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IOT Based Fault Detection of Transformer Using ARDUINO

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Abstract: **This Project aims at monitoring the oil, current & temperature of transformer continuously and protects them from overheating. So, this project is helpful to monitor every transformer easily. This project presents design and implementation of a mobile embedded system to Monitor. By using microcontroller and wireless communication module we simply monitor oil level, current and temperature of the transformer. Here we have to place Oil level Sensor and temperature sensor to find oil level and temperature respectively. Microcontroller takes the inputs from sensors and transmits to monitoring system. Here GSM used for sending SMS and uploading to server. This SMS containing information about the abnormality regarding oil content level and temperature in transformer, and also overload of the Transformer. The values are uploaded to cloud server i.e., Thing-speak by using NodeMCU.**

Keywords* — *GSM; Power Transformer, Distribution transformer, Monitoring system, Temperature, Oil level, Over Load

I. INTRODUCTION

Welcome Electricity plays an important role in our life. Every moment of our life depends upon electricity. Electricity has several components and equipment helping human to transfer and regulate the distribution according to usage. The most crucial equipment of transmission and distribution of electric power is transformer. In Power system, an electrical component transformer directly distributes power to the low-voltage users and its operation condition is a criterion of the entire network operation. The majority of the devices have been in service for many years in different (electrical, mechanical, environmental) conditions. They are the main components and constitute the large portion of capital investment. Operation of distribution transformer under rated condition (as per specification in their name plate) guarantees their long service life. However, their life is significantly reduced if they are subjected to overloading, heating low or high voltage current resulting in unexpected failure and loss of supply to a large number of customers thus is affecting system reliability.

II. LITERATURE REVIEW

For the development of the Indian economy power system safety is very important. To provide the safety and reliability of the transformer monitoring system is used. A transformer is an important asset of the electrical network and it needs extra care and concentration. Sajidur Rahman et. al., 2017 proposes THMS (Transformer Health Monitoring System) for monitoring the condition of the transformer in real-time. Huge numbers of transformers are available throughout the world; it is a very difficult task to observe the condition in a manual way of every transformer. So, an automatic monitoring system is needed to observe the condition of the transformer. This proposed system is embedded with the mobile to observe the load of the current, voltage level, oil temperature, and level of the oil. This system is integrated with the GSM (Global Service Mobile), microcontroller, and various sensors. The sensor data are collected and stored on the memory. The system checks the condition of the transformer using inbuilt instructions. If any abnormal conditions are occurring on the transformer the GSM component sent the message to the receivers' mobile phones contains the data about the abnormal condition. It is a wireless system to offer better monitor the condition of the transformer. The developed system is embedded with the transformer and it sends the abnormal parameters to the cell phone using the GSM technique.

A transformer is a major component used in the electrical field. Measuring faults in the internal part of the transformer is `a very tedious process. P.G. Navamanikumar et al., 2018 proposes a new system to collect the information from the transformer and send the conditions to the users' mobile by

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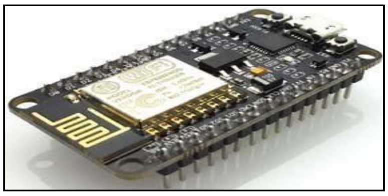
using IoT and GSM concept. Mainly this system is used to monitor the temperature, current, and voltage level of the transformer. MQTT protocol is used to transfer the message to the concerned people. By using this system, the authorized peoples are received an alert message before the transformer going to the fatal condition.

III. SYSTEM ARCHITECTURE

As the world is emerging so fast, for each transformer, its monitoring and taking instant steps when any fault occurs is the first and foremost challenge. To keep a transformer in a better state, various of factors are required to be measured and monitored. But doing it manually, by deploying a person at each sub-station is costly and difficult to work out. In addition, it may lead to human error during measurements. This paper proposed a real time IoT based solution to the problems mentioned above. The system uses sensors to collect the main transformer's factors and in the meantime the monitoring is done remotely using web based wireless applications.



IV. EXISTING METHOD

In existing system, we are using Bluetooth, Zigbee module for monitor the status of transformer. these modules communicate only in short distance so overcome this problem we moving to proposed system. In every time manually, and it is very time taking process. Every time manually operations required present days, we are measuring transformer or generator parameters manually. It is difficult to measure many man power resource so it is difficult to monitor transformer or generator health manually.

Objective:

- Self-protection in the case of overload on the transformer and the separation of the full and inform the maintenance teams.
- No wires are required in the proposed system. As a result, avoiding power or data loss
- Detect of the faults in real time based on current, voltage and temperature, oil level in the Transformer.
- Monitoring multiple transformers remotely.
- The use of Wi-Fi achieves more accuracy and fast response in fault monitoring.
- Increase system reliability and stability by the monitoring system.
- The system prevents faults and losses of the power supply which significantly benefits utility consumers
- Over current, over temperature are prevented using this technique.

V. PROPOSED METHOD

In this project oil level and temperature of the transformers are observed continuously using ultrasonic sensor for oil level monitoring and temperature sensor for monitoring transformer temperature. In this current variation is monitored and is displayed on monitoring. If any of the sensor crosses the limits then bulb will OFF and message alert will be sent

Proposed system Architecture:

Normally the transformer failures occur due to the over voltage fluctuations and over current fluctuations, overheating and spark, etc. We can develop systems to reduce the faults respectively. The parameters of the transformer like voltage fluctuations, current fluctuations, temperature, oil chamber moisture and spark are monitored remotely through NodeMCU. The sensors sense the change in current levels, temperature, oil chamber moisture and then forward the information of the transformers using Wi-Fi module. This data can be accessed remotely by an android application via a thingspeak.com email and display on it respectively. The maintenance of distribution transformers can be achieved by implement the system proposed by this paper. In addition, NodeMCU checks the oil chamber moisture, current, voltage, temperature, status of the transformer. Alert pin of the NodeMCU is activated, and if the load current is over transformer capacity, the buzzer will generate beep sound and optical alert with different colors (red and green). Finally, the NodeMCU checks the status of the transformer in the case of overloading. If an overload occurs, the NodeMCU disconnects some of these loads according to a self-defined strategy by relays. The proposed system architecture is depicted in the Fig 1.

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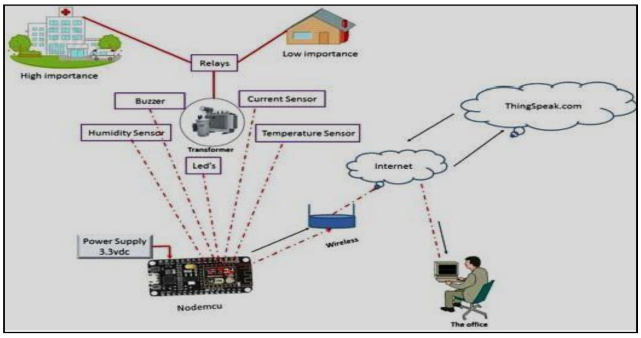

Fig 1: Proposed system architecture

The Fig. 2 block diagram represents the monitoring device mounted near the transformer. The components in the block diagram monitor various parameters associated with the transformer. The circuit diagram of the proposed system. The circuit diagram of the proposed system by using frizzing program.

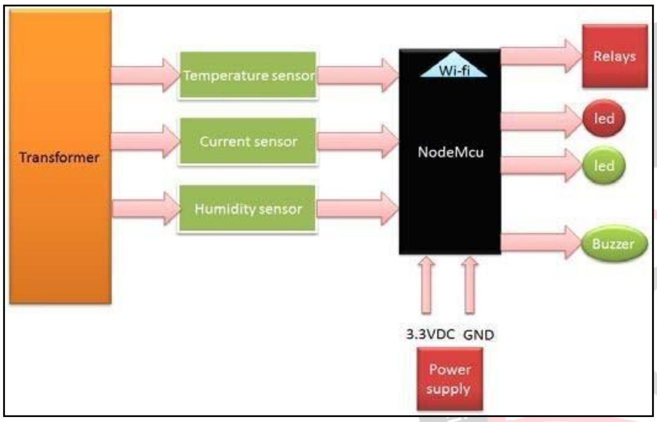

Fig. 2. Block diagram for monitoring transformer

VI. HARDWARE REQUIREMENTS

A. NodeMCU: It is an open source IoT platform. It has a board, which is a Wi-Fi development board of 24GHz. It depends on ESP-12E. It follows a programming language and technology of LUA. NodeMCU is considered as a combined unit and on the board, all resources are available. With the projects that are based on Arduino or the projects using board for development which require available input/output pins, NodeMCU is very easy to supplement as shown in Fig.3 below.

B. *Current sensor:* In the proposed system, the current is measured by using sensor ACS712, as showed in Fig.4. The sensor provides accurate current measurements in terms of both AC and DC signal. Overall power consumption of the system is thus monitored. The sensor produces output voltage proportional to sensed current, based on the Hall Effect principle. In ACS712 sensor, 5V of supply is connect to Vcc and negative 0V is connected to GND. Once powered, Vout produces output represents the current going through the sensing pads. A (Vcc/2) will be produced if the load is in OFF state. ACS712 is able to provide bilateral current measurement, i.e., voltage bigger than 2.5V (Vcc/2) indicates one direction, otherwise indicates the current in another direction.

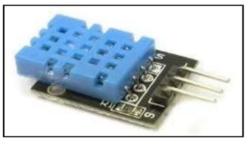

Fig 4: current sensor

C. Temperature and Humidity sensor: In this project the DHT11 is used to measuring is 2.5 mA. [measure the temperature, humidity and it is shown in Fig. 5. The DHT11 temperature range is from 0 to 50 degrees Celsius with +-2 degrees accuracy. The humidity range is from 20 to 80% with 5% accuracy. For the sampling rate, the DHT11 is 1Hz or one reading every second, and the DHT11 has a smaller body size. The operating voltage of both sensors is from 3 to 5 volts, while the max current used. Temperature and Humidity sensor

Fig 5: DHT11 temperature and humidity sensor

D. Relay*:* The relay is an electromagnetic device. It is used to separate two circuits electrically and connect them magnetically. Relays are very useful and makes it possible relay runs by an electric current which is small and can turn on or off a much larger electric current. The core of a relay is an electromagnet. And it is shown in Fig.6.

Fig 6: The relay devices

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E. LED: The LED is a light source and light is created by using semiconductors and electroluminescence, shown the figure no.:

Fig 7: LED

F. Buzzer: A buzzer or beeper is an audio signaling device. It is either mechanical, electromechanically or piezoelectric. Buzzers and beepers can usually be found in alarm devices and timers, or to be used as a confirmation of user input such as a mouse click or keystroke as shown in Fig. 8 below.

Fig 8: BUZZER

Software requirements:

A. Node MCU software: The code is generated and debugged using the IDE language 2017 environment. Codes are written in a Arduino 1.8.5 software. High and Low sensitivity of the sensor, buzzing unit, LED and relay are embedded. The major component of the program is in the control unit of the micro- controller. The reason of choosing IDE is because of its speed, stability and universal availability Fig. 9 shows when the code is running.

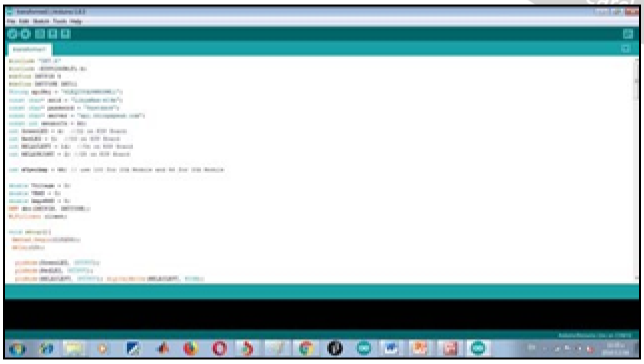

Fig. 9 Running of the code

B. Internet of things (IOT): The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to- computer interaction. Fig. 10 shows the main interface of thingspeak.com.

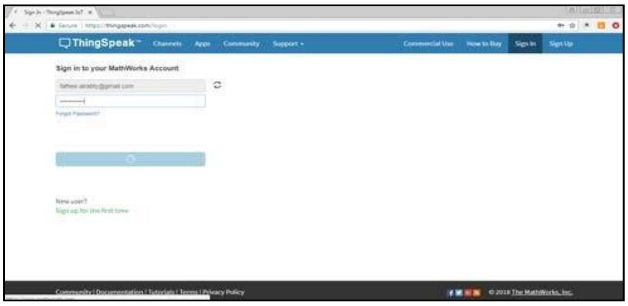

Fig: 10 main interfaces of thingspeak.com

WORKING PRINCIPLE

All the sensors integrated into the transformer unit are interfaced with Node MCU to receive and process the substation parameters. The micro-controller forwards data to cluster-based data aggregation sink, which here is a cloud service as showed in Fig. 11. Next, the data is forwarded to a predefined web application and then could be access remotely. In addition, the status of each transformer is extracted and forward to the same web application along with the parameter values. In addition to this. The status of each transformer is extracted via web application and it is also notified along with parameter values.

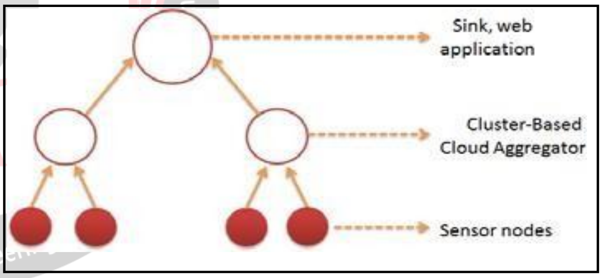

Fig 11. Cluster-based cloud data aggregation

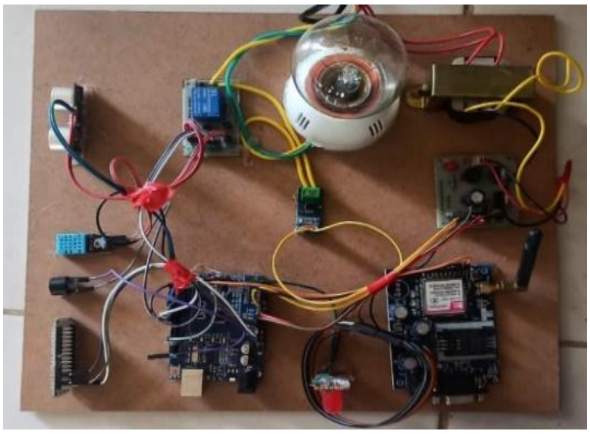

Fig. 12. The hardware prototypes

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VII. RESULTS

In this section, the reactor unit prototype of the proposed system is shown in fig. 12 and the data displayed on web applications is shown.

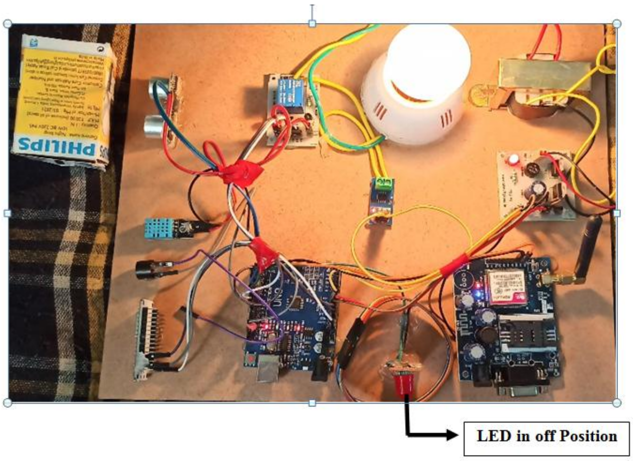

Fig.13. Transformer at Normal Condition

Fig.13. Show the normal condition of the transformer. It means that there is no fault occurring in the transformer.

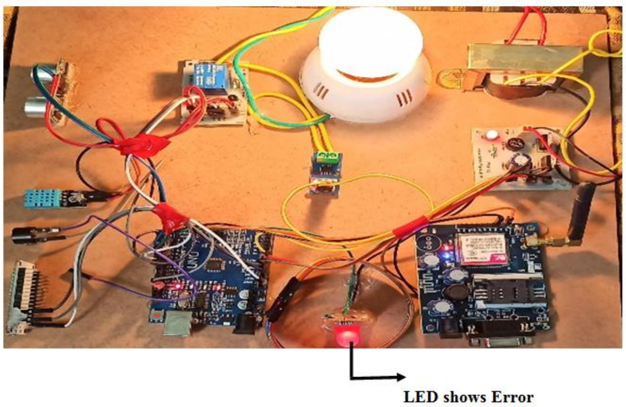

Fig. 14. Transformer at Abnormal Condition (i.e., Oil level decreased)

Fig. 14. Illustrate the abnormal condition of transformer with LED indication. Whenever overload, oil level decreases, and also heat increases automatically alert the observer with buzzer by near and send the message to the faraway to the location through IOT. The observer view the data through the thinkspeak software app. Shown in below Fig. 14.

Fig. 14. Think Speak data indicator (i.e., overload and Oil level)

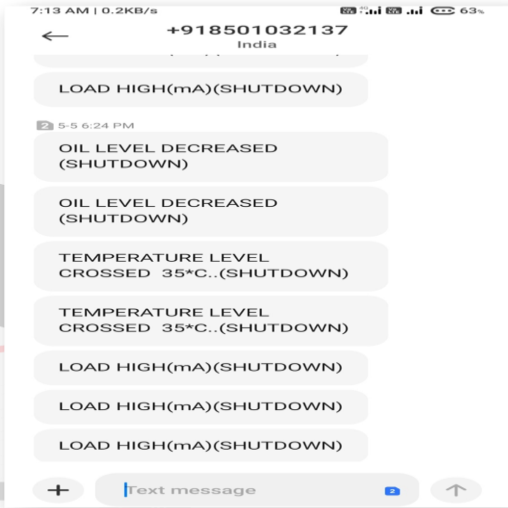

Fig. 15. SMS Message

Fig.15. Message viewed by the observer through SMS.

VIII. CONCLUSION

This paper has proposed a system which is very cost effective and replaced the error prone that would occur by manual transformer monitoring scenario. The system provides a cloud-based storage and is available through a web application where the data is accessible remotely, as well as self-control system in transformer loads. There are visual and auditory alert mechanism to notify substation status. Furthermore, the system provides a pathway to undertake necessary measures in case of emergency for the transformers. The proposed system significantly saves cost as well as improving reliability.

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