International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 10 | Oct - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

IOT-Based Industrial Machine Health Monitoring & Predictive Maintenance System

Mr.Karande.R.G ,Mr.More.P.S,Mr.Agarkar.O.C,Mr.Gund.J.D,Mr.Waghmode.M.N

E&TC Dept. JSPM'S BSP | E&TC Dept. JSPM'S BSP | E&TC Dept. JSPM'S BSP | E&TC Dept. JSPM'S BSP | E&TC Dept. JSPM'S BSP

Abstract-

Industrial machines may develop faults because of excessive vibration, abnormal temperature, or unexpected operating conditions. If these signs are not noticed early, machine breakdown can cause production delays, maintenance costs, and safety risks. This paper propose an Internet of Things (IOT)-based system for monitoring machine health and supporting predictive maintenance. An ESP32 microcontroller is planned as the main controller. Sensors such as vibration/motion sensor and a temperature sensor can collect operating data, which the ESP32 processes and sends to a mobile-friendly dashboard over Wi-Fi. The dashboard can display live readings and indicate abnormal conditions using configurable thresholds. The proposed system aims to provide an affordable learning prototype for small industrial machines. The prototype's final performance must be verified through practical testing; this draft does not claim measured results that have not yet been collected.

Key Words: Internet of Things (IOT), ESP32, machine health monitoring, predictive maintenance, vibration monitoring, temperature monitoring, industrial automation.

1. INTRODUCTION

The Internet of Things (IOT) is an emerging technology that enables physical devices to collect, exchange, and transmit data through the internet. In modern industries, monitoring the health and performance of machines is essential for improving productivity, reducing operational cost, and ensuring workplace safety. Traditional machine maintenance method often rely on periodic inspections or corrective actions after a machine failures occurs. These approaches may result in unexpected breakdown, production delays, and increased maintenance expenses.

The proposed system, titled **"Iot-Based Industrial Machine Health Monitoring And Predictive Maintenance,"** aims to monitor the operating conditions of industrial machines using sensors and an ESP32 microcontroller. The sensors collect machine-related parameters such as vibration, temperature, and other relevant operating data. The ESP32 processes the collected data and transmits it to an IOT-based monitoring platform, allowing users to observe machine conditions through a mobile phone or web dashboard.

The system can help identify abnormal operating conditions by monitoring sensor readings and comparing them with predefined threshold values. When abnormal conditions are detected, the system can generate alerts to inform the users about potential machine faults. This approach supports early fault detection and helps maintenance personnel take appropriate action before a minor issue develops into a major failure.

The main objectives of this project is to develop a cost-effective, reliable, and user-friendly machine monitoring system that improves

equipment availability and supports predictive maintenance. By integrating IOT technology with real-time sensor monitoring, the proposed system has the potential to reduce unexpected downtime, improve maintenance planning, and increase the overall efficiency of industrial operations.

2. PROBLEM STATEMENT

Small workshops and educational laboratories may not have access to expensive industrial condition-monitoring systems. Without continuous observation, abnormal vibration or temperature may go unnoticed until a machine performs poorly or stops. A low-cost, easy-to-understand system is therefore proposed to monitor selected machine parameters and provide a clear indication when readings exceed defined limits.

3. OBJECTIVES

- To design a low-cost IoT based machine health monitoring prototype.
- To use the ESP32 as the controller for acquiring and processing sensor readings.
- To transmit readings through Wi-Fi to a mobile-friendly dashboard.
- To identified potentially abnormal conditions using configurable threshold values.
- To explore how continuous monitoring can support timely inspection and maintenance.

4. SYSTEM ARCHITECTURE

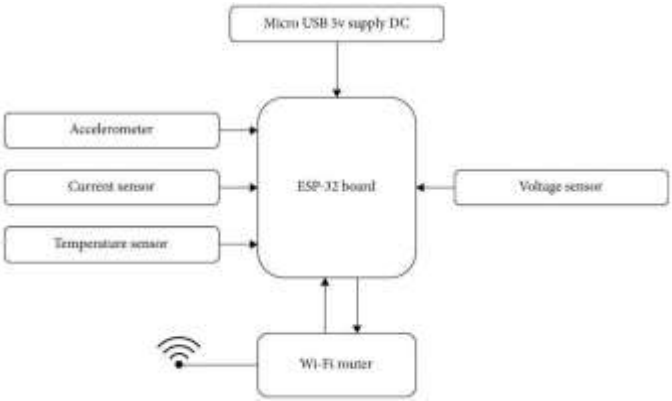


Fig. Block diagram of IoT-based industrial machine health monitoring & predictive maintenance system.

The Micro USB 5V DC power supply provides the required power to the ESP32 development board. The board regulates the input voltage to operate its internal circuits. The Accelerometer measures the vibration and movement of the industrial machine. Abnormal vibration may indicate mechanical faults, imbalance, or bearing problems. The temperature sensor measures the operating temperature of the machine. A sudden rise in temperature may indicate overheating or a possible machine fault. The voltage sensor measures the supply voltage of the machine. It helps identify abnormal voltage conditions that may affect machine performance. The ESP32 is the main controller of the system. It receives data from all the connected sensors, processes the collected information, and transmits the machine health data through Wi-Fi to a monitoring dashboard. The Wi-Fi router provides wireless network connectivity between the ESP32 and the monitoring dashboard. The collected senor data can be displayed on a mobile phone or computer through a suitable dashboard.

5. HARDWARE COMPONENTS

- **ESP32 Development Board:** It acts as the main controller and processes sensor data. It also provides Wi-Fi connectivity for remote monitoring.
- **MPU6050 Accelerometer Sensor:** It measures machine vibration and movement to identify abnormal operating conditions.
- **Current Sensor (INA219):** It measures the electrical current consumed by the machine.
- **Temperature Sensor (DHT11):** It measures temperature for monitoring the machine's operating conditions. For direct motor or machine surface temperature measurement, a suitable contact temperature sensor may be more appropriate.
- **Voltage sensor:** It measures the voltage supplied to the machine or motor.
- **DC Motor:** It represents the industrial machine in the prototype and helps demonstrate vibration, current, and temperature monitoring.
- **Wi-Fi Router:** It provides network connectivity for transmitting sensor data to the monitoring dashboard.

6. COMPONENTS:

6.1 HARDWARE COMPONENTS

ESP32

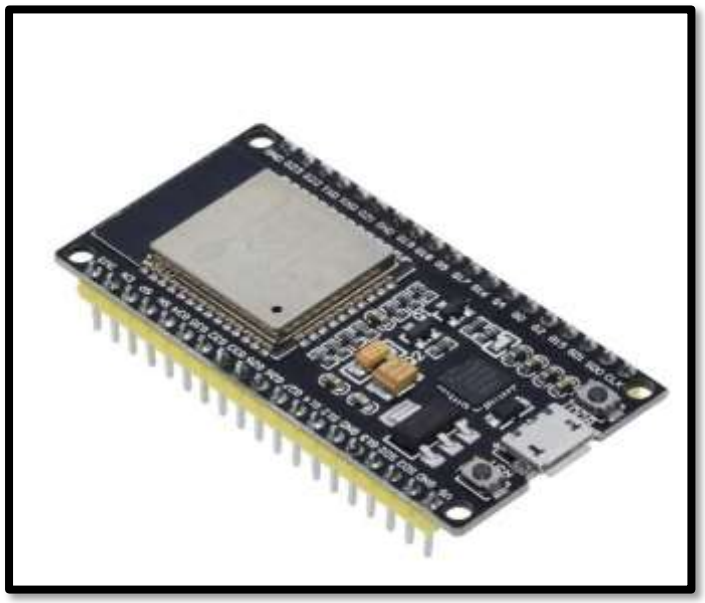


Fig.ESP32

ESP32 is a low-cost microcontroller with built in Wi-Fi and Bluetooth. It is used to connect sensor, collect data, and control electronic devices in this project it processes the data, and transmits it to an IoT dashboard for real-time operating.

MPU6050

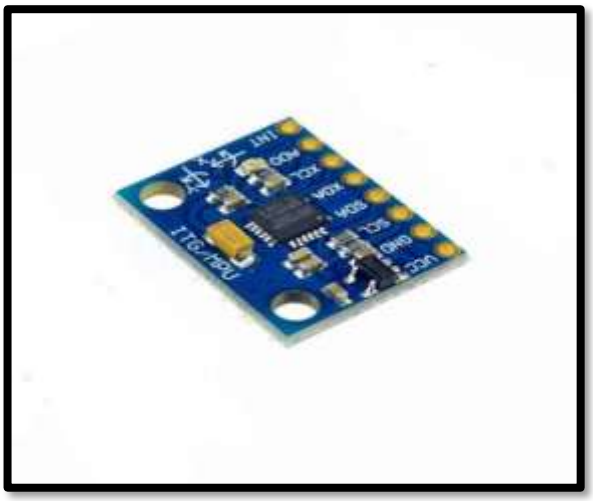
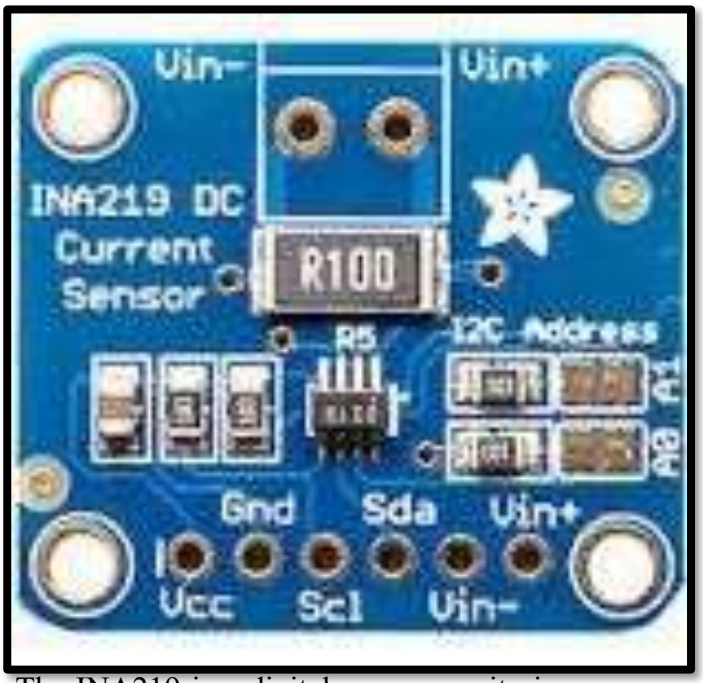


Fig.MPU6050

The MPU6050 is a six-axis motion sensor that consists of a three-axis accelerometer and a three-axis gyroscope. It measures acceleration and angular motion, helping detect abnormal vibration and movement in industrial machines.

INA219



The INA219 is a digital power monitoring sensor used to measure current, voltage, and power consumption. It helps monitor the electrical performance of the machine and identify unusual changes in power consumption.

DHT11



The DHT11 is a digital sensor used to measure temperature and relative humidity. In this

project, it can monitor the surrounding environmental conditions near the industrial machine.

6.2 SOFTWARE COMPONENTS

1. ARDUINO IDE

Arduino IDE is a software development environment used to write, compile, and upload programmes to the ESP32 development board.

2. Embedded c/c++

Embedded c/c++ is used to develop the programs that reads sensor values, processes data, and controls communication between the ESP32 microcontroller.

3. Sensor libraries

Sensor libraries simplify communication with the MPU6050, INA219, and DHT11 sensors.They help obtain sensor readings and process the collected data.

4. BLYNK IOT PLATFORM

Blynk is an IoT platform that can display live readings on a mobile dashboard. It can be configured to show temperature, vibration, voltage, and other available measurements.

7. WORKING PRINCIPLE

The system uses an ESP32 microcontroller to collect from different sensors connected to a DC motor, which acts as a model of an industrial machine.

The MPU6050 accelerometer sensor measures the vibration and acceleration of the motor. Abnormal vibration may indicate mechanical problems such as imbalance or misalignment.

The DHT11 sensor measures the surrounding temperature and humidity near the motor. These readings help monitor environmental conditions during operation.

The INA219 sensor measures electrical current and voltage to monitor the motor's electrical performance. A separate voltage sensor module can be used to measure the supply voltage when required.

The ESP32 uses its built-in-Wi-Fi capability to transmit the collected sensor data to an IoT platform such as Blynk.

The ESP32 receives sensor readings, processes the data, and compares the measured values with predefined threshold limits. If any parameter exceeds its specified limit, the system can identify a possible abnormal operating condition.

The ESP32 uses its built-in-Wi-Fi capability to transmit thee collected sensor data to an IoT platform such as Blynk.

The sensor readings are displayed on a module dashboard, allowing the user to monitor the machine's operating conditions remotely.

When abnormal readings are detected, the system can generate an alert to inform the user that the machine requires inspection or maintenance.

8. IMPLEMENTATION METHODOLOGY

The proposed system is implemented using an ESP32 microcontroller and various sensors. The MPU6050 measures machine vibration, the INA219 monitors current and voltage, and the DHT11 measures temperature and humidity.
The ESP32 collects and processes the sensor data and transmits it to IoT platform such as Blynk through Wi-Fi. The sensor readings are displayed on a mobile dashboard for real-time monitoring. Predefined threshold limits are used to detect abnormal operating conditions and generate alerts for timely maintenance.
The system helps improve machine monitoring and reduce the risk of unexpected failures.

9. TESTING AND EVALUATION

The system is tested by operating the DC motor and monitoring sensor readings. The MPU6050 measures vibration, the INA219 monitors current and voltage, and the DHT11 measures temperature and humidity. The ESP32 transmits the collected data to the IoT dashboard through Wi-Fi.

The system is evaluated based on sensor readings, data transmission, real-time monitoring, and threshold-based fault alerts. This testing help verify the systems ability to identify abnormal operating conditions and support predictive maintenance.

10. APPLICATIONS

- Monitoring the health and operating conditions of industrial machines.
- Detecting abnormal vibration and electrical conditions in machines.
- Monitoring motor temperature, vibration, current, and voltage.
- Monitoring machine parameters through a mobile dashboard using IoT.
- Reducing unexpected breakdowns and supporting timely maintenance.

11. ADVANTAGES

- Monitors machine health continuously.
- Helps identify abnormal machine conditions.
- Helps prevent unexpected machine breakdowns.
- Allows users to monitor sensor readings through a mobile dashboard.
- Uses affordable sensors and an ESP32 microcontroller.
- Supports better machine performance and maintenance planning.
- Transmits sensor data using Wi-Fi.

12. LIMITATIONS AND FUTURE SCOPE

The system depends on Wi-Fi connectivity for remote monitoring and requires a continuous power supply. Sensor accuracy may vary with environmental conditions, and fault detection depends on predefined threshold valued.

In the future, the system can be enhanced using artificial intelligence for accurate fault prediction, cloud storage for data analysis, and mobile alerts for abnormal conditions. It can also be expected to monitor multiple industrial machines and support automatic machine shutdown during critical faults.

13. CONCLUSION

The IoT-based industrial machine health monitoring and a predictive maintenance system enables real-time monitoring of machine vibration, temperature, current, and voltage. Using the ESP32 and IoT technology,

sensor data can be displayed on a mobile dashboard. The system helps detect abnormal operating conditions, reduces unexpected machine failures, and support timely maintenance, it provides a cost-effective solution for improving industrial machine reliability and efficiency.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to our project guide, Head of Department, and all faculty members for their valuable guidance and support in completing our project, **"IoT-based industrial machine health monitoring and predictive maintenance system."**

REFERENCES

[1] "IOT-Based Industrial Equipment Monitoring System: Revolutionizing Maintenance through smart data analytics," *ResearchGate*, Aug 2026.

[2] "IOT-Based health monitoring and fault detection of industrial AC induction motor for efficient predictive maintenance," *ResearchGate* paper, May 2026.

[3] "IOT-Based Real-Time vibration and temperature monitoring system for industrial machinery using ESP32 and MQTT," *ResearchGate* Research, 2026

[4] "IOT-Based predictive maintenance in industrial machinery," *ResearchGate*, July 2025

[5] "AI-Driven Predictive Maintenance in Industrial IoTs: A Comprehensive Survey," IEEE Internet of things Journal, vol. 13, Issue 10,2026.

BIOGRAPHIES

	Mr. Karande.R.G student of department of electronics and telecommunication engineering at Bhivrabai Sawant Polytechnic, Wagholi, Pune
	Mr. Agarkar.O.C student of department of electronics and telecommunication engineering at Bhivrabai Sawant Polytechnic, Wagholi, Pune
	Mr. Gund.J.D student of department of electronics and telecommunication engineering at Bhivrabai Sawant Polytechnic, Wagholi, Pune
	Mr. More.P.S student of department of electronics and telecommunication engineering at Bhivrabai Sawant Polytechnic, Wagholi, Pune
	Mr. Waghmode.M.N Lecturer of department of electronics and telecommunication engineering at Bhivrabai Sawant Polytechnic, Wagholi, Pune