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Protection and Monitoring Of Transformer Using Arduino

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Abstract: ***In this paper, present a "Arduino based protection and monitoring of transformer" main attention is to reduced or overcome the fault occurred in the transformer. To prevent the transformer from the fault due to the over- currents, temperature rise in transformers oil and over voltage we used relay and sensor. In this protective methodology is implemented by using of Arduino controller. It is cost powerful device and high speed of operation with greater accuracy. Load current and transformer temperature are continuously monitored or sense by the controller. If supply voltage and load current crosses the threshold value which are previously set values in programed and protection scheme operates and trips the load. For the testing purpose, one special type of transformer used that is i.e. autotransformer. By using this, we can change the supply voltage of the primary of transformer to produce over voltage and under voltage fault. Also, to occur over-current fault we rise the load by using drilling machine. At the end, successfully we have done this project after clarifying the advanced technique and find out all problems before any failure.***

Keywords: ***Arduino, Relay, Auto-Transformer, CT,*** *PT.*

I. INTRODUCTION

As we know that, transformer is the heart of whole power system (PS).It is very essential to protect them from various faults. Protection against fault in power systems (PS) is very essential and vital for reliable performance. A power system is said to be faulty when an undesirable condition occurs in that power system, where the undesirable condition might be short circuits, over-current, overvoltage etc.

The power transformer is one of the most significant equipment in the electric power system, and transformer protection is an essential part of the general system protection approach. Transformers are used in a wide variety of applications, from small distribution transformers serving one or more users to very large units that are an integral part of the bulk power system. In the design of electrical power transmission and distribution system, there are various factors that need to be considered in the quest to satisfy the needs of electricity consumers. Electrical power systems experience faults at various times due to various reasons. These faults must be foreseen and safety precautions applied to the power system.

The power systems engineer must include in his design, safety measures in order to avert any destructive occurrences that the system may undergo at any given time. Power system protection is very essential and necessary for a dependable electrical power supply. For the protection of transformer, generally we used relay to sense the fault in transformer.

For decades, fuse circuit breakers and electromechanical relays were used for the protection of power system. The traditional protective fuses and electromechanical relays presents several draw backs. In advanced method use in this project for the protection purpose in power system is Arduino instead of 8051 micro controller its better and high accuracy. It's cheaper and programming also simple as compared to micro controller.

II. PROBLEM STATEMENT

Transformer is a static device which convert the voltage from one level to other level without change in frequency and power. Load is connected at secondary winding of the transformer it increases to the rated value. Due to short circuit or suddenly increase in load can cause overloading, over-voltages and overheating that can harmful to the transformer windings insulation and severe damage can be occur on the secondary side of transformer.

Transformer can cause failure due to the different faults occur. Various faults like over currents, over voltage faults, under voltage and also rise in temperature of transformer oil. So, for minimize this above faults a high reliable and speed of operation of relay with more accuracy is needed. In this paper a protection methodology is purposed that introduced the above stated problems. Transformer protection is a important factor in the design of an electrical power system.

III.BASIC BLOCK DIAGRAM

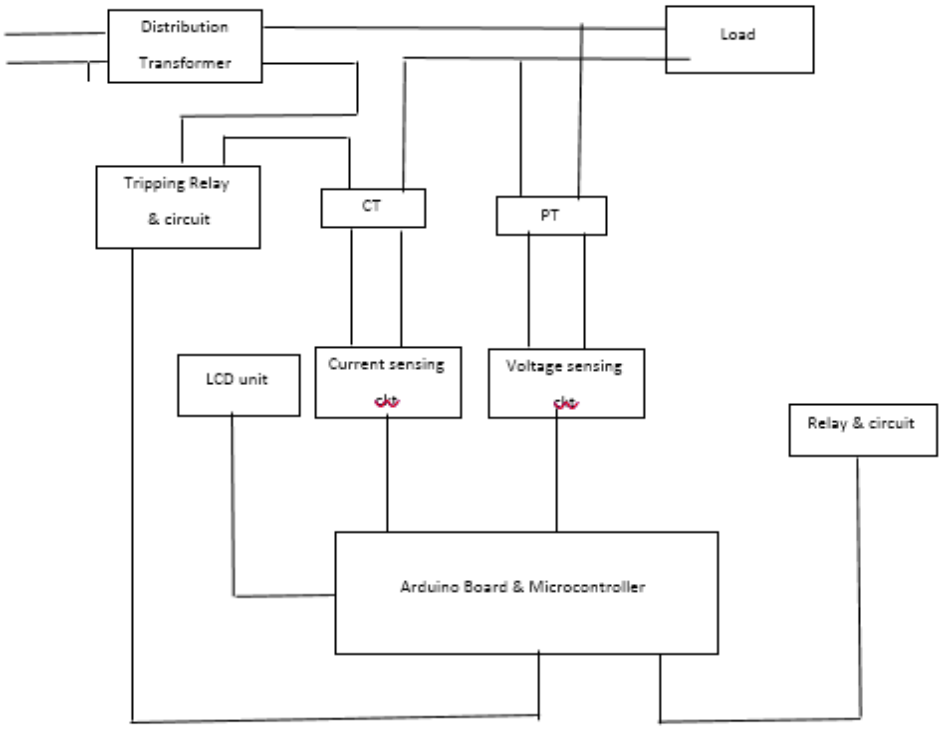

Fig 3 Basic Block Diagram

Basic block diagram of whole model as shown in figure 1.As function of each block or device which are used in this methodology for the protection purposed are explain below.

A. The Main Component

1) Current Transformer (CT): CT are generally used to measure the high value of current. It's necessary for protection and control the fault. A current sensor is a device that detects and converts current to an easily measured output voltage, which is proportional to the current through the measured path. When a current flows through a wire or in a circuit, voltage drop occurs. CT act as current sensor.

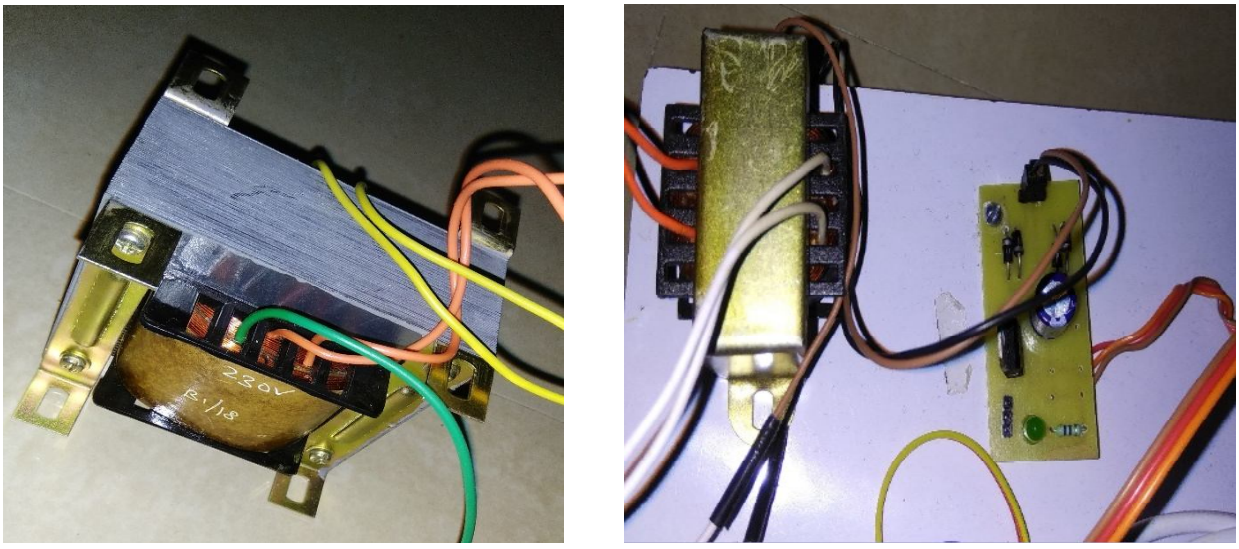

Fig.1 Current transformer and real time picture of current sensor

2) *Potential Transformer (PT):* PT are also generally used to measure the high voltage application. To measure the high voltage by stepping down the voltage. The Potential transformer is act as voltage sensor which is used to sense or measure the voltage flow from the system. The potential transformer place parallel to the load. The bridge rectifier convert AC voltages into DC voltage and attached to the analog pin of microcontroller. For calibration purpose, we use the pots (Variable resistor) to change the supply voltage and produce under voltage and over voltage fault in the power system. Real time picture as shown in below.

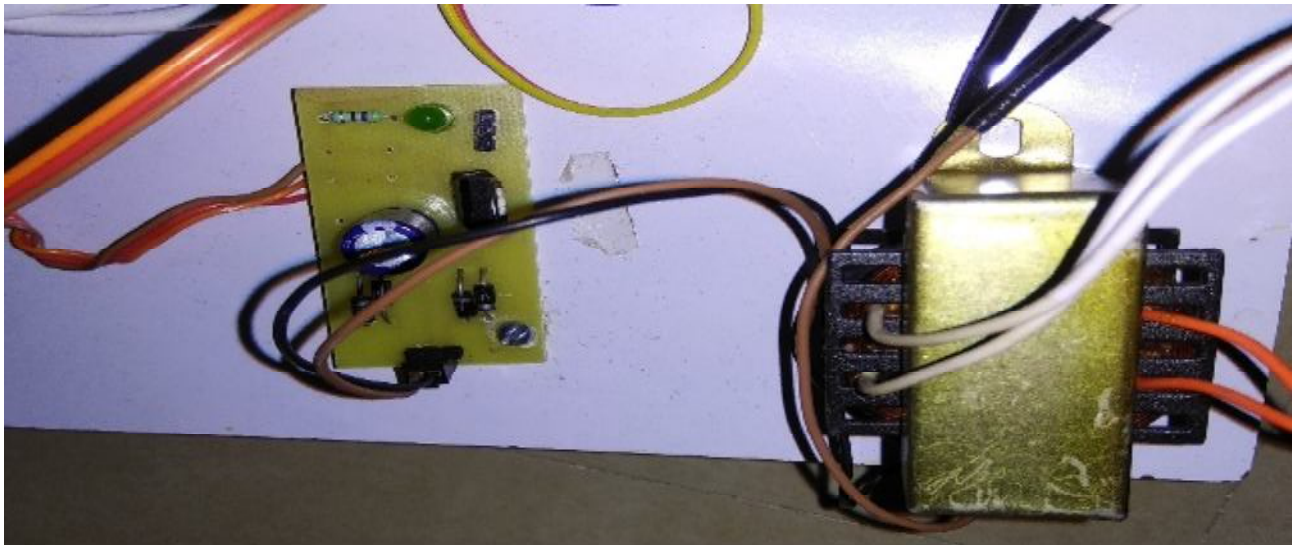

Fig 3.2 real time picture of voltage sensor

3) *Temperature sensor Interfacing with Arduino:* Thermistor is inexpensive and easily-obtainable temperature sensors.it is very easy to use and adaptable. Circuits with thermistor can have reasonable output voltages not the mV outputs thermocouples have. Because of these qualities thermistor are widely used for simple temperature measurements. Thermistors are not used for high temperature.

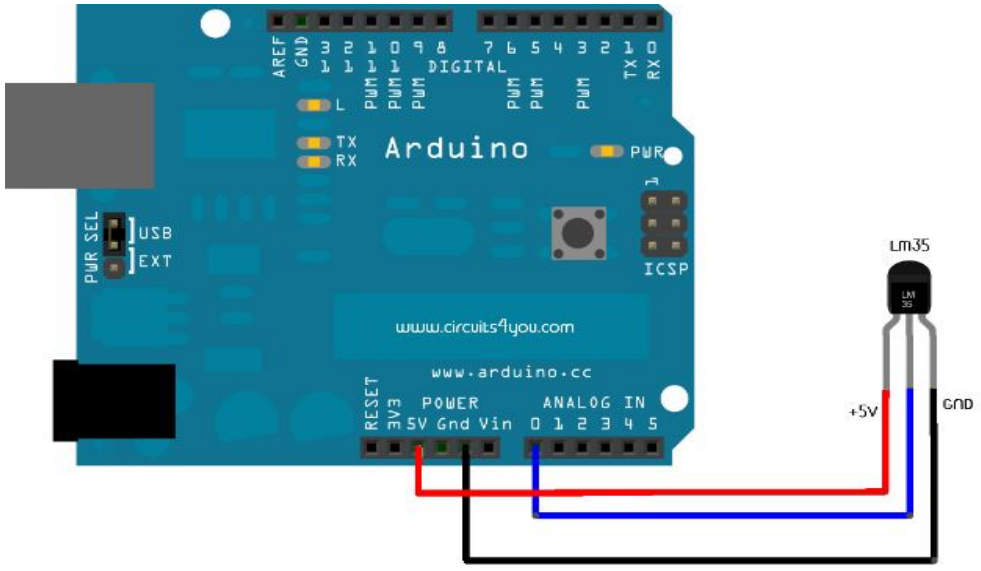

Fig 3. Temperature sensor interfacing with Arduino

4) *Relay:* The function of relay is to disconnect the supply when the faulty condition is happened. The relay circuit is connected to Arduino Board with using of opto-coupler (pc817). Opto-coupler is used for protects the microcontroller from high voltage spikes and the isolation purpose. The transistor is used in relay circuit to operate the relay. The output of Arduino become high, the relay circuit will operate and trips the load.

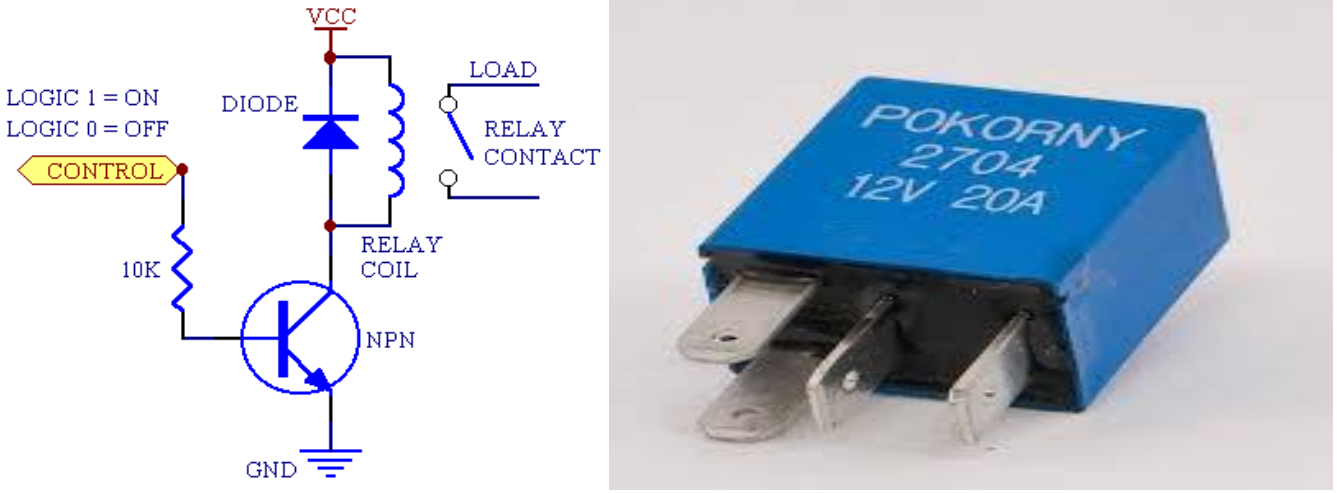

Fig 4. Relay driver circuit and Relay

5) *LCD:* LCD is used to show all result on screen. Most common LCDs connected to the microcontrollers are 16x2 and 20x2 displays. In research 16pin (LMB162AFC) LCD is used to display the parameters of transformer such as voltage, current and temperature. Arduino Platform communicates with the LCD using serial communication protocol.

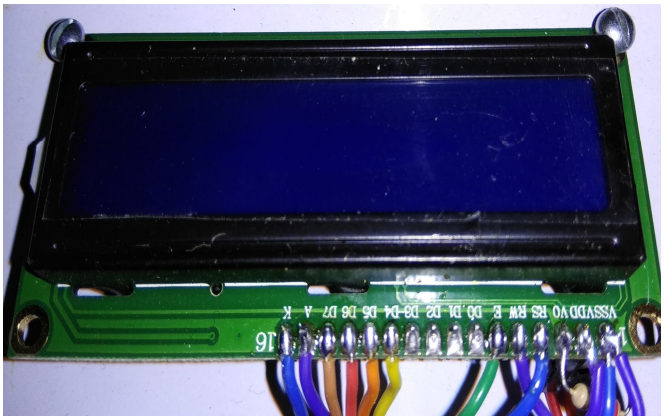

Fig 5 a) Interfacing of LCD with Arduino pins

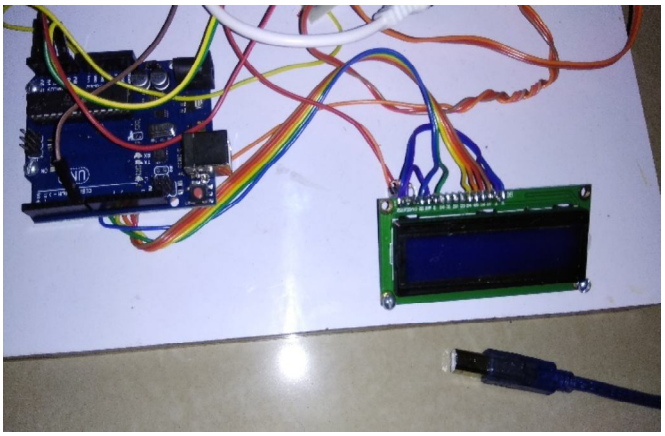

Fig 5 b) Real time picture of LCD interfacing

6) *Arduino Kit:* Arduino Uno is used for implementing the digital controller. Arduino Uno is an AVR based upon microcontroller board. It has ATmega328 microcontroller and other on board peripherals including 16 MHz crystal. Programming is done in C language. Detailed Arduino board diagram is shown in figure (3.6).

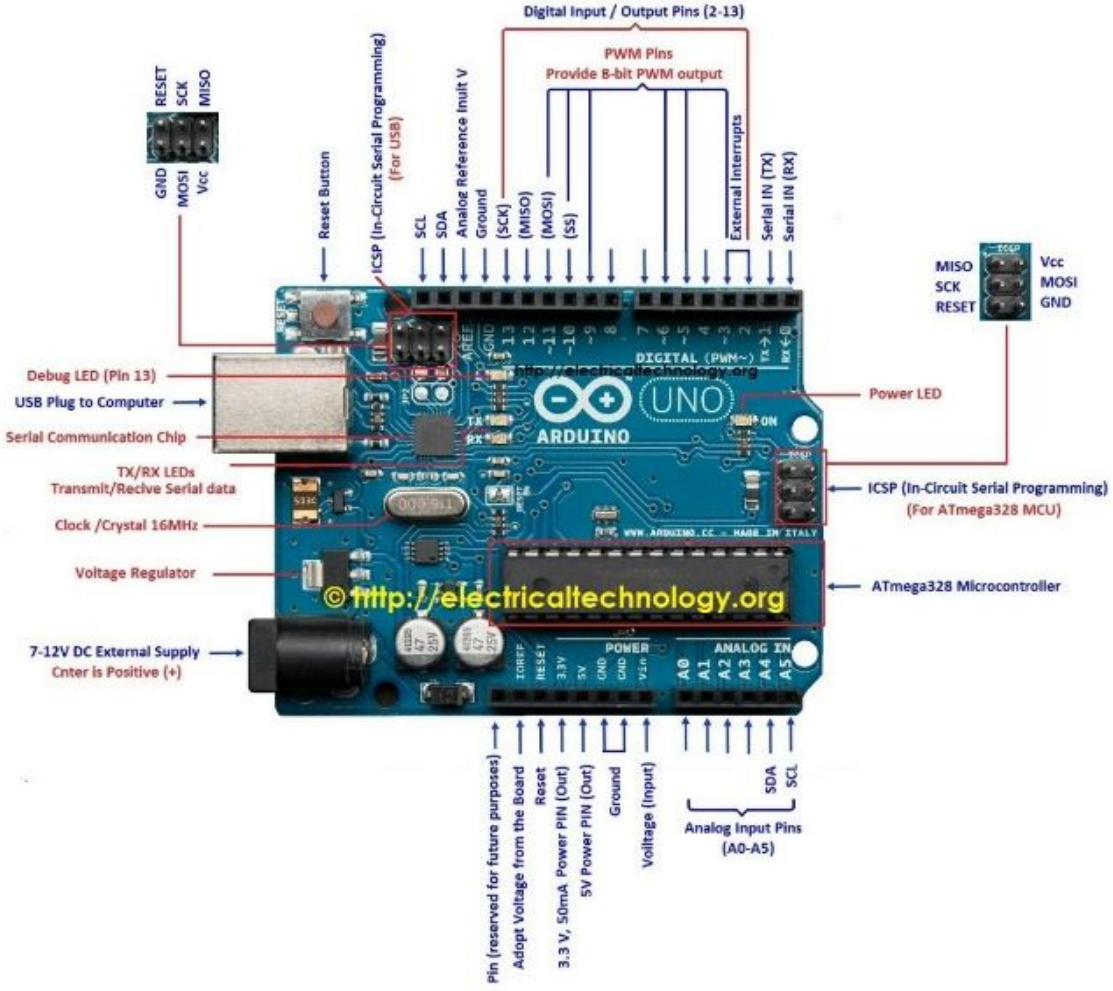

Fig.6. Arduino Kit

IV. PROJECT HARDWARE

The experimental setup as shown below. In this,we used wood board to mount the whole circuitary and devices like, Arduino kit, current sensor, voltage sensor, LCD and temperature sensor. Also,used one extention board to give the supply easily.

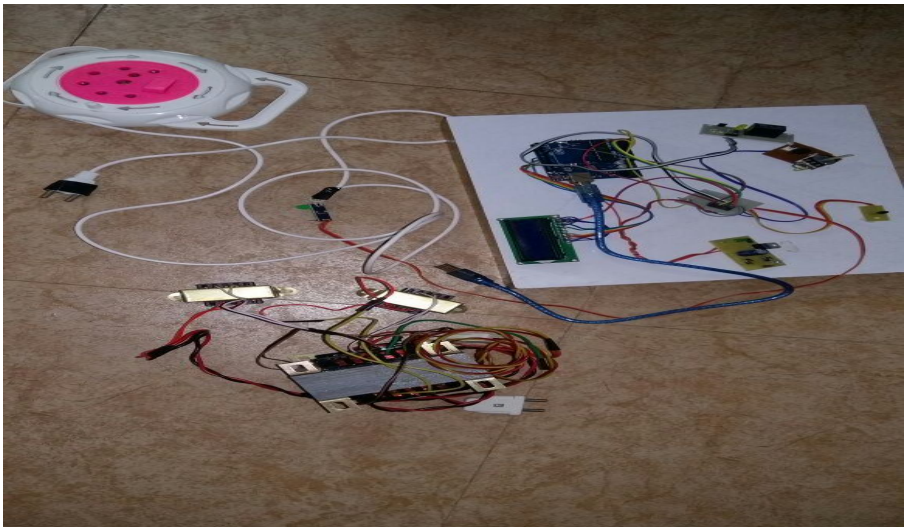

Fig 6. Assembly of protection circuit

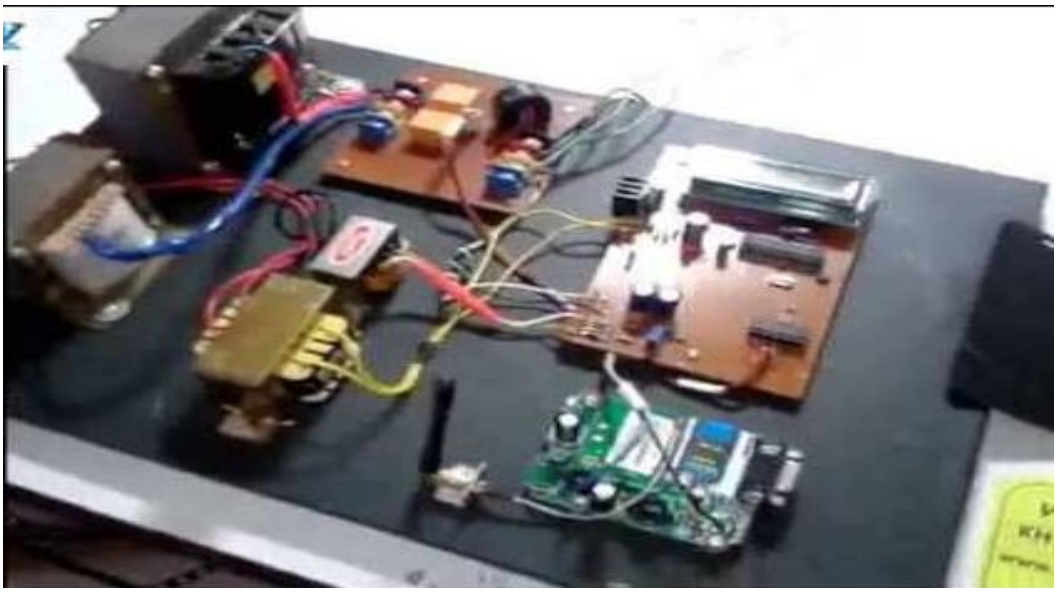

Fig 4 Experimental Setup

V. RESULT

Lab testing is performed on 1A current, 230 V voltages and 45° C temperature settings. When the rating of current and voltage is reaches its defined threshold value, then the load is cut-off. Also the temperature reaches it limits then fan would be turned on for cooling the transformer. If current or voltage exceeds its defined limits then load would be cut-off and as the temperature limit reaches, cooling fan would be turn ON Testing results are as given below.

TABLE I.
EFFECT OF OVER VOLTAGE AND UNDER VOLTAGE

Sr. no.	Supply Voltage (Volt)	Load
1.	>230v	ON
2.	<230	OFF

TABLE II
EFFECT OF LOAD VARIATION

Sr. no.	Current (Amp)	Load
1.	>1A	ON
2.	<1A	OFF

TABLE III
EFFECT OF TEMPERATURE VARIATION

Sr. no.	Temperature (° C)	Load
1.	>45	OFF
2.	<45	ON

VI. CONCLUSION

From this project we can, calculate the current flowing through the circuit and analyzed it. The C.T. is to use to measure the current and displayed on the LCD display.

The relay is used for tripping operation. When the fault is occur due to overloading or over voltages then microcontroller will energies the relay coil to trip the circuit. iii. The temperature measure by using temperature sensor which is interface with Arduino. The temperature increases more than the pre-set value then the circuit will trip and the fan is ON.

VII. FUTURE RECOMMANDATION

For future work, some recommendation has been given below to improve the performance.

1) By using TRIAC instead of relay for protection of transformer due to this improve the protection zone of transformer.

2) By using GSM modem wireless communication has been done successfully. Due to this, information about transformer reading such as, current, voltage and temperature etc. send directly on the mobile of operator.

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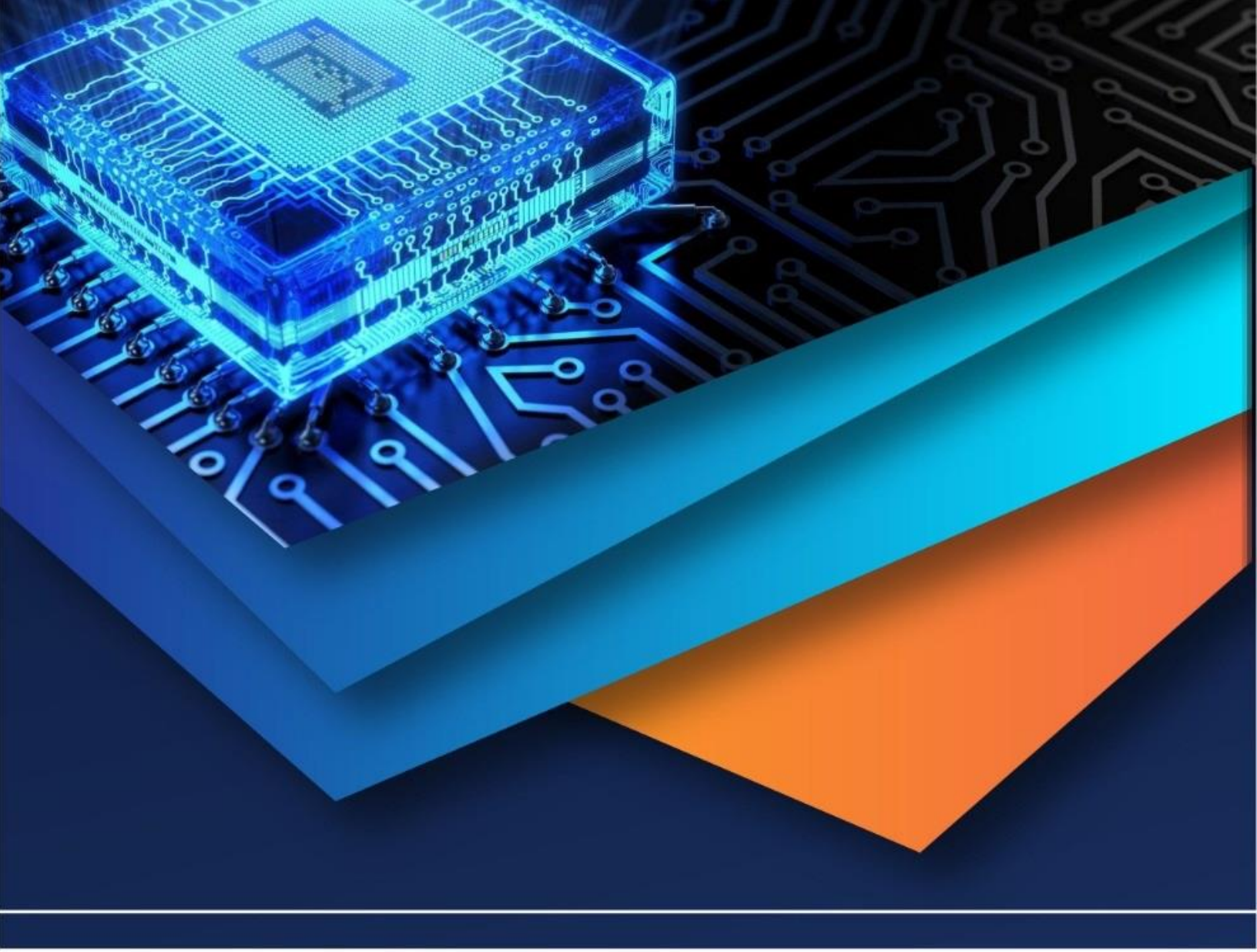

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