oil and the cloud stores the corresponding values. Table 3 shows a oil quantity data sheet.

Table 3- Experimental data of HC-SR04 Ultrasonic Sensor

SI.	Distance Travelled (km)	Quantity(%)	Response
1.	0 km	2%	Full
2.	197 km	4%	Medium
3.	452 km	7%	Low
4.	550 km	9%	Low

The Fig. 15 shows the various lcd displays display of output of the experiment. The lcd screen shows the engine temperature, oil quality and quantity as per the given conditions.

Fig. 15 Final output displayed on LCD

Blynk IoT mobile application is used for real time monitoring of the vehicle engine. It is a open source mobile application which will allow the user to monitor the engine temperature and oil condition and take desire actions for the good health of the engine any time. The Fig. 16 shows the blynk app terminal which gives real time data to the user.

Fig. 16 Real Time Monitoring using Blynk IOT

VI. CONCLUSION

The approach used in this work is based on the creation and application of an automated engine temperature and lubricating oil monitoring system in India is done by a conventional manner which is economically more superior and imprecise resulting the analyzed results of engine temperature as well as quantity and quality of oil shows that the working model device can be made that can be used for cost-effective and very much reliable method for detecting the engine temperature as well as oil impurities and depth of oil in the sump so that the owner can take the desire actions. Additionally, it has the ability to broadcast the computed measured value over the cloud network and display it on different screens or through mobile applications like blynk IoT. The numerous tools and sensors are in good functioning order. The data can be retrieved remotely, and the instrument's output resolution is satisfactory. Additionally, statistical analysis makes use of it.

VII. FUTURE SCOPE

Implementation is only carried out for one vehicle. By putting IOT principles into practise, many vehicles can be integrated, each with a unique ID. where statistical visualization of the data is possible. The IoT based engine temperature and oil condition monitoring system can also be controlled and optimized using PID controllers[12][13]. Also the display in the real time data can be changed according to the users preferences.

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