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Transformer Parameter Monitoring System using IoT Technology

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***Abstract*: Distribution transformer is an important component of an electricity distribution system. The distribution transformer distributes electrical energy to low voltage users directly. This project presents monitoring and protection system of distribution transformer. Which is an embedded system used to monitor different parameters that directly affects transformer. Different sensors are used for monitoring current, voltage, oil level and temperature. According to the interpretation of these sensor's microcontroller takes action to maintain constant operating conditions of transformers. Proposed system is low cost, easy to use, capable of monitoring and displaying data using IoT.**

***Keywords*: Transformer, sensors, microcontroller, IoT.**

1. Introduction

Transformers are vital part of electrical distribution system. Monitoring of transformers is necessary to avoid transformer failure. In India during summer transformer failure rate increases, overloading and overheating are the main reasons of transformer failure. Reliability and life of transformer units depends on monitoring of functional parameters. Since Distribution transformers are directly connected to load therefore sudden variations in loads also causes fault occurrence. The present method of monitoring is manual which are time consuming and requires lot of labor work, which does not give current value of some parameters such as overload current and overheating of transformer. This can reduce transformer life. This project deals with IoT based wireless monitoring system that protects transformer from failure.

2. Block Diagram

Figure 1(a) Shows block diagram of our project. In this diagram there are hardware components like temperature sensor, oil level sensor, current sensor, voltage sensor, ADC, LCD display, Wi-Fi module, circuit breaker. These hardware components are controlled by microcontroller which is main part of our project.

Figure 1(b) Shows that our hardware is connected to our PC and Smart Phone through internet and data is transferred to PC or Smart Phone.

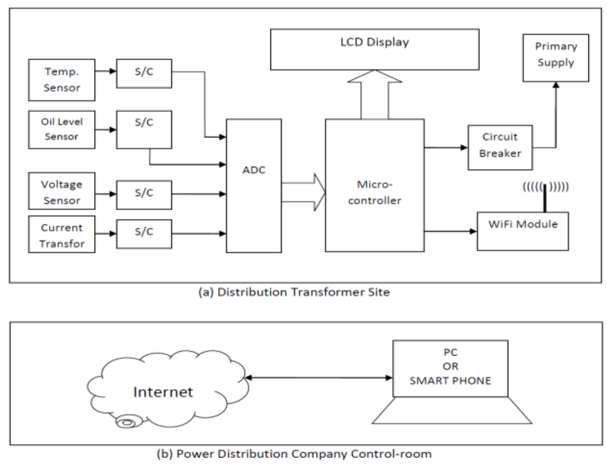

Fig. 1. Block diagram and hardware

3. Hardware Description

A. Microcontroller

Here we are using Microcontroller AT89C52 comes from the 8051 family of Atmel microcontrollers.

Features:

- Compatible with MCS-51™ Products
- 8K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 256 x 8-Bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel
- Low Power Idle and Power Down Modes

In our project, the output of voltage sensor, current sensor, temperature sensor and oil level sensors given to microcontroller AT89S52 and according to command the message will go to LCD and the data is displayed on that LCD screen. Also, if any parameters cross fixed level Circuit Breaker

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will trip circuit.

B. LCD

LCD is Liquid Crystal Display which is situated at top of transformer. When operator is near to transformer, he can see all parameter on LCD. Here we are using 20*4 LCD.

C. ADC 0808

- Easy interface to all microprocessors
- Operates ratio metrically or with 5 VDC or analog span adjusted voltage reference
- No zero or full-scale adjust required
- 8-channel multiplexer with address logic
- 0V to 5V input range with single 5V power supply
- Outputs meet TTL voltage level specifications
- Standard hermetic or molded 28-pin DIP package
- 28-pin molded chip carrier package
- ADC0808 equivalent to MM74C949
- ADC0809 equivalent to MM74C949-1

ADC is Analog to Digital Converter. This is used to convert analog signal collected from sensors to digital signal which will give to the microcontroller.

D. Temperature sensor

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. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the water level. The LM35’s low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies.

E. Voltage sensor

It is used to measure voltage in electrical power system. When voltage is too large to be conveniently used by an instrument it can be scaled downed to standardized low value. A voltage sensor is a device which detects the voltage in a wire, and generates 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.

F. Current sensor

Current sensor provides economical and precise solution for current sensing in industrial, commercial and communication systems. Typical applications include motor control, load detection and management, over-current fault detection and any intelligent power management system etc. A current sensor is a device that detects electric current 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.

G. Oil level sensor

We are using a float type liquid level sensor. It will be a variable resistance type sensor. It will rotate from 0® to 90® and its resistance will vary from 0 ohm to 10k ohm.

H. Wi-Fi module

Our ESP8266 is an impressive, low cost Wi-Fi module suitable for adding Wi-Fi functionality to an existing microcontroller project via a UART serial connection. The module can even be reprogrammed to act as a standalone

Wi-Fi connected device–just add power!

The feature list is impressive and includes:

- 802.11 b/g/n protocol
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack

The hardware connections required to connect to the ESP8266 module are fairly straight-forward but there are a couple of important items to note related to power:

- The ESP8266 requires 3.3V power–do not power it with 5 volts!
- The ESP8266 needs to communicate via serial at 3.3V and does not have 5V tolerant inputs,

so, you need level conversion to communicate with a 5V microcontroller like most Arduinos use.

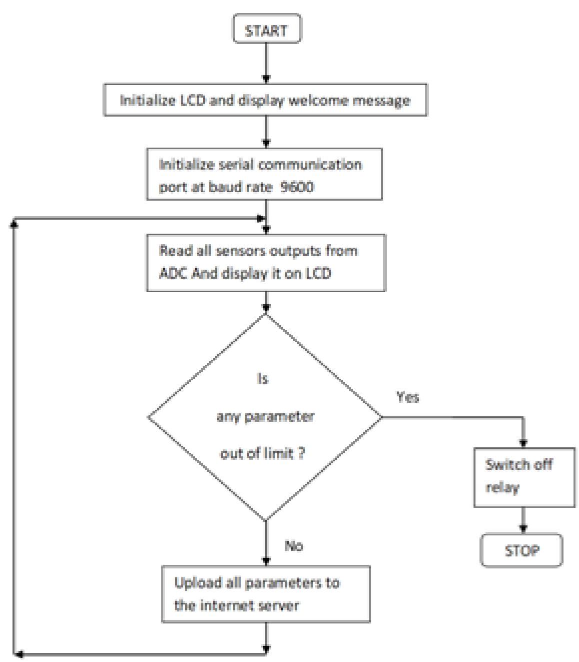

Fig. 2. Flowchart

4. Result

We have made simulation in proteus 8 professional as shown in figure 3. When we start program first LCD initialize and welcome message will be displayed on LCD. Then initialize serial communication.

Form all sensors parameters will be given to the ADC and then displayed on LCD. If any parameter is out of limit then relay will trip and if all parameter is in limit data will be transferred to the internet server.

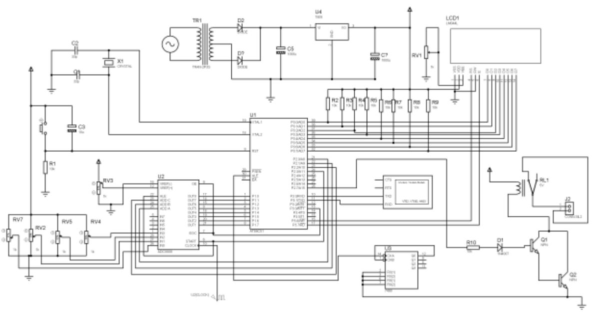

Fig. 3. Simulation diagram

5. Conclusion

In this project, the distribution transformer key parameters like voltage, current, oil level and temperature are monitored using Microcontroller. Monitored parameters are transferred from the Microcontroller to the PC using IoT technology. The environment conditions can affect normal operation of transformer. These cannot be eliminated but we can control some condition. This project does not provide the overall solution for transformer failure but it can control some major parameter so that it can be a good solution for transformer protection.

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