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WIRELESS DATA MONITORING AND FAULT IDENTIFICATION USING ZIGBEE AND GSM IN THERMAL POWER STATION

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ABSTRACT

In Thermal power plant they use static over-flux relay to protect the transformer but we propose numerical over-flux relay which is more efficient than static over-flux relay. Three phase Power transformer receives 15.75kV (primary side) and it is stepped up to 230kV (secondary side).In order to protect this transformer we step-down 230kV to 110V.By using potential transformer we again step-down 110V to 5V. The V/F ratio is set constant at 2.2, if the ratio exceeds above 2.4 heavy vibrations will be produced and due to this the transformer core gets damagedThe step down transformer voltage is rectified using precision rectifier. The rectified output dc voltage is fed to the microcontroller. The display from the microcontroller visualizes the voltage, frequency and V/F values.If the V/F ratio exceeds the preset value or below the preset value, the relay will trips the circuit. V/F ratio and other sensor value like temperature, voltage, current of power transformer calculated by using microcontroller Thermal power plant has to work for 24 hours, it is not possible to monitor the parameters in site at each and every moment. As the demand for power increases, increasing safety and reducing operating and maintenance cost plays a vital role in increasing the reliability of the power plant. So remote monitoring is necessary. This project develops a GSM and zigbee based wireless monitorring system.

KEYWORD: Zigbee, GSM.

I. INTRODUCTION

In Thermal Power Plant, the heat energy is obtained by combustion of coal, then that heat energy is converted as a steam energy which is high in pressure and temperature will reach the prime mover (Turbine).

The Working of a thermal power station can mainly be.

1. Coal Handling Plant.

2. Boiler.

3. Turbine.

4. Generator.

a. Coal Handling Plant:

Coal is employed as a main fuel in thermal station. As the consumption of coal is huge, the layout of a coal handling plant should be simple, reliable and low maintenance. Non-ferrous materials like stones, shells, wood etc. are removed manually. From surge hopper, coal is fed to the coal device through mechanical feeder.

Here coal is crushed to the dimensions of 20-25 millimeter. This sized coal is then sent to coal bunkers through various belts, coal trippers and stored for further processing of coal for combustion in boiler furnace. This cycle is known as bunkering cycle.

b. Boiler:

Boiler is used for generation of steam for power generation. In thermal power station water tube boilers are used. Boiler is balanced from the top on four columns and kept free from the bottom side. In boiler drum, steam

is separated from the mixture in 3 steps i.e. cyclone separators (Primary separators), secondary separators and screen dryers (Final separators). Steam that comes out of boiler is named saturated steam.

This saturated steam is then suffered range of super heaters i.e. primary, platen and final for superheating of steam to a temperature of 540° c. The temperature of the flue gases in the combustion zone is 1200-1400°C and after furnace 1000-1000°C. The temperature of flue gas gradually decreases to 400°C when it leaves second pass. The flue gas then goes through air pre heaters where its temperature drops down to 140°c.

c. Turbine:

The 210 MW turbines are condensing, tandem compound, three cylinder, horizontal, disc and diaphragm type with nozzle governing and regenerative feed water heating. The double flow low-pressure Turbine (LPT) incorporates multi exhaust in each flow.

Live steam from boiler enters two emergency stop valves (ESV) of high-pressure turbine (HPT). From ESV’s steam flows to the four-control valves (CV) mounted on the casing of HPT at the middle bearing side.

d. Generator:

As seen above, boiler produces super-heated steam of pressure 138 Kg/cm2 & 540°C temp. This steam enters in turbine and because of the warmth energy of steam, turbine rotates at about 3000 rpm. The rotary engine is directly coupled to the generator rotor. Electricity is generated as per the Faradays Law in generator.

II. EXISTING METHOD

In electrical power systems, distribution transformer is equipment which distributes power to the low voltage users. For proper operation (i.e., under rated conditions) of the transformers, their operational conditions should be monitored and maintained. Since it is very costly to repair or replace a single transformer, it also has its impact on the economy of the country.

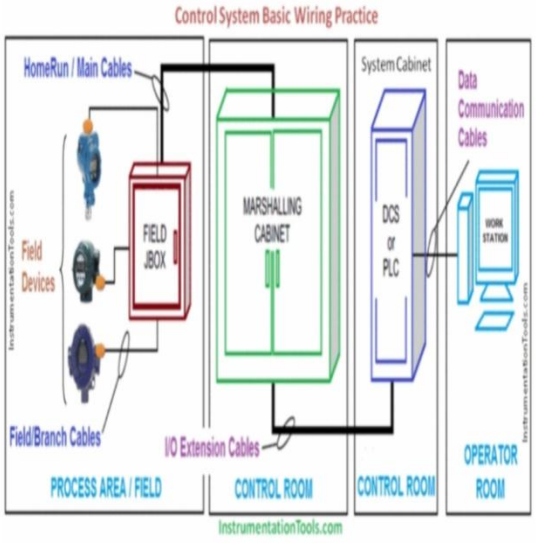

Fig-1: Existing Method

This paper presents the design and implementation of a RF based distribution transformer monitoring system. This system monitors and records key parameters of a distribution transformer like load currents, load voltage, transformer oil temperature.

These parameters provide useful information about the status of a transformer. The system is designed and implemented using RF Technology and key parameters were recorded.

The variations of the recorded values help us in identifying the possible failure that could occur, if the values are over the rated values.

HARDWARE DESCRIPTION:

a) SENSOR:

Sensor are basically use to convert physical quantity in electrical form there are different sensor are Involve for various physical quantity.

b) VOLTAGE SENSOR:

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.

c) CURRENT SENSOR:

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.

d) 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.

e) MICROCONTROLLER:

Micro controller AVRAtMegha16 is heart of our project. We select this micro controller IC for our project for following no. of advantages. Advanced RISC Architecture Data and Non-Volatile Program.

Four 8 bit inputs, output port p0, p1, p2, p3 out of which we use two port to read ADC and other port is use to connect 16x2 alphanumeric display for written current & temperature purpose. Operating voltage is 3.5 to 6vdc.

f) **RF MODULE:**

RF module (radio frequency) is electronic devices that transmit and receive RF signal from one device to other device.

g) VOLTAGE REGULATOR:

The 7805 is a voltage regulator integrated circuit. Fixed output voltage is not obtain due to fluctuation of the voltage source in the circuit .Constant value of output voltage maintain by voltage regulator IC. 7805 provides +5V regulated power supply.

h) 16 X 2 DOT MATRIX LIQUID CRYSTAL DISPLAY:

The display used is 16x2 LCD (Liquid Crystal Display); which means 16 appeals per line by 2 lines. The standard is referred as HD44780U, which refers to the controller chip which receives data from an external source.

Here Atmega16 and transfers directly with the LCD.Here 8-bit mode of LCD is used, i.e., using 8-bit data bus. The LCD's used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data.

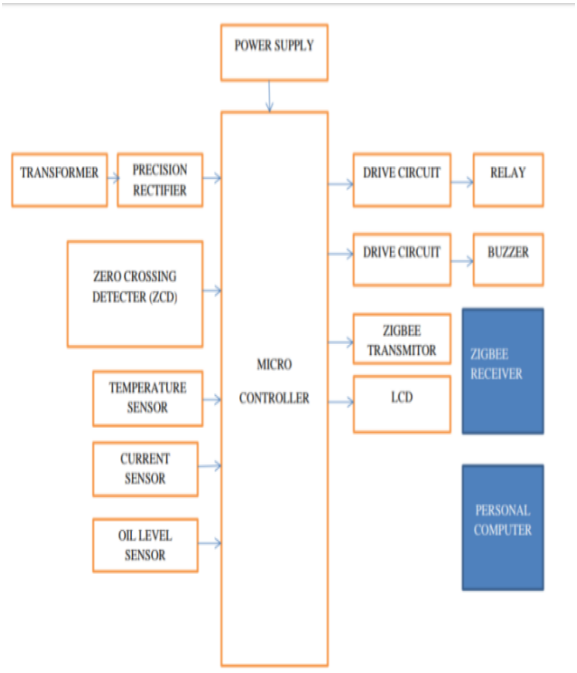

Fig:-2: Hardware Description

PROPOSED SYSTEM:

In this system we are monitoring both voltage (v) and frequency (f) of the transformer the V/F program is fed in a PIC microcontroller with the different ratios, numerical relay interfaced with PIC will automatically trips the circuit.

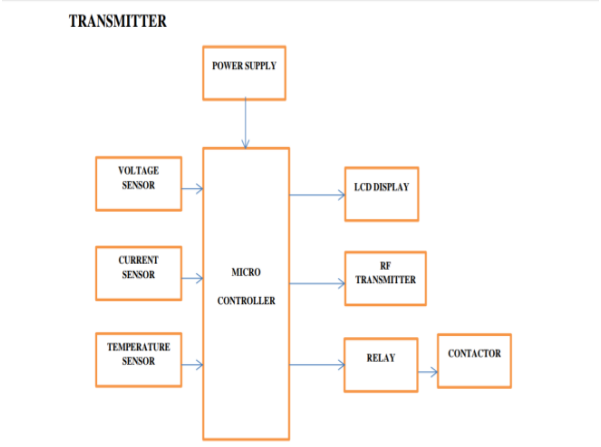

Fig:-3: Transmitter

The transformer parameters are monitoring by using sensors through operator’s mobile with android application.

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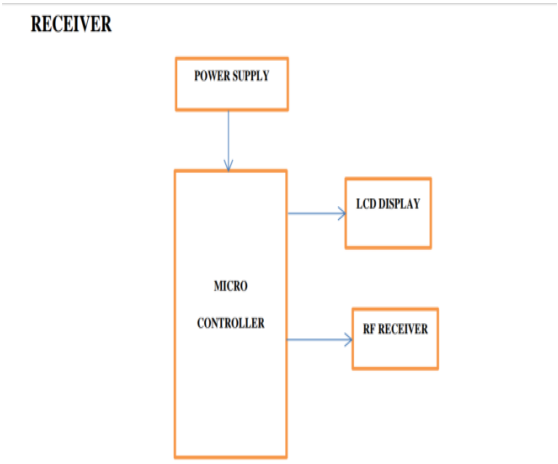

Fig:-4: Receiver

ADVANTAGES:

- It measures both voltage and frequency
- More accurate in measurement
- transformer parameters are monitoring anywhere any place in the world with help of iot
- Multiple group of setting is possible
- Waveforms can be generated

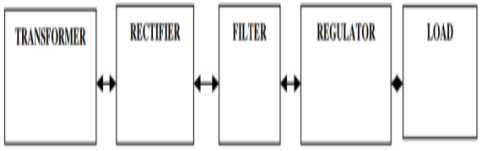

Fig:-5: Block Diagram for Proposed Method

III. WORKING PRINCIPLE

The AC voltage, typically 220 rms, is connected to a transformer, which steps that ac voltage down to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage.

This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes.

IV. WORKING OF PROPOSED METHOD

a) VOLTAGE MEASUREMENT:

This circuit is designed to monitor the supply voltage. The supply voltage that has to monitor is step down by the potential transformer. Usually we are using the 0-6v potential transformer.

The step down voltage is rectified by the precision rectifier. The precision rectifier is a configuration obtained with an operational amplifier in order to have a circuit behaving like an ideal diode or rectifier.

b) FREQUENCY MEASUREMENT:

The zero crossing detectors are constructed by the operational amplifier LM 741. The inverting and non-inverting input terminals are connected to the potential transformer and current transformer terminals respectively.

So the input sine wave signal is converted in to square wave signals. The square signal is in the range of +12v to -12v level.

Then the square wave signal is given to base of the BC 547 switching transistor in order to convert the TTL voltage 0 to 5v level. This square wave signal is given to the pc or micro controller and measure the frequency with help of software.

c) CURRENT MEASUREMENT:

The ACS712Module uses the famous ACS712 IC to measure current using the Hall Effect principle. The module gets its name from the IC (ACS712) used in the module, so for you final products use the IC directly instead of the module.

On the other side we have three pins. The Vcc is connected to +5V to power the module and the ground is connected to the ground of the MCU (system). Then the analog voltage given out by the ACS712 module is read using any analog pin on the Microcontroller.

d) TEMPERATURE MEASUREMENT:

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C.

It can easily be interfaced with any Microcontroller that has ADC function. Power the IC by applying a regulated voltage like +5V (V_S) to the input pin and connected the ground pin to the ground of the circuit. Now, you can measure the temperate in form of voltage as shown below.

ZIGBEE:

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, ZigBee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee has a defined rate of 250 k bit/s, best suited for intermittent data transmissions from a sensor or input device.

Fig-6: Zigbee

ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. Another defining feature of ZigBee is facilities for carrying out secure communications, protecting establishment and transport of cryptographic keys, ciphering frames, and controlling device. It builds on the basic security.

WORKING OF GSM:

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

Fig-7: GSM

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rate.

V. RESULT AND DISCUSSION

The system reduced human effort by providing automation on transformer monitoring and controlling in a simple and cost effective method. the system can be used for automatic controlling depends v/f ratio obtained from transformer parameter. In this method IOT technology is used for data transmission effectively for monitoring transformer parameter through mobile phone with help android application.

VI. CONCLUSION

The system is designed with the help of the PIC microcontroller 16F877A and ZIGBEE which is used for control. This project is very much useful in power transformer protection areas. In transformer protection areas there may be using over flux relays if the supply voltage is above or below the abnormal value the power transformer will be damaged.

So this project is used to monitor the supply parameters if anyone is above or below the abnormal value it automatically turns off the transformer. In order to overcome all these problems, we have designed a module which indicates the faults using driver circuit, relay, LCD display and alarm.

This module consists of PIC microcontroller, precision rectifier, zero crossing detectors and another section of our project is zigbee based transformer parameter monitoring with help of gsm. By implementing this module in

the industry it reduces labour work, time consumption and ensures safety for both the user and the power transformer.

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