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PROJECT FILE

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Project Details:

Project name: IOT-based Transformer Health Measuring System.

Problem Statement:-

Transformer is a vital building block in a power system and any damages in transformers adversely affects the balance of a power system. The damages are mainly occurring due to overloading and inefficient cooling. The main objective of the project is real time monitoring of the health conditions of the distribution transformer using IOT technology. The parameters such as temperature, voltage, oil level and current of a transformer are monitored, processed and recorded in MathWorks server.

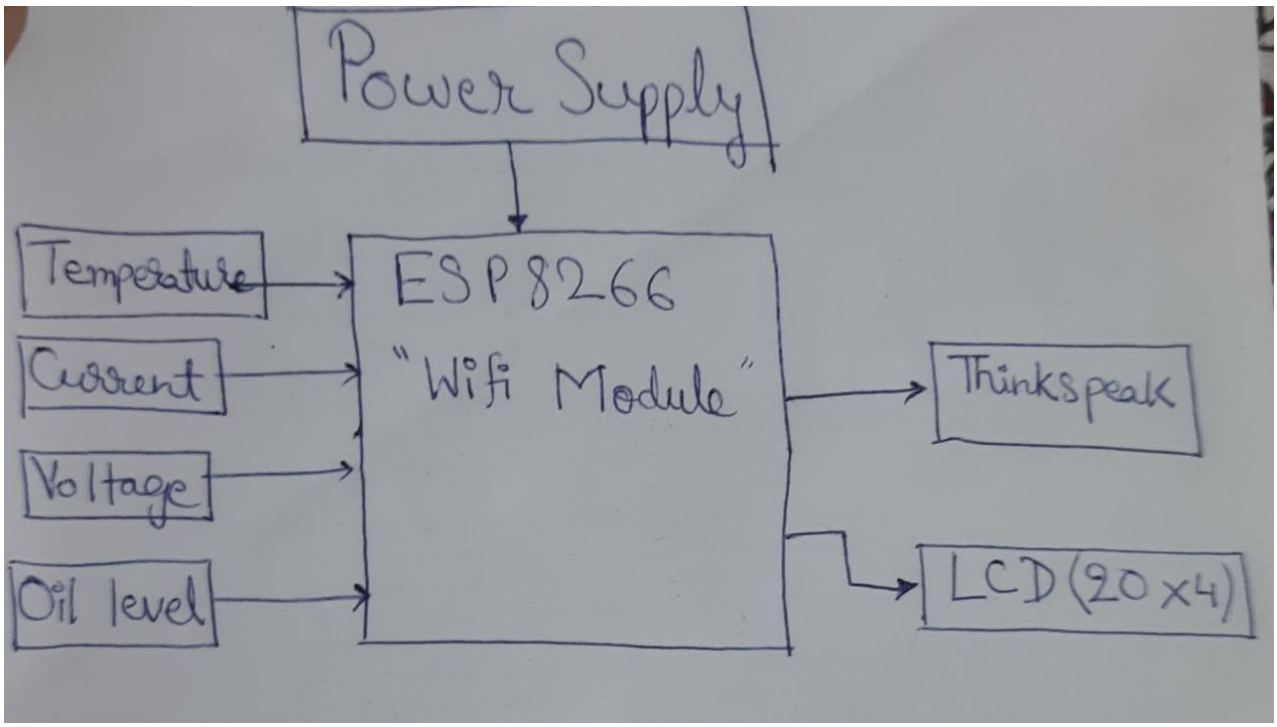
Solution:-

For this purpose, we used one LCD screen, three sensors- for current monitoring(ACS-712), for temperature(DHT11), for oil level(HC-SR04) interfaced with Arduino. The recorded data can be send using wifi-capable microcontroller chip(ESP8266) and accessed from anywhere around the world using IOT technology. All the data points are uploaded on a private channel of MATLAB Server.

Description of the project:-

1. ESP 8266 Wi-Fi Module
2. DHT11 (Temperature Sensor)
3. ACS 712 (Current Sensor)
4. Supersonic Sensor(HC-SR04)
5. LCD Display (12 × 4)
6. Transformer (500 mA)
7. L7805CV BJT (5V,1.5A)
8. D2SB MOSFET(2A)
9. Resistor(1kOhm)
10. Capacitor(25V, 1000uF)
11. LED light (IN4007)

It consists of WiFi-enabled module (microcontroller board), voltage sensor, temperature sensor, current sensor, oil level sensor and power supply as shown in the fig below.



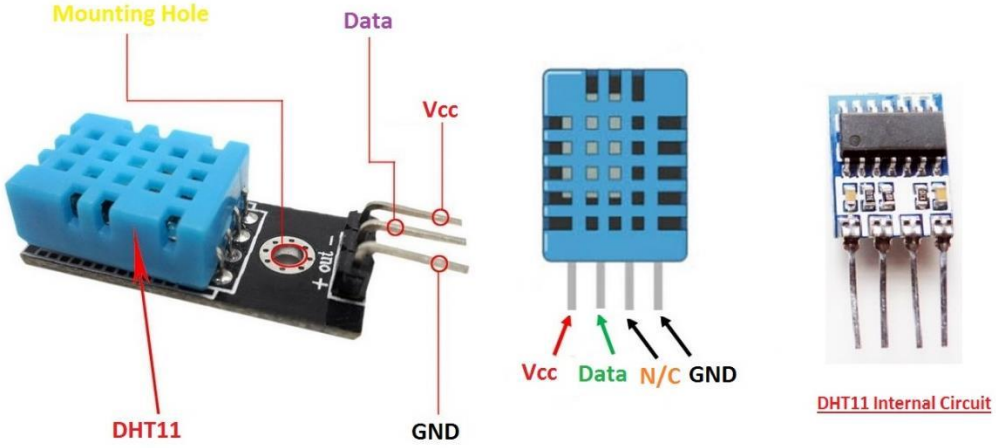
The sensors sense the parameters and send this to ESP8266 board. It processes it and send to Thinspeak server (of MathWorks).

Description of the Hardware Components:-

The project is designed to emit a reduced size and maximum efficiency for transformer health monitoring. The components used are ESP8266 microcontroller, temperature sensor, current sensor, voltage sensor circuit and Oil level sensor, along with a LCD Display

A. TEMPERATURE SENSOR-DHT11=>

Temperature sensor is used to sense the current temperature status of a transformer or generator. It has three pins as shown in figure namely Vcc, gnd and Data. The output obtained from the temperature sensor is proportionally dependent on the temperature in degree Celsius sensed. The operating temperature ranges from 0 C to 50 C. It draws about 60 micro ampere from the supply and has reduced self-heating. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin. It does not tend to possess a temperature rise more than 0.1 0C in still air. For every 0 C rise or fall in temperature the output response will be 10mV variation. This DHT11 operates from 4V to 30V. It has ± 2 ± 2 C
of typical nonlinearity.



B.CURRENT SENSOR ACS 712 =>

ACS712 current sensor produces an analog output voltage proportional to the current sensed by the terminals. The current sensor can operate from an voltage of 5V. Even high AC mains current can be measured. The sensors are based on the Allegro ACS712ELC chip. These sensors are available full-scale reading of 5A, 20A and 30A. For a 30A sensor the output sensitivity s 66mV/A and it can measure a current from 30A to - 30A range. ACS712 consists of a low offset, precise linear Hall effect sensor circuit having a

copper conduction path around the die surface. The hall effect circuit convert the electromagnetic field produced during current flow through the copper part to output voltage.

C.VOLTAGE SENSOR CIRCUIT=>

Voltage measurement circuit. It is a combination of IN4007 diode, a step-down transformer (5mW power), variable resistor of 1K Ω, capacitor 1000microF, 2Ampere MOSFET and Linear voltage regulator BJT (5.0V, 1.5A). Usually, 5V output is obtained during 250V. variable resistance is adjusted to get the output.

D. ESP8266 Wi-Fi Module(NodeMCU V3)=>

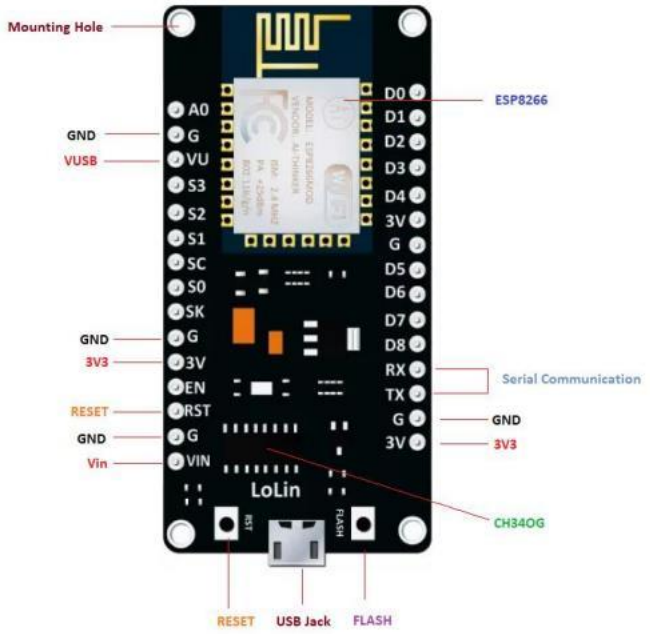
The **ESP8266** is a low-cost Wi-Fi microchip and microcontroller capability. It is a 32-bit microcontroller with Wifi Capability and a CPU of 80 MHz It has 30 pins and runs on a constant DC supply of 3.3V. It has internal flash memory of 4MB and SRAM of 64KB.

NOTE:-

- The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module.
- difference between Vin and VU where former is the regulated voltage that may stand somewhere between 7 to 12 V while later is the power voltage for USB that must be kept around 5 V.

➢ **NodeMCU V3 Features**

- Open-source
- Arduino-like hardware
- Status LED
- MicroUSB port
- Reset/Flash buttons
- Interactive and Programmable
- Low cost and wifi module capability
- ESP8266 with inbuilt wifi
- USB to UART converter
- GPIO pin



PIN Diagram for ESP8266

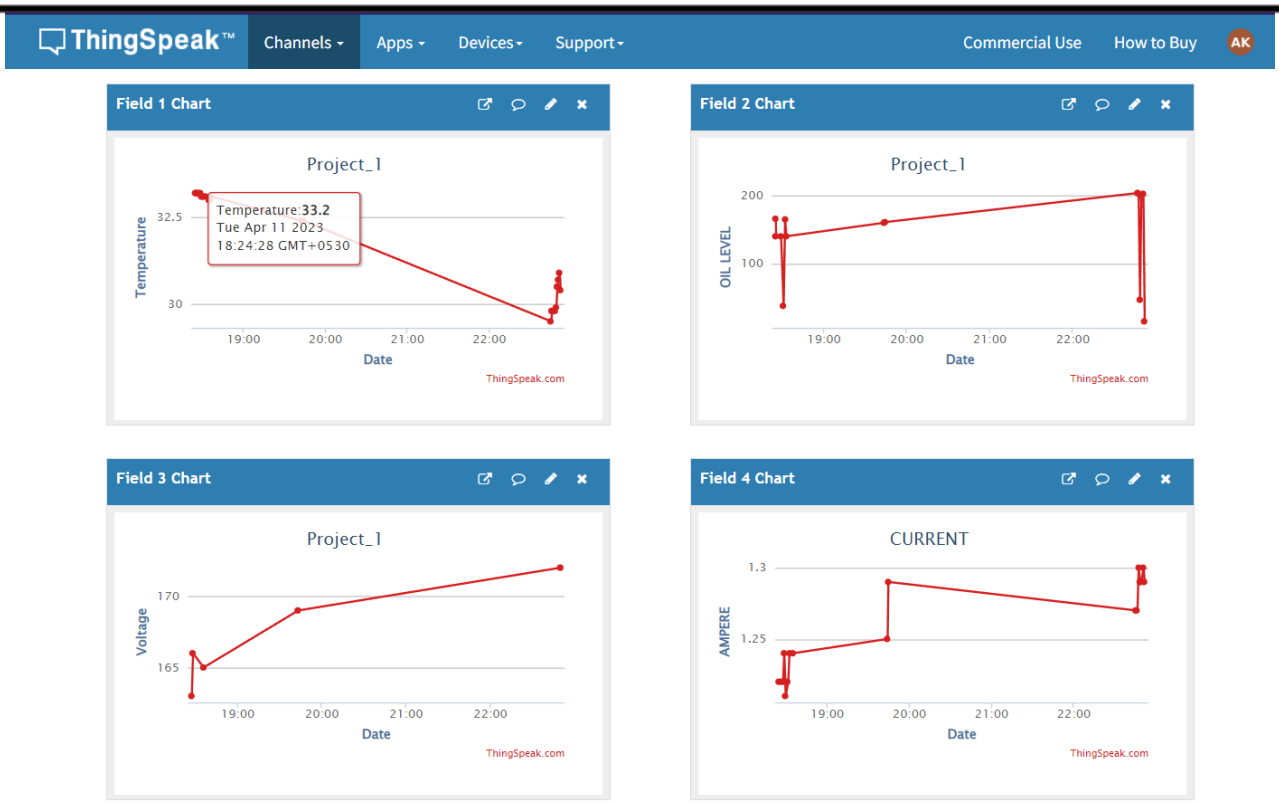
C. ULTRASONIC SENSOR HC-SR04 (Level)=>

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns. Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the

sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensor, used in the project like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

F. IoT TECHNOLOGY =>

IoT is an interconnection of many physical devices by using internet. The controlling and monitoring of any physical devices or parameters are possible with the help of IoT technology. ThingSpeak It is an open – source internet of things applications. This provides with some apps that let analyzing and visualizing the data send by WiFi module. There is a ThingSpeak channel provided. These channels store the data. The channel provide provision for sending, processing and accessing the data when needed. The master device ESP8266 sends the data using HTTP protocol.

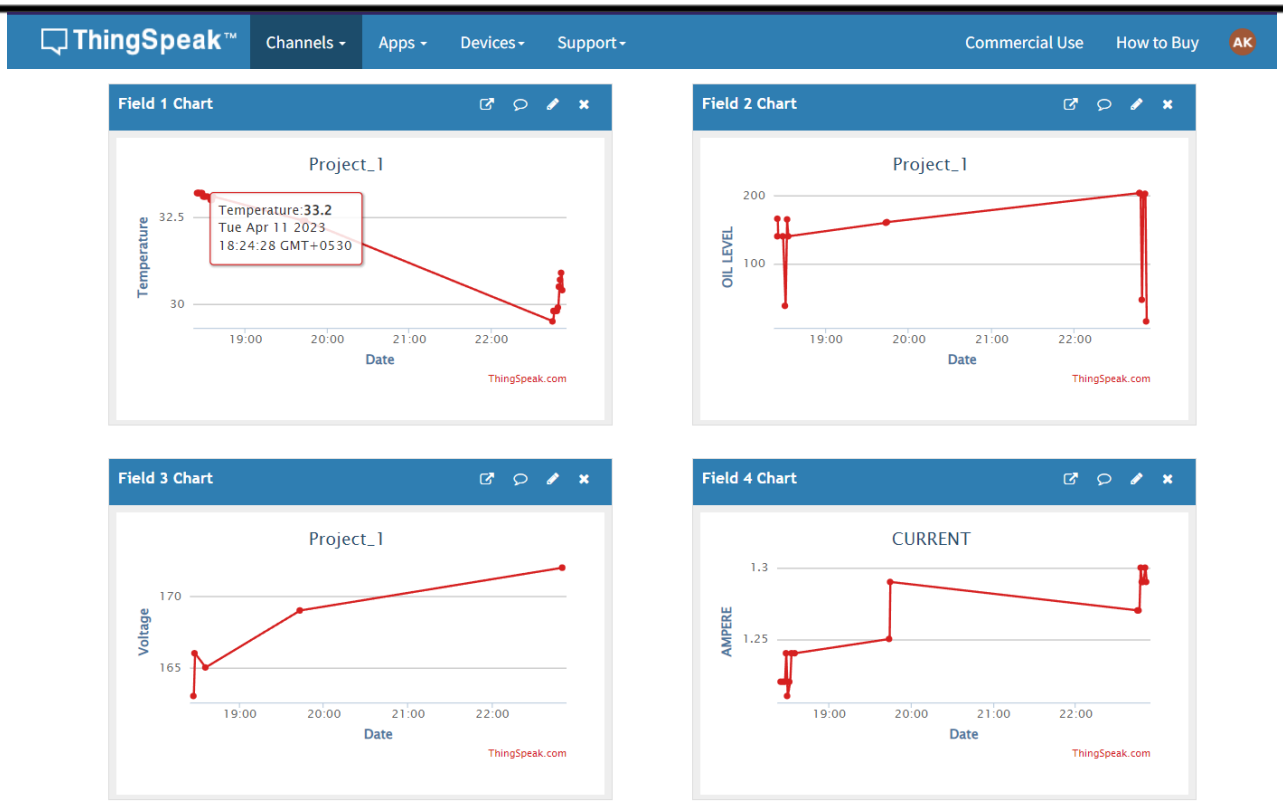


G. RESULT AND OBSERVATION =>

The system consisting of **microcontroller** and sensors **that** senses the transformer health parameters. The data are collected and a node mcu unit communicates with ThingSpeak. The received real time data is processed by it. This data is send using HTTP protocol. The accessed readings can be visualized in ThingSpaek platform**.**

H. CONCLUSION=>

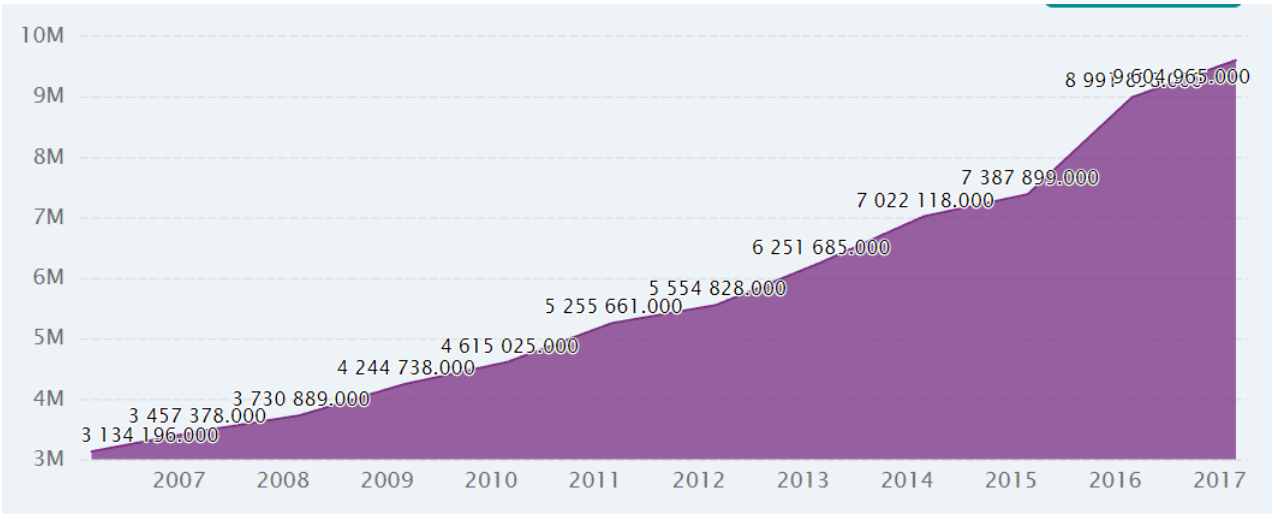
The transformers play a vital role in distribution part of power system. Therefore**,** the monitoring and protection of transformer is very crucial. This system introduces a new and improved method of transformer health parameter monitoring using IoT. The sensors incorporated in the system collect the data of transformer health parameters such as voltage, temperature**, oil level** and current. These data are sen**t** to an IoT platform, using ThingSpeak. These data can be sent and accessed using HTTP protocol. Thus**,** the real time data collection, storage and monitoring of the transformer health parameters are possible with the system.



DISCUSS THE FEASIBILITY O Y OF THE PROJECCT

SCALABILITY: -

This project can be scaled up to mass production level. The use of transformers in electricity distribution network throughout the country and globe is huge. In Inida itself, we can view India's Number of Transformers Distribution from 1996 to 2017 in the chart:



Thus, transformer health monitoring becomes of major importance. Lets take a case study from Surat, of how mismanagement of transformers can pose a serious threat to the lives of the people:-

An electrical transformer perched on the compound wall of residential societies, apartments, in the middle of the roads, outside commercial shopping complexes, hospitals, clinics, or even industrial areas pose a serious threat to the life and property of the people in the diamond city Surat. A 32-years old textile worker received serious burn injuries when an electrical transformer of Dakshin Gujarat Vij Company Ltd exploded on 31st July,2022. Thus, we can install our project in such critical areas where the risks are high.(Source- TOI)

- **HOW REALISTIC TO ACHIEVE/MAKE :-**

Our project can be made simply by small components and a IOT platform to store the data. The costing of this is very less and can be installed even at temperatures as low as -60 °C to 1500 °C . These set-ups are safe and sound and very less prone of mis-information or burning out.

- **ECONOMIC STABILITY:-**

This is a low budget project with al components assembled at one place. It has a voltage level measuring circuit, 3 sensors, 1 LCD display, 1 WiFi-enabled Microcontroller and an IOT platform (ThinkSpeak). If we start making these modules and circuits indigenously on large scale then we can bring the costing even lower with a huge margin.

- **ANY ENVIRONMENT THREATS/RISKS :-**

No, our project is 100% safe and secured. It pose 0 risk to live of people and environment. There are no waste products or anything in its making. We can implement it on a large scale across the nation with widespread usage /application.

- **ANY IMPROVEMENTS IN THE PROJECT:-**

For now our project is capable to tackle any health monitoring problem of transformers at present. But one thing that we can think of is that for now it is made by assembling products/software which are not 100% indigenous. So, in future we can think of using components which are 100% Made in India. This will help lower down the costing and also generate a lot of employment opportunities in India.