IoT Based Real-Time Monitoring System for Propeller Shaft in Vehicles Using Esp8266

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Abstract — The propeller shaft is an essential component in vehicles that transmits power from the engine to the differential and wheels. Failure of the propeller shaft due to excessive vibration, overheating, or abnormal rotational speed can lead to severe mechanical damage and safety issues. Traditional inspection methods are mostly manual and cannot provide continuous monitoring of the shaft condition. This research presents a real-time monitoring system for vehicle propeller shafts using IoT technology. The system employs sensors to monitor temperature, vibration, and rotational speed of the shaft. These sensors are interfaced with an ESP8266 NodeMCU microcontroller which processes the data and transmits it wirelessly through Wi-Fi to the Blynk IoT platform. The data can be monitored remotely using a smartphone application, allowing users to observe shaft conditions in real time. The proposed system also provides fault detection by identifying abnormal values in temperature, vibration, and speed. The developed system is cost-effective, reliable, and suitable for preventive maintenance in automotive systems.

Keywords: IoT, ESP8266, Propeller Shaft Monitoring, Vibration Sensor, RPM Sensor, Blynk IoT, Vehicle Safety.

I. INTRODUCTION

In modern automotive systems, the propeller shaft plays a crucial role in transferring torque from the engine to the wheels. The reliability and proper functioning of the propeller shaft are essential for efficient vehicle operation. However, continuous mechanical stress, misalignment, excessive load, and poor lubrication can cause faults such as vibration, overheating, and abnormal rotational speeds. If these faults are not detected early, they can result in severe mechanical failure and costly repairs.

Traditional methods for monitoring shaft conditions involve manual inspection and scheduled maintenance.

These approaches are time consuming and may fail to detect early-stage faults. With the advancement of Internet of Things (IoT) technology, it has become possible to develop smart monitoring systems capable of real-time data acquisition and remote monitoring.

This research proposes an IoT-based monitoring system for propeller shafts using sensors to measure temperature, vibration, and rotational speed. The data collected from the sensors is processed by the ESP8266 NodeMCU microcontroller and transmitted to a cloud platform using Wi-Fi connectivity. Users can monitor the system remotely using the Blynk IoT mobile application. The proposed system helps detect faults early and improves vehicle safety and maintenance efficiency.

II. SYSTEM OVERVIEW

The proposed system is designed to monitor the condition of a propeller shaft in real time using sensor-based monitoring and IoT communication. The system consists of three primary sensors: a temperature sensor, a vibration sensor, and an RPM sensor.

The temperature sensor measures the temperature of the propeller shaft to detect overheating conditions. The vibration sensor detects abnormal vibrations which may indicate misalignment, imbalance, or mechanical wear.

The RPM sensor measures the rotational speed of the shaft to monitor performance and detect overspeed conditions.

All sensor data is collected by the ESP8266 NodeMCU microcontroller, which processes the data and sends it via Wi-Fi to the Blynk IoT platform. The system also includes an LCD display for local monitoring of sensor readings. The power supply for the system is provided by a 12V adapter, which is converted to the required voltage using a buck converter module.

III. METHODOLOGY

The proposed monitoring system follows a structured methodology to detect faults in the propeller shaft.

Initially, the system is powered using a 12V DC power supply. A buck converter is used to regulate the voltage to a suitable level for the microcontroller and sensors. The sensors are mounted near the propeller shaft to measure temperature, vibration, and rotational speed.

The ESP8266 microcontroller reads the sensor values at regular intervals. The collected data is analyzed using predefined threshold values to identify abnormal conditions. For example, if the temperature exceeds a safe limit, it indicates overheating. Similarly, excessive vibration may indicate imbalance or mechanical wear, while high RPM values may indicate overspeed conditions.

After processing the sensor data, the microcontroller sends the information through Wi-Fi to the Blynk IoT cloud server. The data can be viewed in real time using a smartphone application. This enables remote monitoring and early detection of faults.

IV. BLOCK DIAGRAM AND EXPLANATION

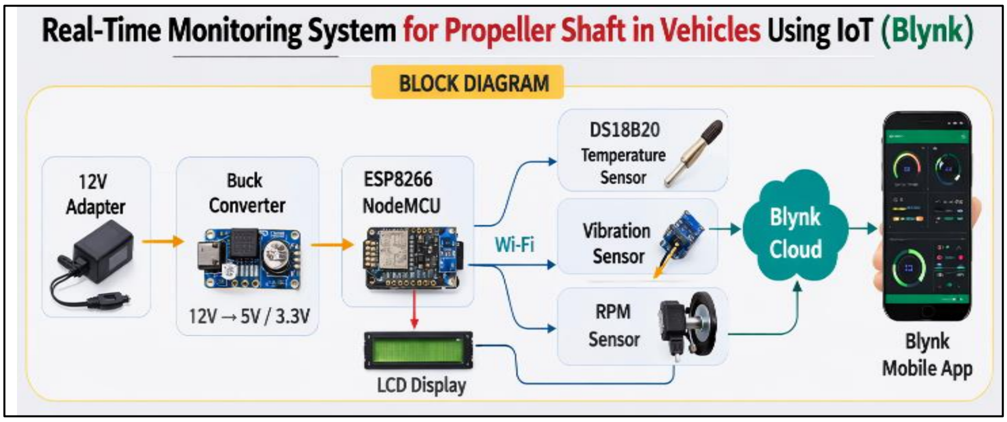

Fig. 1: Block Diagram

The block diagram of the system illustrates the relationship between the power supply, sensors, microcontroller, and IoT communication.

The system starts with a 12V power supply which provides energy to the entire circuit. The buck converter module steps down the voltage to 5V or 3.3V depending on the requirement of the components.

The ESP8266 NodeMCU acts as the main controller that receives input from the temperature sensor, vibration sensor, and RPM sensor. These sensors continuously collect data related to the propeller shaft condition.

The processed data is displayed locally on the LCD display for quick observation. Simultaneously, the ESP8266 uses its built-in Wi-Fi capability to transmit the data to the Blynk IoT cloud platform. The user can monitor the readings using a smartphone application connected to the internet.

V. CIRCUIT DIAGRAM

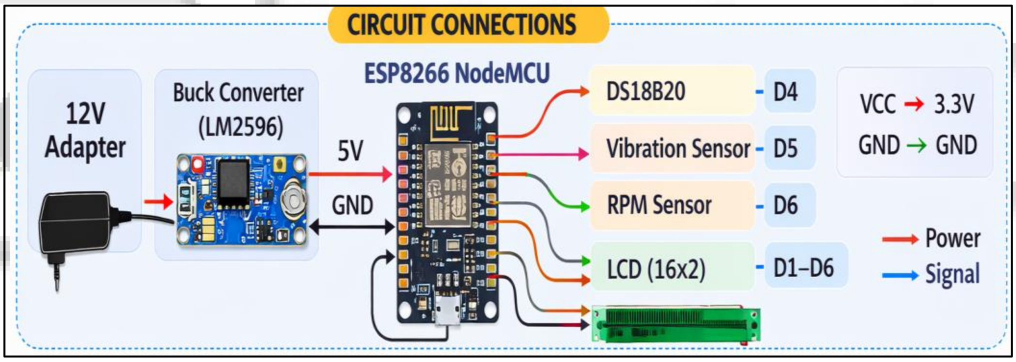

Fig. 2: Circuit diagram

The circuit diagram represents the electrical connections between the components used in the system.

The 12V power supply is connected to the input of the buck converter module. The output of the buck converter provides regulated voltage to the ESP8266 NodeMCU and other sensors. The temperature sensor (DS18B20) is connected to one of the digital pins of the ESP8266, along with a pull-up resistor for proper communication.

The vibration sensor output pin is connected to another digital input pin of the microcontroller to detect vibration signals. The RPM sensor is connected to a digital interrupt pin of the ESP8266 to measure rotational speed accurately.

The LCD display is connected to the GPIO pins of the microcontroller for displaying real-time sensor readings. Proper grounding is maintained across all components to ensure stable operation.

VI. Results and Discussion

A. Result:

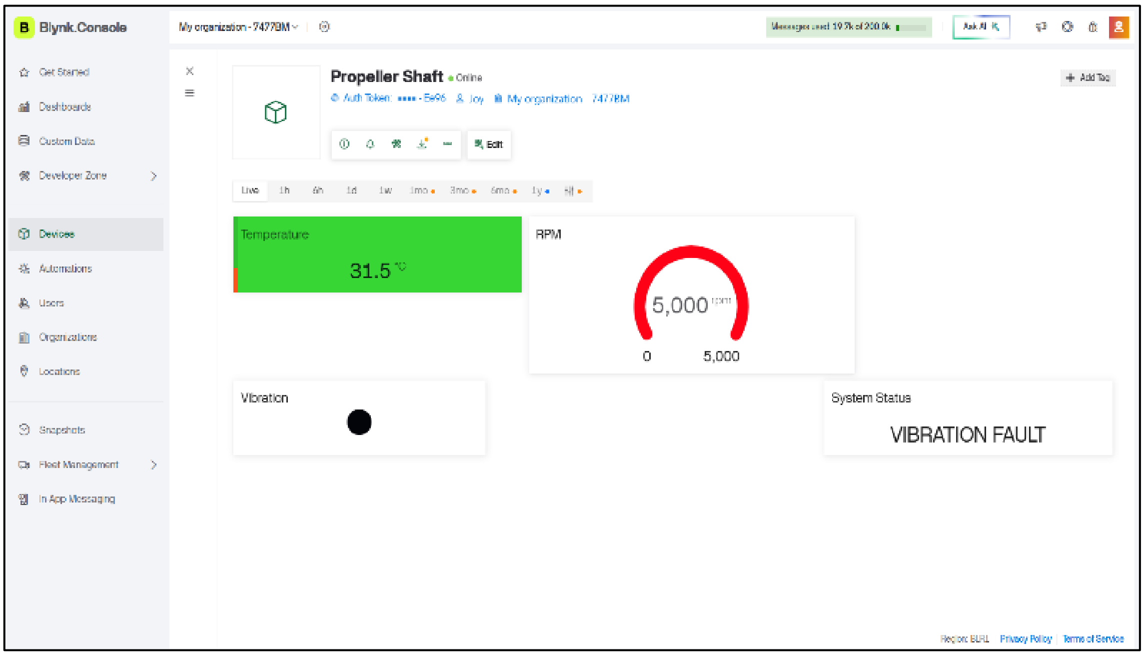

Fig. 3: Vibration Fault

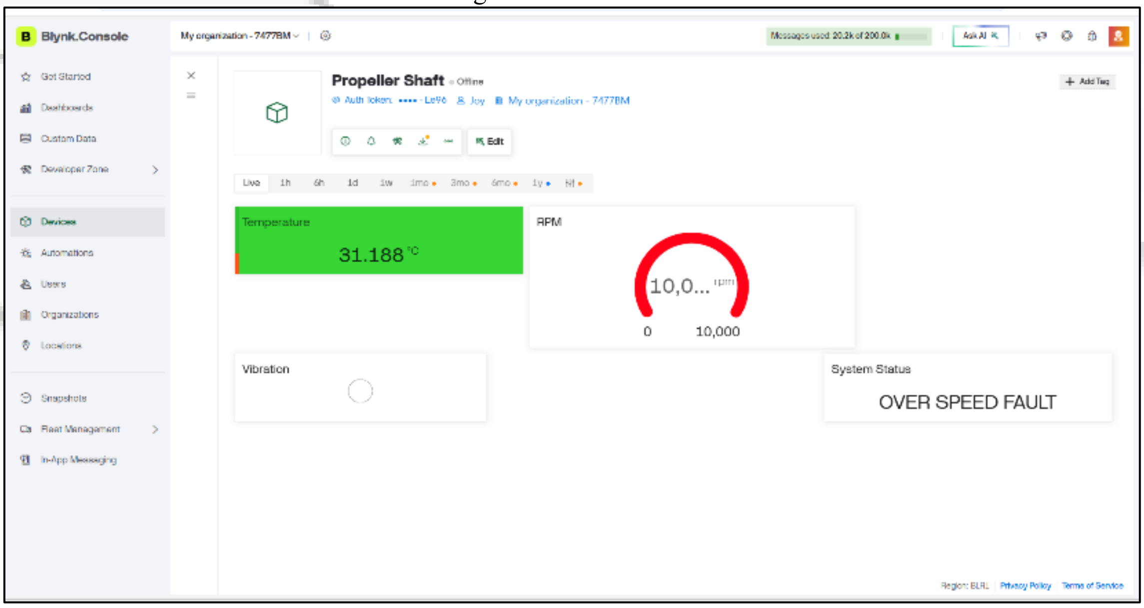

Fig. 4: Overspeed Fault

The developed prototype was tested using the Blynk IoT dashboard to verify real-time monitoring and fault detection performance. The dashboard displayed live values of temperature, RPM, vibration status, and overall system condition. The obtained results confirmed that the proposed system was able to identify abnormal operating conditions and provide immediate fault indication.

1) Vibration Fault Detection

In the first test condition, the Blynk dashboard displayed a temperature reading of approximately 31.5°C and an RPM value of 5000 rpm. The vibration indicator detected abnormal shaft vibration, and the system status showed “VIBRATION FAULT.” This result indicates that the system can successfully monitor vibration changes in the propeller shaft and generate an alert when the vibration level exceeds the permissible condition. The result demonstrates the effectiveness of the vibration sensing and fault identification mechanism.

2) Overspeed Fault Detection

In the second test condition, the dashboard displayed a temperature reading of 31.188°C and an RPM value close to 10,000 rpm. Under this operating condition, the system status changed to “OVER SPEED FAULT.” This confirms that the proposed prototype can identify excessive rotational speed of the propeller shaft and provide an immediate warning through the IoT dashboard. The result validates the RPM monitoring capability of the system and its usefulness in preventing unsafe operating conditions.

Overall, both test results confirm that the proposed IoT-based monitoring system can continuously observe key shaft parameters and detect major fault conditions such as abnormal vibration and overspeed in real time.

VII. Advantages

The proposed monitoring system offers several advantages:

- Real-time monitoring of propeller shaft conditions
- Early detection of mechanical faults
- Remote monitoring through IoT platform
- Low cost and easy implementation
- Improved vehicle safety and maintenance planning
- Compact and efficient system design

VIII. Limitations

Despite its advantages, the system has some limitations.

The system requires a stable Wi-Fi connection for remote monitoring. Sensor accuracy may vary depending on installation conditions. The prototype system has been tested on a model setup rather than a full-scale vehicle environment. Environmental factors such as dust, temperature variation, and mechanical shocks may affect sensor performance.

IX. Hardware Components List

1) ESP8266 NodeMCU — controls the whole system
2) DS18B20 Temperature Sensor — measures temperature
3) Vibration Sensor Module — detects vibration
4) RPM Sensor — measures shaft speed
5) Buck Converter (LM2596) — reduces 12V to required voltage
6) LCD Display (16x2) — shows readings
7) 12V Adapter — supplies power
8) Connecting Wires — connect all components

X. Future scope

The proposed system can be further improved by integrating advanced technologies. Artificial intelligence and machine learning algorithms can be used to predict faults before they occur. Additional sensors such as load sensors and acoustic sensors can also be integrated to enhance monitoring accuracy.

The system can be extended to heavy vehicles, industrial machinery, and railway systems. Cloud data storage and analysis can provide long-term performance monitoring and predictive maintenance capabilities.

XI. Conclusion

This research presents a real-time monitoring system for vehicle propeller shafts using IoT technology. The system successfully integrates temperature, vibration, and RPM sensors with an ESP8266 NodeMCU microcontroller to monitor shaft conditions continuously. The data collected from the sensors is transmitted to the Blynk IoT platform for remote monitoring using a smartphone.

The proposed system provides an effective solution for early fault detection and preventive maintenance. The implementation is cost-effective, easy to deploy, and suitable for automotive applications. The system has the potential to improve vehicle safety and reduce maintenance costs.

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