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Transformer Health Monitoring and Protection Using IoT

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Abstract: Distribution Transformers are a critical part of the electrical power system. Data collection and transformer condition monitoring are very important for preventing transformer failures. In order to monitor the transformer, the operator has to visit the transformer premises. The main purpose of the project is to monitor the transformer parameters such as temperature, current, voltage, and oil level using IoT. Sensor networks are used to obtain transformer parameters. This system can minimize work effort, improve accuracy, reliability, and efficiency. This received data is sent to the Arduino UNO microcontroller. The recorded data is sent through ESP 8266 Wi-Fi module and accessed from anywhere around the world using IOT technology using HTTP protocol. This helps in identifying without human dependency. This helps in identifying and solving a problem before a failure without human dependency.

Keywords: IoT (Internet of Things); ESP 8266; Arduino UNO; OverLoad; Over Voltage; Distribution Transformer.

I. INTRODUCTION

The Internet of Things refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves. IOT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems and resulting in improved efficiency, accuracy, and economic benefits other than reduced human intervention. Transformer durability can be increased by operating them in good and rated condition. Overloading and inefficient cooling of transformers can cause unexpected failure in transformers, which can disturb the delivery of electricity to many consumers. SCADA can be used for online monitoring of power transformers, but it is an expensive approach.

The manual checkup of rise in voltage, rise in temperature, load current, oil level etc. tends to be more complex. This manual monitoring does not provide information about occasional overloads and overheating of transformer oil and temperature. The proposed system based on IOT collets key operational parameters of the transformer which will help the utilities to optimally use their transformers and keep the asset in operation for longer period. Thus the system helps to improve transformer life by identifying the problem before the failure occur. The monitored parameters are compared to the transformer's rated values, and the Arduino is programmed to take protective action if the monitored values surpass the rated values, also displays the monitored values on a remote PC.

II. PROPOSED SYSTEM

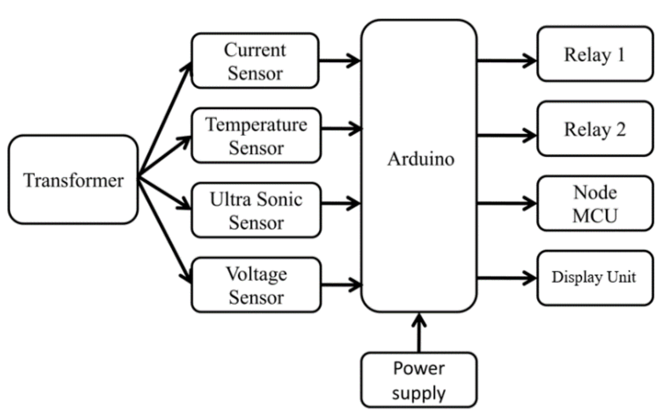

Fig.1: Block Diagram of Proposed System

A. Components

1) Arduino

Fig 2. Arduino

Arduino is open source hardware and software user community that designs and manufactures single boards. Microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control both physically and digitally. [4] With the help of Arduino, we are able to read values from sensors and also convert them to output.

2) Transformer

Fig 3. Transformer

The transformer is a static electrical device that transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding. This varying magnetic flux induces a varying electromotive force (E.M.F) or voltage in the secondary winding.

3) Node MCU

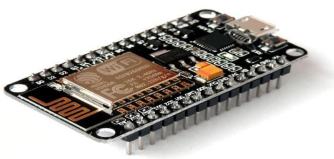

Fig 4. Node MCU

Node MCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP-12 module. Node MCU has four pins available for SPI communication.

4) Temperature Sensor

Fig 5. Temperature Sensor

Temperature sensors calculate the amount of heat energy or even coldness generated by an object or device, allowing us to "feel" or detect any physical change in that temperature, providing an analogue or digital output. The DHT11 series of precision integrated-circuit temperature sensors have an output voltage that is proportional to the temperature in Celsius (Centigrade). In comparison to linear temperature sensors measured in degrees Kelvin, the DHT11 has the advantage of not requiring the consumer to remove a significant constant voltage from the output to obtain convenient Centigrade scaling

5) Voltage Sensor

Fig 6. Voltage sensor

In an electrical power device, it is used to calculate voltage. When a voltage is too high for an instrument to use, it can be scaled down to a standardized low value. A voltage sensor measures the voltage in a wire and produces a signal proportional to that voltage. The generated signal could be analogue voltage, current, or even digital output. It can then be used to display the measured voltage on a voltmeter.

6) Current Sensor

Fig 7. Current Sensor

New sensors are a cost-effective and accurate approach for current sensing in processing, industrial, and networking networks. Typical implementations include motor control, load monitoring and maintenance, over-current fault detection, and any intelligent power management system. A current sensor senses and produces a signal proportional to the electric current flowing through a cable. The generated signal could be analogue voltage, current, or even digital output. The current measured in an ammeter will then be shown using it.

7) Relay Unit

Fig 8. Relay Unit

Every electrical system's make and break contact is handled by the Switching Unit. This unit, on the other hand, is made up of drivers and actuators. The relay is powered by [C1815] transistors, which are used as motors. Relays are used as active components, and resistors and diodes are used as passive elements. The processing unit's output switches on the appropriate transistor, which then activates the relays. The incoming phases from the public utility supply are connected to the relay terminals, and the load's single phase output is also connected to the relay outputs.

8) Display Unit

Fig 9. Display Unit

The display unit shows the status of the system's phase voltage switching and digital range as a result of the resulting phase voltage switching. It is used to view the chosen healthiest available step to feed the load as it is processed.

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9) Connecting Wire

Connecting wires allow current to travel from one point to another in a circuit. Because electricity needs a medium to move.

10) Ultrasonic Sensor

Fig 10.Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

11) Power Supply

A power supply is an electrical device that supplies electric power to an electrical load. The main purpose of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

Table 1. Existing Vs Proposed System

Existing System	Proposed System
In this existing system the worker has to find the fault manually	Sensor based intelligent fault detection system is mainly conceptualized in such a way that the time required to identify the fault is reduced
Drawbacks of existing system: The time requires for identifying the fault is more. The worker has to go manually to identify the fault.	Advantages of proposed system: The time required for identifying the fault is less. The microcontroller will send the identified fault to the WEB SERVER using IOT technology.

B. Software Aspects

The software algorithms are developed in Arduino IDE software which is an open source application. This application allows you to encode, compile and upload files to your Arduino device. All these things happen with the help of microcontroller's native language. The algorithm starts with the initialization of the I/O port data stream. Then according to the algorithm he starts to command the sequence. We have to take voltage, current, temperature and oil level readings continuously and send them to Blynk App by using Wi-Fi. With the help of the Blynk App the operators can monitor data anytime, anywhere. Also it's an open source application. If any parameter value exceeds beyond its threshold value then Arduino trips the power supply.

III. WORKING

The proposed system uses an Arduino to monitor a distribution transformer's voltage, current, oil level, and temperature. These distribution transformer parameters can be displayed on a computer or mobile device using IoT technology, which is a high-performance technology that integrates database recording and simulation on a single platform. The monitored parameters are compared to the transformer's rated values, and the Arduino is programmed to take protective action if the monitored values surpass the rated values, displaying the value on a remote PC. Transformer temperature and oil level was detected using an LM35 temperature sensor and a ultrasonic sensor.

Fig 11. Prototype

The Arduino receives these values as inputs and executes the desired operation. The Arduino will switch off the power supply to the delivery transformer if the voltage and current values surpass the rated values (overloading). If the temperature of the delivery transformer increases above the rated values, the Arduino can switch off the power supply (overheating). The microcontroller is programmed to constantly scan the transformer and adjust the parameters at fixed intervals.

IV. CONCLUSION

Compared to manual monitoring, the IOT-based monitoring of distribution transformer is quite useful for us. Because it is not possible to monitor the voltage, current, oil level and temperature rise manually. So it is also reliable for us. If any abnormality occurs, the operator gets a notification in real-time and automatic tripping of the circuit takes place to prevent any failures of distribution transformers. Thus, we can recover the system in less time and faults before any uncertain failures. Thus, this system is cost-saving. As the controller that we used has a small size compared to other controllers. The overall size of the whole setup is also small.

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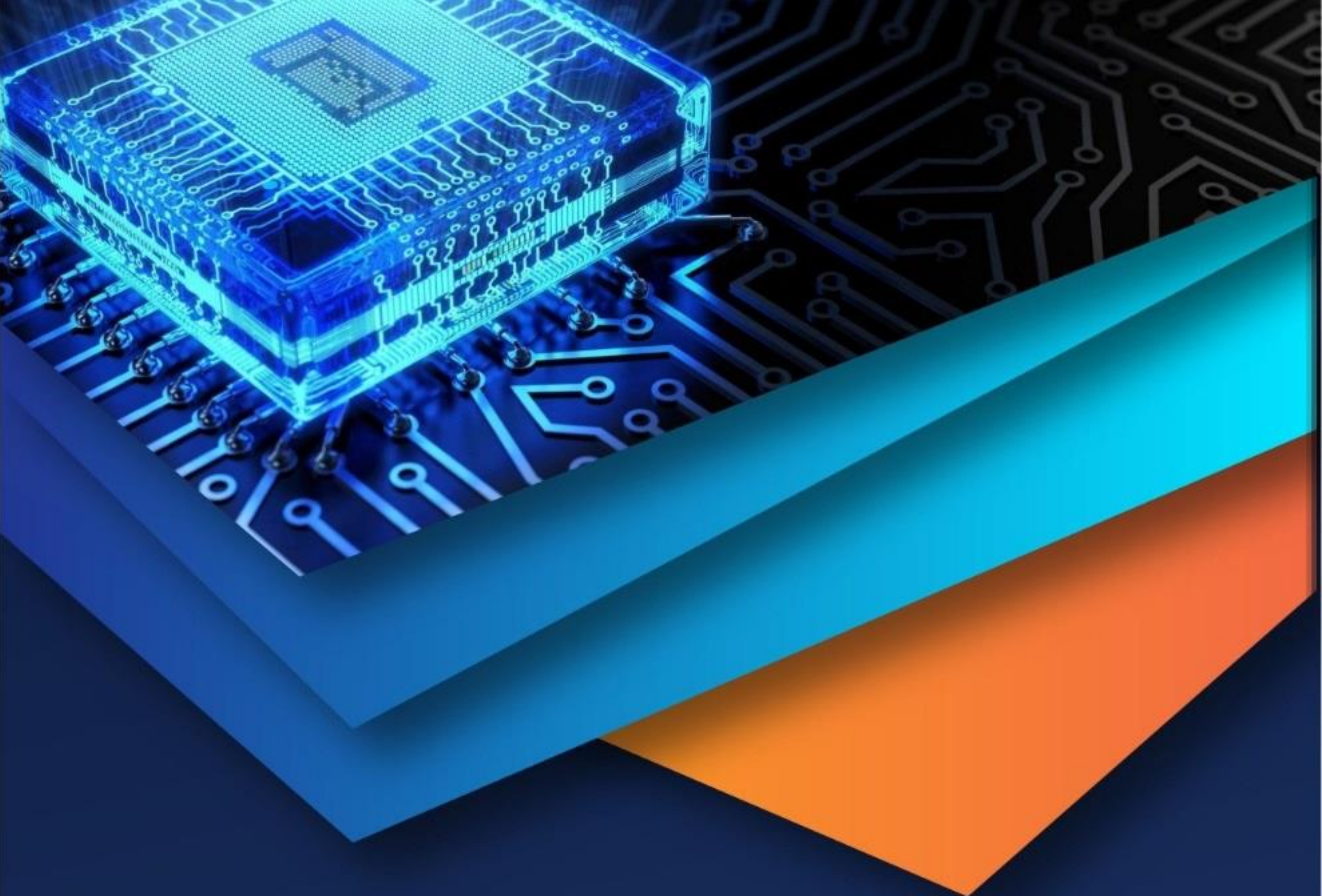

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