International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

IOT BASED TRANSFORMER HEALTH MONITORING SYSTEM USING NODE-MCU

S.S.Sable[1], P.S.Burande[2], Aniket N[3], Omkar B[4],
Sourabh J[5],Vishal W[6].
DY Patil Institute of Engineering And Technology

***Abstract* -** In this paper, we propose an IoT-based system for transformer health monitoring using Node-MCU, a low-cost Wi-Fi enabled microcontroller. The system utilizes sensors to monitor various parameters such as temperature, oil level, leakage current, fire detection in the transformer. These parameters are crucial in determining the health of a transformer and predicting any potential faults or failures.

The data collected by the sensors is transmitted to the Node-MCU, which is connected to the internet via Wi-Fi. The Node-MCU then sends the data to a cloud server for further analysis and visualization. The cloud server utilizes machine learning algorithms to analyze the data and predict any potential faults or failures in the transformer.

The proposed system offers several advantages over raditional methods of transformer health monitoring. Firstly, it is cost-effective as it utilizes low-cost sensors and Secondly, it is highly accurate and reliable as it continuously monitors the transformer parameters in real-time. Thirdly, it offers remote monitoring capabilities, allowing operators to monitor the transformer from a remote location.

***Keywords* — *IoT, Transformer Health Monitoring, Node-MCU,Sensors, Cloud Server*.**

I. INTRODUCTION

IoT (Internet of Things) based Transformer Health Monitoring system using NodeMCU is a technology that enables the remote monitoring and analysis of the health status of transformers in real-time. This system uses the NodeMCU microcontroller and various sensors to gather data from the transformer, which is then sent to the cloud through the internet. The collected data is then analyzed to identify any potential faults or issues in the transformer, allowing for timely maintenance and repairs. The NodeMCU is an open-source platform that is based on the ESP8266 WiFi Module. It is a low-cost microcontroller that comes with integrated WiFi, making it an ideal choice for building IoT projects. The sensors used in this system can include temperature sensors, current sensors, ultrasonic sensors, and flame sensors. The collected data is transmitted to the cloud using MQTT (Message Queuing Telemetry Transport) protocol. MQTT is a lightweight messaging protocol that is designed for the IoT environment. It allows for the efficient transmission of data over unreliable network. Once the data is received in the cloud, it can be analyzed using various machine learning algorithms to identify patterns and anomalies. This information can be used to predict potential faults or failures in the transformer, allowing for proactive maintenance. Overall, IoT-based Transformer Health Monitoring using NodeMCU is a cost-effective and efficient way to monitor the health of Transformers. It enables timely detection of potential failures and allows for preventive maintenance. Which can significantly reduce down time and maintenance cost. Additionally, it enhances the safety and reliability of the power system. Thereby improving the overall quality of power supply.

II. METHODOLOGY

IoT-based transformer health monitoring using Node-MCU is a system that uses Internet of Things (IoT) technology to monitor and analyze the health of a transformer. The Node-MCU is a low-cost, open-source IoT platform that is based on the ESP8266 Wi-Fi modul.It is designed to be easy to use and has abuilt-in Wi-Fi module, making it ideal for IoT applications.

The NodeMCU will be connected to the sensors, which will collect data about the transformer's voltage, current, and temperature. The NodeMCU will then send this data to a cloud -based server using Wi-Fi connectivity. The cloud-based server will store the data and perform analysis to identify any potential issues with the transformer's health. The server will then send alerts to the web application, which will display the results to the user.

Here are the steps to implement this system: Connect the NodeMCU to the sensors (voltage, current, and temperature).

Connect the NodeMCU to the Wi-Fi router using the built-in Wi-Fi module.

Set up a cloud-based server to receive and store the data. You can use cloud platforms like AWS or Google Cloud Platform for this.

Develop a web application to receive and display the data to the user. You can use programming languages like C for this.

III. PROPOSED SYSTEM

IoT based transformer health monitoring using NodeMCU is a proposed system that aims to monitor the health of a transformer using IoT technology. NodeMCU is an open-sourcefirmware and development board that is based on the ESP8266 Wi-Fi module. It is a low-cost solution that is capable of connecting to the internet and transmitting data wirelessly. The proposed system consists of several components such as sensors, NodeMCU, and a cloud-based platform.

The sensors used in the system are responsible for collecting data on various parameters such as temperature, humidity, and voltage. These sensors are connected to the NodeMCU, which collects the data from the sensors and sends it to a cloud-based platform. The NodeMCU is programmed to perform various tasks such as data collection, data analysis, and data transmission.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

The cloud-based platform receives the data transmitted by the NodeMCU and stores it in a database. The platform is also responsible for performing data analysis and generating reports based on the data collected. The reports generated by the platform can be used by maintenance personnel to identify potential issues with the transformer and take corrective actions before a failure occurs.

Overall, an IoT based transformer health monitoring system using NodeMCU has the potential to provide real-time monitoring of transformer health, reduce maintenance costs,and increase the reliability of the transformer. However, the implementation of such a system requires careful consideration of various factors such as sensor selection, data transmission protocols, and cloud platform selection.

IV. HARDWARE COMPONENTS

1. Node-MCU

NodeMCU is a microcontroller that can be programmed using the Arduino IDE and is commonly used in IoT applications. It has a built-in Wi-Fi module, which makes it easy to connect to the internet and send data to the cloud.

Transformer health monitoring is a critical application in the power industry to ensure the reliable and safe operation of transformers. IoT-based transformer health monitoring involves using sensors to collect data about the transformer's performance and transmitting this data to a cloud-based platform for analysis. To implement NodeMCU-based IoT transformer health monitoring, you will need to connect sensors to the NodeMCU board to measure various parameters such as temperature, oil level, and vibration. The NodeMCU board can also be connected to an external power source to power the sensors.

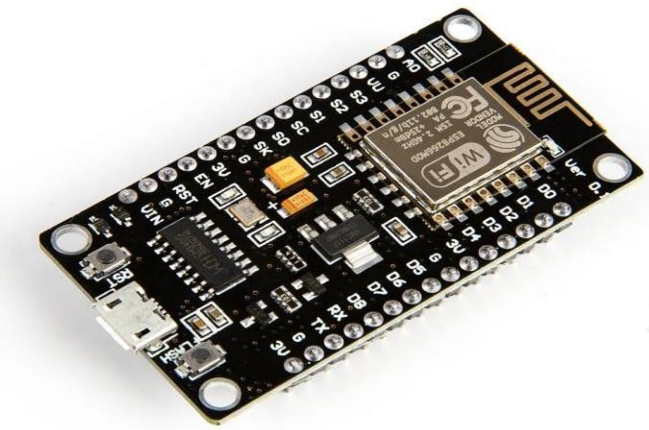

Fig 1. Node-MCU

2. Transformer

A distribution transformer is a type of transformer used in the electrical power distribution system to transfer electrical energy from high-voltage transmission lines to lower voltage distribution lines that deliver power to homes, businesses, and other consumers. Distribution transformers are typically located on poles or pads in the neighborhoods they serve and are responsible for stepping down the voltage from the transmission level to the distribution level.

The voltage level of distribution transformers varies depending on the location and requirements of the electrical distribution system. In North America, distribution transformers typically step down the voltage from 12,470 volts or 24,940 volts to 120/240 volts, which is the standard residential voltage level. In other parts of the world, distribution transformers may step down the voltage to 230 volts or 400 volts, depending on the local power grid standards.

Distribution transformers are designed to be highly efficient, reliable, and safe. They are typically oil-filled to provide insulation and cooling, and are equipped with protective devices such as fuses and circuit breakers to prevent overloading and other electrical faults

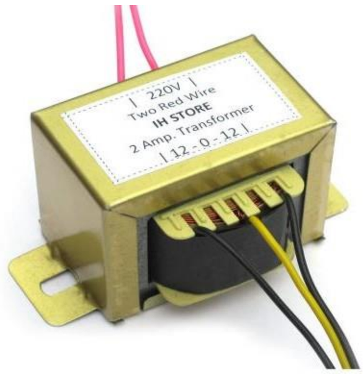

Fig 2. Transformer

3. Flame Sensor

A flame sensor is a device that detects the presence of a flame or fire. In the context of IOT-based transformer health monitoring, flame sensors can be used to detect fires or explosions in transformers, which are potentially dangerous and can cause significant damage to the transformer and surrounding infrastructure.

IOT-based transformer health monitoring involves the use of sensors and other devices to collect data on the performance and condition of transformers in real-time. This data can then be analyzed using machine learning algorithms and other techniques to identify potential issues before they become major problems.

Flame sensors can be integrated into IOT-based transformer health monitoring systems to provide an additional layer of protection against fires and explosions. When a flame is detected, the sensor can trigger an alarm or send an alert to the monitoring system, allowing operators to take immediate actionto prevent further damage.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

4. Temperature Sensor (DS19B20)

Temperature sensors are commonly used in IoT-based transformer health monitoring systems because they provide critical information about the transformer's condition. The temperature of a transformer is an important parameter that can indicate the presence of any faults or abnormalities in the system. In a transformer health monitoring system, temperature sensors can be used to continuously monitor the temperature of the transformer's various components, such as the windings, core, and oil. By monitoring these temperatures, the system can detect any abnormal increases in temperature, which can indicate a fault or malfunction in the transformer.

Moreover, temperature sensors can also provide data for predictive maintenance, allowing the system to detect potential issues before they cause significant damage. This data can be used to schedule maintenance and repairs at optimal times, minimizing downtime and extending the lifespan of the transformer.

Overall, temperature sensors are a crucial component of an IoT-based transformer health monitoring system, providing real-time data and enabling proactive maintenance strategies.

Fig 3. Temperature Sensor

5. Ultrasonic Sensor

Ultrasonic sensors are also commonly used in IoT-based transformer health monitoring systems. They are particularly useful for detecting partial discharge (PD) activity, which is a common indicator of a fault or potential failure in a transformer. PD activity generates ultrasonic waves that can be detected by an ultrasonic sensor. By monitoring the ultrasonic signals, the system can detect any PD activity and alert operators to potential issues before they become critical.

In addition to detecting PD activity, ultrasonic sensors can also be used to monitor the level and quality of transformer oil, which is critical for the transformer's operation and longevity. The sensor can detect changes in the ultrasonic waves as the oil level changes or as impurities are introduced into the oil.

Fig 4. Ultrasonic Sensor

Overall, ultrasonic sensors are a valuable tool in an IoT-based transformer health monitoring system, providing real-time data on PD activity and oil quality. This data can be used to schedule maintenance and repairs, optimize transformer performance, and minimize downtime.

6. Liquid Crystal Display (LCD)

LCDs (Liquid Crystal Displays) are a type of display technology that can be used in IoT-based transformer health monitoring systems to provide real-time data and alerts to operators. LCDs are commonly used to display various types of data, such as temperature readings, oil levels, and other diagnostic information.

By using an LCD display, operators can easily monitor the transformer's status and quickly identify any potential issues. The display can be configured to provide real-time alerts when certain thresholds are exceeded or when there is a critical event,such as a fault or malfunction.

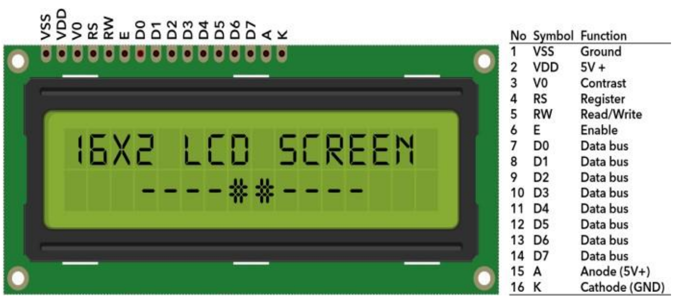

Fig 4. LCD

Furthermore, LCDs can also be used to display historical data, enabling operators to analyze trends and identify patterns that may indicate potential problems. This data can be used to develop predictive maintenance strategies that can help prevent failures and minimize downtime.

Overall, LCDs are a valuable component of an IoT-based transformer health monitoring system, providing real-time data and alerts that can help operators quickly identify and respond to potential issues. They also enable operators to monitor historical data, enabling them to develop proactive maintenance strategies and optimize transformer performance.

V. RESULT AND OBSERVATION

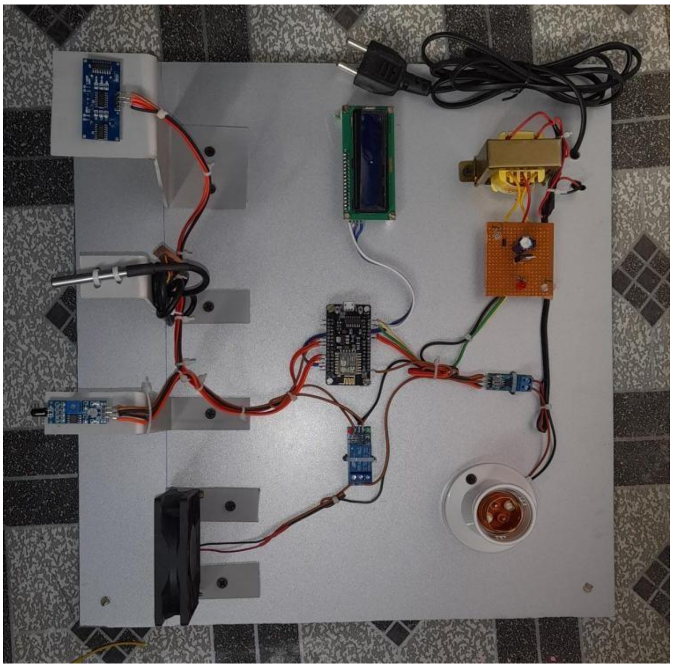

Fig 5. Hardware Setup

The system consisting of Node-MCU and sensors senses the transformer health parameters. The data are collected and a node mcu unit communicates with Blynk IoT. The received real time data is processed by Node-MCU. Analyze the collected data to detect potential faults and prevent transformer failures. This data is send using Blynk IoT Application.The accessed readings can be visualized in LCD.

Overall, the implementation of IoT-based transformer health monitoring using NodeMCU can provide significant benefits to the power industry by improving the reliability and reducing the maintenance costs of transformer.

VI. CONCLUSION

In conclusion, IoT-based transformer health monitoring using NodeMCU is a valuable application of the Internet of Things in the power industry. By leveraging the capabilities of NodeMCU and sensors, we can collect real-time data on the health of transformers and prevent potential faults and failures.

The implementation of an IoT-based transformer health monitoring system using NodeMCU involves selecting appropriate sensors, connecting them to the NodeMCU, writing optimized code to collect and transmit data, setting up a server to receive the data, and analyzing the collected data to detect potential faults.Overall, the benefits of this system include improved reliability, reduced maintenance costs, and enhanced safety.

As the power industry continues to evolve, IoT-based solutions like this will play an increasingly important role in ensuring the efficient and safe operation of critical infrastructure.Thus the real time data collection, storage and monitoring of the transformer health parameters are possible with the system.

VII. REFERENCES

1) E. M. A. El-Sayed, M. A. Elsayed, and M. E. Morsy, "Internet of Things-based transformer monitoring and diagnosis system," IEEE Access, vol. 8, pp. 78863 78872, 2020.
2) P. Sharma and R. Kumar, "IoT-based transformer health monitoring system using NodeMCU," 2019 IEEE 2nd International Conference on Renewable Energy and Sustainable Energy Technology (ICRESET), Chennai, India, 2019, pp. 234-239.
3) N. A. Salam, M. A. Karim, M. H. Ali, and M. M. Rashid, "IoT based transformer health monitoring system" 2019 5th International Conference on Advances in Electrical Engineering (ICAEE), Dhaka, Bangladesh, 2019, pp. 68-71.
4) S. K. Singh, A. Kumar, A. Kumar, and R. K. Singh, "IoT-based transformer health monitoring system using Arduino," 2021 IEEE 8th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), Noida, India, 2021, pp. 1-5.
5) NodeMCU Documentation https://nodemcu.readthedocs.io/en/release/