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ARDUINO BASED PASSWORD PROTECTED WITH MAINTENANCE OF TRANSFORMER

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COIMBATORE

I. ABSTRACT

A password-based controller is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt. During the operation of distribution transformers, the windings will have temperature rise hot spots, which may accelerate insulation aging and decrease service life of the transformers. Monitoring of hot spot temperature is important to ensure safe operation of the transformer. In order to realize accurate monitoring on winding temperature, the paper presents a distributed temperature measurement system for power transformer based on fibre Bragg grating (FBG). Firstly, the principle of the FBG temperature measurement is introduced. Then, temperature distribution of a 10 kV distribution transformer is simulated based on finite element simulation method. Hot spot locations of the windings are obtained. After that, the manufacturing techniques are improved, and a distribution transformer prototype with FBGs is developed. Finally, temperature rise tests under the rated load are carried out to investigate the efficient of the proposed system. The experiment results indicate that the winding hot spot distribution is in consistent with the simulation result, the proposed optical system can be used in the field transformer monitoring.

Keyword---Transformer, Servomotor, GSM network, Embedded C, Real time monitoring, transformer fault.

II. INTRODUCTION

A transformer is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt current flow. Unlike a fuse, which operates once and then must be replaced, a transformer can be reset (either manually or automatically) to resume normal operation. When operated manually we see fatal electrical accidents to the line man are increasing during the electric line repair due to the lack of communication and coordination between the maintenance staff and the electric substation staff. In order to avoid such accidents, the breaker can be so designed such that only authorized person can operate it with a password. This ensures security of the worker because no one can turn on the line without his permission. The system is fully controlled by the Arduino Uno AT mega microcontroller of Atmel family. The password is stored in an EEPROM, interfaced to the microcontroller and the password can be changed any time unlike a fixed one burnt permanently on to the microcontroller. A keypad is used to enter the password and a relay to open or close transformer, which is indicated by a lamp. Transformers are the main building block in a power system. Any damages in transformers adversely affect the balance of a power system. The damages are mainly occurring due to overloading and inefficient cooling. Drawbacks of the conventional transformer monitoring system and the biggest problem in the electricity distribution grid are most of the distribution transformer are remotely located in a rural area, where regular monitoring by human observation is difficult to perform due to insufficient manpower.

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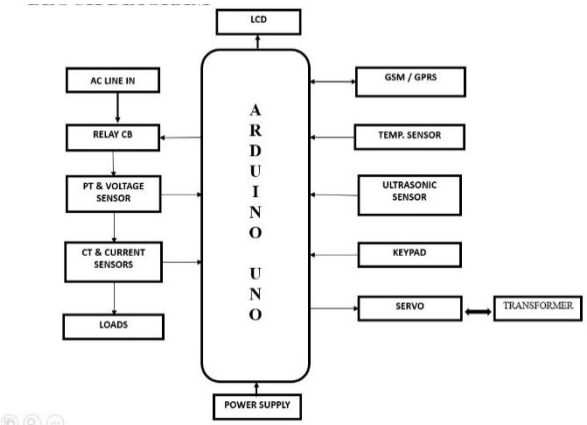
Existing monitoring systems are not supported for real time operations. There are too many transformer failure cases are detected every day. Not allowed for planning operation downtime. The main objective of the real time monitoring of the health conditions of the distribution transformer using IOT technology. The parameters such as oil level, temperature, voltage and current of a transformer are monitored, processed and recorded in servers. For this purpose, we use four sensors interfaced with Arduino. The recorded data can be send using GSM/GPRS module and accessed from anywhere around the world using IOT technology using HTTP protocol. This helps in identifying without human dependency. This helps in identifying and solving a problem before a failure without human dependency. And system also provides over current, over voltage protection and alert regarding that also initiated to protect transformer by 24/7.

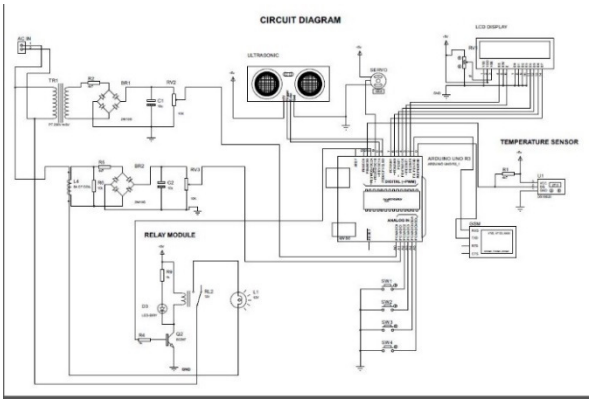
III. BLOCK DIAGRAM



IV. WORKING

The working of **Arduino based protected with maintenance of transformer** using Arduino, servo motor, sensors, relay are implemented using IOT. To avoid manual ON/OFF technology on transformer, Password based system using Arduino is implemented. If the password is entered using keypad, it will be shown on display and the transformer gets turn ON\OFF with the help of servomotor. Additionally, the Ultra Sonic sensor (HCSR04) is installed to check the oil level of the transformer, the temperature sensor (DS18B20) is installed to monitor the temperature of the transformer, the Current and Voltage sensor is installed and used to maintain the current and voltage of the transformer. These three sensors are used to shut off the transformers if it exists the limit of the given data (oil level, temperature level, V&I) respectively. The GSM (SIM800L) is used to send the data from the sensors to the receiver. After rectifying the fault, the transformer gets turn on manually using the password. This will overcome the communication error, manual error, and more safety for human being.

V. METHOD OF APPROACH



Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board Various kinds of Arduino boards are available depending on different microcontrollers used. However, all Arduino boards have one thing in common: they are programed through the Arduino IDE. The differences are based on the number of inputs and outputs (the number of sensors, LEDs, and buttons you can use on a single board), speed, operating voltage, form factor etc. Some boards are designed to be embedded and have no programming interface (hardware), which you would need to buy separately. Some can run directly from a 3.7V battery, others need at least 5V. Here is a list of different Arduino boards available.

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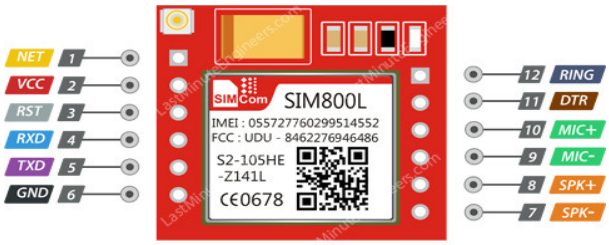
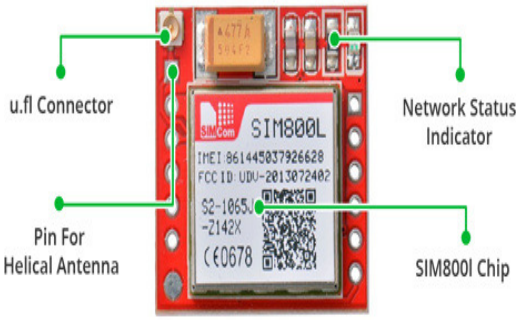
VI. COMPONENTS

GSM / GPRS

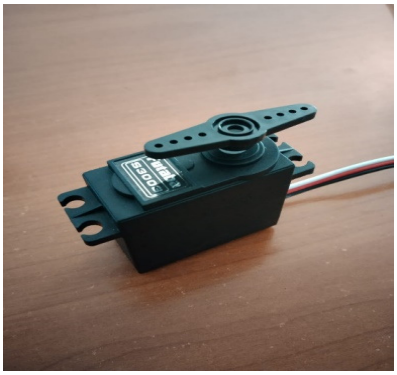
At the heart of the module is a SIM800L GSM cellular chip from Sim Com. The operating voltage of the chip is from 3.4V to 4.4V, which makes it an ideal candidate for direct LiPo battery supply. This makes it a good choice for embedding into projects without a lot of space All the necessary data pins of SIM800L GSM chip are broken out to a 0.1 pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 1200bps to 115200bps with Auto-Baud detection. The module needs an external antenna to connect to a network. The module usually comes with a Helical Antenna and solders directly to NET pin on PCB. The board also has a UFL connector facility in case you want to keep the antenna away from the board.





SERVO MOTOR

Servo implies an error sensing feedback control which is utilized to correct the performance of a system. It also requires a generally sophisticated controller, often a dedicated module designed particularly for use with servomotors. Servo motors are DC motors that allows for precise control of angular position. They are actually DC motors whose speed is slowly lowered by the gears. The servo motors usually have a revolution cut off from 90° to 180°. A few servo motors also have revolution cut off of 360° or more. But servo motors do not rotate constantly. Their rotation is limited in between the fixed angles. The servo motor is actually an assembly of four things: a normal DC motor, a gear reduction unit, a position-sensing device and a control circuit. The DC motor is connected



with a gear mechanism which provides feedback to a position sensor which is mostly a potentiometer. From the gear box, the output of the motor is delivered via servo spline to the servo arm. For standard servo motors, the gear is normally made up of plastic whereas for high power servos, the gear is made up of metal. A servo motor consists of three wires- a black wire connected to ground, a white/yellow wire connected to control unit and a red wire connected to power supply. The function of the servo motor is to receive a control signal that represents a desired output position of the servo shaft and apply power to its DC motor until its shaft turns to that position.

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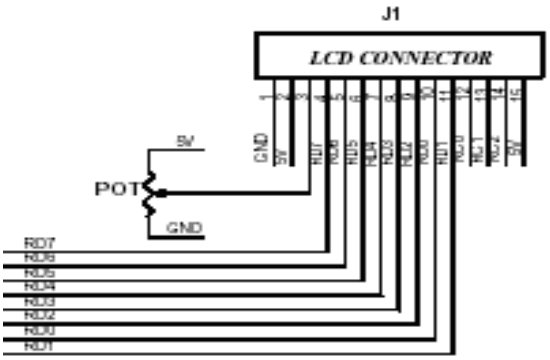
RELAY

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

LCD

Liquid crystal displays (LCD's) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarizes are pasted outside the two glass panels. These polarizes would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizes and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizes, which would result in activating / highlighting the desired characters. The LCD's are lightweight with only a few milli meters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.



SENSORS

TEMPERATURE SENSOR

The **DS18B20** is a 1-wire programmable Temperature sensor from maxim integrated. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from **-55°C to +125°** with a decent accuracy of **±5°C**. Each sensor has a unique address and requires only one pin of the MCU to transfer data so it a very good choice for measuring temperature at multiple points without compromising much of your digital pins on the microcontroller.

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Pin Configuration

No	Pin Name	Description
1	Ground	Connect to the ground of the circuit
2	VCC	Powers the Sensor, can be 3.3V or 5V
3	Data	This pin gives output the temperature value wh can be read using 1-wire method

DS18B20 Sensor Specifications

- Programmable Digital Temperature Sensor
- Communicates using 1-Wire method
- Operating voltage: 3V to 5V
- Temperature Range: -55°C to +125°C
- Accuracy: ±0.5°C

Ultrasonic Sensor Pinout

- VCC is the power supply for HC-SR04 Ultrasonic distance sensor which we connect the 5V pin on the Arduino.
- Trig (Trigger) pin is used to trigger the ultrasonic sound pulses.
- Echo pin produces a pulse when the reflected signal is received. The length of the pulse is proportional to the time it took for the transmitted signal to be detected.
- GND should be connected to the ground of Arduino.

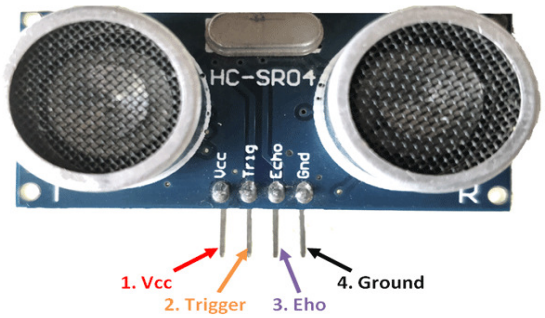
VOLTAGE SENSOR

Potential transformers

- Output Resolution: 9-bit to 12-bit (programmable)
- Unique 64-bit address enables multiplexing
- Conversion time: 750ms at 12-bit
- Programmable alarm options
- Available as To-92, SOP and even as a waterproof sensor

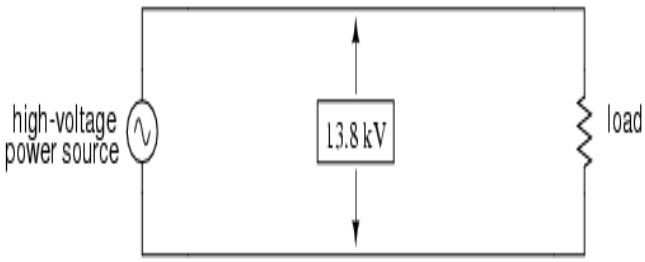
ULTRASONIC SENSOR

The ultrasonic sensor works on the principle of SONAR and RADAR system which is used to determine the distance to an object.



HC-SR04 Ultrasonic Sensor

Transformers can also be used in electrical instrumentation systems. Due to transformers' ability to step up or step down voltage and current, and the electrical isolation they provide, they can serve as a way of connecting electrical instrumentation to high-voltage, high current power systems.



Direct measurement of high voltage by a voltmeter is a potential safety hazard.

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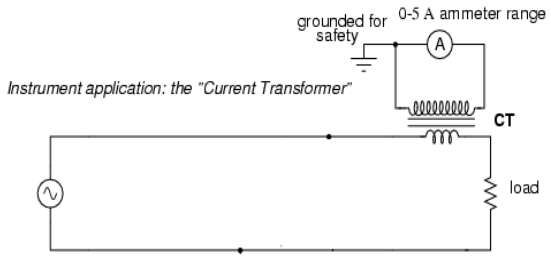
Instrumentation application: "Potential transformer" precisely scales dangerous high voltage to a safe value applicable to a conventional voltmeter.

CURRENT SENSOR

Current transformers

A transformer is to step down current through a power line so that we are able to safely and easily measure high system currents with inexpensive ammeters. Of course, such a transformer would be connected in series with the power line,



Instrumentation application: "Current transformer" steps high current down to a value applicable to a conventional ammeter.

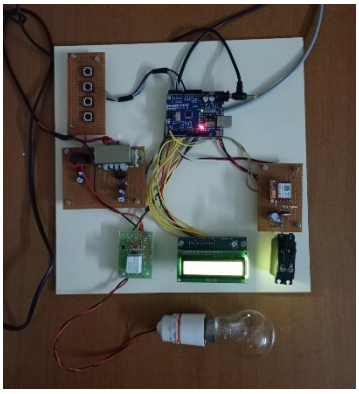
Note that while the PT is a step-down device, the *Current Transformer* (or *CT*) is a step-up device (with respect to voltage), which is what is needed to step *down* the power line current. Quite often, CTs are built as donut-shaped devices through which the power line conductor is run, the power line itself acting as a single-turn primary winding. Current conductor to be measured is threaded through the opening. Scaled down current is available on wire leads.

SOFTWARE REQIREMENT

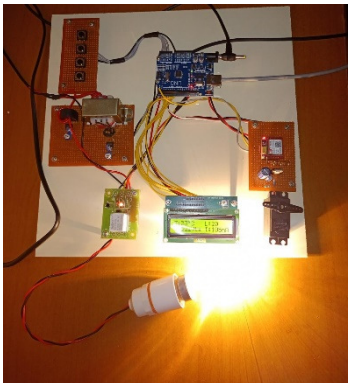
EMBEDDED C

- Set up of password
- Set up of temperature sensor
- Set up of ultrasonic sensor.

VII. RESULT OF THE PROPOSED SYSTEM



OFF stage



ON stage

VIII. ADVANTAGES

- Electrical accidents can be avoided.
- Easy of operation.
- Maintenance will be simple.
- Reduce the chances of human errors.
- Data will be monitored and stored.
- Fault analysing and rectifying time will be less.
- Secured, Safety, and Quality in service.
- Risk is reduced.

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IX. CONCLUSION

If any fault occurs in transformer only authorized person have to access the transformer, but in many rural areas common people are misusing the transformer, to overcome this the proposed system of Arduino based password protected with transformer maintenance is used. This proposed system is safe, affordable and won't be harmful to human beings.

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