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Iot Based Transformer Health Monitoring System

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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. This work presents design and execution of real time monitoring and fault detection of transformer and record key operation indicators of a dispersion transformer oil and encompassing temperatures. They have to look at it continuously by using this project it can minimize working efforts and improve accuracy, stability, efficiency in this project, sensors are used to sense the main parameters of equipment such as temperature and oil level this sensed data is sent to microcontroller and this controller checks parameter limits which further send to the IOT web server Adafruit software using Wi-Fi module of these data makes sure the right information is in hand to the operator and operator can make useful decisions before any catastrophic failure on basis of that data of parameters.

➤ Introduction

Electricity plays an important role in our life. Every moment of our life depends upon electricity. Electricity has several components and equipment helping human to transfer and regulate the distribution according to usage. The most crucial equipment of transmission and distribution of electric power is transformer. In Power system, an electrical component transformer directly distributes power to the low-voltage users and its operation condition is an criteria of the entire network operation. The majority of the devices have been in service for many years in different (electrical, mechanical, environmental) conditions. They are the main components and constitute the large portion of capital investment. Operation of distribution transformer under rated condition (as per specification in their name plate) guarantees their long service life. However their life is significantly reduced if they are subjected to overloading, heating low or high voltage current resulting in unexpected failure and loss of supply to a large number of customers thus is effecting system reliability. Overloading, oil temperature load current and ineffective cooling of transformer are the major cause of failure in distribution transformer. As a large number of transformers are distributed over a wide. Transformer is one of the important electrical equipment that is used in power system. Monitoring transformer for the problem before they occur can prevent faults that are costly to repair and result in a loss of electricity. Currently, failure of the transformer can be detected by color changing of silica gel and decreasing the quality and viscosity of oil. The main aim of the project is to acquire real-time data of transformer remotely over the internet falling under the category of Internet of Things (IOT). 1. For this real-time aspect, we take one temperature sensor, one potential transformer and one current transformer for monitoring Temperature(T), Voltage(V), Current (I) data of the transformer and then send them to a remote location. 2. These three analog values are taken in multiplexing mode and connected to a programmable microcontroller of 8051 families through an ADC 0808. 3. They are then sent directly to a Wi-Fi module under TCP IP protocol to a dedicated IP that displays the data in real-time chart form in any web connected PC / Laptop for display in different charts. The real-time data is also seen at the sending end LCD display interfaced with the microcontroller

OBJECTIVE:

An IoT-based Transformer Health Monitoring System aims to enhance the efficiency, reliability, and lifespan of power transformers by enabling real-time monitoring of critical parameters such as temperature, oil level, humidity, voltage, and current.

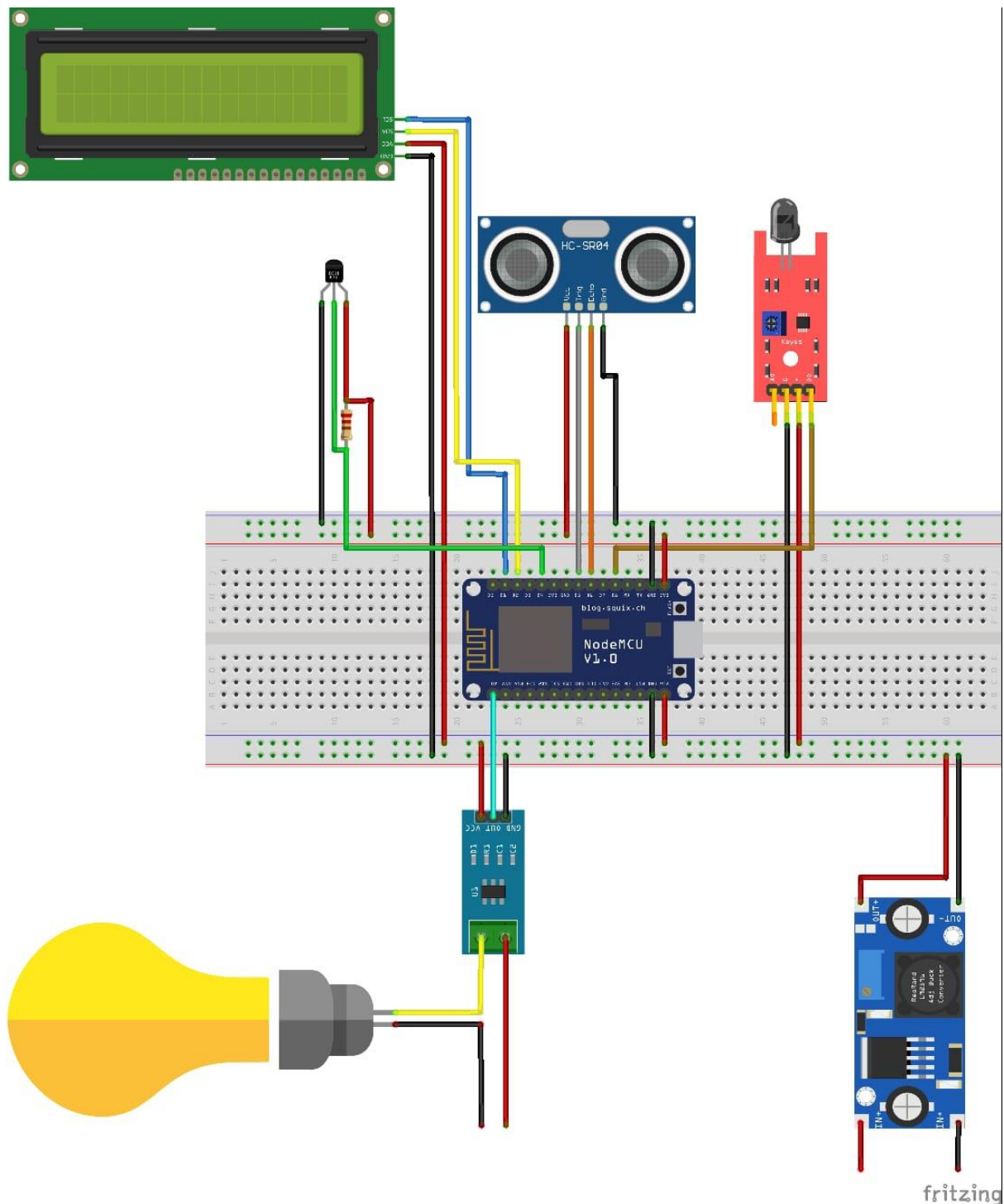


Fig.1 IOT Based Transformer health monitoring system

By leveraging IoT technology, the system facilitates remote access to transformer data, allowing operators to detect anomalies early and implement predictive maintenance strategies, thereby reducing downtime and repair costs. The integration of data logging and analysis enables better decision-making and performance optimization. Additionally, an automated alert and notification system ensures prompt responses to abnormal conditions, enhancing operational safety. By minimizing manual inspections, optimizing energy efficiency, and reducing maintenance expenses, this system

plays a crucial role in preventing transformer failures, ensuring uninterrupted power distribution, and improving overall grid reliability.

□ LITERATURE SURVEY:

In most power companies, for online monitoring of power transformers, use supervisory control and data acquisition (SCADA) system, but for online monitoring of power transformer, the extending the SCADA system is an expensive proposition. Power transformers are currently monitored manually, where a person visits a transformer site, for maintenance and taking records purpose. But main drawbacks of these systems are, it can not provide information about overloads (Voltage & Current) and overheating of transformer oil & windings. Due to these, the transformer life is reduced.

1. **Abdul Rahman Al-ali et al.** This paper presents design and implementation of a mobile embedded system to monitor and record key operation indicators of a distribution transformer like load currents, transformer oil and ambient temperature. The designed system is connected to a distribution transformer and is able to record and send abnormal operating parameters information to a mobile device using a IoT network.

2. **Buyung Sofiarto Munir et al.** In this paper several methods are evaluated to determine which method is better in provides consistent and reliable parameters to be used for transformation condition. Basically there are two evaluated methods are used with vibration signals taken sequentially. First used is fast Fourier transform(FFT) which is used to compute discrete Fourier transform. Second evaluated method is Hilbert Huang Transform(HHT) which is used for to separated vibration signal into a finite and a small number of intrinsic mode functions(IMF).

3. **Xiaohui Cheng et al.** Here compares many combinations ways of internet of things and power, the oil based transformer monitoring system is analyzed, but it has high cost, loss data and feedback control of function. This system uses a single bus multi point temperature measurement method and IoT network remote control and data processing combined, so that speed of the temperature and its analysis becomes improved also accuracy of system is also improved, reducing the cost of temperature monitoring system and using the remote control module to avoid the failure of transformer.

4. **Drasko Furundzic et al.** Neural networks are widespread technique for transformer health monitoring system. Neural networks ensembles are the most advanced neural technique, that improve the accuracy and reliability in the transformer health and failure prognosis. This paper describes the technique to identify causal relation of dissolved gases in transformer oil and current state of the transformers health.

□ RESEARCH MEHOD:

When the supply is given to the transformer output of voltage transformer is given to The Voltage Regulator which Regulates the voltage from transformer first up all we detect the Abnormal voltage condition By increasing the voltage control. When Abnormal voltage occurs it displays on LCD module and send notification through IoT to mobile. When we give heat to DS19B20 temperature sensor above 40 °C It displays on LCD module and send notification to mobile. In this system the transformer oil level is low upto 15cm it detect by using ultrasonic sensor it give notification through IoT on mobile.

It consist of current transformer, power transformer, thermister, oil sensor, Arduino, LCD display, IoT modem and relay. Normally in transformer, failure occurs due to voltage and current fluctuation, overheating, change in oil level etc. In this project, to sense these fault we have used current and power transformer, temperature sensor, oil sensor respectively. All these sensors are connected Arduino. IoT model and LCD respectively. When fault occurs due to above any reason then change in ratings will be shown on LCD and quick SMS will go to control room via IoT modem. A brief discussion about components used is as given below Sensors play a vital role in effective implementation of the project. As we are interested in monitoring over current, over temperature and oil level following sensors are selected and suitable designed with respect to prevailing conditions of power system and rating of transformer to be protected.

Working

LCD display, IoT modem and relay. Normally in transformer, failure occurs due to voltage and current fluctuation, overheating, change in oil level etc. In this project, to sense these fault we have used current and power transformer, temperature sensor, oil sensor respectively.

All these sensors are connected to converter (ADC0808) and digital output from converter is given to micro-controller 89S51. MC89S51 has four ports viz. P1, P2, P3 and PO to which we will be connected to address lines IoT model and LCD respectively. When fault occurs due to above any reason then change in ratings will be shown on LCD and quick SMS will go to control room via IoT modem. A brief discussion about components used is as given below

□ Arduino Uno Board

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P ([datasheet](#)). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, 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 or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

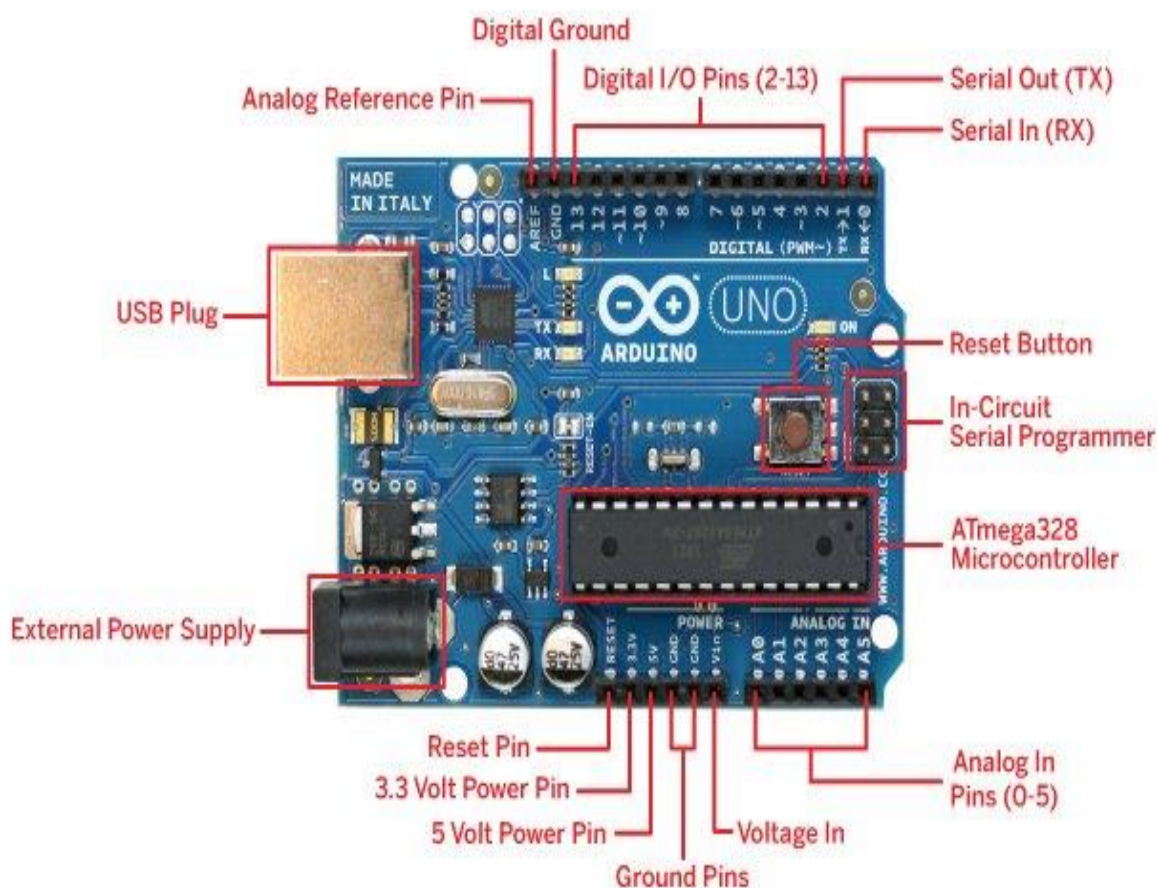


Fig. ARDUINO UNO Board

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

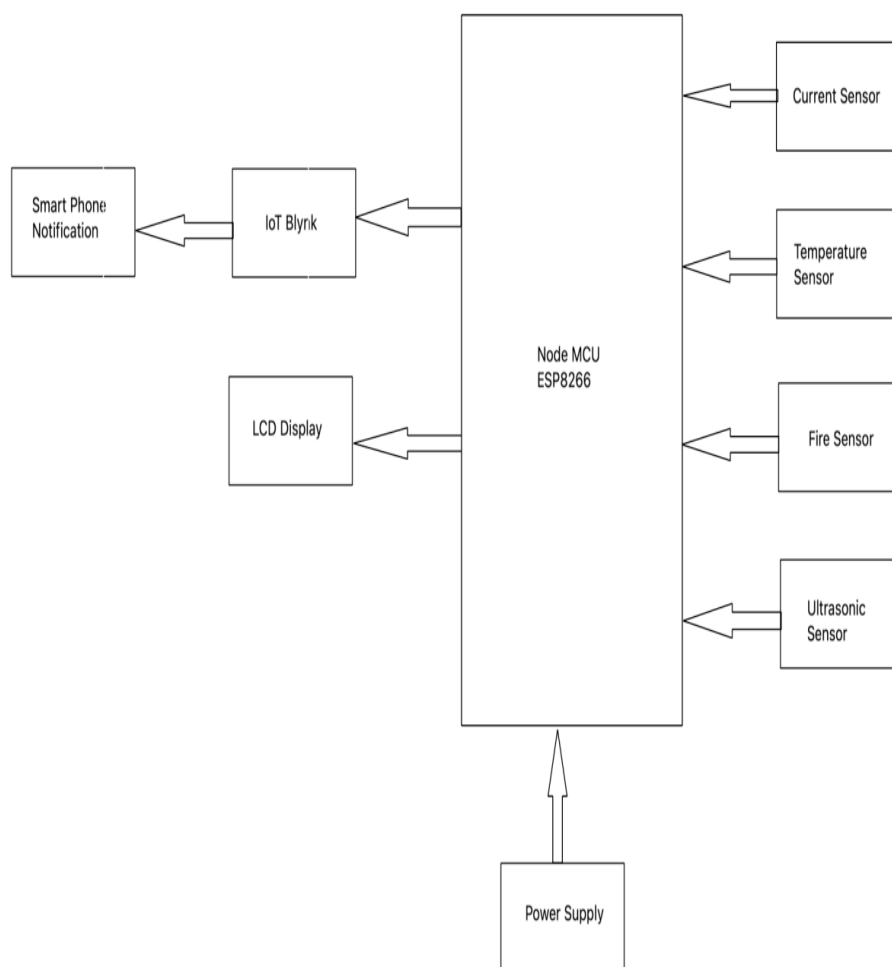
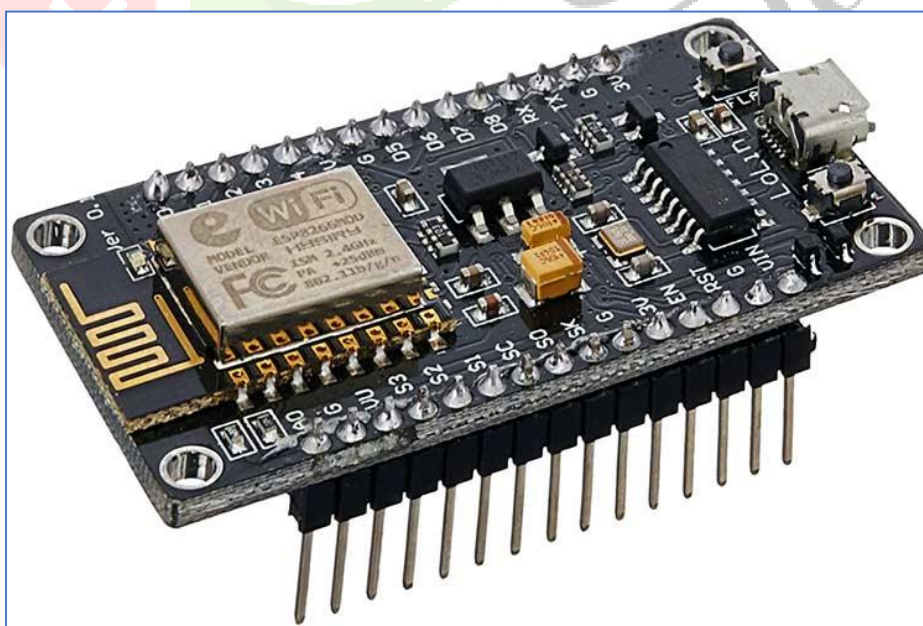
□ **BLOCK DIAGRAM:**

Fig. Block diagram of node MCU ESP8266



WORKING:

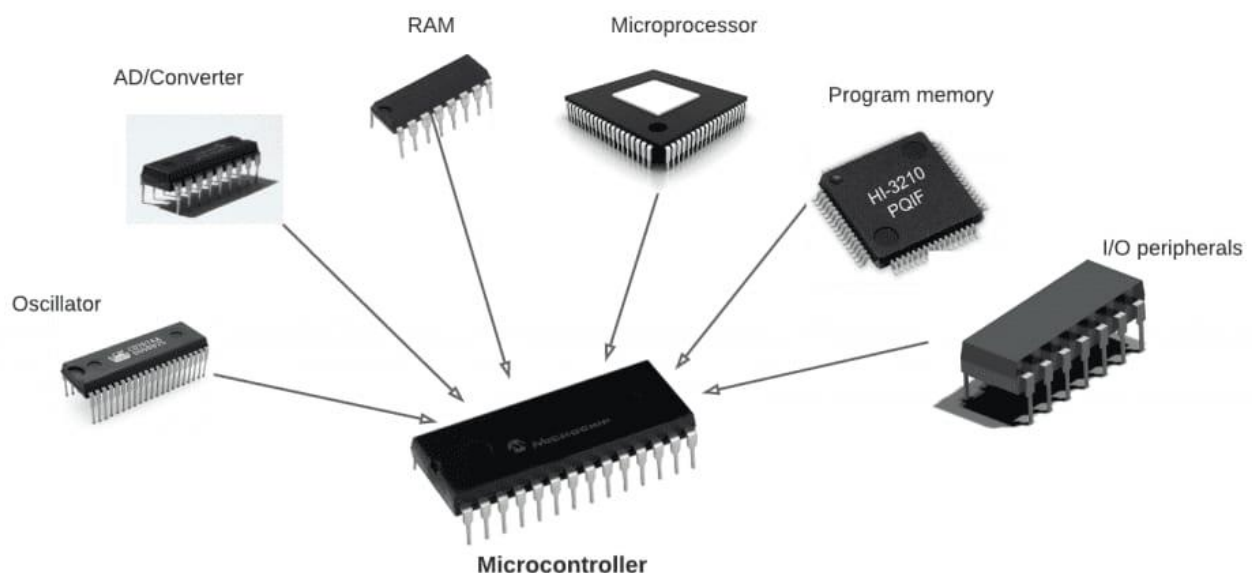
Node MCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented. The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, widely used in IoT applications.

The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

□ MICROCONTROLLER

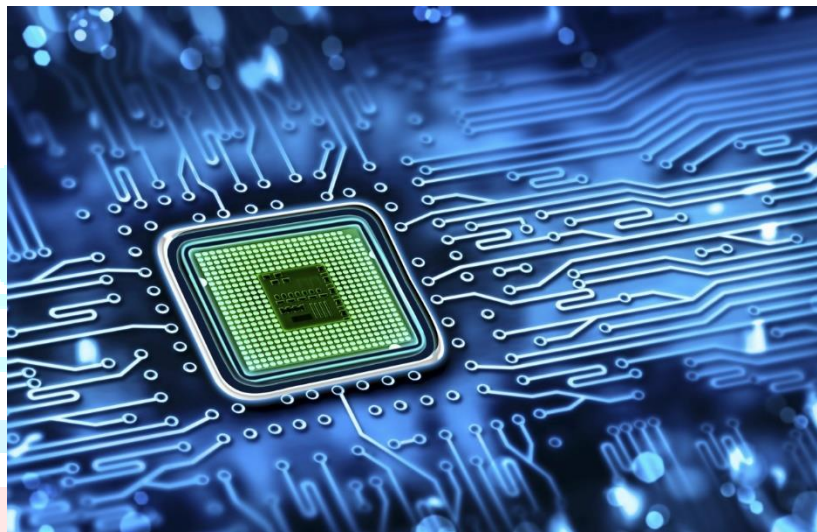


A Microcontroller (or MCU) is a computer-on-a-chip used to control electronic devices. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general-purpose microprocessor (the kind used in a PC). A typical microcontroller contains all the memory and interfaces needed for a simple application, whereas a general purpose microprocessor requires additional chips to provide these functions.

A microcontroller is a single integrated circuit with the following key features:

1. central processing unit - ranging from small and simple 8-bit processors to sophisticated 32- or 64-bit processors
2. input/output interfaces such as serial ports
3. RAM for data storage
4. ROM, EEPROM or Flash memory for program storage
5. clock generator - often an oscillator for a quartz timing crystal, resonator or RC circuit

Microcontrollers are inside many kinds of electronic equipment (see embedded system). They are the vast majority of all processor chips sold. Over 50% are "simple" controllers, and another 20% are more specialized digital signal processors (DSPs) (ref). A typical home in a developed country is likely to have only one or two general-purpose microprocessors but somewhere between one and two dozen microcontrollers. A typical mid range vehicle has as many as 50 or more microcontrollers. They can also be found in almost any electrical device: washing machines, microwave ovens, telephones etc.



➤ INFORMATION

Oil Level Sensor

Oil level sensor is float connected angular Ultrasonic sensor Float is immersed in oil and its mechanical output is given to angular potentiometer. 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. An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound. Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object



Temperature Sensors

The DS19B20 can be applied easily in the same way as other Integrated- circuit temperature sensors. It can be glued or cemented -to a surface and its temperature will be within about 0.010C of the surface temperature. This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature the actual temperature

The DS19B20 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.



Current Sensor Module

ACS712 Current Sensor Module - 20A can sense upto 20A of current flow. Sensing and controlling the current flow is a fundamental requirement in wide variety of applications, which includes over-current protection circuits, battery chargers, switching mode power supplies, digital watt meters, programmable current sources, etc.

ACS712 Current Sensor Module - 20A is based on ACS712 sensor, which can accurately detect AC or DC current. The maximum AC or DC that can be detected can reach 20A, and the present current signal can be read via analog I / O port of a microcontroller or an Arduino.

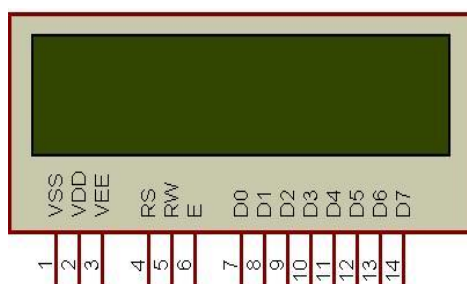


Liquid Crystal Display(LCD)

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.



PROGRAM:

```

#define BLYNK_TEMPLATE_ID "TMPL32OY1A1_Q" // gmsbte
#define BLYNK_TEMPLATE_NAME "IOT TRANSFORMER HEALTH MONITRING" // gmsbte
#define BLYNK_AUTH_TOKEN "R7PmnOxup3UMlSYkF6XKwYV7ckqMcy6T" // gmsbte
#define BLYNK_TEMPLATE_ID "TMPL32D5rAAw9"
#define BLYNK_TEMPLATE_NAME "IOT TRANSFORMER HEALTH MONITRING"
#define BLYNK_AUTH_TOKEN "UQpTaWGmu510tOBTH1yLpB7n6UR_P8f7"
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <Wire.h>
#include <BlynkSimpleEsp8266.h>
#include <OneWire.h>
#include <DallasTemperature.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
#include<ACS712.h>
ACS712 sensor(ACS712_30A, A0);

int flame_sensor = D3;          //D8
int relay = D7;                  // D7

const int triggerPin = D5; //D5
const int echo = D6;          //D6

int flame_sensor_read;
long duration;
int distance;

char auth[] = BLYNK_AUTH_TOKEN;

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "12345678"; //Enter the wifi name
char pass[] = "Arduino@21"; // Enter the wifi password
BlynkTimer timer;
#define ONE_WIRE_BUS D4 // DS18B20 on arduino pin2 corresponds to D0 on physical board " but D4
pin on the nodemcu Module"
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature DS18B20(&oneWire);
float temp;
float Fahrenheit=0;

void setup()
{
  Serial.begin(9600);
  DS18B20.begin();
  Blynk.begin(auth, ssid, pass);
  Wire.begin();
  timer.setInterval(1000L, getSendData);

```

```
sensor.calibrate();
lcd.begin();
lcd.backlight();
lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Transformer Health");
  lcd.setCursor(0, 1);
  lcd.print("Monitoring System");

  delay(3000);

pinMode(flame_sensor, INPUT);

pinMode(relay, OUTPUT);

pinMode(triggerPin, OUTPUT); // Sets the trigPin as an Output
pinMode(echo, INPUT); // Sets the echoPin as an Input

digitalWrite(relay, HIGH);
// Debug console
}

void loop()
{
  flame_sensor_read = digitalRead(flame_sensor); //reading the sensor data on A0 pin
  Blynk.virtualWrite(V0, flame_sensor_read); //sending data to Blynk
  Serial.print("Flame Status:");
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Flame Status: ");
  lcd.print(flame_sensor_read);
  Serial.println(flame_sensor_read);

  if (flame_sensor_read == 0)
  {
    Blynk.virtualWrite(V1, 255);

    Blynk.logEvent("fire", "Alert Fire Detected");
    lcd.setCursor(0, 1);
    lcd.print(" Fire Detected ");
    digitalWrite(relay, LOW);
  }
  else
  {

    digitalWrite(relay, HIGH);
```

```
    }
    delay(2500);

    digitalWrite(triggerPin, LOW);
    delayMicroseconds(2);
    digitalWrite(triggerPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(triggerPin, LOW);
    duration = pulseIn(echo, HIGH);
    distance= duration*0.034/2;
    Blynk.virtualWrite(V2, distance);
    if (distance >= 15){
        Blynk.logEvent("oil", "Alert Low Oil");
        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print("Oil Level: ");
        lcd.print(distance);
        lcd.setCursor(0, 1);
        lcd.print(" Low Oil ");
        delay(1000);
        Serial.print("Distance: ");
        Serial.println(distance);
    }

    float I = sensor.getCurrentAC();

    Serial.println(I);

    if(I>=0.70)

    {

        Blynk.logEvent("current", "EARTH FAULT CURRENT");
        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print("EARTH FAULT CURRENT");
        delay(1000);

    }

    timer.run();
    Blynk.run();

}

void getSendData()
{
    DS18B20.requestTemperatures();
    temp = DS18B20.getTempCByIndex(0); // Celcius
    Fahrenheit = DS18B20.toFahrenheit(temp); // Fahrenheit
    Serial.println(temp);
}
```

```

Serial.println(Fahrenheit);
Blynk.virtualWrite(V3, temp); //virtual pin V3
Blynk.virtualWrite(V4, Fahrenheit); //virtual pin V4
if (temp >= 50)
{
  digitalWrite(relay, LOW);
  Blynk.logEvent("temp", "Alert High Temperature");
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Temperature:");
  lcd.print(temp);
  lcd.setCursor(0, 1);
  lcd.print("High Temperature");
  delay(2500);
}

else{
  digitalWrite(relay, HIGH);
}
}

```

CONCLUSION:-

Transformers are among the most generic and expensive piece of equipment of the transmission and distribution system. Regular monitoring health condition of transformer not only is economical also adds to increased reliability. In the past, maintenance of transformers was done based on a pre-determined schedule. With the advancement of communication technology now it is possible to receive fault information of transformer through IoT technology remotely to the operator and authorities so one can able to take possible solution before converting fault in to fatal situation. Depending upon fault analysis a prototype model of microcontroller based transformer health monitoring kit is developed in laboratory. Using digital controller analysis results are regularly updated. During abnormal conditions exceeding specified limits information is immediately communicated through IoT technology to the operator and also to concerned authority for possible remedial action. This type of remote observation of health condition of transformer not only increases the life of transformer but also increases mean down time of transformer there by increased reliability and decreased cost of power system operations.

□ REFERENCE: -

1. Abdul-Rahman AI-Ali, Abdul Khaliq & Muhammad Arshad "IoT-Based Distribution Transformer Monitoring System," IEEE MELECON 2004, May 12-15,2004, Dubrovnik, Croatia
2. Buyung Sofiarto Munir, Johan J. Smi:"Evaluation of Various Transformations to Extract Characteristic Parameters from Vibration Signal Monitoring of Power Transformer"2011 Electrical Insulation Conference, Annapolis, Maryland, 5 to 8 June 2011
3. Xiao-hui Cheng, Yang Wang, "The remote monitoring system of transformer fault based on The internet of Things," 2011 International Conference on Computer Science and Network Technology
4. Drasko Furundzic, Zeljko Djurovic, Vladimir Celebic, and Iva Salom, "Neurel Network Ensemble for Power Transformers Fault Detection,"11th symposium on Neural Network Applications in electrical Engineering NEUREL-2012
5. Suraj Pardeshi, Ramakant Mahajan, Uma Mahesh Pasumarthi, Rohit Kumar Arora,," Multiprocessor based architecture for On-line Condition Monitoring of Transformers," 2012 IEEE International Conference on Condition Monitoring and Diagnosis 23-27 September 2012, Bali, Indonesia

6. D S Suresh, Prathibha T, KouserTaj,” Oil Based Transformer Health Monitoring System” International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Impact Factor (2012): 3.358 Volume
7. Mallikarjun Sarsamba, Prashant Sangulagi, Dr. Raju Yanamshetty,“The Load Monitoring and Protection on Electricity Power lines using IoT Network,” International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 9, September 2013 ISSN: 2277 128X