IOT BASED TRANSFORMER PARAMETER MONITORING

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Abstract- *Distribution transformers are one of the most important equipment in power network. Because of, the large number of transformers distributed over a wide area in power electric systems, the data acquisition and condition monitoring is an important issue. The main aim of this system is distribution transformer monitoring and controlling through IoT. Here transformers are damaged due to voltage, current, temperature and oil level. Oil level depends on different parameters and environmental conditions. Now in this system we are concentrating on temperature, voltage, current and oil level of transformer. In this system monitoring and control action of all parameters of transformer is performed based on the AVR microcontroller ATMEGA 328. After interfacing the required components, user has to develop one application program in embedded-c. Here controller is continuously reading the temperature, voltage, current and oil level and display it on the LCD.*

Keywords- Words:Transformer parameter, monitoring, voltage, current, oil level and temperature etc.

I. INTRODUCTION

The operation of distribution transformer under rated conditionguarantees 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 at the great extent. The overloading and ineffective cooling of transformers are the major causes of failure in all distribution transformers. The monitoring devices or systems which are presently used for monitoring distribution transformer exists some problems and deficiencies in it. Few of them are mentioned below.

1) All ordinary transformer measurement system generally detects a single transformer parameter, such as power, current, voltage, and phase. While some ways could detect multi parameters, the time of acquisition and operation parameters is too long and testing speed is not fast enough for monitoring.
2) The detection system itself is not reliable. The main performance is the device itself aninstability, a poor anti-jamming capability, low measurement accuracy of the data or even state monitoring system should have no effect on transformers.
3) Timely detected data will not be sent to a monitoring centre in time, which cannot judge the transformers three-phase equilibrium.
4) All monitoring system can only monitor the operation state or guard against stealing the power and it is not able to monitor all useful data and parameters of distribution transformers to reduce a cost.
5) Many monitoring systems use power carrier communication to send the data, but the power carrier communication has some disadvantages in it so due to this, serious frequency interference, with the increase in distance the signal attenuation becomes serious, load changes brought about large electrical noise. So if use power carrier communication to send the data, then 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 the operating parameters and send it to the monitoring centre in time for accurate monitoring. It leads to online monitoring of all the 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 very longer period. This will help us to identify problems before any serious failure which leads to a significant cost savings and greater reliability.

II. OBJECTIVE

The main goal of the Transformer Monitoring System is to read and record important information about transformers. Once recorded, the information is sent through wireless connections to a central hub computer through IoT and Wi-Fi module ESP8266. The web server then presents all of the information in anorganized manner, so that faults can be detected very easily. Several key goals of this entire device are that it needed to be extremely affordable, due to the large quantity of transformers in a given radius.

III. DIAGRAMS AND WORKING

3.1 BLOCK DIAGRAM

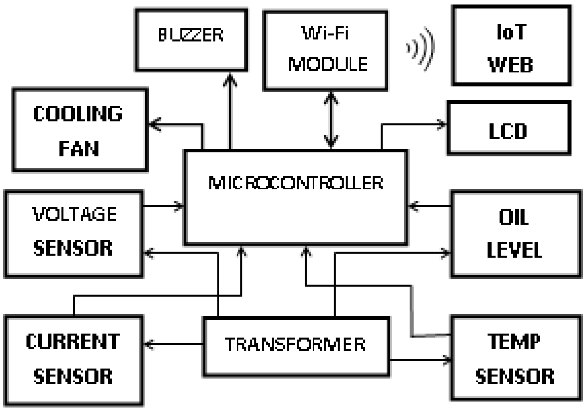

Fig -1: Block Diagram

3.2 CIRCUIT DIAGRAM

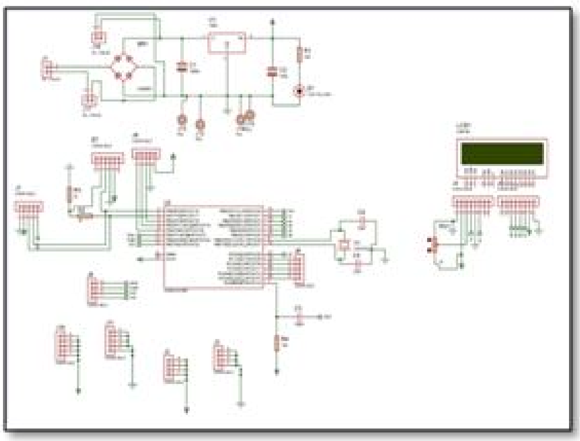

Fig -2: Circuit Diagram

3.3 WORKING

IoT based transformer monitoring system consist of ATmega328 microcontroller which enters all our input and output commands, also it contain ESP8266 Wi-Fi module, it upload all sensors data of transformer to remote server. Such that we can authenticate and observe it by taking an appropriate observation.

Firstly we have used current sensors, voltage sensors and temperature sensors. Voltage sensors work on the principle of potentiometer divider i.e. resistor divider network it gives us output in terms of voltage, we convert it in a 12v in our case into 5v, and that 5v is thenapplied to our microcontroller ADC. ADC converts analog voltage value into digital value that digital value is then again converted it into analog value by some programming calculation. Here we monitor voltage sensor, also current sensor which operate on the bandwidth. Temperature sensors is LM35 which gives 10mv/^{o}c. All values of sensors are recorded to the microcontroller and also display it on LCD display. Oil level of the transformer monitored by HC-SR04 sensor, it gives alert whenever the oil level fall below some certain value.
Whenever any faulty condition occur the microcontroller automatically switched off the relay which switched off the transformer load. When the fault resolves, the transformer will come to the normal condition & it automatically switched on the transformer.

The overall project works on AC power supply which is converted into 5v by using 4v adapter and 12v is converted into 5v by using voltage regulator IC 7805. Here we are using ATmega328 which has 28 pins, 20kbyte internal memory, and 8 bit microcontroller. From those 28 pins, 20 pins are input pins and other 8pins are output pins and they are analog pin.

IV. COMPONENTS USED

The hardware components used in this project are as follows:

1. ATMEGA 328 MICROCONTROLLER (AVR FAMILY)
2. Wi-Fi MODULE ESP 8266
3. SENSORS – VOLTAGE, CURRENT, TEMPERATURE AND OIL LEVEL
4. IC LM7805 VOLTAGE REGULATOR 5. 16X2 LCD

4.1 ATMEGA 328 MICROCONTROLLER (AVR FAMILY)

The high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byteoriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

4.2 Wi-Fi MODULE ESP 8266

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.
The chip first came to the attention of western makers in August 2014 with the ESP01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi. The successor to these microcontroller chips is the ESP32

4.3 SENSORS

4.3.1 VOLTAGE SENSORS

A voltage sensor is a device which detects the electric voltage in a wire, and generates a signal proportional to it. The generated signal could be analog voltage or current or even digital output. It can be then utilized to display the measured voltage in a voltmeter or can be stored for further analysis in a data acquisition system or can be utilized for control purpose.

4.3.2 CURRENT SENSORS

A current sensor is a device that detects electric current (AC or DC) in a wire, and generates a signal proportional to it. The generated signal could be analog voltage or current or even digital output. It can be then utilized to display the measured current in an ammeter or can be stored for further analysis in a data acquisition system or can be utilized for control purpose. The sensed current and the output signal can be: Alternating current input, analog output, which duplicates the wave shape of the sensed current. Bipolar output, which duplicates the wave shape of the sensed current. Unipolar output, which is proportional to the average or RMS value of the sensed current. Direct current input, unipolar, with a unipolar output, which duplicates the wave shape of the sensed current digital output, which switches when the sensed current exceeds a certain threshold.

4.3.3 TEMPERATURE SENSOR

Temperature sensor vary from simple ON/OFF thermostatic devices which control a domestic hot water heating system to highly sensitive semiconductor types that can control complex process control furnace plants. We remember from our school science classes that the movement of molecules and atoms produces heat (kinetic energy) and the greater the movement, the more heat that is generated. Temperature Sensors measure the amount of heat energy or even coldness that is generated by an object or system, allowing us to “sense” or detect any physical change to that temperature producing either an analogue or digital output. There are many different types of Temperature Sensor available and all have different characteristics depending upon their actual application.

4.3.4 OIL LEVEL SENSOR

Oil level sensor is a device which is used to check the oil level in the transformer. Due to overheating the oil start to evaporate and the oil level decreases and thus this decrease in the oil level may be dangerous to the transformer. Thus this sensor indicates the level and we get aware about the level. Thus we can look over the oil viscosity also.

4.4 IC LM7805 VOLTAGE REGULATOR

7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.

4.5 16X2 LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.
A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position,

controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

V. APPLICATION

The major areas captured by it are:

- In power generation station for maintaining big transformer
- In farm for transformer protection
- In chemical and textile industries for protection of fire due to transformer
- In city where main transformer is use to divide electricity area wise.

VI. ADVANTGES

- Easy fault detection
- Reduction in cost due to the use of popular integrated circuit.
- All parameters of transformer are detected like current, voltage, temperature & oil level. Low power consumption & mobility.

VII. LIMITATIONS

- Dependability on the internet networking
- Less privacy due to the use of internet.

VIII. FUTURE SCOPE

- An artificial intelligence can be comprised to this system for receiving and storing transformer parameters information occasionallyabout all the distribution transformers.
- In future, we can have on board computer or the display system on which we can set the parameters of distribution transformers.

IX. RESULT

This system would be eliminating the requirement of human power and thus providing efficiency and accuracy. This project will give accurate details of transformer parameters like voltage, current, oil level and temperature. It will help to manage sensing the parameters and also record details for fault detection and monitoring and display it on LCD. This project will also assure the safety and would not result in any harm to the environment and surroundings.

X. CONCLUSION

An IOT based transformer monitoring system for power transformer will be designed, implemented and tested. It is quite useful as compared to manual monitoring and also it is reliable. A server module can be added to this system to periodically receive and store transformer parameters information about all the power transformers. After receiving message on any abnormality we can take an immediate action to prevent any disastrous failures of power transformers. We need not have to check all power transformers and corresponding phase currents and voltages and thus we can recover the system in less time and faults before any uncertain failures thus resulting in significant cost saving as well as improving system reliability.

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