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Health Index Determination of Distribution Transformer

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***Abstract*— Transformer is a static device which is used to transformer the power from one voltage to another voltage level without change in frequency. Mostly in distribution system step down transformers have been used. The distribution transformer or service transformer is a device which provides the final transformation in the electric power distribution system, stepping down the voltage in the distribution lines to the level used by the customer. Transformer is one of the most essential components of the electrical system. It is also called the heart of the electrical systems. Failure of the transformer may lead to the failure of the whole electric system. Which may cause the power loss, production loss and revenue loss? Therefore continuous monitoring and fault detection of the transformer is of prime importance. Many researchers have been developed various tools and technique for fault detection and diagnosis of distribution transformer. The aim of this paper is to detect and analyses the fault in distribution transformer by using the At Mega Arduino 328 pin microcontroller sensor by monitoring the various transformer parameter like moisture, voltage, and temperature with the help of various sensors which are placed internally and externally on the transformer. These sensors are continuously measure and monitor the health of distribution transformer during healthy and faulty conditions. This feature is essential for effective power transmission and long life of the transformer.**

Keywords*— *Transformer, Condition Monitoring , Relays, Arduino Uno, Microcontroller, Sensors.

I. INTRODUCTION

Distribution transformer is a very essential device in power system they are used in substation, transmission of electrical power and distribution because they can easily convert voltage level and easy to operate at any voltage level. Also, we can vary the voltage level. Transformer plays an important from generation to distribution. In the present era of competitive market, the main aim of power distribution utilities is to provide a stable power supply at least cost, maximum profit and extension of lifespan. Being a Utility engineer, it is observed that failure in distribution transformers is due to oil leakage, overloading and unbalanced loading in remote rural areas. To avoid such problems proper condition monitoring of distribution transformer parameter splays an important role.

Condition monitoring is the process or technique of monitoring the operational characteristics of a distribution transformer. The condition monitoring of the distribution transformer can be done in such a way that changes in the monitored operational characteristics can be used for predictive maintenance advance to avoid any serious deterioration or breakdown. Condition monitoring systems can be used to estimate the distribution transformers health status from the remote end. The failure of these types of assets, results in the creation of badly negative impact on the social life of electricity consumers. This also directly affects the direct and indirect cost of industrial and commercial electricity use. The proper management of such types of assets is discussed in[1-2]. A diagnostics and data interpretation skill has been used to develop the decision making and assets management model with the use of Arduino Uno techniques. Cost effective optimization skills, management activities, maintenance and combination of real time condition monitoring could be used for improvement in reliability of the system is described in [3]. Health index technique is a very important tool for integrating all of the current statistics of transformers have been used to develop the decision making and assets management model with the use of Arduino Uno techniques. Cost effective optimization skills, management activities, maintenance and combination of real time condition monitoring could be used for improvement in reliability of the system is described in. Health index technique is a very important tool for integrating all of the current statistics of transformers. Single quantitative index which shows its total health is obtained with the use of these health index techniques, these health index techniques are used to show the long-term degradation level, to determine the health condition which is not easily possible to determine by routine inspection and to measure the transformer aging such as winding resistance and furans content. The position of any particular portion of a transformer with respect to repair is not shown by health index. Quantitative health index is describe in[4]and[5] Transformer health monitoring and providing the trans former health index which shows it to health is different from the traditional health condition monitoring system. In traditional health condition monitoring techniques, Interaction between attributes have not been considered. The total health status of the power transformer shows with the help of health condition by considering the interaction between various health condition monitoring Health Index Determination of Distribution Transformer2022 tests for transformer are discussed in [6] .The incipient faults are under the severe fault category that may result in damage to the transformer

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and simulation in power system using MATLAB/Simulink software for100MVA, 138/13.8kV power transformer is discussed in [7]. The classical DGA interpretation methods are used to examine the collected DGA results .Consumer and analyze is of reasonable aspects of distribution transformer with remote condition monitoring systems is discussed in [9][10] the is of monitoring and evaluation of health status for distribution transformers with remote condition .Detection of an inter turn fault at the initial stage in power transformers with transformer interterm fault detection system(TIFDS)is discussed an[11]

Consumer and analyze is of reasonable aspects of distribution transformers with remote condition monitoring systems is discussed in [9]. In [10],their issue of monitoring and evaluation of Health status for distribution .Detection of an inter turn fault at the initial stage in detection system (TIFDS) is discussed in[11].In [12] transformer no-load and light load current harmonic analysis to detect the presence of interterm fault at the incipient stage is discussed. In [13] power system health index (PSHI) is discussed which describe power system health in based on adequacy and security. l transformer performance and for that ,three numbers of input considered such as voltage ,load current and transformer oil level whereas one number of outputs considered such as health index ofHealthIndexDeterminationofDistributionTransformer2022

The prime objective of the research work proposed in this paper is to detect healthy and faulty condition in distribution transformer by continuously monitoring the various parameters such as temperature, voltage and moisture. Ardiuno Uno based techniques have been used to detect and analyzed the health index of the distribution transformer on real time data .formatter will need to create these components, incorporating the applicable criteria that follow.

II. PROBLEMSTATEMENT

Distribution transformers are normally heavily loaded without frequent monitoring of their Kilovolt Amper (KVA) demand, operating temperature (i.e., that of the core winding and of the ambient) oil level and the moisture content develop in the transformer cooling medium, which is the oil. These results in sudden breakdown of transformers leading to loss of revenue .Again, during peak hours, field technicians and engineer travel to transformer sites topic load amps to ensure transformer are overloaded. Modern power system requires accurate, reliable technique for detection of faults, real time data monitoring and fast response speed. The reliable operation of the power system depends upon the effective functioning of the distribution transformer. Microcontroller based system has real time data monitoring , detection of abnormal condition ,fast processing speed reduced installation cost , low maintenance cost and more flexibility.

III. BLOCK DIAGRAM AND COMPONENT DETAIL

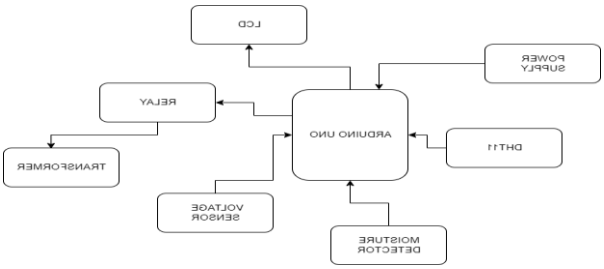

Fig 1. Block Diagram of "Health Index Determination Distribution Transformer"

A. *ARDUINO UNO KIT*

The Arduino UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family.

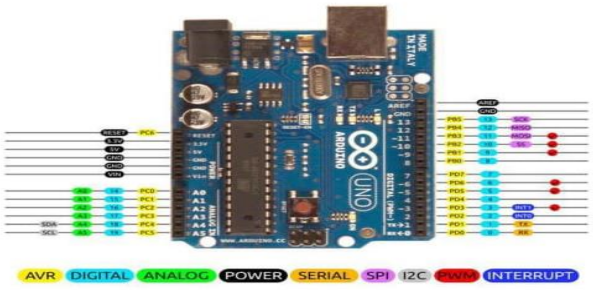

Fig 2. Ardiuno Uno Kit

B. *VOLTAGE SENSOR MODULE*

A voltage sensor is sensor used to calculate and monitor the amount voltage in an object. Voltage sensors can determine the AC voltage or DC voltage level. The input of this sensor is the voltage, whereas the output is the switches, analog voltage signal, a current signal, or an audible signal.

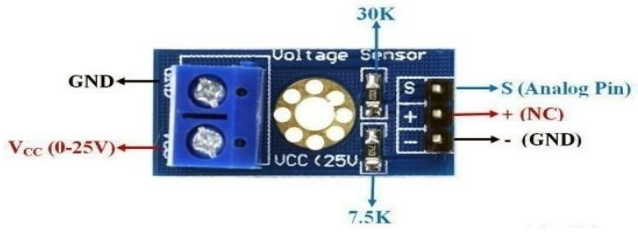

Fig 3. Voltage sensor module

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C. LCD

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones calculators, computers, TV sets, etc. These displays are mainly preferred form -segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

Fig 4.LCD

D. DHT11-TEMPERATURE AND HUMIDITY SENSOR

The DHT11 is a basic, ultra - low-cost digital temperature and humidity sensor. It use a capacitive humidity sensor and thermostat to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins

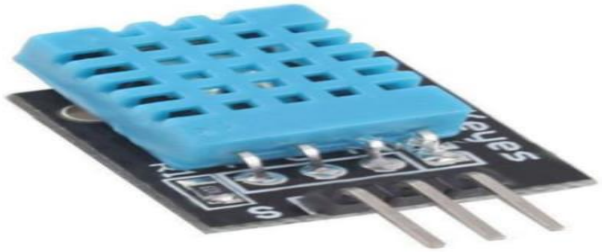

Fig 5. DHT11-Temperature and Humidity Sensor

E. RELAY

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low- power signal from a microcontroller.

Fig 6.Relay

IV. CONNECTION DIAGRAM AND DETAIL WITH FLOW CHART

In this project we used an Arduino uno microcontroller. When we start the project microcontroller and other module systems will be microcontroller one. A voltage sensor is used to measure voltage sensors and will detect temperature. There are two probes connected to the Op-amp circuit to detect oil level of the transformer which act as a moisture sensor, this sensor sends data. To microcontrollers which limit set in the system already. If voltage, temperature & oil level exceeds the limit which is shown on act as indicators to show if the module is powered and if the relay is active or not.

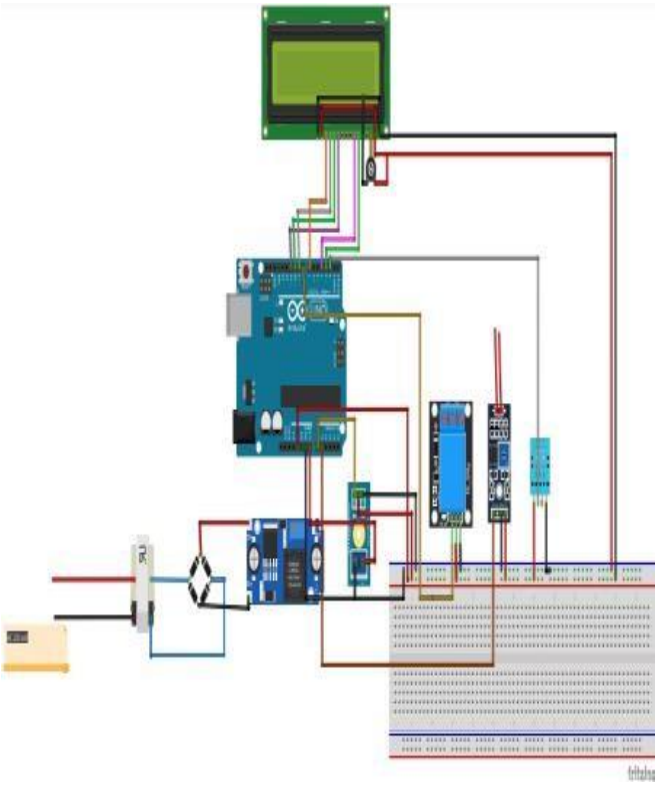

Fig 7. Connection Diagram

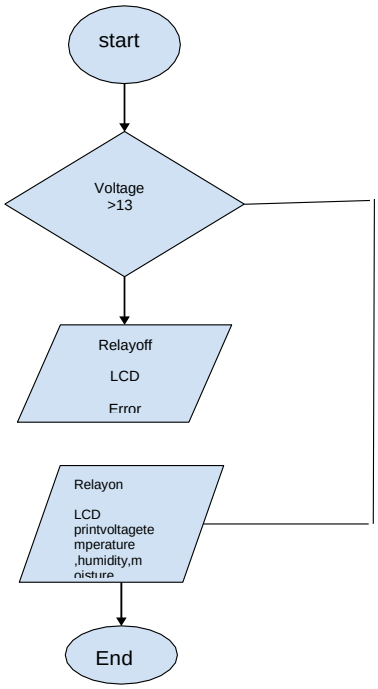

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Fig 8. Flow Chart

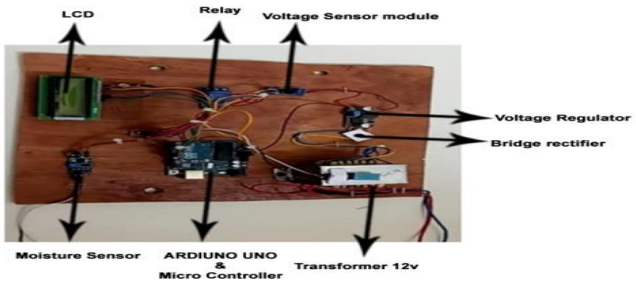

Fig 9. Working Model

V. CODE WRITTEN IN EMBEDDED C

```
int oil = analogRead(moisture);
Serial.print("Oil:");
Serial.print(oil);
lcd.setCursor(0, 1);
lcd.print("Oil:");
lcd.print(oil);
delay(1000);
lcd.clear();

// voltage sensor
adc_value = analogRead(ANALOG_IN_PIN);
adc_voltage  = (adc_value * ref_voltage) / 1024.0;
in_voltage = adc_voltage / (R2 / (R1 + R2)) ;

// Print results to Serial Monitor to 2 decimal places
Serial.print("Input Voltage = ");
Serial.println(in_voltage, 2);
delay(500);


lcd.setCursor(0, 0);
lcd.print("Voltage:");
lcd.print(in_voltage, 2);
delay(1000);
lcd.clear();


if ((t > 40) || (oil < 400) || (in_voltage > 13)) {
  digitalWrite(relay, HIGH);
  lcd.setCursor(0, 1);
  lcd.print("Error Occured");
  delay(1000);
  lcd.clear();
  checkdata();
}
else{
  digitalWrite(relay, LOW);
  checkdata();
}
}


void checkdata() {
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  float f = dht.readTemperature(true);

  if (isnan(h) || isnan(t) || isnan(f)) {
    Serial.println(F("Failed to read from DHT sensor!"));
    return;
  }

  float hif = dht.computeHeatIndex(f, h);
  float hic = dht.computeHeatIndex(t, h, false);
```


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int oil = analogRead(moisture);
Serial.print("Oil:");
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lcd.print(in_voltage, 2);
delay(1000);
lcd.clear();


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  digitalWrite(relay, HIGH);
  lcd.setCursor(0, 1);
  lcd.print("Error Occured");
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  float f = dht.readTemperature(true);

  if (isnan(h) || isnan(t) || isnan(f)) {
    Serial.println(F("Failed to read from DHT sensor!"));
    return;
  }

  float hif = dht.computeHeatIndex(f, h);
  float hic = dht.computeHeatIndex(t, h, false);
```

```
Serial.print(F("%  Temperature: "));
Serial.print(t);
Serial.println(F("°C "));

lcd.setCursor(0, 0);
lcd.print("Temp:");
lcd.print(t);
delay(1000);
int oil = analogRead(moisture);
Serial.print("Oil:");
Serial.print(oil);
lcd.setCursor(0, 1);
lcd.print("Oil:");
lcd.print(oil);
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Serial.println(in_voltage, 2);

lcd.setCursor(0, 0);
lcd.print("Voltage:");
lcd.print(in_voltage, 2);
delay(1000);

}
```

VI. RESULT

ARDIUNO UNO is the method to calculate the value of input into the health index value. ARDIUNO UNO at mega 328 microcontroller interfacing method is used in this paper for converting the numerical values for voltage, temperature and moisture. In this project we determined the health index of the transformer by using an embedded system to detect the transformer healthy and faulty parameters. Of temperature, moisture and voltage which is shown on liquid crystal display which is attached to the project. The Liquid crystal display shows the healthy and faulty parameters of the transformers, If the value of the parameters exceeds the set limit it means the fault occurs on the system and the transformer automatically trips off.

Fig 10. Monitoring Temperature

Shows the temperature reading during healthy and faulty conditions

Fig 11. . Shows the temperature and moisture reading during healthy conditions.

. Fig 12. . shows the temperature reading during faulty

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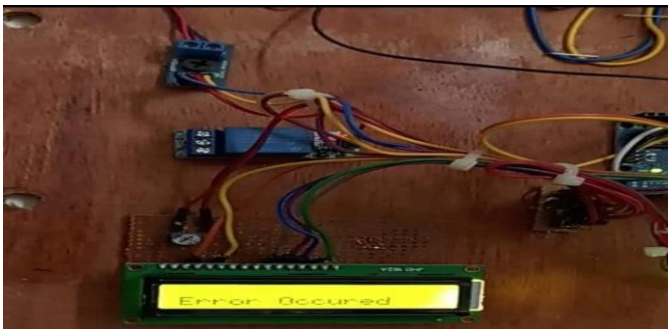

Fig 13. Shows the error occurred during the conditions and the appropriate actions have been taken by the microcontroller.

VII. CONCLUSION:

Real-time monitoring has become a very important technology in the field of distribution transformer maintenance and has attracted more and more attention worldwide, especially with high penetration of PV systems in the distribution power grid. The potential functions of failure prediction, defection identification , and life estimation bring as erase of advantages for utility companies reducing maintenance cost , lengthening the transformer's life, enhancing the safety of operators, minimizing accidents and the severity of destruction , a well as improving power quality .Due to these benefits and the pressure utilizing the existing assets under a competitive environment, real-time monitoring is now a hot topic to power system manager and engineer as well as researchers.

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