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Engine Oil Impurities and level Monitoring System

Birali Prasanthi, Komirishetty Saiteja, Kakumani Sravya

Abstract*: The key element for mechanics of every vehicle be it a 2-wheeler, 3-wheeler, 4-wheeler and so on requires engine oil to work smoothly. Engine oil's primary function is to lubricate the moving elements of engines, which are constantly undergoing friction. As a result, friction is decreased, which tends to diminish longevity of engine parts. During combustion, energy is wasted, and mechanical parts rubbing against one another raise engine temperature. With increased usage the engine takes a lot of wear and tear this leads to accumulation of impurities in the oil. The project describes the design and development of an IoT based oil impurities, level monitoring instrument and its operational methodology. This project uses a unique approach with LED spectrophotometry. The developed instrument in the project will do Qualitative and Quantitative assessment of lubricant oil in IC engine's sump. This in turn aids in carrying out decisive actions to maintain the ecological emissions and engine life cycle.

***Keywords*: Arduino, Engine oil, IOT, LED, Light dependent resistor, Spectroscopy.**

I. INTRODUCTION

Ic engine is an important component of any motor vehicle, in which Motor oil assumes a significant job to run any engine vehicle with most extreme proficiency regarding quantitative and subjective parameters. Engine oil perform multitask during single engine operation such as anti-friction, act as a coolant, rust & corrosion inhibiter etc. Generally, Engine performance mainly depends on lubricating oil provided between moving parts inside the engine in order to reduce friction, gap filer and so forth. As engine runs, its performance factors such as torque provided, smooth functioning, restricted carbon footprints and so on depends on the engine oil. Often use of engine oil starts deteriorating and diminishes day by day. Therefore, periodic change of an engine oil becomes imperative in order to reduce friction and obtain the desired performance of the engine. The deterioration of oil mainly depends upon chemical reaction, temperature rise due to heat produce, corrosion, crushing of moving parts, external contamination, and presence of carbon residue water. Using engine oil persistently reduces automatization, gear transmission and power transmission. Hence change of oil on regular basis becomes advisable but it largely impacts the maintenance charge, so it is not so economical. Consequently, many research and experiments are upheld in order to predict the appropriate method to minimize oil change affirming to safe operation. Therefore, to monitor oil condition qualitatively and quantitatively becomes an important aspect.

Engine oil condition monitoring has turned out to be basic for keeping up and extending the life cycle of IC engines and components utilized in motor vehicles. The constant condition monitoring of engine oil can fundamentally diminish the activity cost by eliminating the requirement for expensive motor overhauling, operational shutdowns, exceptional investigation, and machining work, which maintain a strategic distance from the likelihood of disastrous segment disappointment amid tasks.

A. Proposed System

A new system has been developed to measure the quality of engine oil. The system uses the Lambert-Beer law to measure the amount of light absorbed by engine oil. The more impurities in the oil, the more light is absorbed. The system can then be used to estimate the quality of the oil. The prototype system consists of two pairs of light-dependent resistors (LDRs) and a light-emitting diode (LED). The LDRs are placed on opposite sides of a test tube filled with engine oil. The LED light source is placed between the two LDRs. When the light source is turned on, light passes through the test tube and is absorbed by the oil. The amount of light absorbed is measured by the LDRs. The system can be calibrated by using a new sample of oil. The oil is placed in the test tube and the system is turned on. The amount of light absorbed is measured and recorded. This value is then used as a reference for measuring the quality of other samples of oil. The prototype system is a promising development for engine oil quality monitoring. It is a simple, low-cost system that can be easily used by mechanics and other automotive professionals. The system is also portable and can be used in a variety of settings.

B. Hardware Requirements

1) Arduino uno: Arduino Uno is an open-source microcontroller board that is widely used in electronics projects. It is based on the ATmega328P microcontroller and offers a variety of input/output pins, making it highly versatile. The board can be programmed using the Arduino software and supports various programming languages, including C and C++.

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*Correspondence Author(s)
Birali Prasanthi, Department of Computer Science Engineering, Mahatma Gandhi Institute of Technology, Hyderabad (Telangana), India. Email: bprasanthi_cse@mgit.ac.in .
Komirishetty Saiteja*, Department of Computer Science Engineering, Mahatma Gandhi Institute of Technology, Hyderabad (Telangana), India. Email: komirishettysaiteja@gmail.com, ORCID ID: 0009-0008-3509-7929 .
Kakumani Sravya, Department of Computer Science Engineering, Mahatma Gandhi Institute of Technology, Hyderabad (Telangana), India. Email: kakumanisravya2001@gmail.com

2) ESP-8266 Wi-Fi Module: The ESP8266 Wi-Fi module is a low-cost and highly popular wireless communication device used in IoT applications. It comes with an integrated microcontroller and Wi-Fi chip, which makes it easy to connect devices to the internet. The module can be programmed using various programming languages and can be interfaced with different sensors and peripherals to create smart devices.
3) 16X2 LCD: The 16x2 LCD display is a commonly used alphanumeric display for electronic projects, featuring 16 columns and 2 rows of characters that can display up to 32 characters simultaneously. It is compatible with various microcontrollers and can display data, messages, and other information. As a versatile component, it is a popular choice for a wide range of applications.
4) LDR sensor: The LDR (Light Dependent Resistor) sensor is a widely used component in electronics projects that changes its resistance based on the amount of light falling on it. It is commonly used to detect ambient light levels or to control the brightness of LEDs in a circuit. As a passive device, it does not require any external power supply and can be easily interfaced with a microcontroller or other electronic components. Due to its simplicity and low cost, it is a popular choice for hobbyists and students learning about electronics

C. Software Requirements

Arduino IDE: An open-source application called the Arduino IDE (Integrated Development Environment) is used to program Arduino boards. For authoring, uploading, and debugging code on various microcontrollers, it offers a user-friendly interface. The IDE's straightforward design and syntax highlighting make it usable for both newcomers and specialists.

Programmers can rapidly and easily connect with sensors, displays, and other electrical components thanks to the IDE's collection of libraries. Moreover, a serial monitor is provided, enabling users to communicate with their Arduino boards and get immediate response. The IDE works with a variety of hardware platforms besides Arduino and supports a number of programming languages, including C and C++. Operating systems for Windows, macOS, and Linux are all compatible with the software.

The IDE further supports version control tools like Git, which let users work together on projects and monitor changes over time. On forums and websites, a sizable and vibrant community of Arduino users exchanges code, lessons, and troubleshooting advice. As a result, it is simple to get assistance and find motivation when working on a project.

In general, the Arduino IDE is a vital tool for anyone interested in programming microcontrollers or electronics. It is a valuable tool for both novice and experienced users.

II. LITERATURE SURVAY

Engine oil impurity monitoring has been proposed for several systems. Below, we will only highlight those that are most pertinent to the subject of our study. Lubricating oil is essential for the engine to maintain the required performance. Internal combustion engines' engine oil and lubricating oil are subject to a variety of stresses based on operating circumstances and fuel quality, therefore it's crucial to maintain their quality to reduce friction inside the engine. One must replace the oil in a timely manner to prevent potential engine issues, but superfluous oil changes must be avoided for both environmental and financial reasons.

The project [1][8]“IoT Based Engine Oil Sludge Monitoring System” been capable to identify the amount of sludge present in the engine oil to some extent. The device developed in this project was even capable of transmitting the data wirelessly over the internet to the remote device of choice. In this project the use of RGB sensor to segregate different aspects of white light after passing through the oil and a thin silver cotted film which acted as a mirror. The oil sample is taken from the reservoir and white light is passed through the oil and the sludge level is measured. The values displayed on the remote device were the values of red, blue and green after passing the light through the oil which is hard to interpret for a normal user.

In this paper, [2][7] the project “Diagnostics of Engine oil of Internal Combustion Engine” During the operation of vehicles, the properties of the engine oil undergo significant changes, which directly impact the reliability of modern engines. Each material, including motor oil, possesses unique electrical characteristics based on its dielectric properties. The dielectric permittivity serves as a diagnostic parameter for rapidly estimating the oil's electrophysical properties. To determine the dielectric value of the oil, a series R, C circuit is employed, with a standard signal generator (model Г4-18A) serving as the voltage source. This signal generator enables precise adjustment of AC voltage across a wide range of frequencies. The high-frequency voltage measurement is accomplished using an oscilloscope (model C1-107).

Another study on the work is regarding [3] the aging of engine oil using the properties of the engine oil. It ensures the characterization of the motor oil of a vehicle. It has an open end and is a coaxial line. L=(0/2)=62.5mm is its length, which is equivalent to the wavelength in air. It has a resonant frequency equal to 2.4GHz and its excitation is carried out through a BNC connector, followed by an SMA/BNC adapter. The characteristic impedance of the latter is 50Ω and the dielectric used is Teflon (εr=2.1). The detector made will be placed in the oil pan of the vehicle. The coaxial line consists of two conductors of the same axis Ox: a solid cylinder (the core) of radius A and a cylinder of radius Ri which surrounds the solid cylinder. Between the two cylinders a homogeneous and isotropic dielectric of relative permittivity εr. This dielectric is that of the air or engine oil to be characterized. The central conductor serves to bring an electric current and the outer cylinder ensures the return (playing the role of the mass).

In the last project, [4][5][6] the properties of lubricating engine oil have been studies. As the lubricant is oxygenized and dirtied, there is increment in dielectric constant, along these lines the dielectric constant is viewed as the complete assessment record of lubricant’s degree of deterioration.

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Adjust the limits estimation of the dielectric steady edge sensibly, and after that the degree of lubricants decay can be assessed comprehensively. Determination of dielectric constant(X) based on the cylindrical type of sensor. The capacitor is partly immersed (along the vertical direction) in a liquid considering the effect of gravity. the parameters like Acid value, iron content, moisture content and density can be determined at that instant.

III. ARCHITECTURE AND METHODOLOGY

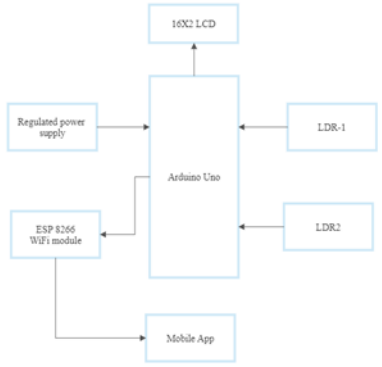

Fig 1: Architecture of Engine Oil Impurities and level Monitoring System.

A. System Architecture

Arduino is used to control the overall functioning of the system. LDR sensor which is used to take the transmittance readings of the engine oil. The ESP 8266 Wi-Fi module is connected to RX, TX pin of Arduino so that the Arduino can receive, transmit data to the mobile application. LCD display is used to show the transmittance and level of engine oil of the vehicle.

B. Methodology

The objective is to provide a portable and easy to use device for all people using vehicles which contain engine lubricating oil. For achieving this, the main proposal consists of using Arduino, LDR sensor and ESP-8266 module which is connected to an app in a mobile phone and displays the transmittance and the level of engine oil. This process is done with the help of LDR sensors placed axially across an LED. When the LED is turned on the light passes through the oil and the value is calculated relative to the value when it is newly used. The app displays the value of the two LDR sensors and the level of the oil. Our approach comprises a sequence of steps for preparing the model. The general training workflow can be seen in the Fig 1.

C. Implementation Steps

1. Connecting Arduino to Mobile applications

Mobile Telnet is the mobile application used to display the details of the status of quality and level of engine oil. First, we need to configure the mobile telnet to the IP address of Arduino by setting the remote host IP as 192.168.4.1 and port number 23 for ESP-8266 Wi-Fi module to connect as shown in Fig 2.

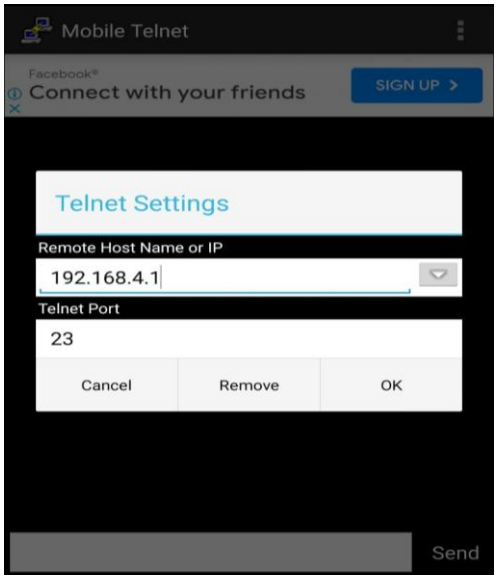

Fig 2: Telnet settings of Engine Oil Impurities and level Monitoring System

After configuring the telnet application we need to connect to the Wi-Fi of ESP 8266 Wi-Fi module. The Wi-Fi is shown in the Wi-Fi section of the mobile after connecting to the Wi-Fi in the mobile Telnet application we need to select connect option and a connection is established.

2. Output

As soon as the mobile application is connected the Arduino.

Fig 3: Displayed output of Engine Oil Impurities and level Monitoring System

Arduino starts calculating the transmittance values and level of the engine oil present in the reservoir. The values of the transmittance is just a relative index for comparison to see the degrading nature of the engine oil. The values are displayed on the LCD display and the same values are also shown on the Mobile Telnet application as sown in Fig. 3

IV. RESULT

The image of the prototype can be seen in the Fig 4. below. The setup includes two pairs of LED and LDR sensors placed axially cross so the flux values of the engine oil can be measured.

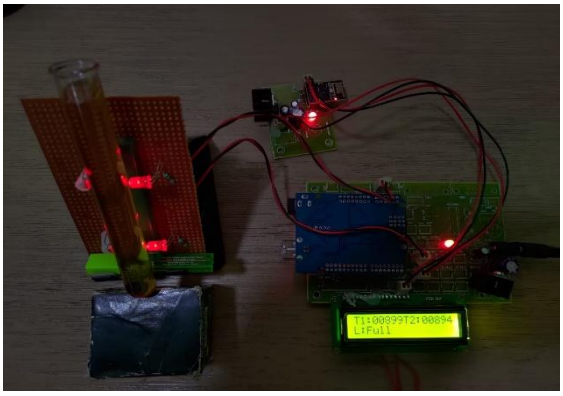

Fig 4: prototype of Engine Oil Impurities and level Monitoring System

The pair LDR sensors display their corresponding flux values of the light transmitted by the LED through the engine oil. The reason for two pair of sensors are to check for sludge in the engine oil which can be seen if there is a large difference in the values of the sensor reading. If the reading differs more than 50, we can conclude that there is sludge present in the engine oil and we need to change the oil. Experiments were conducted on variety of engine oils with respect to the kilometer's driven as seen in Fig.5. a sample was collected over some predefined distance travelled.

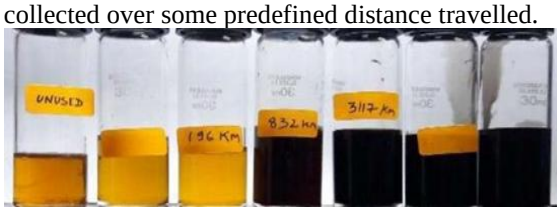

Fig 5: Various oil samples degraded over usage

As observed from the Fig.5 we can see a visible change in the color and transparency of the engine oil. We use the same property to check the quality of the engine oil.

Table- I: Amount of Light Passed Through the Engine oil

Distance travelled [KM]	Transmittance value obtained by the sensor		Difference signal (ref. – obt.)	Status of oil
	Reference band	Obtained band		
0	973	973	0	Good
100	973	946	27	Good
235	973	934	39	Good
820	973	254	719	Medium
3200	973	108	865	Degraded
4000	973	20	953	Degraded

The Table 1. Shows the results of the degrading rate of the engine oil as we can see that the flux of the engine oil at the starting of the experiment with 0 KM on it was 937 as the oil got used the value dropped down to 20. We can generalise that if the flux value goes below 200 the oil has completely degraded and the vehicle needs a oil change.

V. CONCLUSION

Since the global warming and pollution are increasing day by day this project helps in eliminating the unwanted and unnecessary oil change with the help of which the pollution caused by the used engine oil can be decreased. This project has demonstrated the efficiency and potential of using Spectroscopy Technology to improve the life of vehicle engine oil. The device used a cost-effective and reliable method to detect impurities and oil level. It can successfully send the measured value to a mobile application and display it on a smartphone. The instrument is working properly. The output resolution of the instrument is satisfactory and the data can be remotely accessed. It is very useful for static analysis. The designers have more control over different advanced applications with numerous advanced control methods. The recommended mapping method of the whole system is assessed on a small scale in this project. The field of "Spectroscopy Technology" that we have selected for our design is quite broad, and this technology has a very bright future. There are tremendous applications in which Spectroscopy Technology has been implemented or used. There is a lot of future scope for this design because of its easy of use. It can be used in many applications. This framework can be improved or changed in response to changing requirements. We have designed a prototype for engine oil qualitative analysis using LDR sensor. This system can calculate the transmittance values of the engine oil. The performance of this model can be enhanced in the future in many ways. I have just done a basic prototype of the system. The complete system can be made portable and more inclined towards the standards of the road transport authorities such as BS-6.etc. This instrument can be used for different grades of oil like vegetable, edible oil, reagent solution, organic solvent for their adulteration analysis.

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Availability of Data and Material/ Data Access Statement	Not relevant.
Authors Contributions	All authors having equal contribution for this article.

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AUTHORS PROFILE

Birali prashanthi was born on January 10, 1982, in Hyderabad, India. She holds a B.Tech degree in Computer Science and Engineering and an M.Tech degree in Computer Science. Currently, she is pursuing a Ph.D. in the field of Image Processing. Throughout her 15 years of experience, Birali prashanthi has served as an Assistant Professor at Mahatma Gandhi Institute of Technology (MGIT) in Hyderabad. She has a strong background in teaching various subjects such as C, C++, Data Structures, DAA, Unix & Shell Programming, JAVA, Operating Systems, PPL, Data Structures through C++, ADS & A, IRS, and ISMS for M.Tech (Computer Networks & Information Security). In addition to her teaching responsibilities, she actively engages in research, with several publications in international journals and conferences, focusing on efficient image retrieval, image annotation structures, and privacy in cloud outsourcing. Dr. Birali prashanthi is a life member of ISTE (Indian Society for Technical Education). She has contributed significantly to the departmental level at MGIT, serving as the Department Library In-charge, Mini Project Coordinator, Major Project Coordinator, Mentor for Infosys Inspire Program, Co-Convener for Qubit - CSE Technical Fest, and more. At the college level, she has been involved in various committees, such as the MGIT JHUB Member, Gender Sensitization Nodal Member, and Anti-Ragging Committee Member.

Komirishetty Saiteja was born in Hyderabad, India. he holds a B.Tech degree in Computer Science and Engineering at Mahatma Gandhi Institute of Technology, Hyderabad, India, with a CGPA of 7.7. Saiteja completed his Intermediate education at Narayana Junior College, Hyderabad, India, scoring 94.5%, and his SSC at Paramitha High School, Karimnagar, India, with a GPA of 9.3. Saiteja has undertaken several projects, including developing a snake game in Java, creating an IP Tracker using PHP and JavaScript, and building an Engine Oil Level and Impurities Monitoring System using Arduino and WiFi module. Additionally, he has participated in hackathons, contributing to the development of a tourism chatbot using IBM Watson Assistant.

Kakumani sravya was born in Kandukur, India. She holds a Bachelor of Technology degree in Computer Science Engineering from Mahatma Gandhi Institute of Technology, Hyderabad, India, with a CGPA of 7.5. Sravya completed her Intermediate education at Bhashyam IIT JEE Junior College, Guntur, India, scoring 10 CGPA and her SSC at Bhashyam blooms ,Guntur, India, with a CGPA of 10. Her expertise lies in programming languages like C, C++, Java and Python along with web development technologies like HTML, CSS, JavaScript, and PHP. Sravya has undertaken several projects including automatic door unlock with facial recognition, gesture recognition system for paralyzed patients and created a website for book donation. Additionally, she has participated in hackathon contributing to the development of a tourism chatbot using IBM Watson Assistant.