ADVANCED PROTECTION OF TRANSFORMER USING IOT

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ABSTRACT

Transformers are the main building block in a power system. Any damages in transformers adversely affects the balance of a power system. The damages are mainly occurring due to overloading and inefficient cooling. The main objective of the is real time monitoring of the health conditions of the distribution transformer using IOT technology. The parameter such as voltage of a transformer is monitored, processed and recorded in servers. For this purpose, we use three sensors interfaced with Arduino. The recorded data can be send using 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.

Keyword: - *IoT technology, cloud, server*

1. INTRODUCTION

The low voltage consumers are supplied directly by the distribution transformer. As a result, the transformer's condition plays a significant part in the distribution network. For a long life, transformers must be operated in rated condition. This is not feasible throughout the duration of the working day. Overloading and inadequate cooling of transformers can result in unexpected transformer failure, disrupting energy delivery to a large number of users. The manual checking of voltage, ambient temperature, load current, and other parameters is more difficult because incidental parameters cannot be accessible.

Sensors and actuators are used to interface between the physical and digital worlds in IoT. To perceive the physical characteristics of the respective environment, a sensor or a network of sensors is utilized. With the aid of different network devices, these processed sensor outputs are subsequently sent to the main server or cloud. The data may be accessible over the internet from any location on the planet. The primary goal of IoT technology is to monitor and control. As a result, IoT-based monitoring is preferable than manual monitoring. The system monitors transformer properties such as voltage in real time. This will aid in the detection of flaws before a catastrophic failure happens.

2. FAULTS IN TRANSFORMER

Overload, over/under voltage, temperature increase, oil level problem, and other severe failures can occur in a transformer.

(A) Overload / Overcurrent: The passage of fault current in the power system through the transformer is known as overload / overcurrent. Protection relays separate the power supply for roughly or less than 2 seconds, resulting in these conditions.

(B) Over / under voltage: When the voltage to frequency ratio surpasses 1.05 pu at full load and 1.10 pu at no load, overvoltage occurs.

(C) Temperature Rise: Transformers are typically intended to operate for 24 hours at a temperature of 300 degrees Celsius. Overvoltage and current produce a rise in oil temperature, which leads to transformer winding insulation breakdown.

(D) Oil level fault: Cooling and insulation are provided by the oil in transformers. Temperature can lower the oil level, and lowering it below a certain point has an impact on cooling and insulating.

3. PROPOSED SYSTEM

The proposed project is about acquiring real time status of transformer. Voltage and current of transformers are monitored and send over internet. These characteristics can be tracked in real time with IoT technology from any location on the planet. In nature, this is cost-effective. As a result, the competent authority has access to data on any power outage or repair.

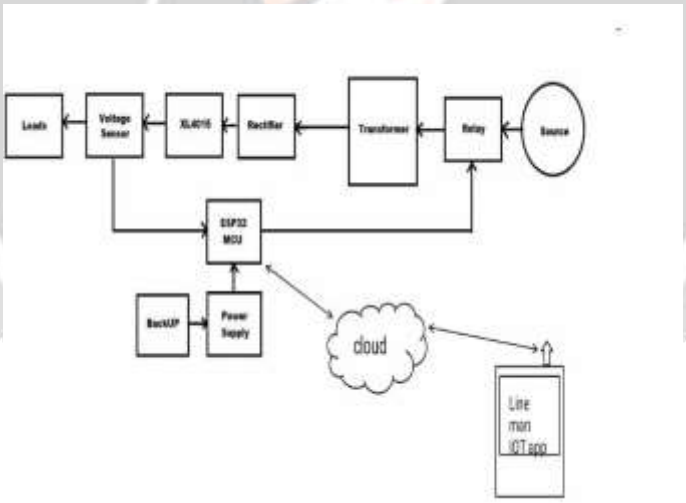

Fig 1. Block diagram of proposed system

It consists of arduino board, ESP32 mcu, voltage sensor and power supply as shown in the fig 1. The sensor sense the parameters and send this to arduino Nano. It processes it and send to Wi-Fi module.

4. HARD WARE COMPONENTS: -

The project is designed to emit a reduced size and maximum efficiency. The components used are Arduino, voltage sensor circuit and Node MCU.

4.1 VOLTAGE SENSOR CIRCUIT

Fig 2. Voltage measurement circuit.

It is a combination of IN4007 diode, a step-down As a result, the competent authority has access to data on any power outage or repair.

AC Voltage = (230/1024) * ADC_ Value

4.2 ESP 32 MCU

ESP32 MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP -12 module. This is a single board microcontroller. The operating system is XTOS.This is version 3 and it is based on ESP - 12E. Multiple GPIO pins on the board allow us to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications. USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication. Instead of the regular USB port, MicroUSB port is included in the module that connects it with the computer for programming and powering up the board as shown in fig 5 . LED blinks giving the current status of the module if it is running properly when connected with the computer. The power voltage for USB be kept around 5 V. It has a memory of about 128kBytes. Storage is about 4Mbytes.

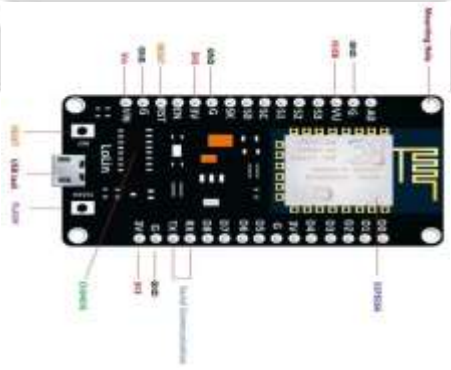

Fig 3. ESP32 MCU

The arduino nano and ESP32 MCU exchange data through serial communication. The ESP32 MCU will be treated as master and arduino nano act as slave during this communication. Arduino acts according to the instructions given by ESP32 MCU.

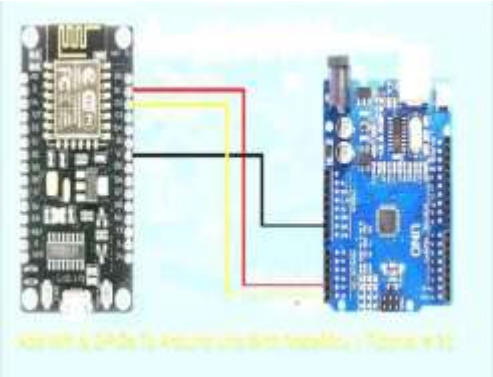

Fig 4. Interconnection of arduino nano and ESP32 MCU

4.3 AURDINO NANO

It is based on ATMEGA328P microcontroller. It works with a mini-USB cable. It is a small sized one. Operating voltage is 5V, with an input voltage variation of 7 to 12V. it has 14 digital pins, 8 analog pins, 2 reset pins and 6 power pins. Arduino nano is provided with a crystal oscillator of frequency 16MHz. It cannot be supplied power with an external source. Flash memory is16KB or 32KB. This is programmed using arduino IDE. The serial communication is achieved by digital pins like pin0 (Rx0) and pin 1 (Tx).

Specifications

- Microcontroller ATMEGA328P
- Operating voltage 5V
- Input voltage 7-12V
- Digital i/o pins 14
- PWM 6 out of 14 digital pins
- Max. current rating 40mA
- USB mini
- Analog pins 8
- Flash memory 16KB or 32KB
- SRAM 1KB OR 2KB
- Crystal oscillator 16MHz
- EEPROM 512 bytes or 1KB
- USART Yes

The important parts of a typical Arduino nano board is depicted in fig 6. It has a dimension of about 4.5cm * 1.9cm * 1.5cm. It weighs about 29g.

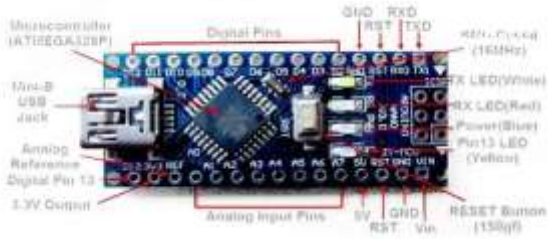

Fig 5. Arduino nano

5. IOT TECHNOLOGY

IoT is an interconnection of many physical devices by using internet. The controlling and monitoring of any physical devices or parameters are possible with the help of IoT technology.

5.1 THING SPEAK

It is an open – source internet of things applications. This provides with some apps that let analysing and visualising the data send by WiFi module. There is a ThingSpeak channel provided. These channels store the data. The channel provide provision for sending, processing and accessing the data when needed. The master device ESP32 MCU sends the data using HTTP protocol.

Max. current rating 40mA

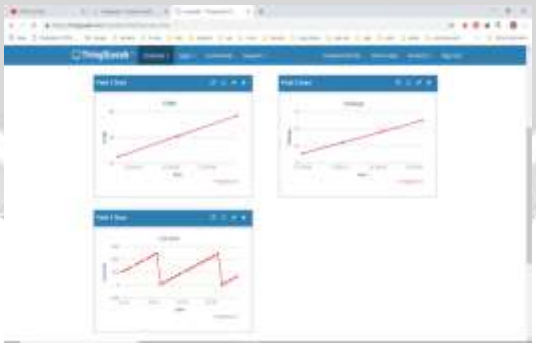

Fig 6. Thingspeak showing chart

6. RESULT AND OBSERVATION

The system consisting of arduino and sensor senses the transformer health parameter. The data are collected and a ESP32 mcu unit communicates with ThingSpeak. The received real time data is processed by it.

This data is send using HTTP protocol. The accessed readings can be visualized in ThingSpaek

platform.

Fig 7. Hard ware components

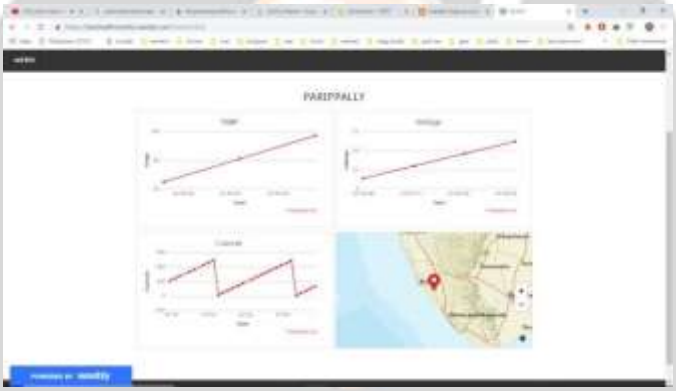

Fig 8. website view

7. CONCLUSION

The transformers play a vital role in distribution part of power system. Therefore, the monitoring and protection of transformer is very crucial. This system introduces a new and improved method of transformer health parameter monitoring using IoT. The sensors incorporated in the system collect the data of transformer health parameters such as voltage, temperature and current. These data are send to an IoT platform, Thing Speak using. These data can be sent and accessed using HTTP protocol. Thus, the real time data collection, storage and monitoring of the transformer health parameters are possible with the system.

8. ACKNOWLEDGMENT

The authors would like to thank Dr Moorthy Veerasamy, Ph.D, Head of the Department, for support to this work and carried out at project laboratory department of Electrical and Electronics Engineering. Authors would like to thank all the faculty members of Department of Electrical & Electronics Engineering and management of KKR & KSR Institute of Technology and Sciences.

9. REFERENCES

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