

## Advanced Monitoring for Auxiliary Transformer Failures and Alerting System

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**ABSTRACT** -Auxiliary transformers are critical components in power distribution systems, and their failure can lead to costly downtime and potential damage to electrical infrastructure. This paper proposes the development of a real-time alert system will be designed to monitor auxiliary transformer health and promptly detect anomalies and failures. The development of a transformer health monitoring system involves the utilization of Arduino-based embedded systems to interface with temperature, ultrasonic, and current sensors. The system aims to monitor essential parameters such as temperature, oil level, and current values. In case of abnormalities, it triggers immediate alerts through GSM messaging and implements protective measures by controlling the load using relays and a buzzer for audible alerts.

**Key Words:** Auxiliary Transformer, GSM Technology, Arduino, Temperature Sensor, Ultrasonic Sensor, Current Sensor.

### 1. 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 entire network operation. Thus is effecting system reliability. 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.

### 1.1 OBJECTIVE:

The main objective of this project is to alert the system based on the increase in temperature, oil level, current and voltage parameters so that we can reduce transformer failures.

### 2. EXISTING METHOD:

Conventional approaches to transformer health monitoring often rely on manual inspections and periodic checks. Technicians visit transformer sites at scheduled intervals, collecting data on parameters such as temperature and oil level. This methodology is labor-intensive, time-consuming, and prone to human errors. Moreover, it lacks real-time monitoring capabilities, making it challenging to identify issues promptly.

In situations where abnormalities are detected, response times can be delayed, potentially leading to transformer damage or failures. The drawbacks of manual monitoring are exacerbated in remote or hard-to-reach locations, where access is limited, and technicians' visits may be infrequent. Additionally, conventional systems rarely incorporate immediate alert mechanisms, leaving the response to anomalies largely dependent on human intervention, which can be inconsistent and unreliable.

In present days we are measuring transformer or generator parameters manually. It is difficult to measure every time manually, and it is very time taking process. Every time manually operations required many man power resource so it is difficult to monitor transformer health manually.

### 3. PROPOSED METHOD:

The transformer health monitoring system introduced here offers a revolutionary approach to address the limitations of conventional methods. Leveraging Arduino-based embedded systems, this solution provides monitoring, immediate alerts, and automated protective actions. It employs temperature sensors to continuously measure the transformer's operating temperature, ensuring that it remains within safe parameters. Ultrasonic sensors monitor the oil level, and current sensors track the electrical load. In the event of decreasing oil levels, signaling potential issues such as leaks or inadequate lubrication, the system triggers an alert via GSM messaging. This timely notification allows for swift intervention, preventing further damage or operational disruptions. Moreover, if the current values surpass predefined thresholds, indicating overload conditions, the system initiates protective measures. A relay is activated to disconnect the load, preventing excessive stress on the transformer, while a buzzer provides an audible alert for immediate attention.

In contrast to manual monitoring, the proposed method offers several advantages. It eliminates the need for frequent on-site visits, reducing costs and minimizing the risk associated with physically accessing transformers in remote or hazardous locations. Monitoring ensures early anomaly detection, reducing the likelihood of costly transformer failures and unplanned downtime.

#### 3.1 BLOCK DIAGRAM:

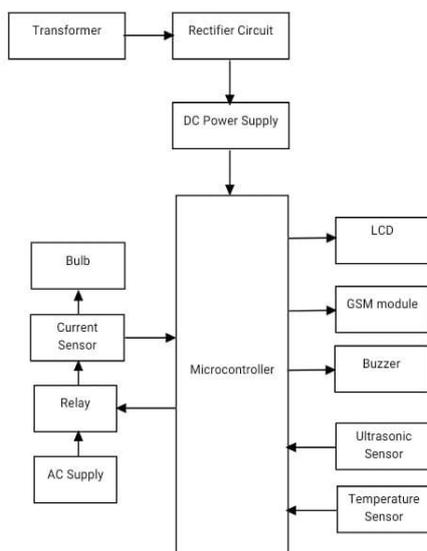


Fig-1: Block Diagram

In this project oil level and temperature of the transformers are observed continuously using ultrasonic sensor for oil level monitoring and temperature sensor for monitoring transformer temperature. In this current variation is monitored

and is displayed on LCD. If any of the sensor crosses the limits then bulb will OFF and have alerted and GSM is used to send SMS and upload data to thing speak server. Also measuring current of transformer.

### 4. HARDWARE COMPONENTS:

#### 4.1 ARDUINO:

The Uno with cable is a Microcontroller board base on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs) 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything need to support the Microcontroller simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.



Fig-2: Arduino

#### 4.2 TRANSFORMER:

A transformer of 12V is a static electrical gadget that exchanges control between at least two circuits. A fluctuating current creates a changing attractive motion in one transformer curl, which thus actuates a differing electromotive power over a second loop twisted around a similar center.



Fig-3: Transformer

#### 4.3 ULTRASONIC SENSOR:

An ultrasonic sensor transmit ultrasonic waves into the air and detects reflected waves from an object. There are many applications for ultrasonic sensors, such as in intrusion alarm systems, automatic door openers and backup sensors for automobiles.



Fig-4: Ultrasonic Sensor

#### 4.4 LCD:

Liquid Crystal Display (LCD) is the innovation utilized in scratch pad shows and other littler PCs. Like innovation for Light-Emitting Diode (LED) and gas-plasma, LCDs permit presentations to be a lot more slender than innovation for Cathode Ray Tube (CRT). LCDs expend considerably less power than LED shows and gas shows since they work as opposed to emanating it on the guideline of blocking light.



Fig-5: LCD

#### 4.5 TEMPERATURE SENSOR:

The digital temperature sensor like DS18B20 follows single wire protocol and it can be used to measure temperature in the range of -67°F to +257°F or -55°C to +125°C with ±5% accuracy. The range of received data from the 1-wire can range from 9-bit to 12-bit. Because, this sensor follows the single wire protocol, and the controlling of this can be done through an only pin of Microcontroller.



Fig-6: Temperature Sensor

#### 4.6 CURRENT SENSOR:

Measurement of current is necessary for the proper working of devices. Measurement of voltage is passive task and it can be done without affecting the system. Whereas measurement of current is an intrusive task which cannot be detected directly as voltage.



Fig-7: Current Sensor

#### 4.7 RELAY:

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts.



Fig-8: Relay

#### 4.8 GSM:

GSM is a mobile communication modem it is stands for Global System for Mobile Communication (GSM). It is widely used mobile communication system in the world.

GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.



Fig-9: GSM

#### 4.9 BUZZER:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Active buzzer 5V rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to plug and play.



Fig-10: Buzzer

#### 4.10 RECTIFIER:

A rectifier is an electrical device that converts alternating current, which periodically reverses direction to direct current, which flows only in one direction. Rectifiers have many uses, but are often found to serve as components of DC power supplies and direct power transmission systems with high voltage. Rectification can be used in roles other than direct current generation for use as a power source.



Fig-11: Rectifier

### 5. SOFTWARE COMPONENT:

#### ARDUINO IDE:

Arduino IDE where IDE stands for Integrated Development Environment. An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go.

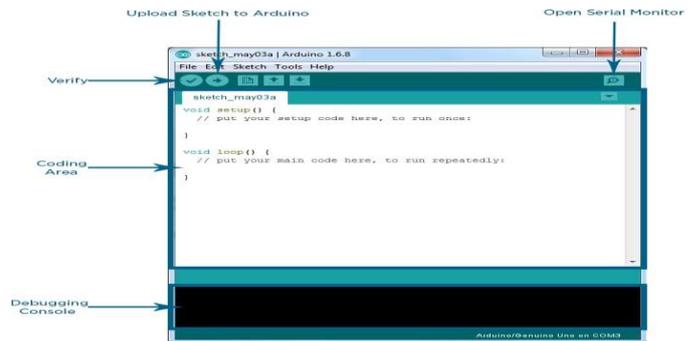


Fig-11: Arduino IDE

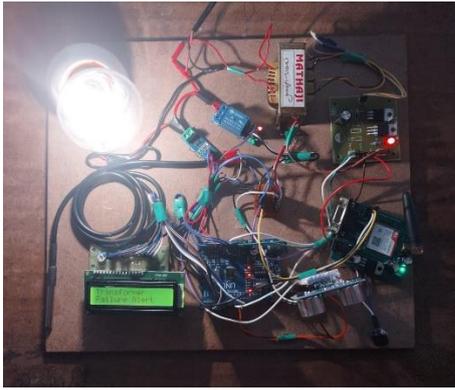
### 6. TESTING RESULTS:



Fig-12: Experimental Setup



Fig-13: Inserted SIM on GSM module



**Fig-14: By using 60W bulb**



**Fig-18: By using 200W bulb**



**Fig-15: Value of Current under normal condition**



**Fig-19: Value of Current under fault condition**



**Fig-16: Value of Distance under normal condition**



**Fig-20: Value of Distance under fault condition**



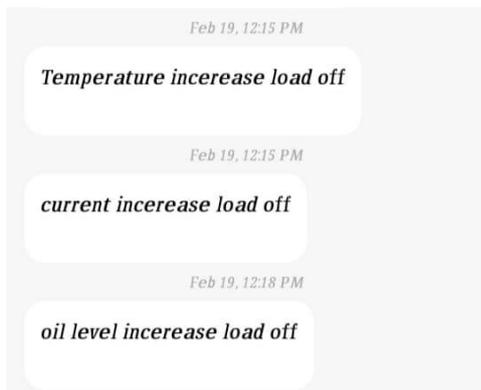
**Fig-17: Value of Temperature under normal condition**



**Fig-21: Value of Temperature under fault condition**



**Fig-22: Measuring oil level with the help of container**



**Fig-23: Received messages under fault condition**

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**7. CONCLUSION:**

In conclusion, a transformer monitoring system is proposed and is experimentally performed on the hardware. Also different parameters of transformer is captured and monitored. The different parameters of transformer are continuously access through the condition of transformer is continuously monitored wirelessly at Master Secondary Substation and necessary actions are taken to improve the performance of the system. This scheme can be effectively used to control the substation.

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