Gsm Based Manless Power Transmission Control For Remote Thermal Station

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Abstract - A recent huge interest in Machine to Machine communication is known as the Internet of Things (IOT), to allow the possibility for autonomous devices to use Internet for exchanging the data. 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 damaged. To get accurate fault value we are proposing a numerical over-flux relay. The step down transformer voltage is rectified using precision rectifier. The rectified output dc voltage is fed to the microcontroller. To measure the frequency the sinusoidal waveform is passed on to the zerocrossing detectors and the waveform is again fed on to the microcontroller along with the digitized voltage. 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, the calculated data is sent to the IOT web server Adafruit software using Wi-Fi module. It also reduces the fault analysis time. This data can be accessed from anywhere in the world by an android application.

I. INTRODUCTION

In Mettur 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. 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. This coal is then feeded on coal conveyor belt through vibrating feeder. These feeders area unit of electro-magnetic kind and controls the speed of feeding needed for bunkering. By the various combinations of conveyor belts, coal is conveyed to the surge hopper of a crusher house. Before the coal involves the device house, the ferrous material which comes along with the coal is taken out with the help of suspended and rotating type magnetic separators. 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. *GENERATOR:*

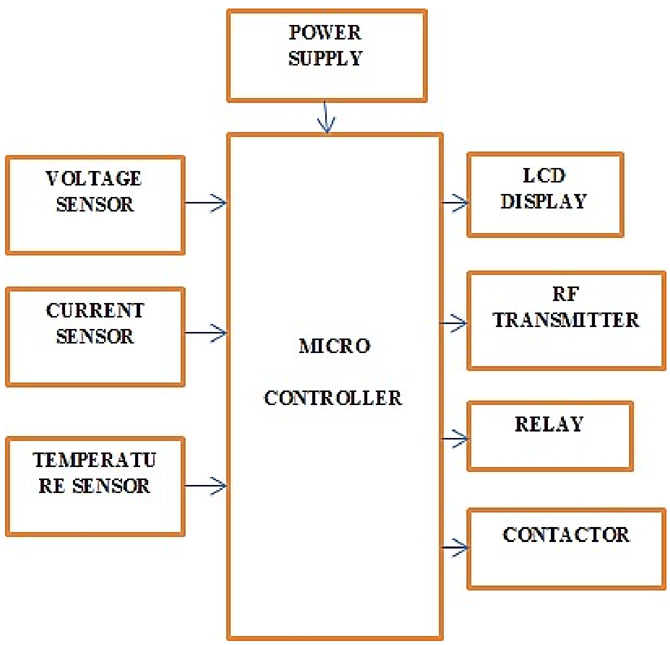
As seen above, boiler produces super-heated steam of pressure 138 Kg/cm2 & 540°C temp. This steam enters in turbine and because of the warmth energy of steam, turbine rotates at about 3000 rpm. The rotary engine is directly coupled to the generator rotor. Electricity is generated as per the “Faradays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

II. CONVENTIONAL 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. Overloading and overheating are two sources of transformers failure that cause power disruption for the customers and reduce the life time of the equipments on the power distribution system. Since it is very costly to repair or replace a single transformer, it also has its impact on the economy of the country. Hence, system that properly monitors the power system and take corrective action should be in place. 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, and transformer oil temperatures. These parameters provide useful information about the status of a transformer. The acquired parameters are processed and the data is sent to a central monitoring station through the RF interface. The data will then be further processed and analyzed regularly by the system operator. RF has a very low latency which is best for real time systems. Besides that it provides balance among trade-offs between cost, capacity, performance, and density.

III. BLOCK DIAGRAM OF CONVENTIONAL METHOD

TRANSMITTER



RECEIVER

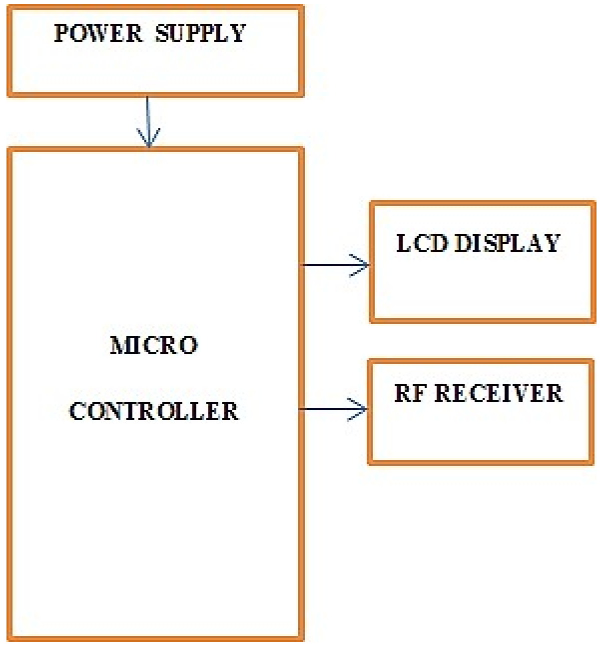


Fig 3.1 block diagram of existing system

IV. HARDWARE DESCRIPTION

SENSOR

Sensor are basically use to convert physical quantity in electrical form there are different sensor are Involve for various physical quantity. In our project we control three parameters first is Voltage, Current Temperature, this three parameters we use three different sensors.

VOLTAGE SENSOR

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 in a data acquisition system or can be utilized for control purpose.

CURRENT SENSOR

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 crrent 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.

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.

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 Memory on Chip Debug Interface (debug wire) Internal 8 K bytes of electrically erasable programmable read only memory for feeding programmed so that there is no need of external EPROM. 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. This is easily available by using voltage regulator IC. Internal 128 byte RAM to store temporally storage of data. In which we can feed took up table to turn ON/OFF relay. Three 8-bit time/counter are present for timing and counting purpose. Four external and two internal interrupt are available. Micro controller can read the data (for the Corresponding channel) available at output of ADC and convert in equivalent alphanumeric code & Display on 16x2 dot matrix liquid crystal display.

RF MODULE:

RF module (radio frequency) is electronic devices that transmit and receive RF signal from one device to other device. It is a Transmitter module through which data can be transmitted and received by receiver simultaneously.

VOLTAGE REGULATOR:

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.

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. The recent advances in technology have resulted in better legibility.

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

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

HARDWARE DESCRIPTION

POWER SUPPLY

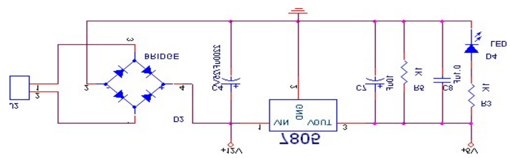


Fig 3.1: Circuit Diagram of Power Supply

V. 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.

PRECISION RECTIFIER

The precision rectifier or super diode is an arrangement achieved with one or more op-amps (operational amplifiers) in order to have a circuit perform like a rectifier and an ideal diode.

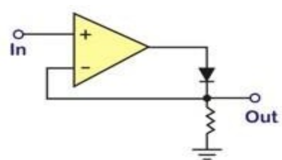


Fig 3.2 :operational amplifier

Circuit designers have two standard methods for designing a precision rectifier. They can amplify the AC signal and then rectify it, or they can do both at once with a single operational amplifier. The latter method is often considered a much better way to get the job done. The fundamental circuit of the precision rectifier is shown below. When the voltage given this circuit is negative, then there will be a negative voltage on the diode. So this circuit works like an open circuit. It means there is no flow of current in the load, as well as output voltage, is zero.

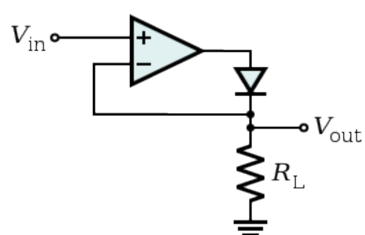


Fig 3.3 :precision rectifier

When the input is positive, it is improved by the op-amp, which activates the diode and there will be a flow of current through the load, because of the response, the output voltage is equivalent to the input voltage. The super diode‟s actual threshold is very near to zero. It equivalents the actual threshold of the diode, separated by the operational amplifier gain.

Precision Rectifier using LT1078

The LT1078 is a micro power dual operational amplifier; it is obtainable in 8-pin packages including the little outline plane mount package. It is raised for single supply function at 5V. ±15V conditions are also offered.

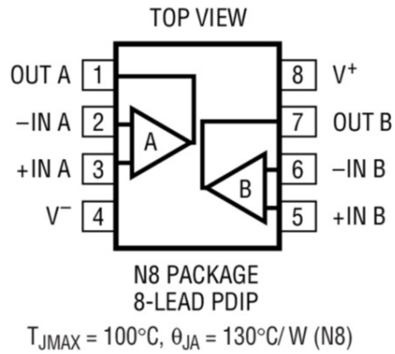


Fig 3.4 :Pin diagram of LT1078

LT1078

The features of LT1078 include the following

- It is available in 8-Pin SO Package
- Supply Current per Amplifier-50µA Max

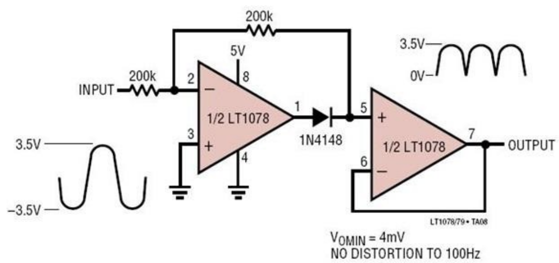


Fig 3.5 :Precision Rectifier using LT1078

The precision rectifier using LT1078 circuit is shown above. The first section of negative i/ps operates as a closed-loop inverter (A=-1) and the second section is just a buffer for the positive o/p. When the i/p signal is +ve, then the output of first op-amp remains saturated near GND, and the diode turn into high-impedance, letting the signal to flow straight to the buffer stage non-inverted. The complex result is a full-wave rectified waveform at the output of the buffer.

PIC MICROCONTROLLER

The PIC16F887 is one of the latest products from Microchip. It features all the components which modern microcontrollers normally have. For its low price, wide range of application, high quality and easy availability, it is an ideal solution in applications such as: the control of different processes in industry, machine control devices, measurement of different values etc. Some of its main features are listed below.

FEATURES OF PIC16F877A

1. RISC architecture
   - Only 35 instructions to learn
   - All single-cycle instructions except branches
2. Operating frequency 0-20 MHz
3. Precision internal oscillator
   - Factory calibrated
   - Software selectable frequency range of 8MHz to 31KHz
4. Power supply voltage 2.0-5.5V
   - Consumption: 220uA (2.0V, 4MHz), 11uA (2.0 V, 32 KHz) 50nA (stand-by mode)
5. Power-Saving Sleep Mode
6. Brown-out Reset (BOR) with software control option

7.33 input/output pins
   - High current source/sink for direct LED drive
   - software and individually programmable pull-up resistor
   - Interrupt-on-Change pin
     K ROM memory in FLASH technology
   - Chip can be reprogrammed up to 100.000 times

9. In-Circuit Serial Programming Option
   - Chip can be programmed even embedded in the target device
10. 256 bytes EEPROM memory
11. Data can be written more than 1.000.000 times
12. 368 bytes RAM memory
13. A/D converter:
   - 14-channels
   - 10-bit resolution

LCD DISPLAY

An LCD is a small low cost display. It is easy to interface with a micro-controller because of an embedded controller (the black blob on the back of the board). This controller is standard across many displays (hd 44780), which means many micro-controllers have libraries that make displaying messages as easy as a single line of code.

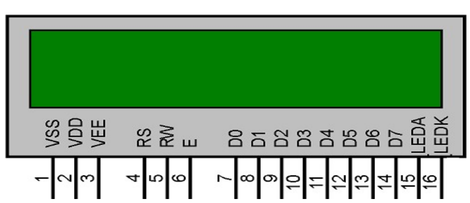


Fig 3.6: Schematic view of 16 x 2 LCD display

Features:

- ✓ 5 x 8 dots with cursor
- ✓ built-in controller (ks 0066 or equivalent)
- + 5v power supply (also available for + 3v)
- ✓ 1/16 duty cycle
- ✓ b/l to be driven by pin 1, pin 2 or pin 15, pin 16 or a.k (led)
- ✓ n.v. optional for + 3v power supply
- ✓ Table 4.1:lcd pin diagram

4.1.8 OIL LEVEL SENSOR

Oil Level Sensor Oil level sensor is float connected angular potentiometer. Float is immersed in oil and its mechanical output is given to angular potentiometer.

Fig 3.7 : float sensor

When there is any mechanical movement of float, there is voltage generation corresponding to mechanical movement of float. That voltage is used for oil level monitoring.

3.1.9 RELAY

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

Fig 3.8: RELAY

A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section consists of contactors which connect or disconnect mechanically. In a basic relay there are three contactors: normally open (NO), normally closed

(NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, and DPDT etc., which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Get inner details about structure of a relay switch.

WORKING OF PROPOSED METHOD

VOLTAGE MEASUREMENT

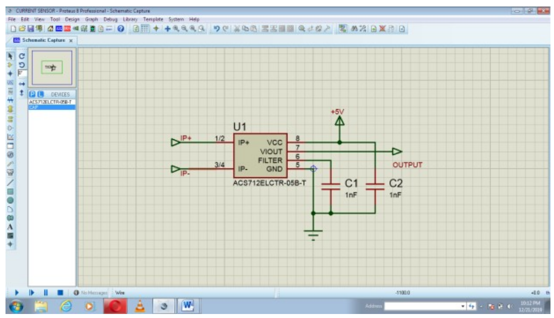


Fig 4.1: voltage measurement

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. The full wave rectifier is the combination of half wave precision rectifier and summing amplifier. When the input voltage is negative, there is a negative voltage on the diode. So it works like an open circuit, there is no current in the load and the output voltage is zero. When the input is positive, it is amplified by the operational amplifier and it turns the diode on. There is current in the load and, because of the feedback, the output voltage is equal to the input. In this case, when the input is greater than zero, D2 is ON and D1 is OFF, so the output is zero.

FREQUENCY MEASUREMENT

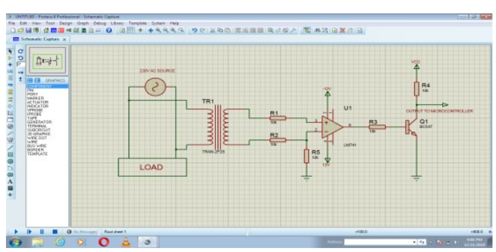


Fig 4.2 : frequency measurement

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.

CURRENT MEASUREMENT

The ACS712 Module 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.

These ACS712 module can measure current AC or DC current ranging from +5A to -5A, +20A to -20A and +30A to -30A. You have to select the right range for your project since you have to trade off accuracy for higher range modules. This modules outputs Analog voltage (0-5V) based on the current flowing through the wire; hence it is very easy to interface this module with any microcontroller. The ACS712 module has two phoenix terminal connectors (green color ones) with mounting screws as shown above. These are the terminals through which the wire has to be passed. In our case I am measuring the current drawn by the motor so the wires that is going to the load (motor) is passed through the ACS 712 Module. Make sure the module is connected in series with the load and be extra cautious to avoid shorts.

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.

Vout (mV) = (ADC Value/ 1023)*5000

After calculating the output voltage we can, calculate the value of current from the voltage using the below formulae

Current Through the Wire (A) = (Vout(mv)-2500)/Scale factor

Note that the value of scale factor changes for every module based on its range. The values of scale factor for all three modules are giveQn in the specifications above.

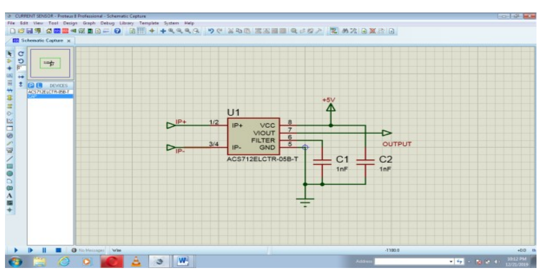


Fig 4.3: current measurement

4.3 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.

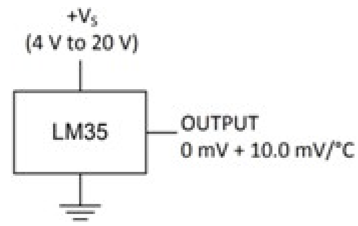


Fig 4.3: Temperatrure sensor

If the temperature is 0°C, then the output voltage will also be 0V. There will be rise of 0.01V (10mV) for every degree Celsius rise in temperature. The voltage can converted into temperature using the below formulae.

V_{OUT} = 10 mv/°C × T

where

- V_{OUT} is the LM35 output voltage
- T is the temperature in °C

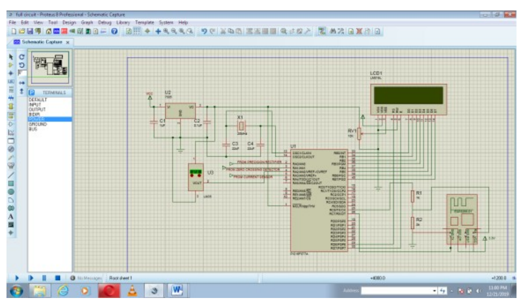


Fig 4.4 : proposed system circuit diagram

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.

CONCLUSION

The system is designed with the help of the PIC microcontroller 16F877A and NodeMCU 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 IoT based transformer parameter monitoring with help of NodeMCU. 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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