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Implementation of Wireless Sensor Network for Monitoring and Protection of High Voltage Transformer

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ABSTRACT: The paper proposes an innovative design to develop a system based on AVR microcontroller that 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. Providing the protection to the distribution transformer can be accomplished by shutting down the entire unit with the aid of the Radio frequency Communication. Moreover the system displays the same on a PC at the main station which is at a remote place. Furthermore it is capable of recognizing the break downs caused due to overload, high temperature and over voltage.

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I. INTRODUCTION

As discussed earlier, maintenance of a transformer is one of the biggest problems in the Electricity Board (EB). During strange events for some reasons the transformer is burned out due to the over load and short circuit in their winding. Also the oil temperature is increased due to the increase in the level of current flowing through their internal windings. This results in an unexpected raise in voltage, current or temperature in the distribution transformer. Therefore, we are proposing the automation of the distribution transformer from the EB substation. In the automation, we consider the voltage, current and temperature as the parameters to be monitored as the transformer shows its peak sensitivity for the same. Hence, we design an automation system based on microcontroller which continuously monitors the transformer. Because of the microcontroller operation, the transformer present in the substation which is turned off in the main station.

II. PROBLEM DEFINITIONS

Problem definition in the existing system, transformer monitoring is not at its efficient level. Hence life of transformer is going to decrease day by day due to its less maintenance.

To solve the problem of this problem, the present system is proposed. This include a WSN(wireless sensor network), a ZigBee protocol, and a CAN BUS to create an highly efficient system that can be used with high economical way and universly.

In high voltage industrial environments, electromagnetic interferences are expected at different frequency bands. These EMIs could increase a bit error rate and data packet loss in wireless communication. In such environment expected EMIs can also affect the WSN device's sensitivity, which causes the packet loss and delay in response time. Our research questions are: How the high voltage and harsh industrial environments do affect the WSN performance? Do the EM frequencies produced due to high voltage and industrial environments, interfere in WSN communication?

We assumed that the WSN performance is degraded due to the presence of high voltage and industrial environments. External EM interferences cause time delay and transmission loss.

III. DESIGN METHODOLOGIES WITH HARDWARE

3.1 Block Diagram

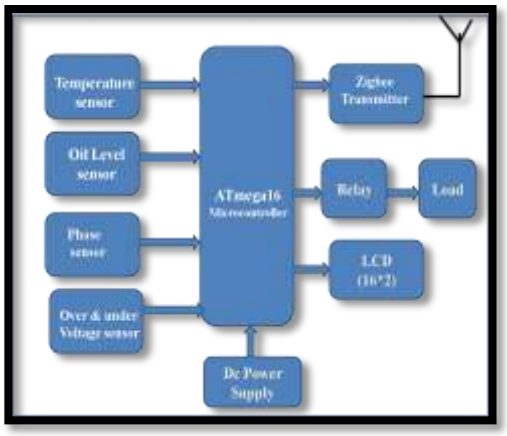

Fig.3.1 Transmitter

 ISSN: 2321-8169
199 – 202

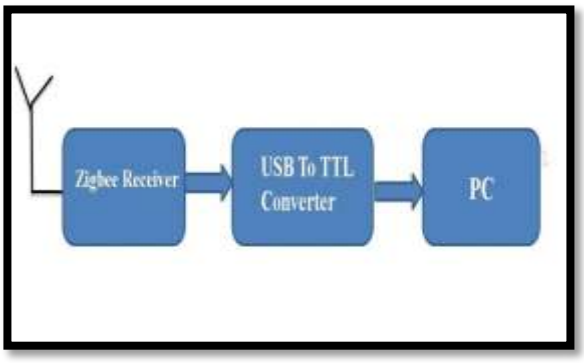

Fig.3.2 Receiver

The monitoring system is constituted by three major units, namely,

1. Data processing and transmitter unit
2. Load and Measurement Systems
3. Receiver and PC display unit

We have designed a system based on microcontroller (AVR) that monitors and controls the voltage, current and oil temperature of a distribution transformer present in a substation. The monitored output will be displayed on a PC at the main station that is at a remote place, through RF communication. Additionally the breakdowns caused due to the overload and high voltage are sensed and the signals are transmitted to the main station using RF communication. The software in the PC compares the received values with the rated measurements of the distribution transformer and shuts down the transformer so that it can be prevented from damages and performances can be enhanced quiet to a remarkable level.

The controller consists of a sensing unit which collects the essential parameters such as current, voltage and the oil temperature within the distribution transformer. The controller also senses the overload and high current flow conditions in the internal windings that may lead to breakdown of the corresponding unit. The parameter values sensed by the microcontroller are transmitted through the RF transmitter connected to the microcontroller unit.

The transmitted signals are received at the main station using the RF receiver. The received signals are then passed to the PC. The software loaded in the PC is used to monitor the changes in the parameters that are measured from the distribution transformer. When a remarkable change is noticed in the measured values it controls the unit by ending it from any serious damages.

3.2 Circuit Diagram

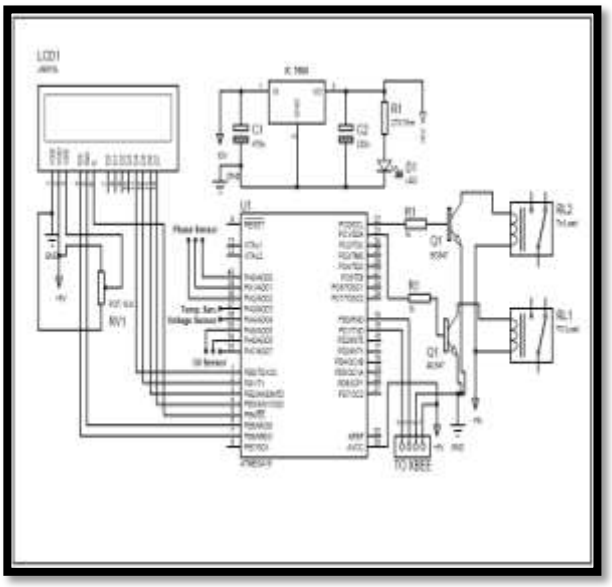

Fig.3.3 Circuit Diagram

IV. RESULT AND DISCUSSION

4.1 Advantages

- The sensor networks are programmed with various user interfaces suitable for users of varying ability as well as for expert users.
- The System can be maintained easily and interacted with very simply.
- It allows automation and monitoring of a transformer without the need of any change infrastructure.

4.2 Applications

It can be used in Electrical substations for its monitoring, protection, and control. This project can be used in industries where lot of machineries run on heavy power as it monitors all the machines process. Large scale industry and small scale industry can use it for its safety. Automation of any small area where many electrical devices are present can be done for e.g Process Controlling Unit. Real-time reporting of production information can be observed and Custom reports can be created upon request. Integrates work orders, production orders, quality, downtime and process parameter results.

4.3 Result

4.3 LCD Output

 ISSN: 2321-8169
199 – 202

Fig.4.1 Output 1

4.3.1 Result on Flash Magic

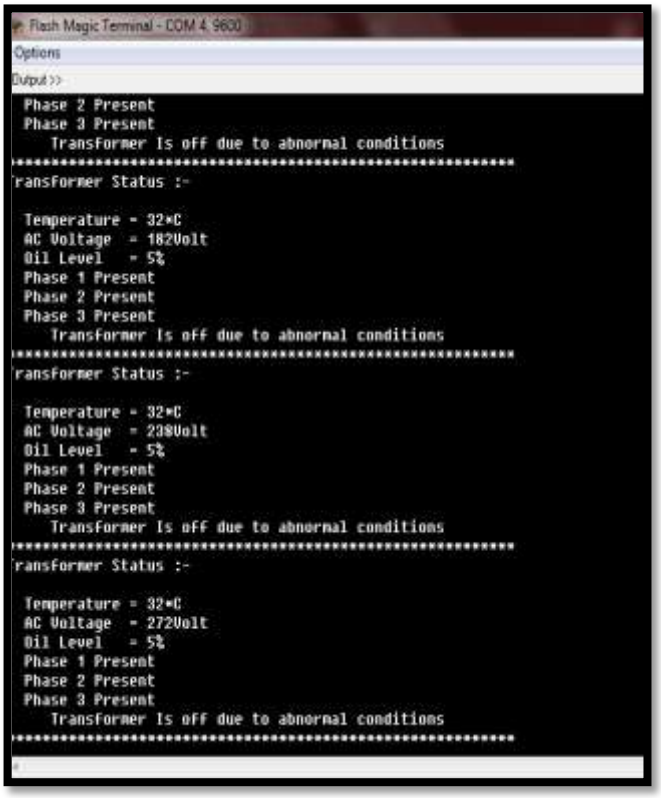

Fig.4.2 Result

V. CONCLUSIONS AND FUTUR SCOPE

5.1 Conclusion

In this Project we have presented a design of a system based on AVR microcontroller that is used to monitor and control the voltage, current and temperature of a distribution transformer. The proposed system which has been designed to monitor the transformers essential parameters continuously monitors the parameters throughout its operation. If the microcontroller recognizes any increase in the level of voltage, current or temperature values the unit has been made shutdown in order to prevent it from further damages. The system not only controls the distribution transformer in the substation by shutting it down, but also displays the values throughout the process for user‟s reference. This claims that the proposed design of the system makes the distribution transformer more robust against some key power quality issues which makes the voltage, current or temperature to peak. Hence the distribution is made more secure, reliable and efficient by means of the proposed system.

Analyses of these stored data help the utility in monitoring the operational behavior of their distribution transformers and identify faults before any catastrophic failures thus resulting in significant cost saving as well as improving system reliability.

5.2 Future Scope

The work conducted in this thesis has focused on the development of samrt powe monitoring and controlling based on the wireless sensor networks. Verious design intricacies, hardware and software level analysis and experimental tests have been done to achieve the research objectives. The developed unit can be easily implemeteted in the real time scenario. Furthermore, additional areas have also opened for the investigation in the future.

1. The sensing unit hardware size can be reduced.
2. The sensors used in this research need to be further calibrated to improve the results, although complexity of the sensing unit could be increased.
3. The sensing unit should be further expanded by installing more sensors to monitor envirnmental factors like temperature and humidity.
4. System capability can be further improved in terms of data storage.

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