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Real Time Monitoring & Controlling System for Distribution Transformer

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Abstract:

This paper presents a GSM technique for monitoring and controlling the distribution transformer. In the substation SCADA system is used for protection of transformers. But when feeders come out after substation there is no any protection system in distribution. The number transformers in the distribution system are very large and it is very difficult to proper manual maintenance. So this paper presents a method of monitoring and controlling for distribution transformers. In this method monitoring on voltage, current, temperature of transformer and oil level in the tank of transformer. The data from sensors sent to Arduino where it compares the preset and real time parameters, if parameters value exceeds the alert message through GSM for particular number of transformer. If parameter value exceeds beyond particular value, command for controlling transformer is given. This method gives advantages for continuous monitoring, proper alert to detect fault, so the life of transformer increases.

Introduction:

Electrical power is real time operating power and flowing continuously. This electrical power is generated, transmitted and distributed by transmitting lines over long distance. The transformers playing major role in providing this electrical power in the consumer area. The distribution transformers are intermediate between substations and consumers.

Distribution transformers are very important part of distribution system. The large number of distribution transformers are present under a one substation and they are working for day and night continuously. If one transformer breaks down, it makes big inconvenience for that particular area. The life of these distribution transformer depends upon the load applied and proper maintenance. The major breakdowns are happening due to overvoltage and over current. The continuous over loading leads to aging of transformer also increase the copper losses. Due to overloading, insulation breaks and insulating strength of transformer oil also degrades. The low strength of transformer oil effects on cooling factor of transformer and leads to over temperature. The failure of transformer is hazardous and also leads to deadly accident.

The maintenance of current distribution system is manually but less manpower is the reason behind poor maintenance of transformer. The manual operations are delays sometime and also irrelevant. The lack of technology and awareness about transformer health causes the transformer failure. In India the 50% of transformer failures are taken place due low maintenance and carelessness towards distribution transformer. Every year so many people faces accidents due to sudden transformer blasts and other break downs in distribution system.

To overcome these all problems and to maintain transformers life, we need one system which will reduce the failure of transformer increase their life. To reduce the failure current, voltage, temperature and oil level has to monitor real time and give information of failure at instance without manpower.

Scope of research:

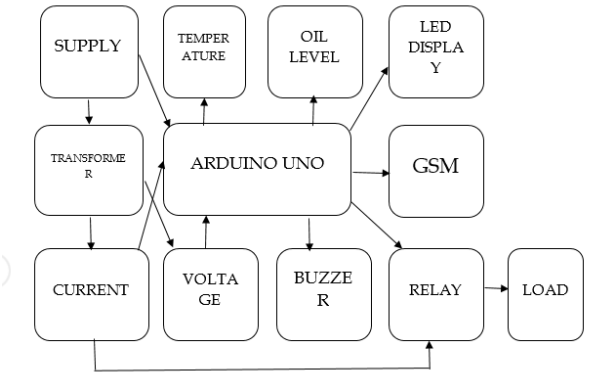
- Faults can be detected at an early stage before it becomes a hazard.
- The number of transformers are large, hard to maintain due to less man power.
- Easy to find location of transformer in which fault occur.
- Reason of fault is detected.
- Losses are reduced due to online controlling.
- Enables data acqision at remote site.
- Online monitoring and controlling.

- The area of use which is not covered under substations is covered here.

***Keywords*:**

Distribution transformer; Monitoring; Controlling; GSM.

***Block Diagram*:**



***Hardware Requirements*:**

Arduino UNO

Arduino UNO is microntroller based on ATmega328. It has 14 digital input/output pins and 6 analog pins. The operating voltage of Arduino is 5V. It is programmed with Arduino IDE which is Integrated Communication Area on USB type B and supplied with USB cable.

GSM

GSM is global system for mobile communication. GSM modem is device which is mobile phone having SIM card inserted for communication over wide range network. In this project GSM SIM 900 is used for smooth interface. Antenna is present on device

which controls the signal. It has operating voltage 5 - 15V DC. When the actual values of transformer go beyond the preset values, the Arduino detects the fault and sent a message of fault to defined mobile number through GSM technique.

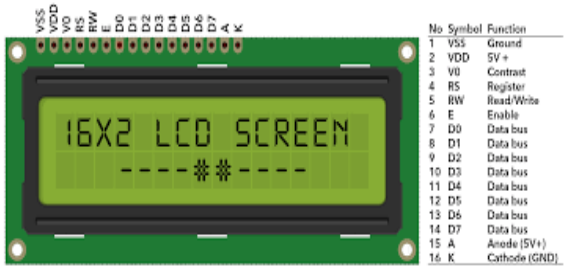
Relay

Relay is electrically operated switch which is used to control single or multiple circuits by only one signal. Relay has 3 contacts normally open, normally closed and common one. It turns to normally open or normally close from common after providing voltage to relay. The operating voltage of relay used in project is 12V consuming current of 150-200mA with trigger current 100mA.

Buzzer

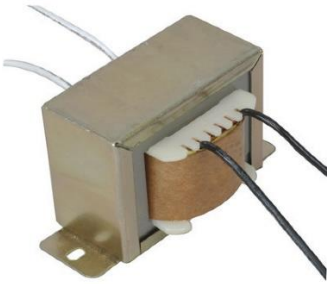
Buzzer is device used for audio signal. Buzzer has given DC voltage supply to convert into sound. The micro buzzer is used having positive terminal connected to supply and negative terminal to ground. The operating voltage is 4-8V DC and current is 30mA.It gives beep sound when relay is operated.

LCD



LCD is liquid crystal display used to represent the values. It uses light modulating properties to display values. The electric voltage is applied to liquid crystal so that changes occurs in optical properties. The LCD operates between 4.7V to 5.3V. We have used number of columns 16 and number of rows 2 to display values of parameters like current, voltage, oil level and temperature.

Transformer



Transformer is electromechanical device used to change the voltage ratio with principle of electromagnetic induction. According to the need voltage it steps up or step down the voltage through transformer. Step up or step down is controlled by winding ratio between primary and secondary winding. By electromagnetic induction property flux from primary get linked with secondary winding when supply to primary winding is given. The step down transformer is used in project as the demonstration of distribution system. The output voltage is 12V or 0V and output current is 5A.

Sensors:

For monitoring purpose current, voltage, oil level and temperature parameters are selected. So the following sensors are used to detect the parameters.

Voltage sensor

For sensing the voltage of transformer Potential Transformer of rating 230V/12V AC is used. It has output current of 500mA. It is connected with bridge rectifier to convert AC to DC which is required for Arduino. But the bridge rectifier does not convert complete AC to DC, ripples are still present and to eliminate these ripples using capacitors of 100uf.Arduino has operating voltage 5V so to reduce present DC voltage up to required voltage potentiometer of 10K is used.

Current Sensor

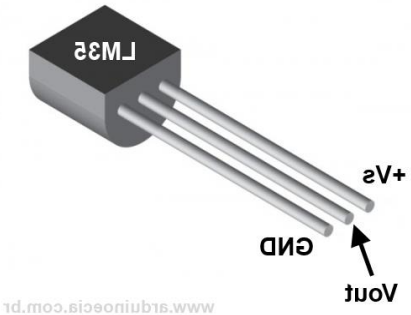
Current Transformer is used to sense the current present in the transformer. Current transformer converts high current of primary to low current of secondary winding which is proportional with primary winding. The ratio of CT used is 10/1mA.

Oil Level Sensor

Ultrasonic sensor is used to measure distance of oil present in transformer tank by emitting ultrasonic sound waves. It has transmitter and receiver between which signal travels. In the project HC-SR04 model is used having 8mA operating current and supply given of 3.3V to 5V. The measuring angle is 15 degrees.

Temperature Sensor

For measuring the temperature of transformer LM35 is used. It is operating in range of 55° C to 150°C. The sensor is working between 4V to 30V.It works on simple principle, as the temperature increases the voltage across diode is also increases.



***Working and circuit Diagram*:**

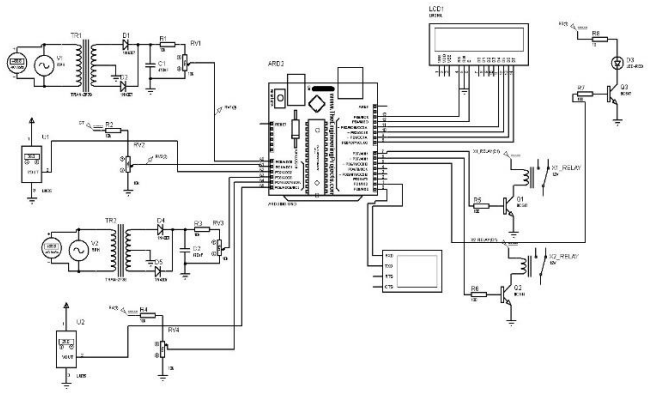
The voltage supply of 230V is given to the primary side of transformer and stepped down to 12V. This supply is further given to current transformer, loads connected in series, Buzzer and LCD panel. The main supply is also provided to Potential Transformer. Arduino has given DC supply through adapter of 12V. The output of Arduino is given to GSM, Relay and Buzzer. The transformer is tested for overvoltage, under voltage, overcurrent.

When Arduino compare the real time values with predefined values. the voltage in transformer is increases or decreases beyond the preset value, the Arduino gives message of fault to defined mobile number through GSM. When the voltage value is increased or decreased to Arduino limit, Arduino gives signal to relay and buzzer to operate them.

When the current in transformer is greater than defined value, Arduino send signal to GSM and further message of fault to defined mobile number. If the current value beyond particular limit the relay trips the transformer.

The signal from temperature measured by sensor is given to Arduino and Arduino gives output to LCD to display the value of temperature present in transformer.

The oil level in transformer is sensed by ultrasonic sensor and output given to Arduino. The output signal from Arduino is given to LCD which gives oil level in form of percentage. All the parameters values are displayed on LCD.



All the sensors are connected to Transformer and Arduino. The particular values of all parameters are mentioned in the code. The code has all procedure to respond the all conditions. In working condition Arduino compare data from all sensors and display on LCD. It also gives output of fault through GSM. When fault increased to limit the Arduino sends signal to trip the relay and to operate buzzer.

***Result*:**

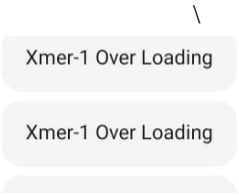
Voltage:

- Warning High Voltage: 245V (GSM operate)
- Warning Low Voltage:200V (GSM operate)

- Under Voltage: 190V (relay trip)
- Over Voltage: 250V (relay trip)

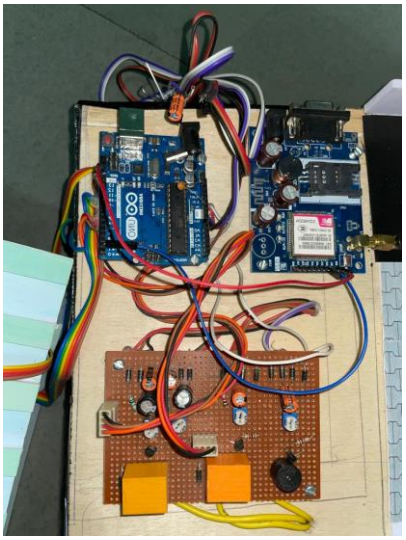
Current:

- Warning Current: 0.8A
- Over Current: 1A (relay trip)



Oil Level:

- 100% Level: 12cm
- 10% Level: 1.2cm



***Advantages*:**

- Easy Monitoring
- Greater reliability and greater cost savings
- No manpower is required
- Cost effective
- High speed data acquisition(GSM)

Limitations:

- Initial cost is high.
- GSM message output is network dependent.
- It will give message only whenever fault occurs.
- Real time values of all parameters are shown through LCD display in control room.

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