Industrial Transformer Monitoring And Controlling Using IoT

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Abstract- *A Transformer network wireless monitoring system is developed to monitor parameters like load current,over voltage,oil level and temperature. It consist of a microcontroller based circuit with solid state components for handling sensors, power back-up, data communication module based on IOT protocol.Sensors are including current sensor,voltage sensor,oil level sensor and temperature sensor. The system is installed at the transformer site and by measuring above parameters it will help the utilities to optimally utilize transformers and identify problems before any failure. This paper provides a solution for reducing the man power in monitoring of the transformer in online by analyzing various parameters like voltage, current, temperature, oil level by using current sensor,voltage sensor,oil level sensor and temperature sensor. The sensors are used to monitoring the various parameters in transformer with the help of microcontroller.*

Keywords- Transformer, PIC16F887A, Wifi module (ESP8266),LCD display,Arduino Uno(Atmega 328p).

I. INTRODUCTION

Transformer is a very important and critical component which acts as a link between the generation, distribution and consumer end of a power network [1]. System programmed with some predefined instructions to check abnormal conditions. If there is any abnormality on the system, details are automatically updated in the internet through serial communication [2]. If there is any abnormality on the system, the GSM module will send SMS(Short Message Service) messages to designated mobile telephones containing information about the abnormality according to the aforesaid predefined instructions [3]. A sensor or a network of sensors are used to sense the physical parameters or the respective environment. These processed sensor output are then send to the main server or cloud with the help of various network devices [4]. Health monitoring of electrical equipment using IOT may help to replace the equipment before failure and continuity of the power will not be disturbed [5].If there is any abnormality on the system, the GSM module will send SMS(Short Message Service) messages to designated mobile telephones containing information about the abnormality according to the aforesaid predefined instructions[6].Deregulation in power industry accelerates competition among various power companies[7]. PIC microcontroller of series 16F877A is used in the proposed model. The various parameter that are monitored in this system arefed to the microcontroller is fed to various ports [8]. Protection of the power system is an important aspect to protect electrical components against the faults to increase their lifetime, postpone unwanted replacement cost of damaged ones and assure continuity of supply to serve the growing demand [9].

The distance between the generator and the load might be several miles, the scale of the commerce of massive force over a long distance has emerged due to the low cost of electric force [10]. Because of the popular extension for client-side power, the request for client-side power has raised the alarm [11]. A transformer is very important in substation and power system. The data assets and provision of transformer is an very important aspect in electric network as huge number distribution transformers are distributed a huge area[12].

II. RELATED WORKS

V.A.PATIL , et al.,2017 “Transformer Monitoring and Controlling with GSM Based System” If we look back towards our daily routine we can conclude that electricity is the inseparable part of our life and transformers plays a role of electricity carrier to us from generation stations[13].

Divyank Srivastava,M. , et al., Published in 2018 “Health monitoring of electrical equipment using IOT” may help to replace the equipment before failure and continuity of the power will not be disturbed[14].

T. Anil Kumar, et al., 2017 “Development of IOT has (Internet of Things) framework for condition monitoring and controlling of larger number of distribution [15].

S. Gokula Krishnan , et al.,at 2019 "GSM Based Transformer Fault Monitoring System". Transformers are a vital part of the transmission and distribution system [16].

Walid K A Hasan, et al., 2019 ,"Design and Implementation Smart Transformer based on IoT" Power transformers, which perform the function of transforming the voltage levels, are one of the most important electrical equipments that are used in power transmission systems[17].

Siddhant Gaikwad , et al.,2017 GSM based "Distribution Transformer Monitoring System International Journal of Engineering Research & Technology "(IJERT) ISSN: 2278-0181.GSM based Distribution Transformer Monitoring System is about design and implementation of a mobile embed-ded system to monitor and record key parameters of a Distribution transformer like load currents, oil levels and ambient temperature [18].

Bhakare Govind A, et al., 2017 GSM BASED DISTRIBUTION TRANSFORMER MONITORING SYSTEM 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[19].

III. SYSTEM DESIGN

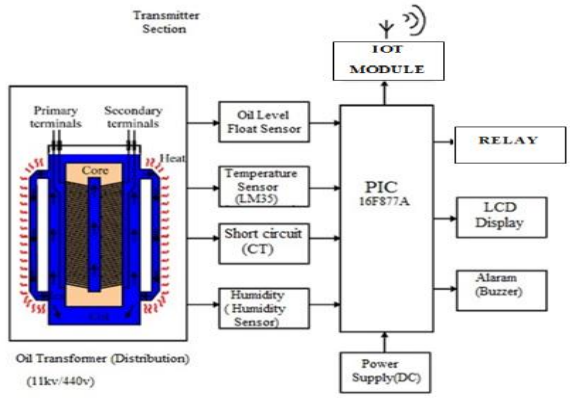

Figure 1.Block diagram

Power supply is used to turn on the microcontroller. Coolant oil level, humidity sensor and voltage sensor, current transformer are used to detect the transformer's parameters.Indicators and LCD are connected to the microcontroller.To control the whole process control driver connected with micro controller is used.From the controller the data's of the transformer is send to the mobile app(cloud) through Wi-Fi module which is ESP8266.

1.Arduino Uno (Atmega 328p)

The Arduino Uno is a microcontroller board based on the Atmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable.The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter[20].

Figure 2.Arduino Uno

2.Current sensor

The Allegro ACS712 provides economical and precise Solutions for AC or DC current sensing in industrial, commercial, and communications systems. Typical applications include motor control, load detection and management, switch mode Power supplies and overcurrent fault protection[21].

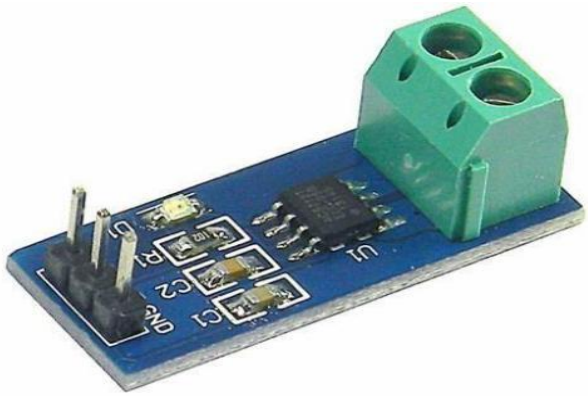

Figure 3.Current sensor

3.Voltage sensor

A voltage sensor is a device which detects the celectric voltage in a wire, and generates aq 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[22].

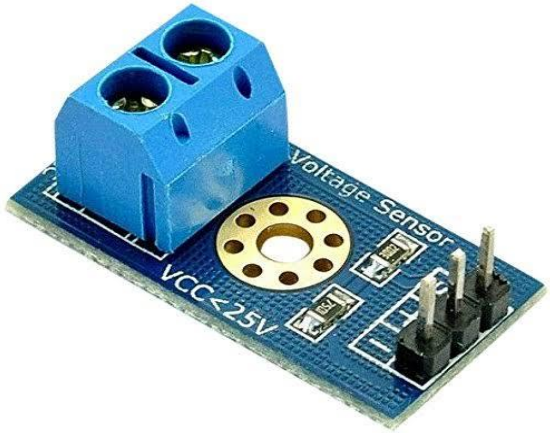

Figure 4.Voltage sensor

4.Oil level sensor

Oil in addition to serving as insulating means serves to transfer the heat generated in the windings and the core toward the wallsof the tank and the radiators. Due to this it has: High dielectric breakdown– Low viscosity– If the oil leaks from the transformer tank due to some reason, the oil level in the tank will drop. In the worst case, the connections to bushings and parts of the winding will get exposed to air. This will increase the temperature of the windings. This in turn, would damage the insulation of the winding. Apart from this moisture can get in through the leak, and degrade the transformer oil – leading to an overheated transformer. In power transformer, the conservator tank is provided with an oil level indicator having an alarm facility. If the oil level drops below a predetermined level, the alarm will ring. It allows the operator to initiate necessary action[23].

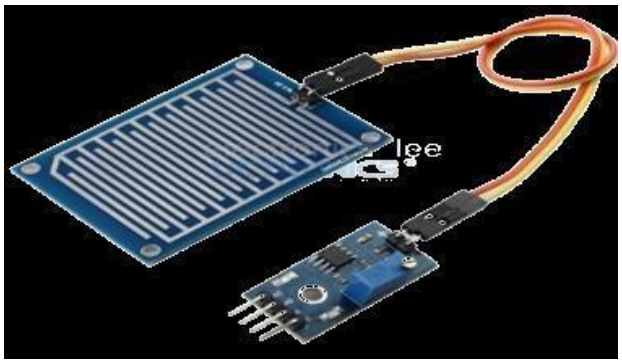

Figure 5. Oil level sensor

5.Temperature sensor

LM35 measures temperature of windings for distribution transformer. As temperature sensor is integrated circuit sensor which gives analog output. Voltage increases whenever temperature rises. Actually sensor records any voltage drop between the transistor base and emitter. This voltage is then amplified and gives analogue signal that is proportional to the temperature[24].

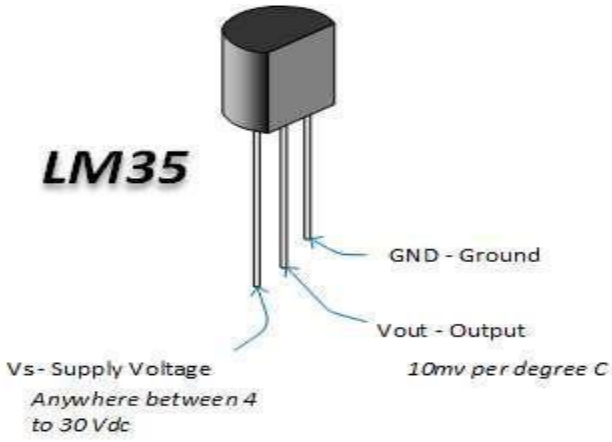

Figure 6. Temperature sensor

6.Relay

A Relay Is An Electrical Switch That Uses An Electromagnet To Move The Switch from The Off To On Position Instead Of A Person Moving The Switch. It Takes A Relatively Small Amount Of Power To Turn On A Relay, But The Relay Can Control Something That Draws Much More Power. The AC Unit Probably Runs Off Of 220VAC At around 30A. Few Watts to Pull the Contacts together[25].

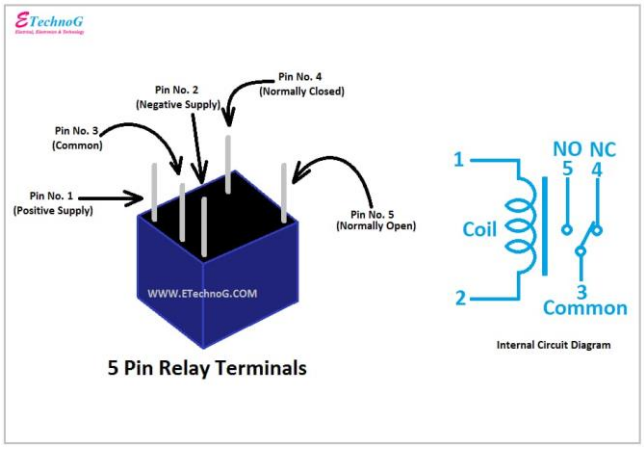

Figure 7.Relay

7.LCD display

The liquid-crystal display has the distinct advantage of having low power consumption than the LED. It is typically of the order of microwatts for the display in comparison to the some order of mill watts for LEDs. Low power consumption requirement has made it compatible with MOS integrated logic circuit. Its other advantages are its low cost, and good contrast. The main drawbacks of LCDs are additional requirement of light source, a limited temperature range of operation (between 0 and 60° C), low reliability, short operating life, poor visibility in low ambient lighting, slow speed and the need for an ac drive[26].

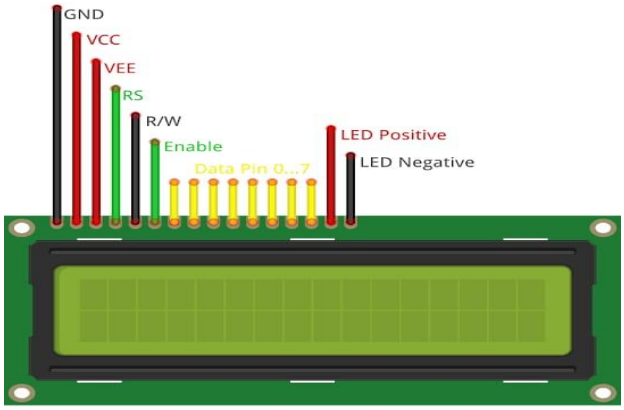

Figure 8.LCD display

8.Wifi module

The ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi- ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever growing, community[27].

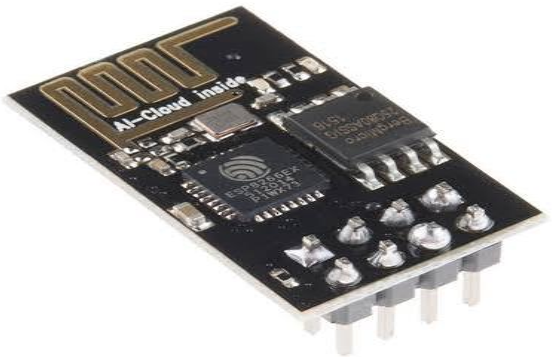

Figure 9.Wifi module

9.PIC Microcontroller –PIC 16F877

PIC16F877A is the brain of this protection circuit. This microcontroller has on chip ADC which converts analog values to digital values. This sampled value compared with pre-set values and decision is taken according to programming, hence microcontroller is decision making device. As compared to microprocessor microcontroller have simple structure and fast responding capacity. Power consumption is less for PIC16F877A microcontroller. It has wide range of temperature so it can be used.

Figure 10.Microcontroller

10.Causes failures of transformer fault

Internel	External
Partial Discharge	Lighting Strike
Insulations Deterioration	System Fault
Humidity	System overload
Moisture	Switching operations
Overheating	
Winding resonance	
Designing defects	
Loss of winding clamping	
Insulating oil sild contamination	

IV. RESULT

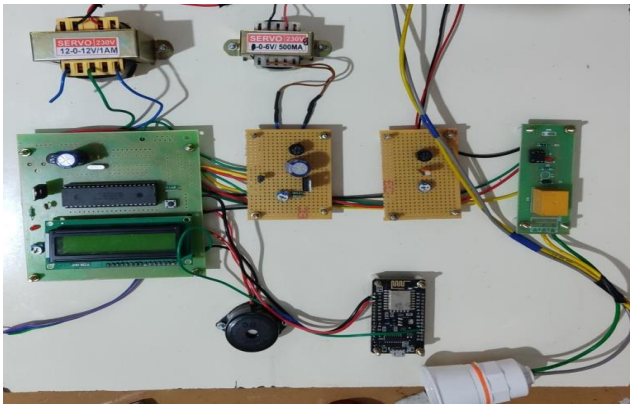

Figure 10.Industrial transformer monitoring and controlling using iot

The system consisting of arduino and sensors senses the transformer health parameters. The IOT based solution for monitoring and controlling of distribution transformers is quite easy and effective compared to manual monitoring method. Reliable power distribution system must use protective devices which will essentially reduce running cost. Continuous monitoring of Distribution transformer, timely alerts to rectify the abnormality if any, there by extending the lifetime of distribution transformers. The data are collected and a node mcu unit communicates with thing speak. The received real time data is processed by it. This data is send using HTTP protocol. This will help in cost minimization by reducing the workforce in maintenance. This system would be eliminating the requirement of human power and thus providing efficiency and accuracy. This paper will give accurate details of energy theft. It will help to manage sensing the parameters and also record details for electricity theft. This paper will also assure the safety and help in decrease in theft level &would not result in any harm to the environment and surroundings. And real-time load monitoring and control will help to improve system efficiency. The accessed readings can be visualized in thing Spaek platform. Proper monitoring and maintenance can ensure a smooth service life for industrial transformer. This system would be eliminating the requirement of human power and thus providing efficiency and accuracy .It will help to sensing the parameters and also record details.

V. RESULT COMPARISION

Existing Method	Proposed work
➢ The time requires for identifying the fault is more. ➢ The worker has to go manually to identify the fault.	➢ The time requires for identifying the fault is less. ➢ The microcontroller will send the identified fault to the WEB SERVER using IOT technology.

VI. CONCLUSION AND FUTURE SCOPE

In this paper we have presented a design of a system based on PIC microcontroller that is used to monitor and control the voltage, current and temperature of a distribution transformer. The proposed system has been designed to monitor the transformer's essential parameters which continuously monitor the parameters throughout its operation, and sending alert to the operator's mobile phone using IOT technology. 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. 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. Proper monitoring and maintenance can ensure a smooth service life for distribution transformer. The IOT based solution for monitoring and controlling of distribution transformers is quite easy and effective compared to manual monitoring method. Reliable power distribution system must use protective devices which will essentially reduce running cost. Continuous monitoring of Distribution transformer, timely alerts to rectify the abnormality if any, there by extending the lifetime of distribution transformers. And real-time load monitoring and control will help to improve system efficiency.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 future enhancement. This sysem is is very intelligent for protection fault and send alert messages to user for power generator serve as a reliable an efficient system.

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