GSM based Distribution Transformer Monitoring System

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***Abstract*— GSM based Distribution Transformer Monitoring System is about design and implementation of a mobile embedded system to monitor and record key parameters of a Distribution transformer like load currents, oil levels and ambient temperature. The idea of on-line monitoring system integrates a global service mobile (GSM) modem, with a standalone single chip micro-controller and different sensors. It is installed at the distribution transformer site and the above parameters are recorded using the analog to digital converter (ADC) of the embedded system. The obtained parameters are processed and recorded in the system memory. If any abnormality or an emergency situation occurs the system sends SMS (short message service) message to the mobile phones containing information about the abnormality according to some predefined instructions programmed in the micro-controller. This mobile system will help the transformer to operate smoothly and identify problems before any catastrophic failure.**

Keywords: Distribution Transformer, GSM, Microcontroller.

I. INTRODUCTION

In power systems,a distribution transformer is an electrical equipment which distributes power to the low power low-voltage users directly, and its operating condition is an important component of the entire distribution network. Operation of distribution transformer under rated condition (as per specification in their nameplate) guarantees their long life. However their life is significantly reduced if they are subjected to overloading resulting in unexpected failure and loss of supply to a large number of customers thus affecting system reliability. Overloading and ineffective cooling of transformers are the major causes of failure in distribution transformer exist some problems and deficiencies. Few of them are mentioned below.

(1) Ordinary transformer measurement system generally detects a single transformer parameter such as power, voltage, current and phase. While some detect multi parameter, the time of acquisition and operation parameter is too long and testing speed is not fast enough.

(2) Detection system itself is not reliable. The main problem is the device's instability, poor anti jamming capability, low measurement accuracy of the data..

(3) Timely detection data will not be sent to monitoring centers in time, which cannot judge transformers three phase equilibrium.

(4) A monitoring system can only monitor the operating state or guard against steal the power, and is not able to monitor all useful data of distribution transformers to reduce costs.

(5) Many monitoring systems use power carrier communication to send data.But the power carrier communication has some disadvantages like serious frequency interference, with the increase in distance signal attenuation, serious load changes brought about large electrical noise. So if we use the power carrier communication to send data in real time data transmission, reliability cannot be guaranteed.

According to the above requirements we need a distribution transformer's real time monitoring system to detect all operating parameters which affect the operation, and should be transmitted to the monitoring centre in time. It leads to online monitoring of key operational parameters of distributing transformer which can provide useful information about the health of transformer and keep the asset in operation for a longer period. This will help to identify problems before any serious failure which leads to a significant cost saving and greater reliability. Widespread use of mobile networks and GSM devices modems and their decreasing costs have made them an attractive option not only for voice media but for other wide area network applications.

II. LITERATURE SURVEY

There are different kinds of system developments, papers and thesis work done around this area, The supervisory control and data Acquisition (SCADA) system has been developed since about 1998 and it is implemented starting from generation up to substations level. But it is not used to monitor and control the status of distribution transformer status and were mainly focused on GSM technologies and most stayed at the substantial level.

In the journal of energy and power Engineering 7 (2013) 2181-2187, Samson et al published a paper titled "Development and implementation of GSM-based distribution Automation System with graphic user Interface in Nigeria electric power distribution Network". They developed a distribution automation system for Nigeria's electric power distribution network which mainly uses a GSM network for communication on the published paper. They stated that lack of up to date information on efficient operations and maintenance of electric power distribution system (EPDS), Nigeria is addressed by designing and implementing an indigenous real time monitoring and diagnosis system. Their system encompasses the

development of software driven hardware positioned at the remotely located sub-stations at the low voltage level to keep track of the network in real time. They achieved fault reporting time of 2 sec. The developed system exhibits a high degree of accuracy and manifests no spurious reports during testing. They then concluded that the resultant system limited the effects of interruptions and increases power availability by reducing the down time. The system strengthened engineering and management capabilities required to enhance reliability by providing information about the network health status

In the thesis paper titled "development of a novel fault management in distribution system using distribution automation system in conjunction with GSM communication" development and implementation of novel fault management at low voltage to enhance reliability of power for the consumer was focused on. Their system has been equipped with current sensor as field data interface device, microcontroller as remote terminal unit, GSM as communication network, computer as master terminal unit and visual basic as human machine interface (HMI) software. A fault design development of WCDMA based DTMS 12 management strategy has also been designed to find out the fault location effectively without human intervention after a fault occurred .The laboratory results were compared with the stimulation results to make the final conclusion on the functionality of the algorithm. This was published on International Journal of Smart Grid and Clean Energy, vol 2, no.3.

On another thesis paper published on the IOSR Journal of Electrical and Electronics Engineering titled "Microcontroller Based Substation Monitoring and control System with GSM Modem" , AmitSachan designed a project to acquire the remote electrical parameters like voltage, current and frequency and send these real time values over GSM network using GSM Modem/phone along with temperature at power station. Their project was also designed to protect the electrical circuitry by operating an Electromagnetic Relay. The Relay can be used to operate a circuit Breaker to switch off the main electrical supply. User can send commands in the form of SMS (short message service) message to read the remote electrical parameters. Their system also can automatically send the real time electrical parameters periodically (based on time settings) in the form of SMS. The system can be designed to send SMS alerts whenever the circuit breaks trips or whenever the voltage or current exceeds the predefined limit.

III. METHODOLOGY AND DATA

In our research approach we used three methods — identifying the problem clearly, literature review and design and development – to investigate the research areas and answer our research questions

- Identifying the problem: In this research we first identified the existing problem in the power system of Ethiopia and gave more emphasis on those problems of the distribution power system. We then tried to address the issue of monitoring a distribution transformer which help in increasing the efficiency of the distribution system. Therefore we identified the key parameters which are mainly affected when power system disturbances occur.
- Literature review : We identified the research gap and formulated a refined research goal .We knew more about the study area of the topic which we are going to research and learned from previous works done by other researchers in the area. In addition to this we gained better insight of our own research in relation to what has already been done

Design and Development: In this thesis we designed a prototype for monitoring a transformer using GSM network. Since this study is not concerned solely about creation of a prototype, we also made our work a factor that contributes to the existing knowledge. The prototype is used to demonstrate the contribution of knowledge from the data gained in the literature review and this part.

At the distribution transformer site, the parameters to be transmitted are sensed and converted in digital form.The digital signal is then recorded and transmitted to the control centre with the help of the GSM module.The entire block diagram is shown in

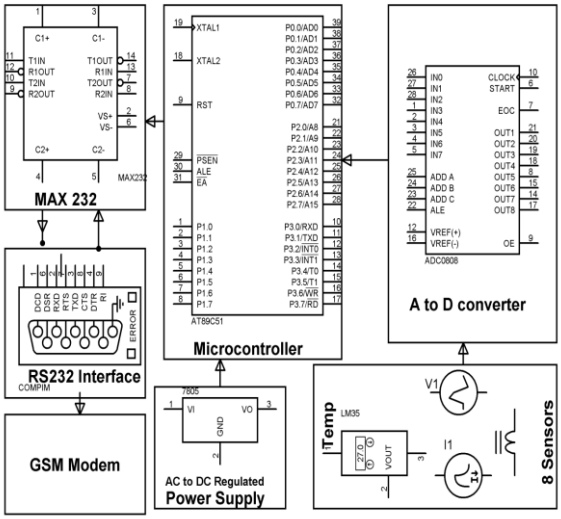

Fig no.1 Transmitter block diagram.

At the control centre,the received signal is decoded by the microcontroller and the corresponding parameter is displayed on the lcd display.The relays are triggered according to the predefined instructions stored in the microcontroller in abnormal working conditions of the distribution transformer.

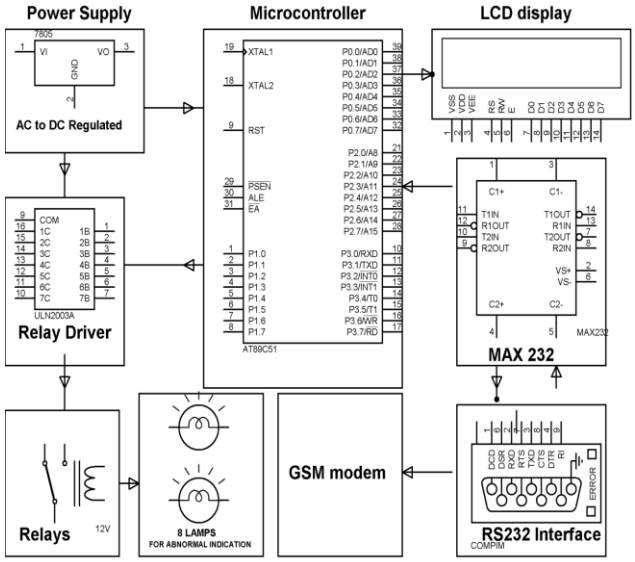

Fig no.2 Receiver block diagram.

IV. CONCLUSION

The GSM based monitoring of distribution transformer is quite useful as compared to manual monitoring and also it is reliable as it is not possible to monitor always the oil level temperature rise, ambient temperature rise, load current manually. After receiving a message of any abnormality we can take action immediately to prevent any catastrophic failure of distribution transformers. In a distribution network there are many distributions transformers and therefore associating each transformer with such system, we can easily figure out that which transformer is undergoing fault from the message sent to mobile .We need not have to check all transformers and corresponding phase currents and voltages and thus we can recover the system in less time. The time for receiving message may vary due to the public GSM network but still then it is effective than manual monitoring.

V. FUTURE WORK

A server module can be included to this system for receiving and storing transformer parameters information periodically about all the distribution transformer of a particular utility in a database application. This database will be useful source of information on the utility transformer. Analysis of these stored data helps the utility in monitoring the operational behavior of their distribution transformer and identities faults before any failures thus resulting in significant cost saving as well as improving system reliability.

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