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Transformer Monitoring and Controlling Using Iot and GSM

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ABSTRACT: We developed a project aimed at providing a solution that ensures the safety of the transformer and serviceman. So, we are implementing a password-based circuit breaker. Our system reads the serviceman's RFID tag information with help of an RFID reader and then this system generates passwords and a relay switch to turn the ON or OFF transformer using the GSM module. A special number given is a key part of this system. Along with increasing the lifespan of a distribution transformer by measuring some of the parameters like oil level, temperature, silica gel color condition, winding fault, and power supply fault. Use of IoT and GSM for controlling and monitoring for transformer.This solution is necessary to maintain transformer health and less maintenance.

Keywords: IoT, RFID, GSM, KEYPAD, COLOR SENSOR.

I. INTRODUCTION

Computers and microcontrollersplay a very important role in industries to reduce the n error and increase productivity. This is one of the projects by using the microcontroller to monitor the parameters of the substation transformer using IOT and to control it in abnormal conditions.

The electrical parameters of the substation transformer are sensed by the different sensors and the feed to the microcontroller. The voltage is measured using the potential transformer with low rating and the current flow is measured by Current transformer. The temperature is sensed by the LM35 sensor. These signals are converted into digital signals through the ADC and fed to the microcontroller. The oil level of the transformer can also feed to it. And the colour sensor senses the colour of the new silica gel used in the transformer as blue. Silica gel is a good absorbing chemical solid gel used for moisture areas to remove it. These parameters' status is monitored wirelessly through internet of things (IoT) technology. Thus, we can monitor and control the substation transformer and load using IOT.

The addition of this project focuses on the safety of the lineman while working so they do not feel the sudden electric shock. As a serviceman has to deal with live wires so it is important to take care of the power supply during the repair period. However, with the right amount of coordination among servicemen and substations, a lot of these accidents can be avoided. The project aimed at providing a long-life transformer with less maintenance and OTP protected circuit-breaking mechanism for servicemen. Our system reads the lineman's RFID tag information with help of an RFID reader and then this system generates passwords and a relay switch to turn on or off the transformer using the module. A special number given is a key part of this system. For particular circumstances, the serviceman has to risk their lives to regain the power supply and repair the issues in the power line. So, it is necessary to ensure the circuit is open and there is no return power supply in the phase line due to false grounding. when the one-time passcode received by the servicemen in his mobile. He enters the Keypad and after that, the power supply is disconnected and the repairing process takes place. Once the work is done, When the RFID reader is shown back the RFID reader recognised the number shown is the same as the previous one. Ifthey are the same the power supply is connected and power flows through the line.

II. PROPOSED SYSTEM

At first, we designed a system that coordinates all the important parameters of the transformers having oil, temperature changes, load demand, and mechanical strength. These sensors qualify for monitoring of equipment such as transformers and power lines.The voltage and current

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are sensed by the potential and current transformer along with the temperature and oil level of the transformer are measured and sent to the PIC microcontroller.If the above parameter value exceeds the threshold level, the information will be updated in the LCD. The transformer load will be controlled using the LCD.

A system is designed to improve the power quality and reliability of the power supply. Using smart grid-based sensors like current, voltage, and temperature sensors along with IOT wireless communication protocol real-time monitoring of Power line parameters like voltage, current, temperature, etc. can be carried out. These sensors qualify for the remote monitoring of equipment such as transformers and power lines. The voltage and current are sensed by the potential and current transformer along with the colour sensor,temperature, and oil level of the transformer are measured and sent to the PIC microcontroller. If the above parameter value exceeds the threshold level, the information will be updated in the server using the IoT module. The transformer load will be controlled through the cloud.

Based on the program done in the microcontroller a relay switches to turn on or off the circuit breaker. The system comprised an RFID READER & TAG, a GSM module, an LCD, a buzzer, a matrix keypad, and a relay. A special one-time number given is the key part of our system.The password generated by the microcontroller using different pattern code line have a limited time for authorization to open the circuit. From the PIC family,the PIC16F877A microcontroller is used.Normally the supply to the line is always on and it is indicated by using a lamp that is always on.When a problem arises with a power supply live wire serviceman is required to repair it. so, they are guided bythe RFID system. The first lineman should scan their ID card (RFID TAG) using an RFID reader and our system batches with the database.

Our system has 4 digits digital one-time passcode and also indicates "OTPGENERATED".The OTP generated was transmitted through the GSM module to the allotted mobile number in form of SMS.After entering it using the keypad, it will be compared with the generated password (stored in the ROM). If the passwords sent by the RFID reader and the password entered by the servicemancoincide,then the LCDs "OTP VERIFIED" and turns the power supply to the line to OFF condition i.e., the lamp will be turned off. Therefore, the serviceman can work onthe safer side of the mind and with trust. When the maintenance work is done, he will close the power supply using his RFID reader only. Thesystem generates another passcode that allows the serviceman to turn ON the power supply. If the passwords are not matched up to or more than three times, an alarm will be activated. The GSM module provides communication between the system and the serviceman. The number of the phone to which the OTP is sent is stored in the program. This number may be eitherthe sub-engine ear's number or the line man's number. It is possible to send the status of the line to various people based on the priority of the power lineto maintain safety precautions also, wireless communication can use depends on the distance.

III. METHODOLOGY

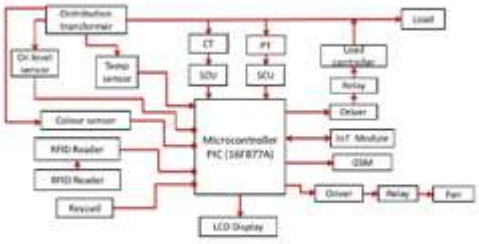

FIG. 1 Block diagram of theproject

At first, we choose the PIC microcontroller as the processing unit .then the oil and temperature sensors are connected to the distribution transformer where the D.T. is connected with the current transformer and potential transformer for monitoring the current and voltage respectively.the color sensor is placed near the breather which holds the silica gel (moisture arrester) .all these are provided as an input signal to the microcontroller.

Then for the maintenance work done by the specific person can use an RFID reader attached tothe transformer to control the power supply where an RFID reader with the help of the GSM module present sends the OTP for his mobile after the verification of OTP only, the control of the transformer has been handed over to the respective person.

The IOT is connected to the microcontroller processed all the data and sent these data as a report to the server and can be controlled with the turn ON / OFF of the transformer in times of emergency without the need for manual intervention which leads to undesirable consequences.All the data that are displayed on the LCD present are the indication of several values and steps taken through the IOT module.

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IV. PRACTICAL OBSERVATION

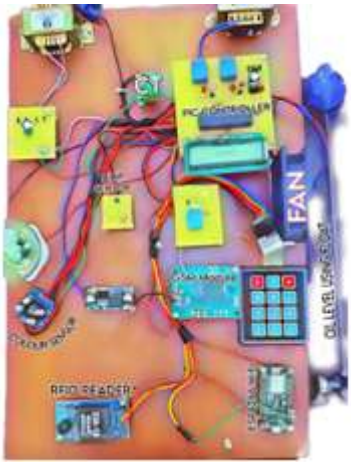

Fig. 2 Hardware outlook of the project

After the connections are given as per the schematic diagram in fig 2. The power is supplied through the step-uptransformer. the ac power is stepped down and the bridge rectifier converts 230 v AC to 12v,5v DC power given to the other components of the circuit.We connected all the required hardware components and for the software requirement, we programmed the microcontroller,GSM and IOT.Proceeding the several steps of the project we did the test run of the project and the fig represents the parameters that are displayed as output in the LCD.

V. RESULT AND DISCUSSION

Thus, the temperature recorded from thedistribution transformer increases the input value then the condition activated the FAN and alerts the person using the IOT, and displaysa warning SMS using GSM.

FIG. 3LCD Display

The output value as the resultant value in Fig. 3
Were,
V-voltage
I-current
T-Temperature
O-oil level

LCD OUTPUT

Fig 4 displays the condition of the moisture-arresting agent Silica gel present on the breather depending on the colour of the gel analysed using the colour sensor placed near the gel Then the microcontroller process the input signal from the sensors and analyses and controls the hardware all the actions taken by the microcontroller are displayed in the LCD display

The normal colour of the silica gel initially is blue which fades over time which was monitored by a colour sensor that was initially set with the pixel rate of the good colour of pure silica gel as mentioned in fig. 4

FIG.4 Silica in good condition

FIG. 5 Good colour condition(blue)

Fig. 5 displays the condition of the moisture-arresting agent Silica gel present on the breather depending on the colour of the gel analysed using the colour sensor placed near the gel was poor and needs to be replaced.

FIG.6 Status display

FIG.7 Bad colordetection (light pink)

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Nature	Values	Status
LEVEL 1	BLUE	NORMAL(GOOD)
LEVEL 2	LIGHT PINK	ABNORMAL(BAD)

TABLE 1 CRITERIA FOR GEL

FIG.8 Resultant output value

At last, the LCD shows the oil, voltage, current, and temperature level as it processes every 30 seconds and is updated in the IOT server.

VOLTAGE AND CURRENT

Voltage and Current are measured by using separate voltage transformers and current transformers respectively.

FIG. 9 V and I value

Any abnormal values found in voltage or current rating the transformer will shut off Immediately.

TEMPERATURE SENSOR

Table. 2 Temperature level

Temperature	VALUES	STATUS
LEVEL 1	(T < 39)	NORMAL
LEVEL 2	(T > 40)	ABNORMAL

FIG. 10 Temperature Level

When The Temperature of The Transformer Reaches 40 degrees C, The Relay Will Send a Signal To the fan to turn ON condition.

OIL LEVEL SENSOR

FIG. 11 Lively Coolant oil level

The oil level sensor that contains a floating ball at the end detects the amount of oil present in the transformer tank displaying an analog output that we can convert into a digital value using calculation.

GSM MODULE

ONE-TIME PASSWORD VALUE

FIG. 12 OTP SMS image

The RFID card taps to the RFID reader GSM send to SMS for OTP Value to mobile phone.The RFID reader plays an important life in saving the lives of the lineman who was in service as aone-time password will be received as shown in fig. 12 was used by the lineman in service who used it to turn ON/OFF the supply during service no other person have the authorization to use the power supply.

A separate number will be provided for every lineman in service as it was registered in the RFID reader which can be used to identify the most fault occurring transformer and the amount of work done concerning time and the performance of the worker.

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FIG.13 RFID Reader

SILICA GEL COLOR CONDITION

The condition of the silica gel is analysed and the process is transferred through the microcontroller by the colour sensor. Then, the decision was taken whether it is good or bad and the data will be sent to the mobile through the GSM module as shown in the Fig. 14

FIG. 14 Silica gel colour condition SMS

COOLANT OIL LEVEL

The coolant mentioned here is the transformer oil which was always maintained in full condition to prevent accidental conduction

FIG.15 Coolant oil levelSMS

Inside the transformer tank using coolant oil we can reduce the temperature of the windings. If the volume of oil is reduced an SMS will be sent through the GSM module as shown in the fig. 15

TEMPERATURE CONDITION

It is necessary to maintain the primary and secondary windings at low temperatures for better flux and in case of any abnormal condition found immediately an SMS is sent through the GSM module as mentioned in the fig. 16 and we can monitor them by studying the IoT module placed in the circuit connected with the host device.

FIG. 16 Temperature condition SMS

IoT ADDITION

In the IoT module, we used the ESP8266Wi-Fi module which was connected to the microcontroller and the network connection of the host device. The IoT has a certain parameter namely.

- Temperature
- Oil level
- Voltage
- Current
- Silica gel colour

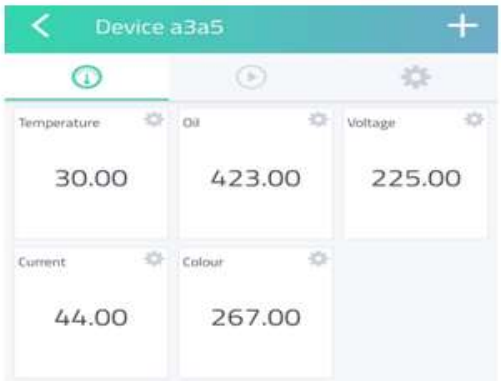

FIG. 17 IoT interface

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We can have instantaneous data of the properties of the transformer without the need for the real inspection of a human during times of emergency and rainy seasons.

The IoT we used here is the ESP8266 Wi-Fimodule so we can able to monitor the health parameters of the parameters which in turn increases the life span of the transformer. The IoT helps service workers to identify the frequency of errors occurring in the transformer and the efficiency of the particular transformer.

VI. CONCLUSION

Monitoring of the distribution transformers is useful as the manual operating system.It was not an easy task to take the manual operation of measuring the transformer oil level, temperature, and colour of the silica gel. It can easily take action immediately to for heck any failure of distribution transformers. In a distribution system there are many distribution transformers and connecting each transformer with the such system can easily figure out faulty transformers from the output LCD, thereby is no need of checking all transformer's phase currents and voltage and thus it can improve the system in less time. Our project deals vitals of the transformer and monitors despite any parameter considered. So, of all these efforts the lifespan of the transformers can be easily maintained without any faults for a very long period.

SOME OF THE ADVANTAGESOF THE ABOVE RESULTS

a. In the existing system, the voltage and current of the transformer as well as the temperature and oil level of the transformer are measured.
b. If sensor values are exceeding the predefined threshold values, the GSM module will send the predefined SMS to the remote-control room using GSM.

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