GSM BASED DISTRIBUTION TRANSFORMER MONITORING SYSTEM

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ABSTRACT

This paper presents design and implementation of a mobile embedded system to monitor and record key operation indictors of a distribution transformer like load currents, transformer oil and ambient temperatures. The proposed on-line monitoring system integrates a Global Service Mobile (GSM) Modem, with standalone single chip microcontroller and sensor packages. It is installed at the distribution transformer site and the above mention parameters are recorded using the built-in 8-channel analog to digital converter (ADC) of the embedded system. The acquired parameters are processed and recorded in the system memory. If there is any abnormality or an emergency situation the system sends SMS (Short Message Service) messages to designated mobile telephones containing information about the abnormality according to some predefined instructions and policies that are stored on the embedded system EEPROM. Also, it sends SMS to a central database via the GSM modem for further processing. This mobile system will help the utilities to optimally utilize transformers and identify problems before any catastrophic failure.

Keyword: - *GSM kit, Transformer, sensors, rectifier, microcontroller, power supply, LCD..*

1.INTRODUCTION

In power systems, distribution transformer is electrical equipment which distributes power to the low-voltage users directly, and its operation condition is an important component of the entire distribution network operation. 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 failures and loss of supply to a large number of customers thus effecting system reliability. Overloading and ineffective cooling of transformers are the major causes of failure in distribution transformers [2]-[4]. The monitoring devices or systems which are presently used for monitoring 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, current, voltage, and phase. While some ways could detect multi-parameter, the time of acquisition and operation parameters is too long, and testing speed is not fast enough.

(2) Detection system itself is not reliable. The main performance is the device itself instability, poor anti-jamming capability, low measurement accuracy of the data, or even state monitoring system should is no effect.

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

(4) A monitoring system can only monitor the operation 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: serious frequency interference, with the increase in distance the signal attenuation serious, load changes brought about large electrical 2 noises. So if use power carrier communication to send data, the real-time data transmission, reliability cannot be guaranteed.

According to the above requirements, we need a distribution transformer real-time monitoring system to detect all operating parameters operation, and send to the monitoring center in time. It leads to online monitoring of key operational parameters of distribution transformers which can provide useful information about the health of

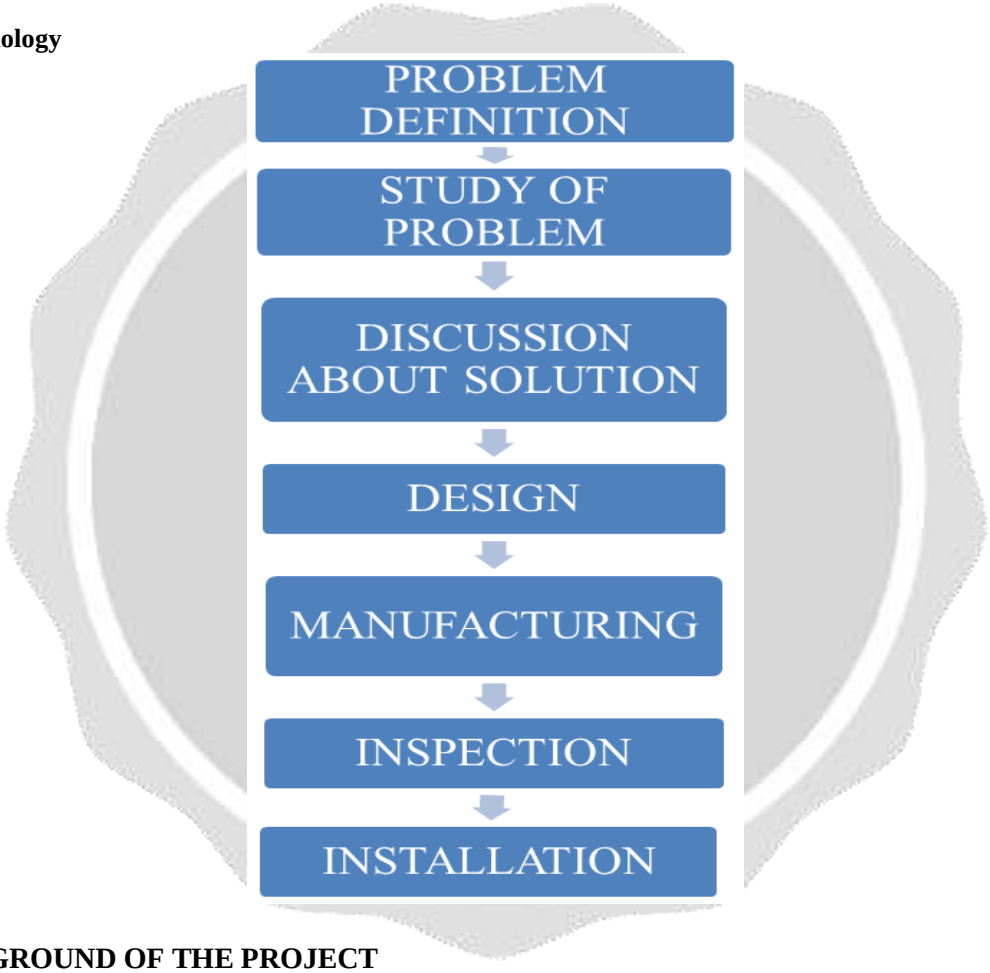
transformers which will help the utilities to optimally use their transformers and keep the asset in operation for a longer period. This will help to identify problems before any serious failure which leads to a significant cost savings and greater reliability. Widespread use of mobile networks and GSM devices such GSM modems and their decreasing costs have made them an attractive option not only for voice media but for other wide area network applications.

1.2 Objectives

There are three main objective of this system is as follows

- providing protection against overheating .
- proper indication of oil level .
- proper indication of over current.
- increase safety of transformer .

1.3 Methodology

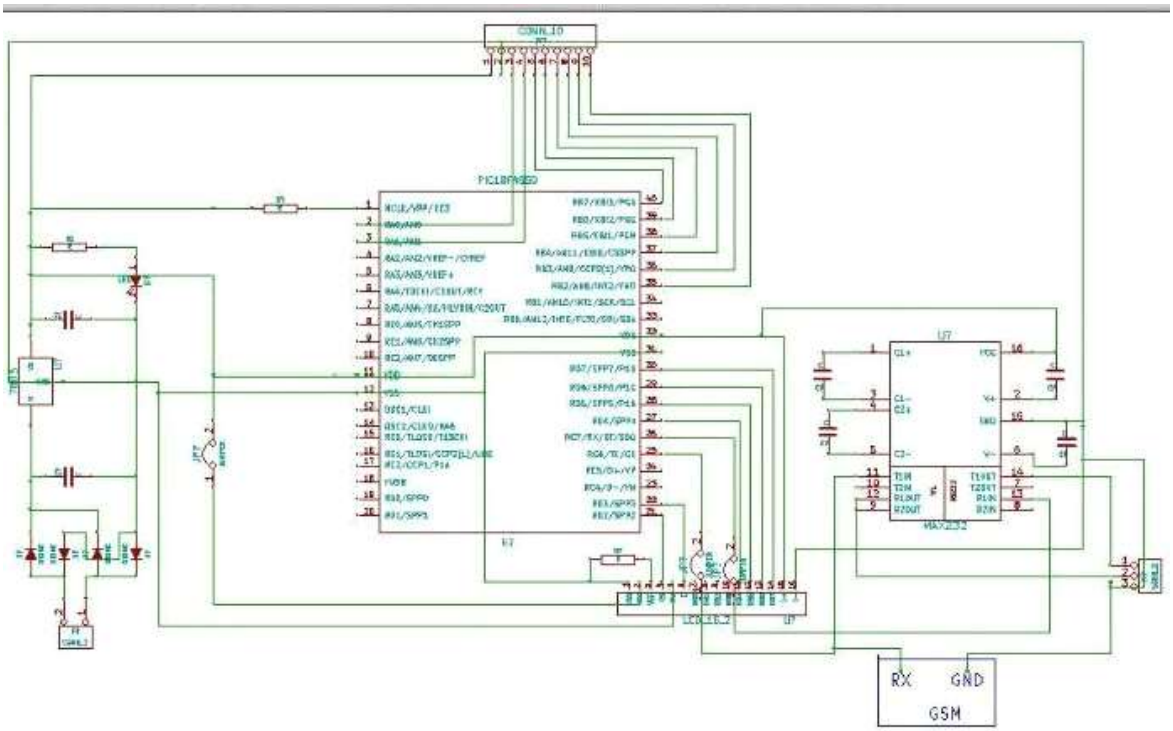


2. BACKGROUND OF THE PROJECT

Abnormality in distribution transformer is accompanied with variation in different parameters like Winding temperature , Top and bottom oil temperatures, Ambient temperature, Load current, Oil flow (pump motor), Moisture in oil ,Dissolved gas in oil, Bushing condition, LTC monitoring, Oil level. However, we are dealing with oil temperature and load current.

Online monitoring system consists of embedded system, GSM modem, mobile-users and GSM networks and sensors installed at transformer site Sensors are installed on transformer side which reads and measures the physical quantity from the distribution transformer and then it converts it into the analog signal. The embedded module is located at the transformer site. It is utilized to acquire, process, display, transmit and receive the parameters to/ from the GSM modem. The second is the GSM module. It is the link between the embedded system and the public GSM network. The third is utility module that has a PC-based -server located at the utility control center. The server is attached to GSM modem and received transmits SMS from/to the transformer site via the GSM module.

3.WORKING



First sensors which are installed at the transformer site sense the various parameters of transformers and convert into analog signal to be processed in signal conditioning circuits

- Next the SCC consisting of opamps and resistors manipulates the analog signal to a compatible value so that can be read by the embedded system.

- Next the signal is passed through microcontroller. The ADC is used to read the parameters, built-in EEPROM is used to host the embedded software algorithm that takes care of the parameters acquisition, processing, displaying, transmitting and receiving. The built-in EEPROM is used to save the online measured parameters along with their hourly and daily averages.

- The GSM modem is interfaced with the microcontroller through RS 232 adapter by which it upload and download SMS messages that contain information related to the transformer parameters and status.

- This GSM modem then sends this SMS to mobile users containing information about parameters value of the distribution transformers.

4. GSM MODEM

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem is like a dial-up modem. The basic difference between them is the dial-up modem sends and receives data through a fixed telephone line while the wireless modem sends and receives data through waves. Like a GSM mobile phone, a GSM[7] modem also requires a SIM card from a wireless carrier to operate. SIM 300 is a Fixed Cellular Terminal (FCT) used for data applications. It is a compact and portable terminal which satisfy various data[7] communication over GSM. It also can be connected to a computer with a standard RS232C serial port. SIM 300 offers features like Short Message Services (SMS), Data Services (sending and receiving data files), Fax Services and data file connectivity through wire is not available or not possible. The SIM 300 is very easy to set up. It also finds its applications in IT

companies, Banks, Financial Institutions, Service Providers, Far away Project Sites, and other business establishments.

4.1 INSTRUCTION OF GSM MODEM

AT commands: AT commands are the instructions used for controlling a modem. AT stands for Attention. Each and every command line starts with "AT" or "at". Because of this modem commands are called AT commands. Many of the commands are also used for controlling wired dial-up modems. These are supported by GSM/GPRS modems and mobile phones. Apart from this common AT command set, GSM/GPRS modems and mobile phones also support an AT command sets which are specific to the GSM technology, which also includes SMS-related commands.

Basic Commands and Extended Commands:

There are two types of AT commands: They are basic commands and extended commands.

- Basic commands are AT commands that do not start with "+". For example, D (Dial), A (Answer), H (Hook control) and O (Return to online data state) are basic commands.

- Extended commands are AT commands that start with "+". All GSM AT commands are extended commands. For example, +CMGS (Send SMS message), +CMSS (Send SMS message from storage), +CMGL (List SMS messages) and +CMGR (Read SMS messages) are extended commands.

5. SOFTWARE IMPLEMENTATION

This chapter describes about the software implementation of the project. This discuss about the programming and the software tools used and how output is obtained by programming.

5.1 SOFTWARE TOOLS

AVR Studio and Pro Load are two software used to program microcontroller.

5.2 PROGRAMMING MICROCONTROLLER

The compiler for high level language helps to reduce production time. For programming ATmega16L AVR Studio is used. The programming is done in embedded C language. The 24

compilation of the C program converts it into machine language file (.hex). This is the only language the microcontroller will understand, because it has the original program code converted into a hexadecimal format. During this process some errors and warnings occurs. If there are no errors and warnings then run the program, the system performs all the given tasks and behaves as expected the software developed. If not the whole procedure is repeated again.

5.2.1 AVR STUDIO

AVR studio is software used where machine language code is written and compiled. After compilation machine source code is[6] converted to hex code to be burnt into the microcontroller. The program is written in C language code.

5.2.2 PROLOAD

Proload is software that accepts only hex files. After the machine code is converted into hex code, that hex code has to be burnt into the microcontroller which done by the Proload. Proload is a programmer which contains a microcontroller in it other than the one which is to be programmed. The program is written in the Proload microcontroller in such a way that it accepts the hex file from the AVR Studio and burns this hex file into the microcontroller which is to be programmed. The Proload programmer kit requires power supply to operate, this power supply is given by the power supply circuit. It is noted that this programmer kit contains a power supply section in the board but in order to switch on the power supply, a source is required. This is accomplished from the power supply board with an output of 12 V.

- Microcontroller Software Compiler generates a Hex file.
- Hex file accepted and sent to MCU program Loader.
- Hex file programmed into Target Microcontroller device.

6. RESULT

Nameplate rating of Distribution Transformer:
KVA rating: 500
Cooling type: oil natural
Voltage rating:
HV: 11KV
LV: 0.4KV
Current rating:
HV: 26.24A
LV: 666.70A Impedance voltage: 3.92%
Vector Group: Dy11
Maximum Temperature Rise in oil: 45 deg.C
We need to monitor voltage and currents in phase.
Under normal condition
Ia=121.4A Vab=442.0V
Ib=108.8A Vbc=437.2V
Ic=138.5A Vca=440.3V
Taking the data of previous fault condition
Instantaneous load current in phases
Ia=318.6A
Ib=294.4A
Ic=333.1A
These currents of high magnitudes can't be fed directly to our designed system. It needs to be scaled down. For this purpose current transformer and potential transformer can be used in practice. The current and voltage after being scaled down is fed to microprocessor based system where it compare it with the reference value and take consequent action.

7.CONCLUSION AND FUTURE WORK

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, oil temperature rise, ambient temperature rise, load current manually. After receiving of message of any abnormality we can take action immediately to prevent any catastrophic failures of distribution transformers. In a distribution network there are many distribution transformers and 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 messages may vary due to the public GSM network traffic but still then it is effective than manual monitoring.

A server module can be included to this system for receiving and storing transformer parameters information periodically about all the distribution transformers of a particular utility in a database application. This database will be a useful source of information on the utility transformers. Analysis of these stored data helps 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.

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