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IoT Based Distribution Transformer Health Monitoring System

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***Abstract:** This paper is about acquiring real time status of transformer. Transformer plays an important role in power system so, it is essential to monitor its condition for uninterrupted operation of any distribution network. This paper presents an IoT (Internet of Things) based health monitoring system, in this paper NodeMcu has been selected as the processor for transmitting the data sense by sensors, while Thingspeak platform has been used for the display of output data. Adoption of IoT technique in transformer may help for continuity of power supply. This low-cost system can be installed in the transformer to get monitored remotely, which not only determine health condition but also to assist in predicting the life span as well.*
***Keywords:** Sensors, IoT, Transformer, Monitoring, NodeMcu, Thingspeak*

I. INTRODUCTION

The transformer plays an important and crucial role in the network of the electrical system. In every area, we can see at least one transformer. Overloading and insufficient cooling of transformer may causes them to fail unexpectedly affecting electricity distribution to a significant number of people.

Because identical data cannot be retrieved manual assessment of voltage, temperature, humidity, smoke and other factors are more difficult. We are in an era where it is impossible to live without electricity even for a minute. Every core activity whether it is residential or for plants and factories is dependent on the power supply.

There are various implicit and explicit reasons due to which the performance of transformer may deteriorate. The most commonly observed contingencies are like partial discharge, insulation deterioration, humidity, moisture, overheating, winding resonance, loss of winding clamping, insulating oil solid contamination, lightning strike, system faults, system overload, switching operations etc. The Dissolved Gas Analysis (DGA) is performed to identify emission of different gases released by transformer are hydrogen gas, carbon monoxide, carbon dioxide, Methane.

Emission of these gases indicates the following faults like Corona, Cellulose insulation breakdown, Low temperature oil breakdown, arcing respectively. For this purpose, NodeMcu, DHT11 Temperature and Humidity sensor and MQ-9 Gas sensor module are being implemented[1].

This has become tedious processes to identify the same within the stipulated time so that the equipment can be saved well before occurrence of a hazard. This depicts that a periodical test needs to be conducted on regular basis to protect the device from failure. Hence for proper maintenance & monitoring of transformer new techniques like IoT. One server is used for the client server request. Thingspeak server is a very useful platform and it also provides a backtalk feature that helps in controlling the commands and output waveforms[5].

This communication process helps in sending messages to a designated device. Detection of the faults in real time based on temperature, humidity and smoke, also overcurrent and overtemperature are prevented using this technique .The system prevents faults and losses of the power supply which significantly benefits utility consumers[4]. The distribution transformer supplies the low voltage users directly.

As a consequence, the transformer's operating status in the distribution network is crucial. We implemented and designed IoT based monitoring system using NodeMcu, temperature and humidity sensor with smoke sensor, which will take data and send it to the IoT server. After processing, the data and information will be sent to a remote secured server through a Wi-fi module and data will be obtained in the form of waveforms with real time and figures.

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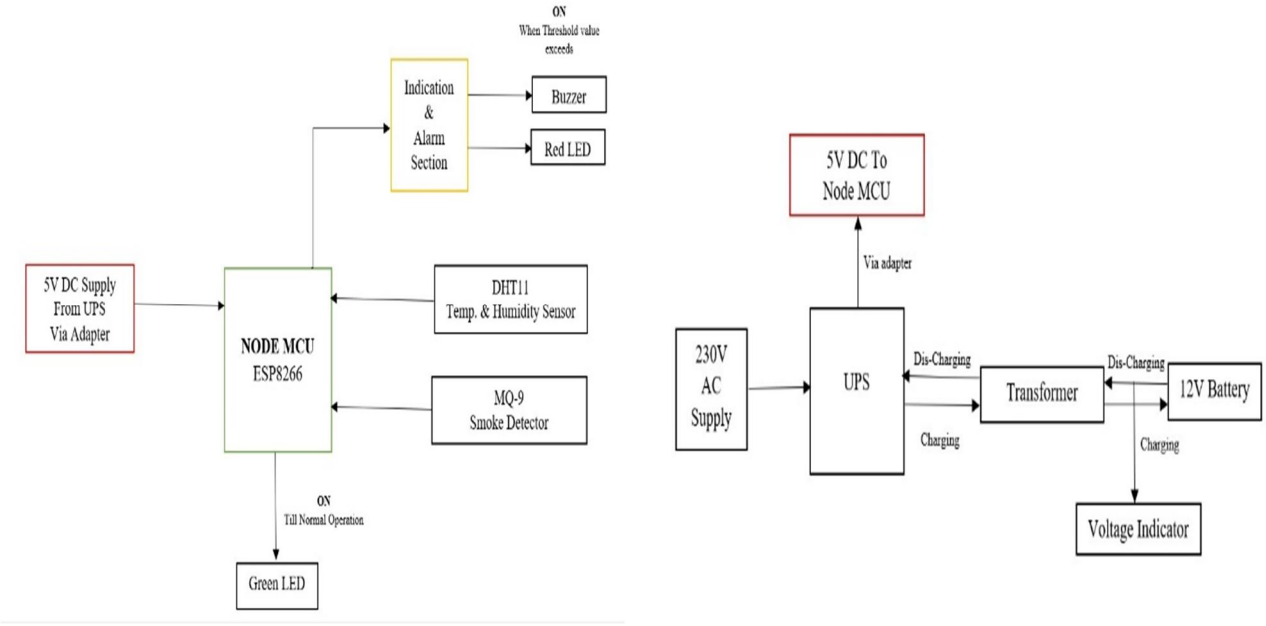
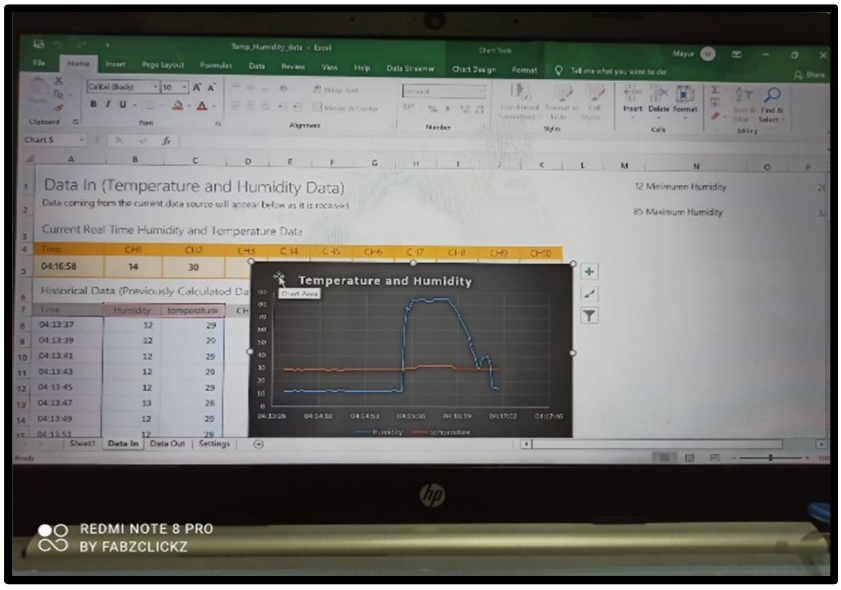


Fig. 1 Block diagram of IoT based Distribution Transformer Health monitoring system

II. METHODOLOGY

This paper have been divided into three separate modules, which are all listed below: -

First and foremost, we built our model's simulation in Tinkercad, and after that, we planned on building a hardware for which we used Arduino IDE and some hardware requirements, such as sensors like MQ-9, DHT-11, voltage indicator, and Arduino UNO as the Microcontroller, as well as other components such as LEDs, buzzer, jumper wires, and breadboard. This was the first step in designing a simulation and hardware using arduino UNO. When it comes to IoT, data is referred to as well, so we used microsoft excel for data visualization and data analysis. Using an add-In tool called data streamer, we captured data from the serial monitor and used it in our excel sheets for different classes for temperature, humidity, and smoke sensor.



Finally, we used NodeMCU, also known as WI FI-module, which is basically our ESP8266 Microcontroller, to send our data to any cloud based platform and then visualize it live using line graphs. There are many cloud based iot platforms, but we used thingspeak in our project. we also built an application where we can get the visualization of the IOT based platform in our application using app developer platform.

A. NodeMcu

ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash.



Fig. 2 Node Mcu

B. UPS

The process of monitoring different parameters of a UPS, such as voltage, battery state, charge, and current, is known as UPS monitoring. UPS monitoring ensures that power is available and that the device is operational. Keeping track ensures that gadgets remain operational and that corporate activities are uninterrupted. The transformer used in UPS system having rating of 650VA.



Fig. 3 UPS

C. DHT11- Temperature & Humidity sensor

The sensor used to detect the flame in the area is a DHT 11. A Temperature Sensor detects, measures, and transforms temperature into an electrical signal. They have a significant role in the environment, agriculture, and industry. These sensors, for example, can measure soil temperature, which is more beneficial in crop production. NTC thermistor, resistance temperature detectors RTDs, thermocouples, and thermopiles are some of the most used temperature sensors.

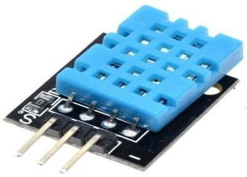


Fig. 4

D. Smoke Sensor

A smoke sensor detects the presence of smoke and its intensity. The alarm has a pulsed Infrared LED that checks for smoke particles every 10 seconds by pulsing a stream of light into the sensor chamber.



Fig. 5

E. Transformer

A transformer is a static electrical device that transfers electrical energy between two or more circuits. A varying current in one coil of the transformer produces a varying magnetic flux, which, in turn, induces a varying electromotive force across a second coil wound around the same core. Electrical energy can be transferred between the two coils, without a metallic connection between the two circuits.

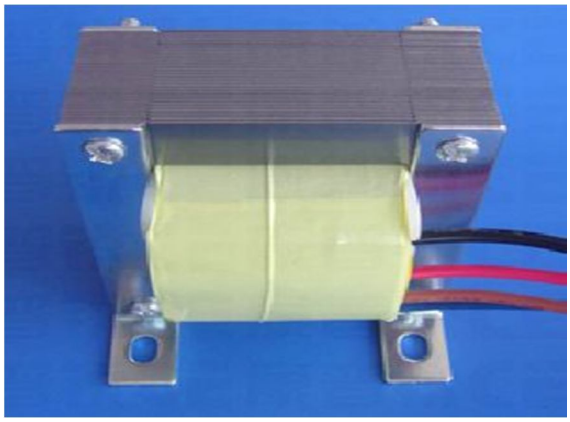


Fig. 6 Transformer

F. Voltage Indicators

Voltage indicators are simple devices that measure both alternating and direct voltages in the field. Both alternating and direct voltages are measured using voltage indicators. The current voltage is constantly shown on voltage indicators. Voltage indicators are used to assess the voltage of batteries or the mains. Voltage indicators with scalability can convert a voltage value to the relevant measured quantity. Our voltage indicators have a wide range of uses. Some voltage indicator devices may also monitor current and temperature in addition to alternating and direct voltage



Fig. 7 Voltage Indicator

G. LED's

When current passes through a light-emitting diode (LED), it produces light. Electrons recombine with electron holes in the semiconductor, producing energy in the form of photons. In contrast to LEDs, incandescent lamps can be engineered to work at nearly any source voltage, can use AC or DC current interchangeably, and can give consistent light whether driven by AC or pulsating DC at frequencies as low as 50 Hz.



Fig. 8 LED's

H. Buzzer

A buzzer or beeper is a mechanical, electromechanical, or piezoelectric audio signalling device (piezo for short). Alarm clocks, timers, and confirmation of human input such as a mouse click or keyboard are all common applications for buzzers and beepers.



Fig. 9 Alarming buzzer

III. RESULTS

We have used our first module of Arduino for Getting live data of different sensor like temperature (DHT-11) and smoke (MQ-9) sensor and we have done the same thing for simulation also using tinkercad. We will first link our NodeMCU to our Wi-Fi network by supplying it with a username and password in our arduino code, and then we will connect NodeMCU to DHT11 (Temperature and Humidity Sensor) and MQ-9 (Smoke Sensor) Buzzers. Green LEDs indicate that the module is in good functioning order, while red LEDs indicate that smoke has been detected.

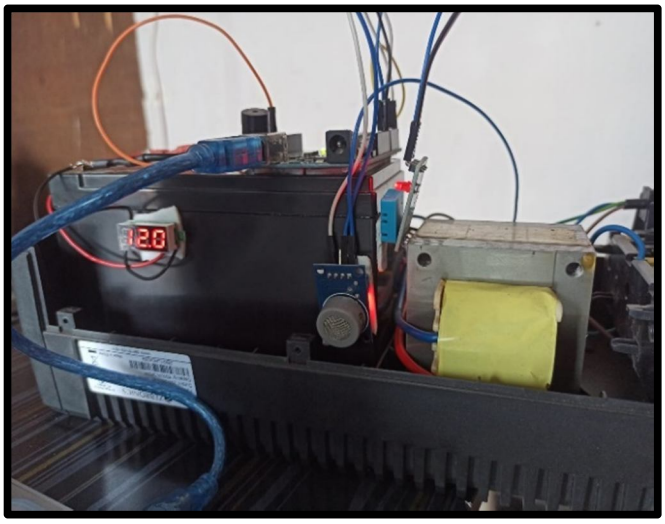


Fig. 10 Module

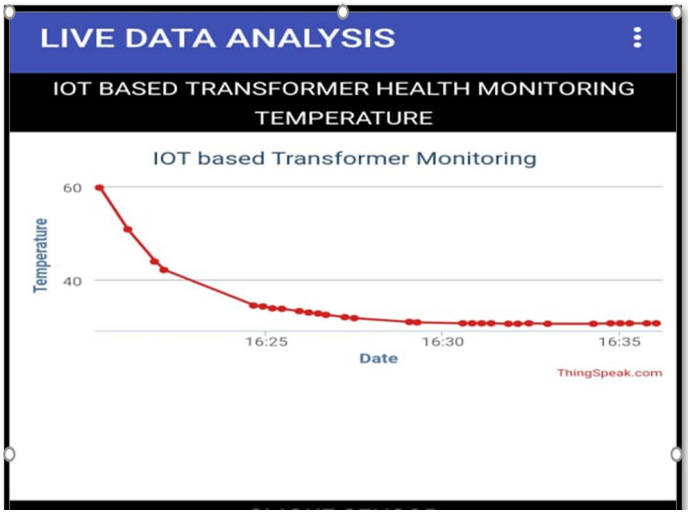


Fig. 11 Real time data of Temperature

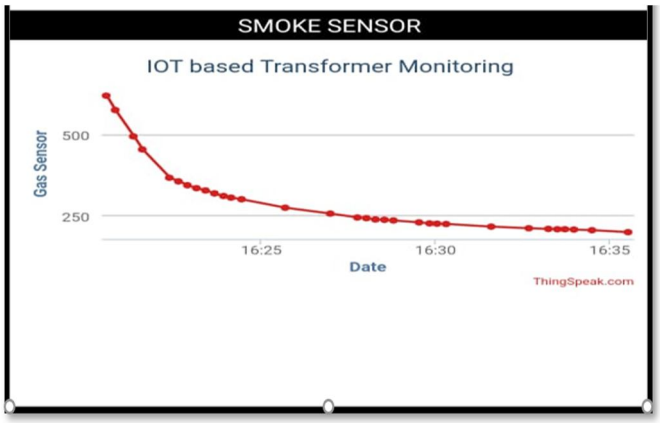


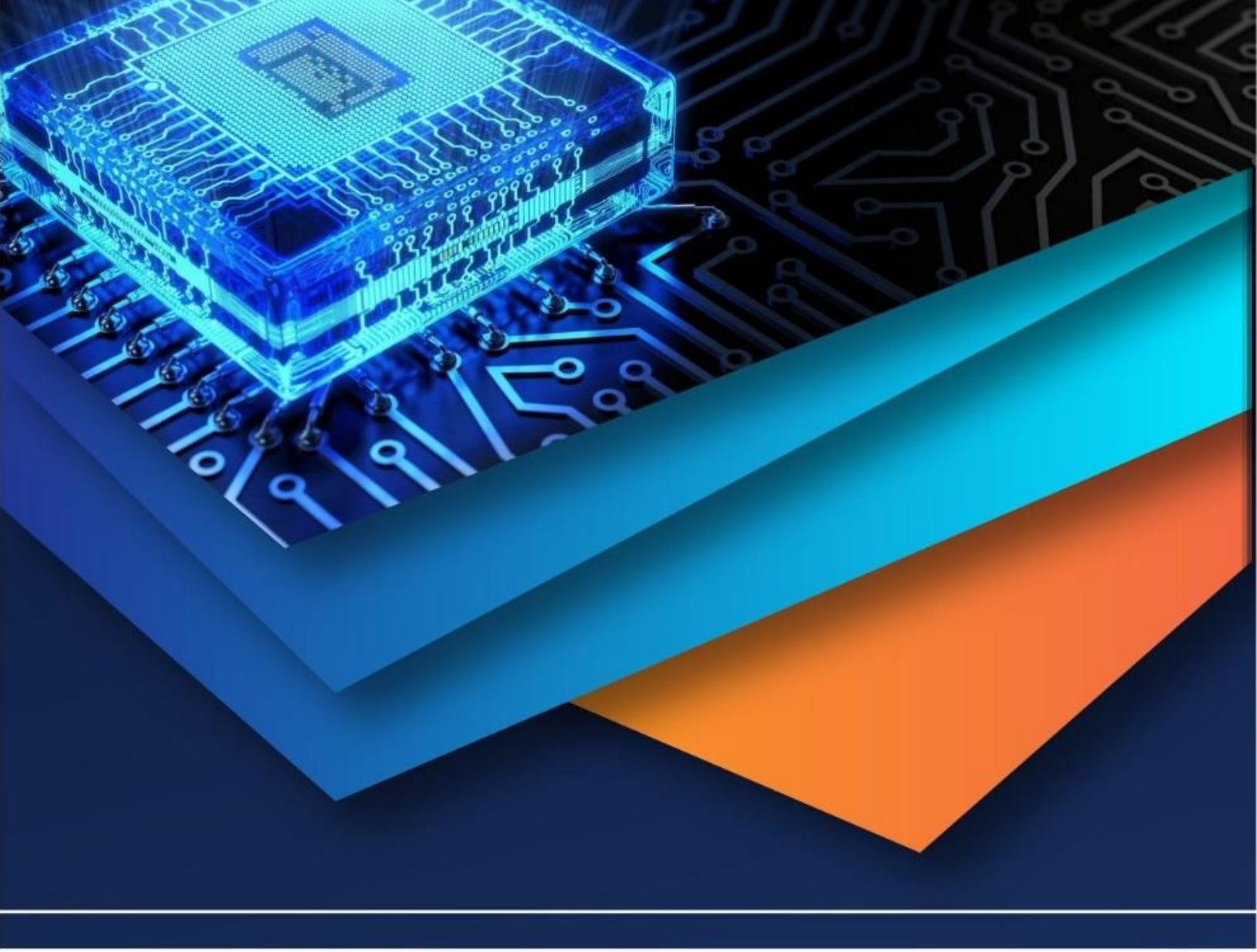
Fig. 12 Real Time data of Smoke

IV. CONCLUSION

From the above discussion it is observed that online health monitoring with the help of the internet provide better and accurate results rather than traditional methods. As a consequence, transformer safety and monitoring are essential. This system makes advantage of the Internet of Things to provide a new and improved method of monitoring transformer health indicators. The sensors in the system capture transformer health indicators such as voltage, temperature, and current. ThingSpeak, an IoT platform, receives this data. Data may be sent and received via the HTTP protocol. As a consequence, real-time data on transformer health is provided, and the system may be monitored and changes can be made. To design and build an Internet of Things Transformer Monitoring System that can show the transformer's current status in real time. The system was successfully tested once the gadget was constructed. That example, the gadget can monitor the transformer's state and transfer data gathered from the sensors through Wi-Fi to be presented on the IoT platform. All important and required parameters that have surpassed their threshold may be notified by SMS for prompt action to be performed. Even though the system was built successfully, there were some difficulties. The widespread usage of prefabricated microcontrollers in projects requiring particular characteristics increases the complexity and number of hardware components required to do a basic task.

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