Substation Monitoring System

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***Abstract*— The project named 'Substation Monitoring System' proposes an innovative design to develop a system based on microcontroller. It is used for monitoring the voltage, current and temperature of a distribution transformer in a substation and to protect the system from the rise in mentioned parameters. The objective is to monitor the electrical parameters continuously and hence to guard the burning of distribution transformer due to the constraints such as overload, over temperature and input high voltage. If any of these values increase beyond the limit then the entire unit is shut down by operating an Electromagnetic Relay. This relay is activated as soon as the parameters exceed the predefined threshold values. The relay also works as a circuit breaker to switch off the main power supply. RF communication is used to continuously send the instantaneous values to the intermediate station. The GSM modem is used to send the real time electrical parameters in the form of SMS. The system is designed to send a SMS alerts to the authorized person whenever the parameters (Voltage, Current and Temperature) exceeds the predefined limits.**

***Index Terms*—distribution transformer, GSM modem, monitoring system, RF communication, substation.**

I. INTRODUCTION

Supplying electricity to consumers necessitates power generation, transmission, and distribution [4]. Initially electric power is generated by using electric generators such as: nuclear power generators, thermal power generators and hydraulic power generators and then transmitted through transmission systems using high voltage. Power departs from the generator and enters into a transmission substation, where huge transformers convert the generator's voltage to extremely high voltages (155kV to 765 kV) for long-distance (up to about 300 miles) transmission [4].

Then, the voltage level is reduced using transformers and power is transferred to customers through electric power distribution systems. Power starts from the transmission grid at distribution substations where the voltage is stepped-down (typically to less than 10kV) and carried by smaller distribution lines to supply commercial, residential, and industrial users [4]. Novel electric power systems encompassing of power transmission and distribution grids consist of copious number of distributed, autonomously managed, capital-intensive assets like power plants, transmission lines, transformers, and protection equipment [5].

Monitoring and controlling of substations is an important task for supplying healthy power to the consumers in this automated era. But due to the aging infrastructure of the distribution grids (substations) and lack of automation systems that monitors the critical conditions at the substations, the risk of blackouts, brownouts and fire are rapidly increasing. Substations consist of different electronic components like transformers, circuit breakers, relays etc. The transformer fluid leaks or internal insulation breakdown cause overheating that leads to failures. The traditional method includes periodic manual checking of the system which is time consuming and with very low accuracy. Also the substations in the rural areas are even more difficult to monitor manually and hence requires more time to take respective actions.

The solution to all these problems is automation of the substations. The various parameters like current, temperature and voltage are continuously sensed with the help of different sensors. The outputs of these sensors is given to Analog to Digital Converter (ADC) and then to the microcontroller. Microcontroller is preprogrammed in such a way that if the parameters exceed predefined threshold value then it will inform the intermediate or main station with the help of wireless communication technologies like RF, GSM etc.

II. EXPERIMENTAL PROCEDURE

A. Literature Survey

The existing systems are based on wired as well as wireless communication media.

A system is based on reliably proven electronic technology to measure temperature and current and the communication media they used was optical fibers [1].

Lifespan and maintenance cost of the wired media is more than wireless media.

Another system is based on RF technology [3]. RF technology includes a lot of noise problems when there is a long distance communication.

One more system is based on GSM technology in which an SMS can be sent to the authorized person if the parameters exceed threshold value [2].But it found that installing GSM modem at each and every substation increases the cost and complexity of the system.

B. Proposed Work

The current project uses the combination of RF and GSM technologies. With the help of RF communication, the information is sent to the nearby intermediate station. This intermediate station then informs the authorized person by sending an SMS with the help of GSM technology. In this way the n number of substations can be connected to the intermediate station with the help of RF communication and

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then the critical condition is informed to the main station via GSM modem.

C. System architecture

System architecture is divided into two different modules. One is located at the local substation and another at the intermediate station.

Current and temperature are sensed by using the respective sensors. For voltage measurement AC to DC step down circuitry is used and potentiometer to vary the voltage. All these parameters will be displayed on LCD 16X2. If any of the parameter exceeds to some threshold value, buzzer will beep for indication purpose. Also an SMS will be send to some authorised person.

Heart of the system is Microcontroller. ARM Microcontroller is used to monitor and control the system.

D. Figures

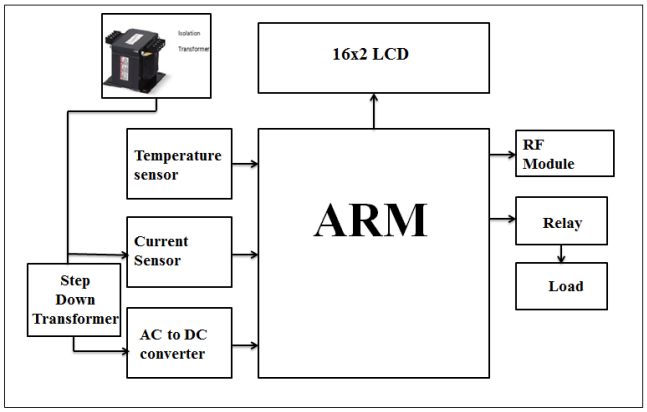

Figure 1: Module at local substation

The fig 1 consists of isolation transformer that represents substation, also known as distribution transformer.

The system not only controls the distribution transformer in the substation by shutting it down, but also displays the values on LCD. This claims that the proposed design of the system makes the distribution transformer more robust against some key power quality issues which make the voltage, current or temperature to peak [3].

The instantaneous values of these parameters are sent to the intermediate stage via Radio Frequency wireless communication. Also the primary controlling action is taken place with the help of a relay.

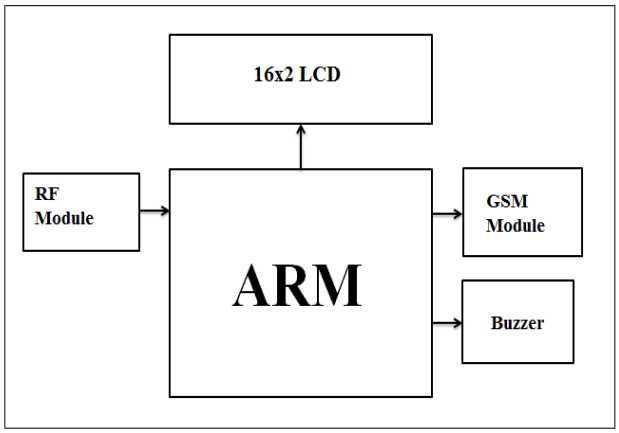

Figure 2: Module at Intermediate Station.

The fig 2 consists of RF receiver which collects data from the local substation. The same data is displayed on the LCD. An SMS is sent to the authorized person with the help of GSM modem and same is indicated with the help of a buzzer.

III. Result Analysis

The other system that can be used is PLC, SCADA and FPGA which is accurate than Embedded but including higher cost and bulky model. So the system reliability is achieved by using Embedded and Power Electronics including the RF module and GSM for the communication purpose.

IV. Advantages

1) Wireless Monitoring System.
2) Faster Control Action.
3) Automatic Control Action.
4) Accurate System.

V. Applications

1) In industries to monitor different modules located at different places.
2) Distribution Points (DP) where the huge amount of power distribution takes place.
3) In the rural areas which are far away from the main stations.
4) Monitoring and controlling the home appliances.

VI. Conclusion

The current project describes a monitoring system for distribution transformers utilize the existing RF and GSM communication network, which has low investment and operation costs. It is also easy to install and use.

It may reduce human efforts with the automation of the substation which increase transformer life, reduce faults and increase stability. It increases the efficiency of the system.

This leads to accurate and reliable operations. It will provide fast and easy monitoring with more efficient way as compared to existing manual monitoring of the sub-station.

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