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Real-Time Engine Oil Monitoring System

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ABSTRACT –

IoT is a clever way to communicate in the present day and will have a big impact on the automotive sector in the future. The increasing times that call for a better human way of life may be linked to the development of IoT innovation in every industry. Its applications are many and extensive. Since car technicians in India continue to employ traditional methods of engine lubricant supervision, one potential application for the automotive sector may be to monitor the lubricant in real time. This research work presented a real-time Engine Oil Monitoring (EOM) system for engine lubricant diagnostics that is based on Internet of Things technology. This study paper's primary goal is to lessen the amount of labour required by humans and to offer the automotive industry a smart sensing method for monitoring engine oil conditions in real time. With the aid of NodeMCU, the EOM system's sensor devices—the pH sensor for engine oil level measurement, the float sensor for oil quality, and the temperature sensor for temperature—are created.

Keywords: IoT, Float Sensor, pH Sensor, Temperature Sensor, Turbidity Sensor.

Introduction :

A real-time engine oil monitoring system is a technology designed to continuously monitor the condition and performance of engine oil in vehicles or machinery. These systems typically utilize sensors and data processing algorithms to gather information about various parameters such as oil level, temperature, pressure, viscosity, and contamination. Engine oil monitoring systems play a crucial role in modern vehicle and machinery maintenance strategies, enabling proactive and data-driven approaches to ensure optimal performance and reliability. It is essential for maintaining the reliability, performance, and longevity of engines in various applications, from automotive vehicles to industrial machinery. By proactively managing engine oil condition, businesses can optimize operations, reduce downtime, and minimize maintenance costs while also promoting environmental responsibility and ensuring compliance with regulations.

Various sensors are installed within the engine or oil reservoir to monitor different aspects of the oil. These sensors could include level sensors, temperature sensors, pressure sensors, viscosity sensors, and even sensors to detect contaminants such as metal particles or water. In many cases, these monitoring systems are integrated with the vehicle or machinery's onboard diagnostics system. Some advanced systems may offer remote monitoring capabilities, allowing operators or fleet managers to access real-time oil condition data from anywhere via a connected dashboard or mobile application. This enables proactive maintenance planning and optimization of operational efficiency. This allows for seamless communication and coordination with other systems and alerts the operator or maintenance personnel of any issues. Based on the analysis, the system can provide real-time feedback on the condition of the engine oil. This could include alerts for low oil levels, abnormal temperatures or pressures, changes in viscosity, or the presence of contaminants. The system can also generate recommendations for maintenance actions based on the condition of the oil. This might include suggesting oil changes, filter replacements, or further diagnostics if potential issues are detected.

Benefits of a real-time engine oil monitoring system include:

- Early detection of potential issues, leading to reduced downtime and maintenance costs.
- Improved engine performance and longevity through timely maintenance interventions.
- Enhanced safety by preventing catastrophic failures due to oil-related issues.
- Better resource utilization by optimizing oil change intervals based on actual usage and condition rather than predetermined schedules.

2. Necessity for Engine Oil Monitoring System :

- **Optimal Engine Performance:** Engine oil plays a critical role in lubricating engine components, reducing friction, and dissipating heat. Monitoring the condition of the engine oil ensures that it maintains its lubricating properties, which is vital for optimal engine performance.

- **Prevention of Engine Damage:** Contaminated or degraded engine oil can lead to accelerated wear and tear on engine components, potentially causing significant damage or even engine failure. Regular monitoring helps identify issues such as contamination, degradation, or insufficient oil levels before they can cause damage.
- **Extended Engine Life:** By ensuring that the engine is always running with clean and properly lubricated oil, monitoring systems contribute to extending the life of the engine. Proper maintenance of engine oil can prevent premature wear of critical components, ultimately prolonging the engine's lifespan.
- **Fuel Efficiency:** Maintaining the right level and quality of engine oil can also contribute to improved fuel efficiency. Well-lubricated engines experience less friction, which translates to better fuel economy. Monitoring systems help ensure that the engine is operating with the right oil properties to maximize efficiency.
- **Environmental Impact:** Engine oil that becomes contaminated or reaches the end of its useful life can pose environmental risks if not properly managed. Monitoring systems help ensure that oil changes are performed at the right intervals, reducing the likelihood of oil leaks or spills that could harm the environment.
- **Cost Savings**: Regular monitoring and timely maintenance of engine oil can lead to cost savings in several ways. By preventing costly engine repairs or replacements due to oil-related issues, businesses can save on maintenance expenses. Additionally, optimizing oil change intervals based on actual condition rather than fixed schedules can reduce the overall cost of oil and filter replacements.
- **Compliance and Safety:** In many industries, compliance with regulations regarding equipment maintenance and safety standards is mandatory. Engine oil monitoring systems help ensure that vehicles and machinery meet these requirements by providing evidence of proper maintenance practices and early detection of potential safety hazards.

Methodology :

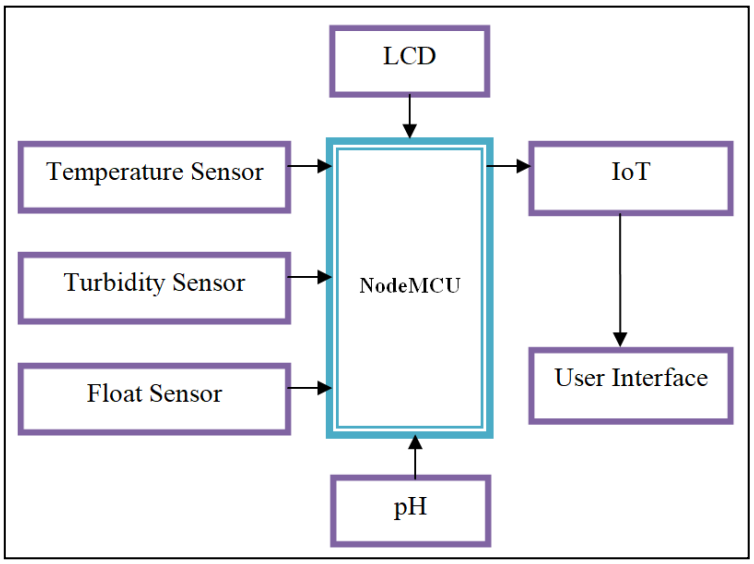

Figure 1 Block Diagram

NodeMCU

NodeMCU is a low-cost open source IoT platform. Its original hardware components were ESP-12 modules and firmware based on the ESP8266 Wi-Fi. Support for the 32-bit ESP32 MCU was added in subsequent versions. The NodeMCU Dev Kit/Board includes the ESP8266 WiFi chip. The TCP/IP protocol is used by Espressif Systems' low-cost ESP8266 Wi-Fi chip. To learn more about the ESP8266, use the WiFi Module. Using a NodeMCU for engine oil monitoring can be an effective and versatile solution, especially when combined with appropriate sensors and software. Use the NodeMCU to read data from the connected sensors at regular intervals. Ensure the NodeMCU and associated components are powered adequately, either through a USB connection, battery, or external power supply. Consider housing the NodeMCU and sensors in a suitable enclosure to protect them from environmental factors such as dust, moisture, and vibration. By utilizing a NodeMCU for engine oil monitoring, you can create a cost-effective, customizable, and scalable solution that provides real-time insights into the condition of the engine oil, helping to optimize maintenance schedules, prevent failures, and prolong the lifespan of the engine.

Temperature Sensor

Temperature sensors play a crucial role in engine oil monitoring systems, providing essential data for maintaining optimal engine performance, preventing damage due to overheating, and supporting predictive maintenance efforts. Temperature sensors for engine oil monitoring are crucial components in ensuring the proper functioning and longevity of an engine. These sensors measure the temperature of the engine oil, providing valuable data for engine management systems and allowing for timely interventions when needed. Temperature sensors provide real-time data on oil temperature to the engine control unit (ECU) or other engine management systems. This information allows the system to make adjustments such as controlling oil flow, adjusting fuel injection timing, or activating cooling systems to maintain optimal engine operating conditions. Engine oil temperature sensors can

trigger alerts or alarms if the oil temperature exceeds safe operating limits. This helps prevent potential damage to the engine due to overheating and allows for timely intervention or shutdown if necessary.

Turbidity Sensor

Using a turbidity sensor for engine oil monitoring can provide valuable insights into the cleanliness and quality of the oil. Turbidity sensors are commonly used in water quality monitoring to measure the cloudiness or turbidity of a liquid caused by suspended particles. While they are not traditionally used for engine oil monitoring, their principles can be adapted for this purpose. Connect the turbidity sensor to a microcontroller board. Calibrate the turbidity sensor to correlate its readings with the level of particulate matter or contaminants in the engine oil. This calibration process may involve using standard solutions with known turbidity levels to establish a calibration curve. Integrate the turbidity sensor data with Temperature sensors and monitoring systems used for engine oil monitoring. This comprehensive approach provides a more holistic view of the engine oil condition. Enclose the turbidity sensor and associated electronics in a suitable enclosure to protect them from environmental factors

Float Sensor

Float sensor for engine oil monitoring can provide a simple and effective method to track oil levels within an engine. By incorporating a float sensor into an engine oil monitoring system, can accurately track oil levels and ensure that the engine always has an adequate supply of oil for proper lubrication and performance. Integrate the float sensor data with temperature sensor and monitoring systems used for engine oil monitoring. This comprehensive approach provides a complete picture of the engine oil condition, including both oil level and other parameters such as temperature and viscosity.

pH Sensor

Monitoring the pH of engine oil can be a critical aspect of maintaining the health and performance of an engine. However, unlike monitoring the pH of aqueous solutions, measuring the pH of oil presents some challenges due to its non-aqueous nature and potential for contamination. The pH sensors typically utilize different types of electrodes compared to standard pH sensors used in aqueous solutions. It may use solid-state or ion-selective electrodes that are compatible with oil. Regularly monitor the pH of the engine oil and establish thresholds for acceptable pH levels. pH monitoring of engine oil can be integrated into the engine's overall monitoring and control system. It's worth noting that while monitoring the pH of engine oil can provide valuable insights into its condition.

LCD

LCD for engine oil monitoring can provide real-time feedback on various parameters related to the engine oil's condition. Determine oil level, temperature, pH and any other relevant factors of the engine oil want to monitor and display. Test the functionality of the LCD display system under various operating conditions to ensure accuracy and reliability. Calibrate sensors and verify the accuracy of displayed readings against known reference values. Implement procedures for maintaining and updating the LCD display system as needed. LCD display system for engine oil monitoring that provides valuable real-time feedback to operators, helping them monitor the condition of the engine oil and make informed maintenance decisions.

Result and Discussion

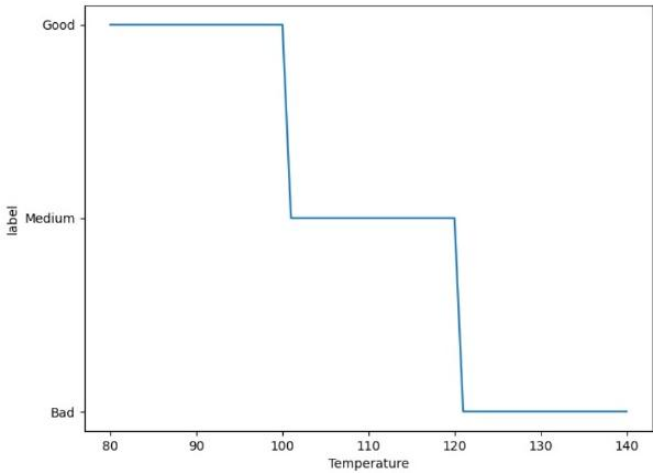

Figure 2 Condition-based on the Range Results Temperature Sensor

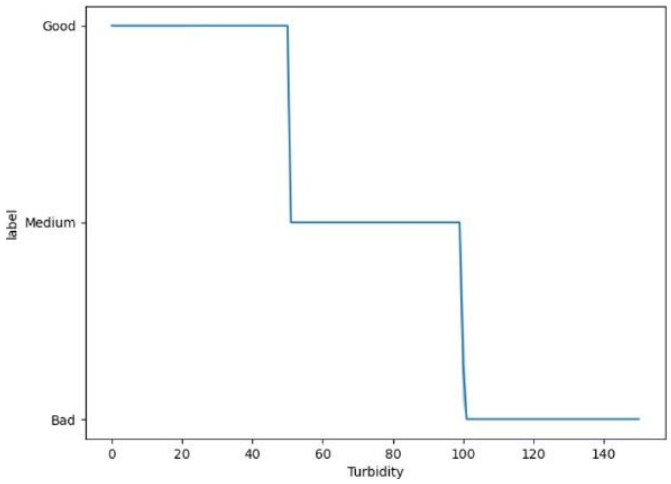

Figure 3 Turbidity Sensor

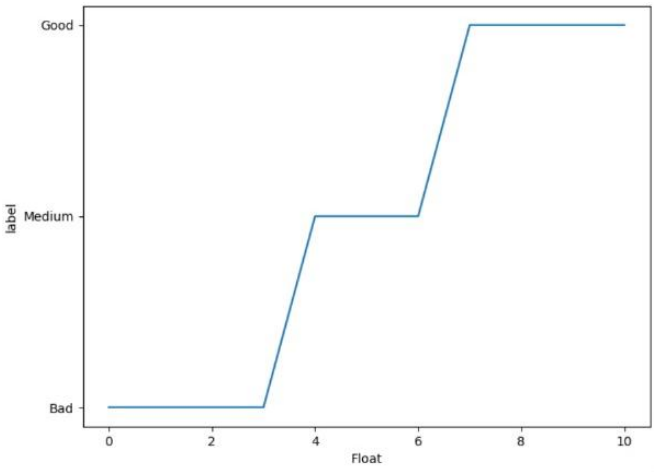

Figure 4 Float Sensor

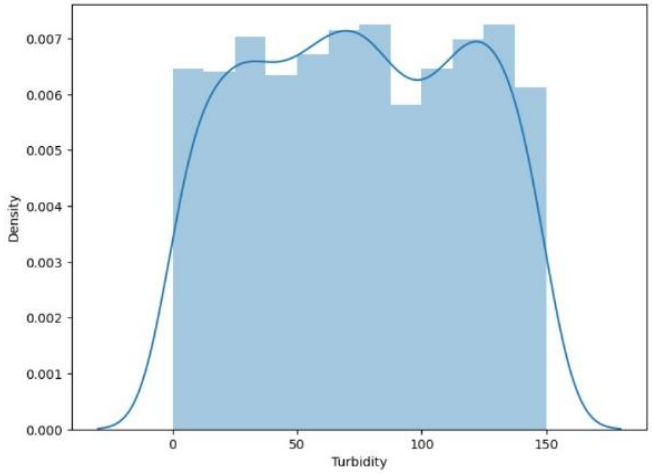

Figure 5 Turbidity sensor for engine oil density

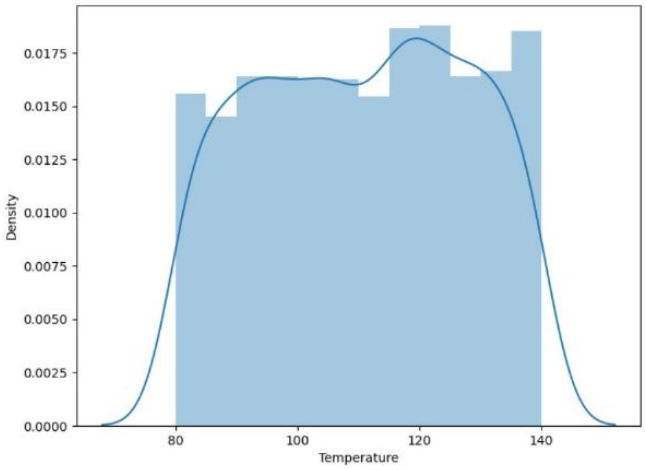

Figure 6 Temperature sensor for engine oil density

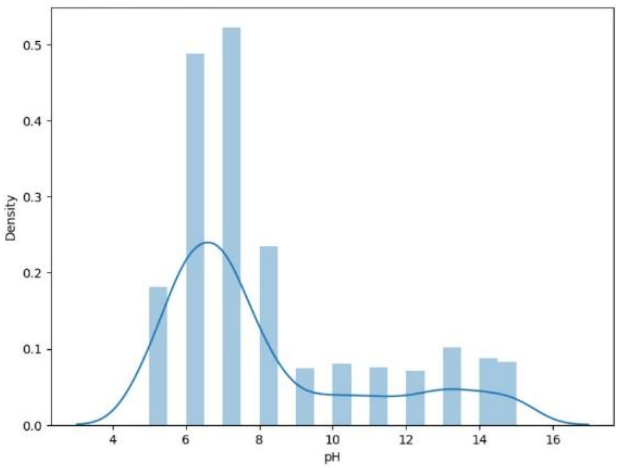

Figure 7 pH sensor for engine oil density

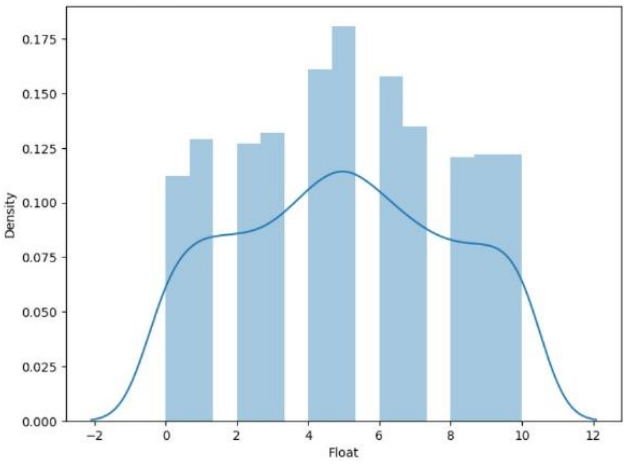

Figure 8 Float sensor for engine oil density

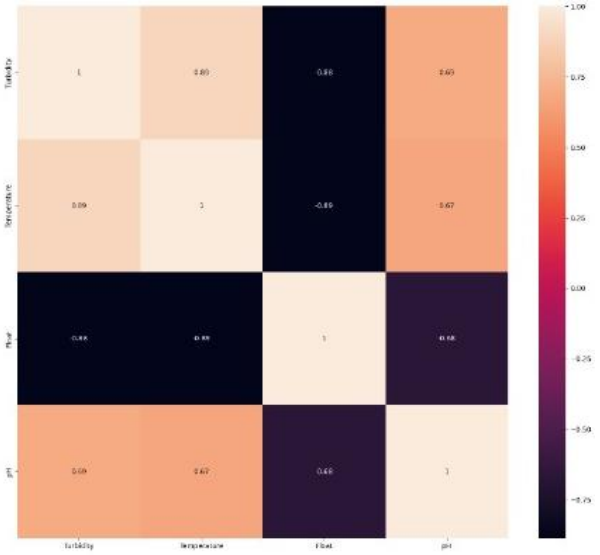

Figure 9 Heat map of engine performance analysis

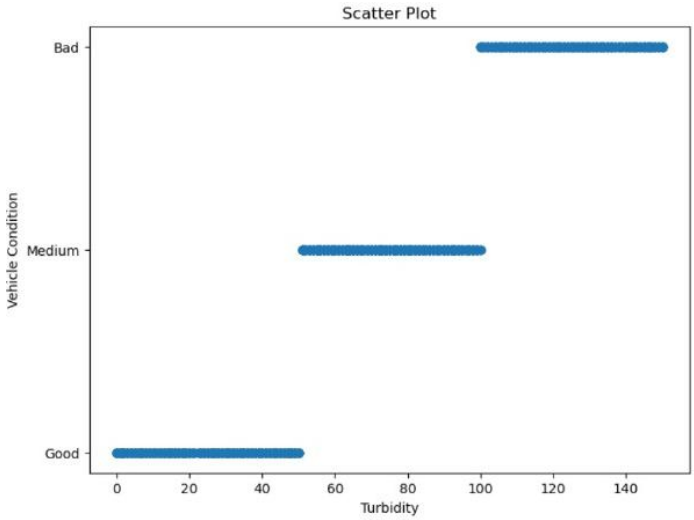

Figure 10 Turbidity sensor denotes vehicle condition

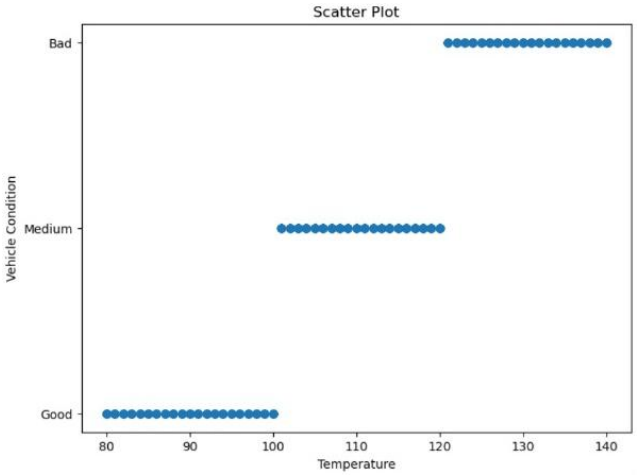

Figure 11 Temperature sensor denotes vehicle condition

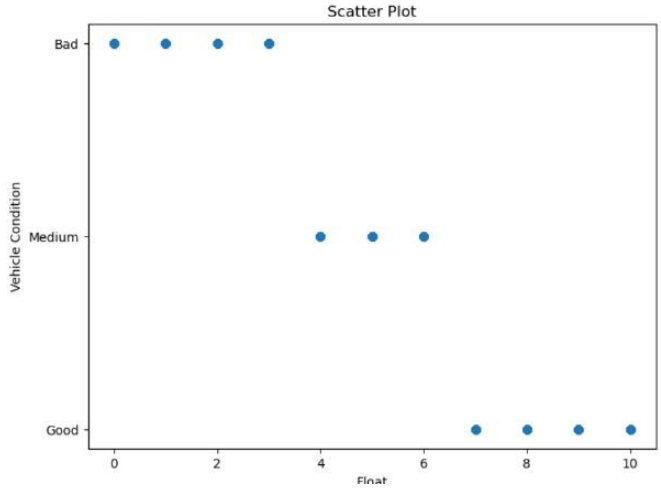

Figure 12 Float sensor denotes vehicle condition

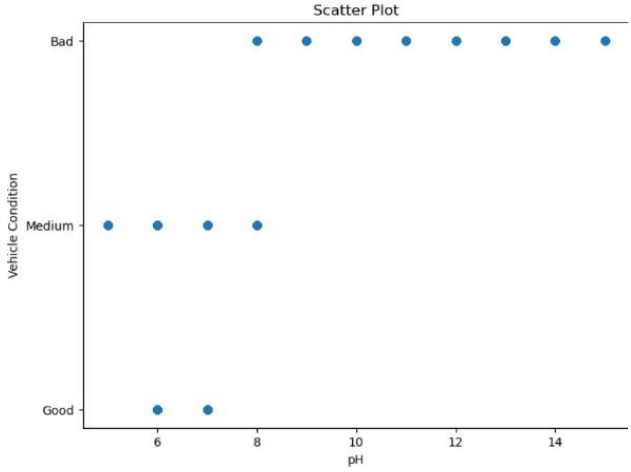

Figure 13 pH sensor denotes vehicle condition

5. Conclusion :

This study proposes a real-time engine oil monitoring (EOM) system for IoT-based engine oil diagnosis. The experimental results demonstrate the improved model efficiency when utilising a dependable and reasonably priced sensor device to determine the engine oil's condition and level based on

the distance travelled by vehicles. Additionally, the developed EOM system can effectively communicate the measured value via an IoT network and show it on a display unit for smart devices. Essentially, this initiative provides evidence of how technology can transform and improve our transportation experiences, guaranteeing that two-wheelers will continue to be essential for urban mobility while also becoming models of safety, efficiency, and environmental responsibility.

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