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Monitoring and Control Of 500 KVA Transformer Through GSM Based Raspberry Pi Controller

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***Abstract* — This project is concerned with the design and implementation of mobile interfaced systems to monitor and record key parameters of the 500 KVA Distribution Transformer, such as load current, voltage, oil level, vibration and temperature of the transformer. The idea of this monitoring system, which integrates a Global Mobile System (GSM) modem with a standalone single-chip Raspberry PI3 controller, works like a mini-computer and the various sensors. This system is installed in the location of distribution transformer and above-mentioned parameters are recorded by an Analogue to Digital Converter (ADC) of the embedded system, the parameter obtained is proceed and recorded in the system memory.**

When there is any abnormal or emergency condition, the system is sending a short message through GMS based mobile network i.e. SMS to the mobile phone, that contain the information about the such problem. This corresponds to some standard instructions that are programmed in the Raspberry Pi3 controller. The mobile phone system alert us from the abnormal condition which has occurred.

***Index Terms* — 500 KVA Distribution Transformer, Raspberry Pi controller, Global System for Mobile (GSM).**

I. INTRODUCTION

An electrical transformer is one of the most important devices in the electrical network, which is installed at different points in the network with different power ratings and voltages. Electrical transformers have a long service life when used under nominal conditions. If the transformer is overloaded or the temperature rises above the desired temperature, its service life will be significantly shortened or shortened, resulting in sudden and unexpected failure and power outage for many end users or customers due to system's reliability. Overloading and inefficient cooling of the transformers are the main reasons of failure of electrical transformers. The life of a transformer depends on the fact that it can cause significant damage and losses. Therefore, protecting the electrical transformer is very important. The monitoring system protects the electrical transformer from such problems as current, overvoltage, temperature and transformer oil level. Some techniques are not currently used for offline and online monitoring of power transformers. Some electrical transformers are manually monitored if you regularly visit a transformer site to perform maintenance and record transformer settings. This type of monitoring system cannot provide information about the overloading, overheating of the oil and transformer's winding.

That type of monitoring system does not provide real-time information on overload, overheating, oil level and temperature. In addition to these factors, the life of the distribution transformer can be shortened significantly. Our system provides online real-time monitoring of key distribution transformer parameters that can provide useful information on the health status of distribution transformers so that utilities can get the most out of their distribution transformers. The real-time monitoring system helps utility companies identify problems before they go out of service, the online by monitoring partial discharges, recording their load condition, analyzing the gas and moisture in the oil. All these measures provide useful data for monitoring. and diagnosis. The diagnosed data is transmitted to the control room site or off site through a communication link, resulting the life of the distribution transformer can be increased and system is more reliable.

II. WORKING OF PROJECT MODEL

The process begins with the devices that have sensors attached with them. These devices are connected to GSM Module through Raspberry Pi3 controller which collect data from all the connected devices and show them on LCD (Liquid Crystal Diode) Screen and at mobile phone screen. The GSM chip or circuit that will establish the communication between a mobile phone device and GSM which is embedded on distribution transformer.

III. WORKING OF GSM MODULE

The process begins with devices that have sensors attached with them. These devices are connected to GSM Module (SIM900A) through Raspberry Pi3 controller which collect data from all the connected devices and show them on Led Screen. These important data are then used to perform tasks. In this way, GSM module works with systems that collects and send data to mobile phone.

IV. MAJOR STEPS OF WORKING OF PROJECT MODEL

There are 4 major steps of working of GSM module through which it performs the operation from sensing to final user interface (display data) these are as follows.

1. Sensors

The foremost component to consider in GSM technology is sensor. A sensor picks up all the real time data from attached

devices. These sensors are built in the devices which collects all the data to be used later.

2. Connectivity
Once the data is collected then controller transferred the data to the GSM module, and GSM module will transfer the data to mobile phone through SMS (Short Message Service) via cellular network.

3. Data Processing
After reaching the data to GSM module the data has to be analyzed so that the right action can be taken. After processing data, it is sent to display unit.

4. User Interface
The last stage is user interface when the data is processed it is displayed on LCD screen as well as mobile phone screen where we can control the load by switched ON and OFF as well as we can measure the different parameters like voltage (V) , current (I) , oil level Indicator and Temperature of transformer (T).

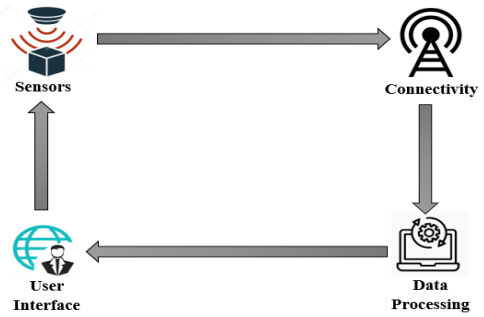

Fig. 1. GSM System

V. METHODLOGY

A. BLOCK DIAGRAM

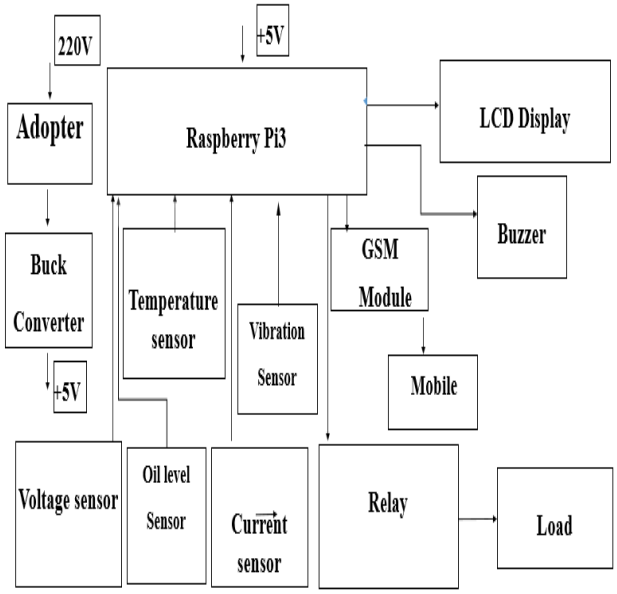

Fig. 2. Block Diagram

The detailed methodology of our project is to achieve the objectives of research is as under:
In this project we have used Raspberry Pi3 and GSM (Global System of Mobile) module are the main components in this circuit that will be monitoring different parameters and controlling by using raspberry pi controller as a minicomputer that is interfaced with GSM module. Here Raspberry pi is used as a controlling device. And different sensors are used to measure the different parameters of transformer, which relate to the controller for monitoring and control. The GSM Module was used as transceiver to send and receive messages when the any fault occurs in the distribution transformer. An LCD was also used to display the fault which was occurred.
Wires were used to connect the transformer with the main supply and jumper wires (Male to Female) were used to connect different sensors with Raspberry Pi3 controller board.

B. Flow Chart of Project

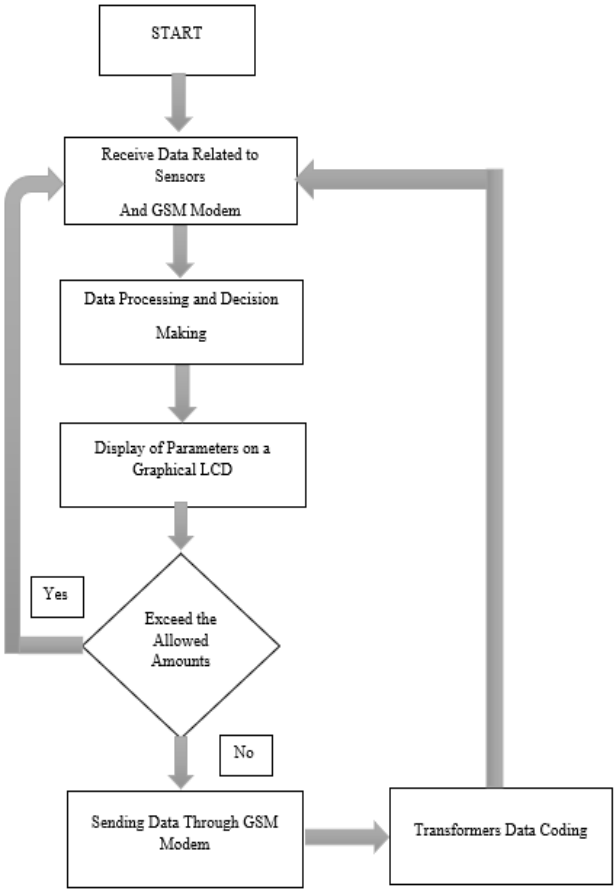

Fig. 3. Flow Chart of project

C. Components of the Project

The components used in this project are as following:

1. Raspberry PI3 B Controller
2. GSM Module (SIM900A)
3. DC-DC Buck Converter
4. Oil Level Sensor
5. DC Voltage Sensor
6. AC Voltage Sensor (ZMPT 101)
7. Temperature Sensor
8. Current Sensor (ACS712)
9. Vibration Sensor
10. Relay Module
11. Adopter 12V, 4.2A
12. LCD (20*2)
13. Buzzer
14. Connecting Wires
15. Wire Connector
16. Raspberry Pi3 Cables

D. Implemented Hardware (Prototype Model)

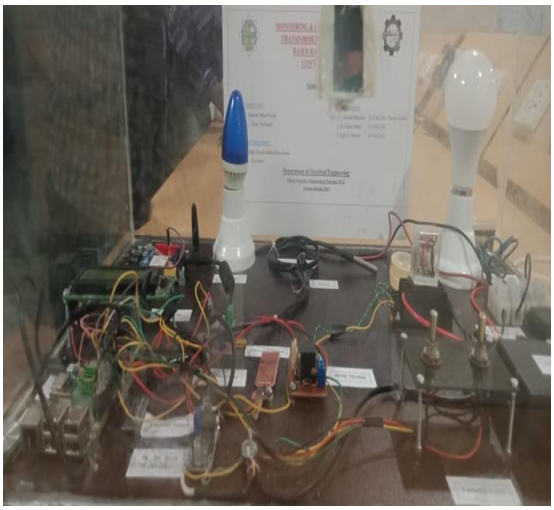

Fig. 4. Prototype Model

VI. RESULTS & DISCUSSION

All the settings in our project are working properly on 500 KVA Distribution Transformer and we have observed the results both on the (20*2) LCD screen and on the mobile phone via SMS based on the GSM module.

The mode of operation is different from case to case depending on the condition of the system, here are some situations in the normal operation or when the fault occurs.

1. Case: No. 01

When the fault occurs due to overload of the distribution transformer shown in the figure no: 6. That shows the fault on LCD display that is occurred in the transformer and mobile phone SMS alert that contain the fault alert due to overloading of transformer received by the GSM modem and bulb is in OFF condition.

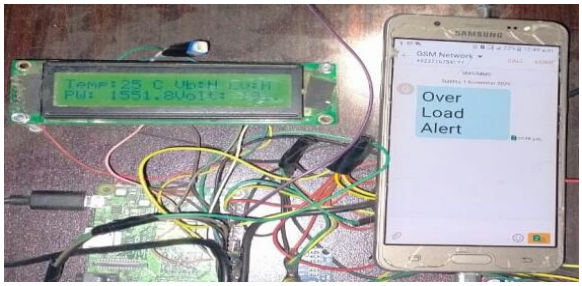

Fig. 6. Fault Due to overload

2. Case: No. 02

When the fault occurs due to temperature rise above 50 degree Celsius shown in the figure no: 7. That shows the fault on LCD display that is occurred in the transformer and mobile phone SMS alert that contain the fault alert due to high temperature of transformer received by the GSM modem and bulb is in OFF condition.

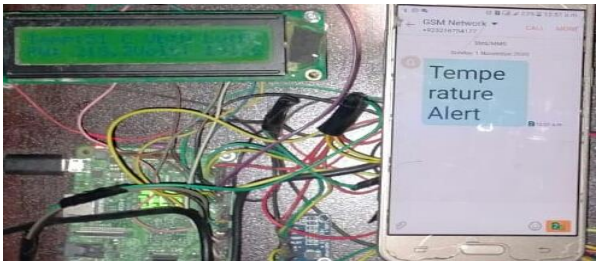

Fig. 7. Fault Due to Temperature

.3. Case: No. 03

When the fault occurs due to high voltage of the distribution transformer shown in the figure no: 8. That shows the fault on LCD display that is occurred in the transformer and mobile phone SMS alert that contain the fault alert due to overvoltage of transformer received by the GSM modem and bulb is in OFF condition.

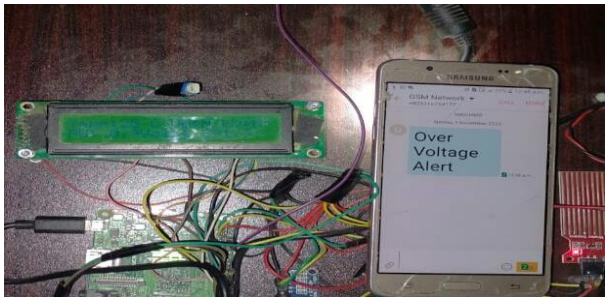

Fig. 8. Fault Due to Overvoltage

4. Case: No. 04

When the fault occurs due to low oil level of the distribution transformer shown in the figure no: 9. That shows the fault on LCD display that is occurred in the transformer and mobile phone SMS alert that contain the fault alert due to low oil level of transformer received by the GSM modem and bulb is in OFF condition.

Fig. 9. Fault Due to Low Oi level

5. Case: No. 05

When the fault occurs due to vibration of the distribution transformer shown in the figure no: 10. That shows the fault on LCD display that is occurred in the transformer and mobile phone SMS alert that contain the fault alert due to vibration of transformer received by the GSM modem and bulb is in OFF condition.

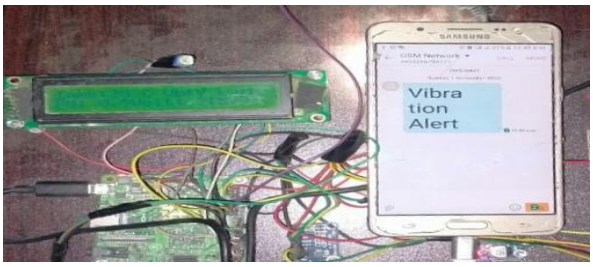

Fig. 10. Fault Due to Vibration

6. Case: No. 06

When the fault occurs due to temperature, overload, under voltage and low oil level of the distribution transformer shown in the figure no: 11. That shows the fault on LCD display that is occurred in the transformer and mobile phone SMS alert that contain the fault alert due to high temperature, overloading, undervoltage and low oil level of transformer received by the GSM modem and bulb is in OFF condition.

Fig. 11. Fault Due to temperature, overload, under voltage and low oil level

7. Case: No. 07

When there is no fault occurs in the distribution transformer, the bulb is in ON condition as shown in the figure no: 12, hence no SMS received by mobile phone, which shows that transformer works in normal state.

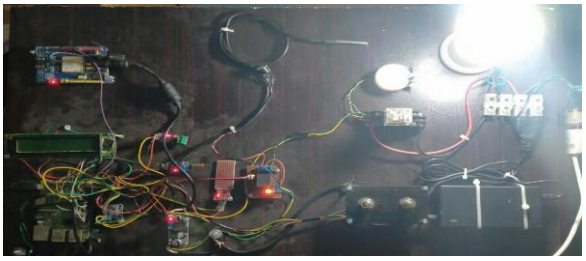

Fig. 12. Transformer Without Fault

VII. CONCLUSION

This project is particularly designed for a 500 KVA distribution transformer, to identify problems before failure of transformer, which leads to save a significant cost and greater reliability. Based on programmable raspberry pi3 controller using GSM technology to monitor transformer's parameters, using different type of sensors and control use of ON/OFF switching technique, transformer can be protected from any undesired fault. The GSM (Global System for Mobile) based transformer protection scheme has main aim to remotely control, monitoring and reliability of distribution transformer. It is more beneficial as compared to manual monitoring and controlling beside its economic advantage. The project has been shaped to control and monitor the parameter of transformer: voltages, current, vibration, temperature and oil level. It has been implemented through programmed Raspberry Pi3 controller and related components: DC sensors, AC sensors, Adopter (12V 4.2A), Controller Cable, Temperature sensor, Vibration sensor, Current sensor ACS712, Oil level sensor, LCD display (20*2), Relay for load etc.

VIII. FUTURE RECOMMENDATIONS

This model is latest improved form of previous done work. The extra modification can be made in future work this project can be magnified further at large scale.

The expectations, that can be predicted in future are summarized as:

- Different features can be added to improve its functioning, just like adding more sensor
  e.g. density of oil etc.
- The size of project can be more compact by using integrating components.
- More components can be added to find unsymmetrical different faults i.e. (L-L, L-G, L- L-G) and thereby alerts to the controller.

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