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Industrial Fault Detection and Monitoring System Based on Internet of Things

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ABSTRACT

Industrial machines are used in manufacturing plants, workshops, processing units and many other working environments. During operation a machine may develop a problem because of excess vibration, a rise in temperature an unusual change in electrical current or an abnormal voltage condition. If these changes are not noticed in time they may lead to machine stoppage, repair costs, production delays and possible safety concerns. This paper presents a proposed Industrial Fault Detection and Monitoring System that uses an ESP32 microcontroller and a group of sensors to observe selected operating conditions. An MPU6050 sensor is proposed for measuring acceleration related to vibration an ACS712 module for measurement a DS18B20 sensor for temperature measurement and a ZMPT101B module for voltage sensing. The ESP32 reads the sensor values checks them against limits selected for the test equipment and can send readings or warning messages through wireless network connectivity to a monitoring dashboard or connected device. The paper introduces the project reviews related research on maintenance describes the block diagram and explains the proposed system in simple terms. The design is intended as a prototype and a starting point for condition monitoring. Its usefulness must be established through construction, sensor calibration, controlled testing and recording of actual results. Since experimental measurements are not available in this draft no detection accuracy or performance improvement is claimed.

1. INTRODUCTION

Industrial machines play a role in production and manufacturing. Motors, pumps, fans, conveyors and other equipment are expected to operate reliably. However components can wear out electrical connections can become loose bearings can develop problems and operating conditions can change over time. These problems may first appear as changes in vibration, temperature, current or voltage. If such changes are not observed a minor issue can become a fault and interrupt the work of a machine or production line.

In settings machine condition is checked during planned maintenance or after an operator notices a problem. Planned maintenance is useful. It may not show every developing issue between inspections. Continuous condition monitoring provides another option. Sensors collect information while equipment is operating and a controller checks whether the measurements remain within a range. This information can help an operator decide when a closer inspection may be required. Condition monitoring does not remove the need for maintenance workers but it can provide additional information to support their decisions.

The wider use of devices has increased interest in the Internet of Things (IoT) where sensors and electronic controllers collect and exchange information over a network. In applications connected monitoring can make equipment readings available at a display or remote dashboard. Predictive maintenance research also explores how collected data may be used to identify patterns that appear before equipment failure. The quality of this approach depends on sensor selection, installation, data quality, suitable limits and careful testing.

The project described in this paper proposes a system built around an ESP32 microcontroller. Four measurements are considered: vibration-related acceleration, electrical current, temperature and voltage. These measurements are useful because they describe aspects of machine operation. A change in any measurement does not always prove that a fault has occurred so the readings must be interpreted according to the machine, sensor location and operating conditions. Looking at measurements together may provide a more useful picture than relying on only one parameter.

The main purpose of the project is to develop and demonstrate a low-cost prototype that reads sensor values checks them against selected limits and provides a warning when a value moves outside the chosen range. A wireless connection can be used to display readings on a monitoring interface. The initial design uses threshold-based checking because it is understandable practical for a student prototype and easier to test than a prediction model. Advanced methods may be added later if enough verified measurements are collected.

The proposed system is not intended to replace certified industrial protection equipment, safety interlocks or professional inspection. Electrical measurements around equipment can be dangerous especially where mains voltage is involved. Any practical build must use rated modules, proper isolation, suitable fuses and enclosures and supervision from a qualified person. The system should first be tested on a demonstration setup before any consideration of industrial use.

2. LITERATURE SURVEY AND BLOCK DIAGRAM

Research on maintenance has grown as industries have adopted connected sensors and data-based monitoring. Zonta and co-authors presented a review of predictive maintenance in Industry 4.0 [1]. Their work discusses how connected technologies and data analysis can support maintenance planning. This research provides a reason for collecting equipment-condition information instead of depending only on occasional inspection. It also shows that monitoring technology must be connected to a maintenance purpose to be useful in practice.

Dalzochio and co-authors reviewed machine learning and reasoning methods for maintenance in Industry 4.0 [2]. Their work considers the state of these methods and the challenges involved in using them in practical environments. A system may collect amounts of data but the data must still be reliable and relevant to the condition being studied. The system must also produce information that maintenance staff can understand and use. These points are important for a student project because the quality of the sensors and the testing procedure may matter much as the controller itself.

A review presented at the 2023 International Conference on Smart Systems and Advanced Applications discusses machine-learning methods for maintenance in smart manufacturing [4]. This work supports the view that smart manufacturing combines sensing, data processing and connected technologies. At the time an embedded monitoring project still needs to address practical matters such as sensor placement, electrical noise, communication loss, calibration and the way alerts are presented to the user.

The reviewed literature supports four ideas for the present project. First machine condition should be observed using measurements that're relevant to the equipment. Second the readings should be. Checked consistently. Third abnormal conditions should be reported in a way that's understandable to the operator. Fourth claims about detection performance should be based on measured results than assumptions. The proposed project follows these ideas by using sensors, an embedded controller, threshold checks and wireless reporting. It does not claim to implement a validated model or to guarantee that every fault will be detected.

Figure 1 shows the functional blocks of the proposed system. The power supply provides power to the controller and sensor modules. The vibration, current, temperature and voltage sensors collect measurements from the selected test equipment or demonstration setup. Their outputs are connected to the ESP32 controller, which reads and processes the data. The controller checks the readings against the selected limits. Through wireless network connectivity the readings and warning status can be sent to a dashboard or connected device. The diagram represents the information flow; it is not a detailed wiring diagram.

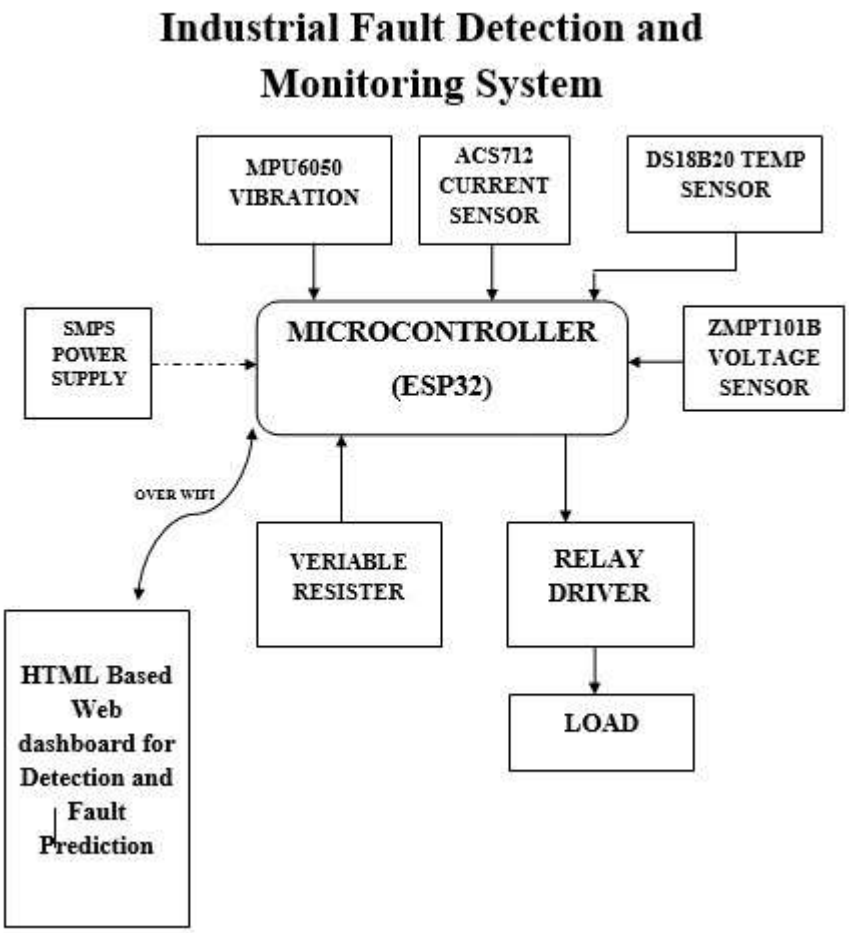


Fig. 1. Block diagram of the proposed Industrial Fault Detection and Monitoring System.

3. PROPOSED SYSTEM

The proposed Industrial Fault Detection and Monitoring System is made up of a power supply, sensing modules, an ESP32 microcontroller, a wireless communication link and a display or dashboard. The system is planned to observe four types of operating information. Each sensor has a role and the final sensor arrangement must be selected according to the machine or test rig being monitored.

The MPU6050 is a motion-sensing module that measures acceleration along three axes. When it is mounted firmly to a surface its readings can be used to observe changes associated with vibration. The sensor must be installed in a position because mounting location and mechanical contact affect the measurements. A single acceleration value should not be treated as a vibration diagnosis; repeated measurements and a suitable analysis method are needed to understand changes over time.

The ACS712 is a sensing module that can be used to measure electrical current within the limits of the specific module and its circuit arrangement. Current may change when a load changes or when an electrical or mechanical problem affects the way a machine operates. However a current change can also occur during starting or changes in workload. Therefore the system should compare readings with a baseline and should not label every change as a fault. The module rating, connection method and isolation details must be checked before use.

The DS18B20 is a temperature sensor. It can be placed at a point to observe temperature changes in a component or area of interest. A temperature rise may indicate increased load, poor ventilation, friction or another condition. The meaning depends on the equipment and the location of the sensor. The sensor should be attached securely. Protected from environmental conditions that could damage it or make its readings unreliable.

The ZMPT101B module is intended for voltage sensing, in supported configurations. Before it is used the exact module design, voltage rating, isolation and required interface circuit must be checked. Voltage sensing around mains-powered

equipment creates a hazard and should only be performed using appropriate protection and qualified supervision. For software development, simulated or low-voltage signals can be used where suitable so that the controller logic can be tested without exposing the student to hazardous voltage.

The ESP32 works as the main control unit. It gathers the sensor data at times and looks at each number against a limit that is in the program or settings. Limits should not be taken from another device without making sure they work. They should come from the equipment details the sensor range, regular working numbers and help from a trained person. The controller can say a number is okay or outside the range. A warning means something needs to be looked at, not that a specific problem is there.

The wireless link can send the numbers to a screen, computer or another device. The screen might show the sensor numbers, when the reading was done and if a limit was passed. If the connection stops the system should show that the connection is lost of showing old numbers as if they are new. If the final version has stored data the information should have time details and a clear name for each sensor so the results can be checked later.

The way the system works starts when the system is turned on and the controller starts the sensors and the connection. Then the controller takes readings again and again. Each reading is checked to make sure it is correct and compared with the set limits. If all readings are within the set limits the screen shows the numbers and a normal monitoring message. If any numbers go past a limit the controller. Shows a warning and sends it through the connection. The person in charge can then look at the equipment. Do the right steps for maintenance.

Tests need to happen in an controlled place. First numbers should be taken during work to create a starting point. The sensors should be compared with measuring tools where they are available. Then safe test conditions can be made to see if the program notices the changes that are expected. The test notes should have the setup of the equipment or test machine, where the sensors are placed how often readings are taken, the limits used and what happened. Results can show how wrong the numbers are, how fast the warning comes, warnings and not seeing unusual situations but only if these things were measured during testing.

The system has some limits. Sensor numbers can be changed by noise, wrong placement, temperature changes, wiring issues and different loads. A limit system might miss a problem that does not go past the set limit or it might warn during a change in working conditions. Wireless connections can also stop working. These limits need to be talked about in the report. Future ideas could add storing data way to process signals, a better screen and using machines to learn but these ideas need more work and testing.

Table I. Components of the proposed system

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No.	Component	Description / Function	Purpose
1	ESP32 Microcontroller	Reads sensor signals, checks configured limits, and sends monitoring data through Wi-Fi.	Processing and communication
2	MPU6050 Sensor	Measures three-axis acceleration; changes can be studied as vibration-related indicators.	Vibration monitoring
3	ACS712 Current Sensor	Measures electrical current within the module's specified range.	Current monitoring
4	DS18B20 Temperature Sensor	Measures temperature at the selected equipment or test-rig location.	Temperature monitoring
5	ZMPT101B Voltage-Sensing Module	Provides a voltage-sensing interface in supported configurations.	Voltage monitoring
6	Regulated Power Supply	Provides suitable regulated power to the controller and sensor modules.	System power
7	Wi-Fi Connection	Transfers sensor readings and alert status to a dashboard or connected device.	Remote monitoring

8	Dashboard / Monitoring Interface	Displays sensor readings and indicates when configured limits are crossed.	Display and alerts
9	PCB and Connecting Wires	Provide electrical connections between the controller and sensors.	Circuit assembly
10	Protective Enclosure	Houses the circuit and helps prevent accidental contact when suitably selected.	Physical protection

4. CONCLUSION

This paper explained a system that uses the Internet of Things for finding problems and checking machines in industry. It uses an ESP32 microcontroller and sensors for vibration, electrical current, temperature and voltage. The study of what others have done shows why connected checking and predicting when machines need work is important in factories. The system takes sensor readings checks them against set limits and can send the readings and warnings to a checking screen. The system is meant to be a low-cost tool for learning and not a certified safety device for industry. The next step is to make the tool check the sensor connections make sure the numbers are correct choose the limits for the test setup and write down what happens in a safe place. Real tests are needed before saying anything about how good the system's how reliable it is or if it can find certain problems. Future work might improve how data is saved how warnings are. How patterns over time are looked at.

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REFERENCES

[1] T. Zonta, C. A. Da Costa R. Da Rosa Righi, M. J. De Lima, E. S. Da Trindade and G. P. Li, "Predictive maintenance in the Industry 4.0: A literature review," Computers & Industrial Engineering vol. 150 Art. No. 106889 Dec. 2020 Doi: 10.1016/j.cie.2020.106889.

[2] J. Dalzochio, R. Kunst, E. Pignaton, A. Binotto, S. Sanyal J. F. Barbosa and J. A. P. De Freitas "Machine learning and reasoning for maintenance in Industry 4.0: Current status and challenges " Computers in Industry vol. 123 Art. No. 103298 Dec. 2020 Doi: 10.1016/j.compind.2020.103298.

[3] D. Guidotti, L. Pandolfo and L. Pulina "A literature review of supervised machine learning techniques for predictive maintenance in Industry 4.0 " IEEE Access, vol. 13 Pp. 102479–102504 2025 Doi: 10.1109/ACCESS.2025.3578686.

[4] "Industry 4.0 technologies for manufacturing: A systematic review of machine learning methods for predictive maintenance " in Proc. IEEE International Conference, on Smart Systems and Advanced Applications (ICSSAS) 2023, doi: 10.1109/ICSSAS57918.2023.10331740.