INDUSTRIAL PROTECTION OF TRANSFORMER USING ARDUINO WITH GSM AND IOT SYSTEM

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Abstract: *Transformers are the foremost important devise within the facility. Therefore, the continual operation is incredibly necessary. Permanently protection should create for transformers. Differential protection technique we are able to use to guard the transformers. During this project, we have got used relay driver mechanism with GSM 800 module. The GSM and IOT are synchronized with Arduino microcontroller. Arduino UNO microcontroller is extremely high speed and low cost device with more accuracy.*

A recent huge interest in Machine to Machine communication is thought because the Internet of Things (IOT), to permit the chance for autonomous system to use Internet for data exchanging. This work presents design fault detection of transformer and record key operation indictors of a dispersion transformer like load current, voltage.

Keywords: Transformer, Toroidal Current Transformer, Arduino Uno, LCD, Relay IOT System, GSM 800 module.

INTRODUCTION:

A monitoring system which monitor the operation state. The event of the current research work on the transformer monitoring has been presented by Alessandro Ferrero for protection of transformer monitoring system required. If the rise in temperature rises beyond the desirable max. temperature, the projected protecting system will protect the transformer by problems. In power system transformer is most vital link. Transformer is static device which has step- and step-down types, which transforms electricity from one circuit to different circuit. It's totally enclosed to shield from atmospheric dirt & dust. In transformer chances of occurring faults are very rare but these rare faults are very dangerous so we've got disconnected the transformer from system. The chance of occurrence of faults hence automatic protection is required. Internal faults are those within the protected portion of the transformer. These faults are often between phase to phase and it should occur in phase to ground. Faults occurs in transformer due temperature rise .it provides minor damage. Faults include with none connection in conducting path, sparking, and small arcing. With the assistance of IOT we are able to gate quick information and with the assistance of relay tripping we are able to improve transformer life.

CURRENT TRANSFORMER (CT):

The C.T. is act as current sensor which place series with the load. Basic function of current transformer is to step down and calculate the current. C.T load of 330 Ω is connected on secondary winding of C.T. Then AC signal rectification done DC analog signal is transferred to the analog pin of Arduino Board Platforms analog pin.

PROBLEM IDENTIFICATION:

From the referred papers I found that industries are still following traditional way for reliability testing of electrical devices which leads to human error, late recognition of fault, no record of fault occurrence.

As we can do continuous testing it help to detect fault fast and we can protect transformer. It helps use to minimise the required cost of repairing which results in maintain continuous and healthy life for transformer, due to this industries manufacturing is done in regular manner without any disturbance.

With the help of IOT we can gate quick information and with the help of relay tripping we can improve transformer life

PROPOSED SYSTEM

The controller consists of different sensors which collects the essential parameters. The digital LCD module display connected to the processing unit displays related parameter values at the industies for any technical operations. The controller senses the overload condition and high current flow in the internal windings that may lead to breakdown of the related unit. The Arduino uno microcontroller is programmed likewise so as to continuously monitoring the transformer and update the parameters at a particular time interval. The parameter values sensed at particular time intervals by the Arduino-uno microcontroller are transmitted through the ADC transmitter connected to the Arduino controller unit.

PROPOSED METHODOLOGY:

The monitoring system based on IOT consists of mainly following systems:

- Parameter measurement of industrial related systems
- Protection of industrial related systems
- Data reception of industrial related systems

Protection of industrial transformer using Arduino UNO and GSM Module sim 800 current transformer is act as current sensor which placed in series with load when transformer temperature increases beyond limit then stepdown occur. CT's with 20Amp Load of 330E. We can calculate the difference between I1& I2 using IOT system.

SYSTEM DESIGN

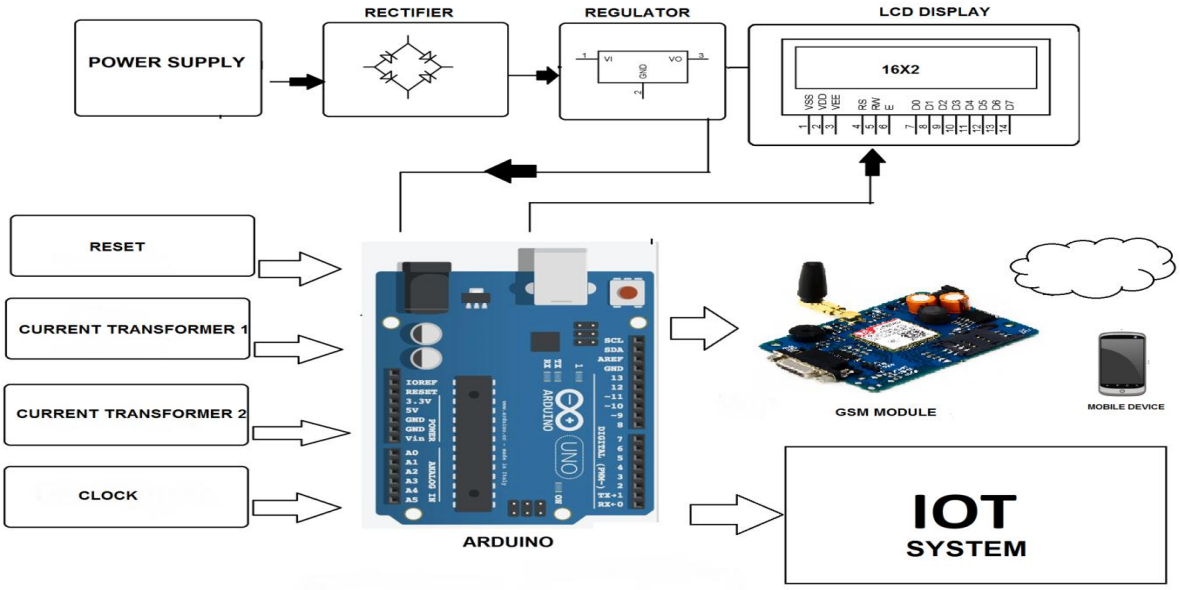
a. SOFTWARE IMPLEMENTATION:

For Software Implementation we've got used the software "c". In Software Implementation, the important part is programming of Arduino and signal is transmitted to each device like sensors. Once the power supply is on, as per

our hardware circuit is get initialized. The Arduino interfacing with LCD screen module display. Which display parameters information like voltage, current and temperature. When any problem occurs in transformer current increases and relay trip and. It will display on LCD module screen display. After display data on LCD it sends to user through GSM sim 800 module. Then suddenly data message sends to user mobile so user understand which transformers problem occur and that we can observe on website also.

b. HARDWARE IMPLEMENTATION:

In this system, power supply is employed to produce the ability Current to the transformer (current sensor), Arduino, relay, relay driver, GSM, transformer, are the important components used for designing the system. When power supply is on this system worked . Arduino UNO is automatically interfaced which give results in the output which is displayed on the LCD screen display. i.e I1 &I2 through .GSM module message send to user understand mentioned parameter.



BLOCK DIAGRAM OF TRANSFORMER PROTECTION SYSTEM

c. ARDUINO CIRCUIT:

Arduino Uno AT328 is used for work as a digital controller. Arduino UnoAT328 is an AVR based upon microcontroller board. It has AT mega 328 microcontroller and other on board peripherals including 16 MHz crystal Programming is done using in C language.

In This system one of the C language the microcontroller will used to perform operation, it has to the original program code signal converted into a hexadecimal format. During this process some errors and warnings may occurs. If there are no errors and warnings are occurred then run the program, the system will performs all the given tasks and behaves as per expected the software developed. If it is not behaves then whole procedure is repeated again.

TECHNICAL SPECIFICATIONS OF ARDUINO UNO:

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 can provide PWM output)
- UART: 1
- I2C: 1
- SPPI: 1
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB employed by boot loader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

SPECIAL PIN FUNCTIONS:

Each of the 14 digital pins and 6 analog pins on the Uno will be used as an input or output, under software control (using pin Mode(), digital Write(), and digital Read() functions). They operate at 5 volts. Each pin could provide or receive 20 mA as because the selected operating condition and has an internal pull-up resistor (disconnected by default) of 20-50K ohm. A maximum limit of current is 40mA on any I/O pin to avoid damage to the microcontroller. The Uno has 6 analog inputs, labeled A0 through A5; each provides 10 bits of resolution (i.e. 1024 different values). When default occurs, they measure from ground to 5 volts, though it is possible to change the upper end of the range using the AREF pin and therefore the analog Reference () function.

In addition, some pins have specialized functions:

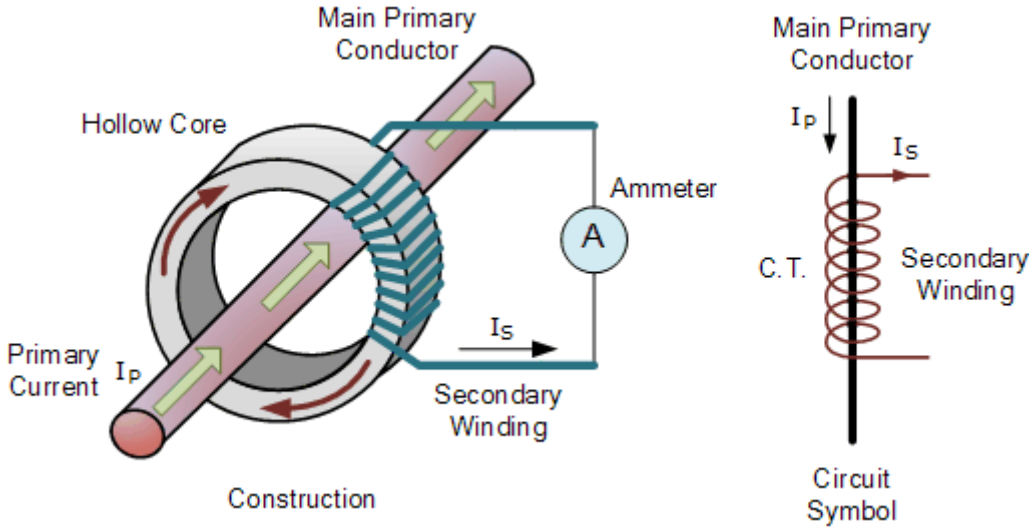
- **Serial** / UART: pins 0 (RX) and 1 (TX). Accustomed receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL serial chip.
- **External interrupts**: pins 2 and 3. These pins may be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM** (pulse-width modulation): pins 3, 5, 6, 9, 10, and 11. Can provide 8-bit PWM output with the analog Write() function.
- **SPI** (Serial Peripheral Interface): pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK). These pins support SPI communication using the SPI library.
- **TWI** (two-wire interface) / I^2C: pin SDA (A4) and pin SCL (A5). Support TWI communication using the Wire library.
- **AREF** (analog reference): Reference voltage for the analog inputs.

AUTOMATIC (SOFTWARE) RESET:

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board is meant in an exceedingly way that enables it to be reset by software running on a connected computer. One among the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip.

d. CURRENT TRANSFORMER:

Toroidal Current Transformers (CT's) we are often using for monitoring current Toroidal Current Transformer – These don't contain a primary. Instead, the load that carries this flowing within the network is threaded through a window or hole within the toroidal transformer. Some of current transformers have a "split core" which may allows it to be opened, installed, and closed, without decouple the circuit to which they are attached toroidal CT are generally wont to measure the high value of current. It's necessary for defence and control the fault. A current sensor could be a device that detects and converts current to an easily measured output voltage, which is proportional to the current through the particular path. When a current flows through a wire or in a very circuit, voltage drop occurs. CT act as current sensor.



e. RELAY:

The relay is electrically activated switch. The standard uses of relay is to permit an occasional voltage circuit to change ON or OFF a high voltage circuit without direct electrical connection between them. The important function of relay is to disconnect the availability in system when the abnormal condition is happened. The relay circuit is connected to Arduino Board relay driver is employed to shield the microcontroller from high voltage spikes and also the isolation purpose. The output of Arduino uno which is current become high, the relay circuit will operate and trips the load.

f. GSM MODULE SIM800:

SIM800 supports GPRS class 12 with max. 85.6 kbps (downlink/uplink) speed which is enough bandwidth for our real time transformer protection monitoring system using IOT projects. SIM800 gsm module is most suitable choice for this project as we are reaching to monitor circuit of transformer.

A GSM module sim800 is working on same principal of mobile device phone. It is unique verity of module which can receives a signal in the form of massage in sim card and operating as a mobile operator, as like a mobile device phone. From the mobile operator perspective. The GSM is interface with the Arduino uno and it is used to send the information to the mobile phone about the faulty condition of the system through the SMS.

Designed for global market, SIM800 is a Dual-band GSM/GPRS module that works on frequencies EGSM 900MHz and DCS 1800MHz . SIM800 features GPRS multiple-slot class 12/ class 10 (optional) and supports to the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. SIM800 is a SMT package with 68 pads, and provides hardware interfaces as below:

- One full function UART port
- One USB port for debugging and firmware upgrading
- Audio channel which includes a microphone input and a receiver output
- One SIM card interface
- Support up to 4*5 Keypads
- One display interface
- One I2C master interface for peripheral management
- Programmable general purpose input and output
- Two PWM output
- One ADC input
- Bluetooth antenna interface
- GSM antenna interface

SIM800 is designed which save power that's whys the current consumption is as low possible as 0.55mA in sleeping mode.

GSM Module SIM800

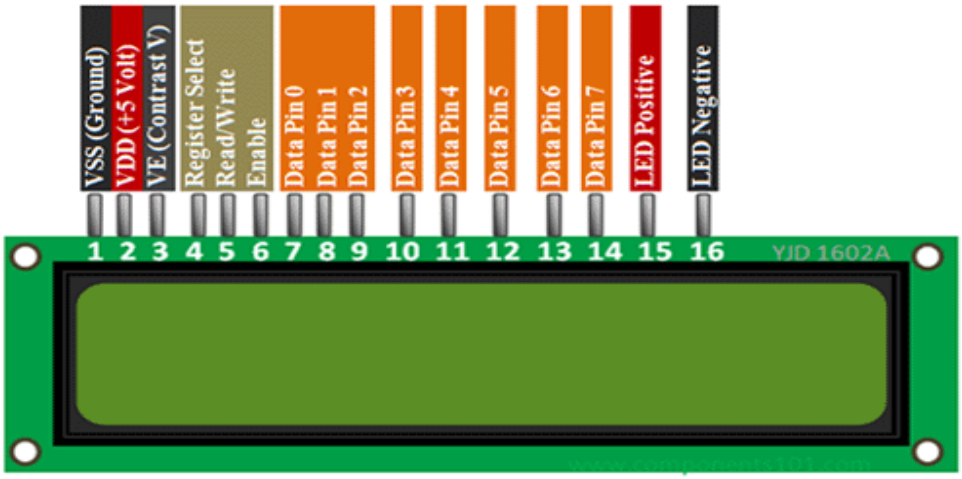
Some key features of SIM800 Module

- Control via AT commands
- Easy to Use
- Low power consumption

- Easily Available
- Low Cost

g. LCD MODULE 16×2

To show the measured parameters we are using LCD screen display. LCD is used to show required result on screen. In research 16pin LCD is used to display the parameters of transformer currents. Arduino uno communicates with the LCD using serial communication protocol.as per information each character has (5×8=40) 40 Pixels and for 32 Characters we will have (32×40) 1280 Pixels. Further, the LCD should may be instructed about the Position of the Pixels. Hence it will be a hectic task to handle all most everything with the help of MCU, hence an Interface IC like HD44780is used, which is mounted on the backside of the every LCD Module itself. The important function of this IC is to get the instructed Commands and Data from the MCU and as process them to display valuable information onto our LCD Screen. You can learn how to interface an LCD using the above mentioned links. If you are an advanced programmer and would like to create your own library for interfacing your Microcontroller with this LCD module then you have to understand the HD44780 IC is working and as per instructed commands which could be found its in datasheet.



LCD Module 16×2

A Single character with all its Pixels is shown in the below picture.

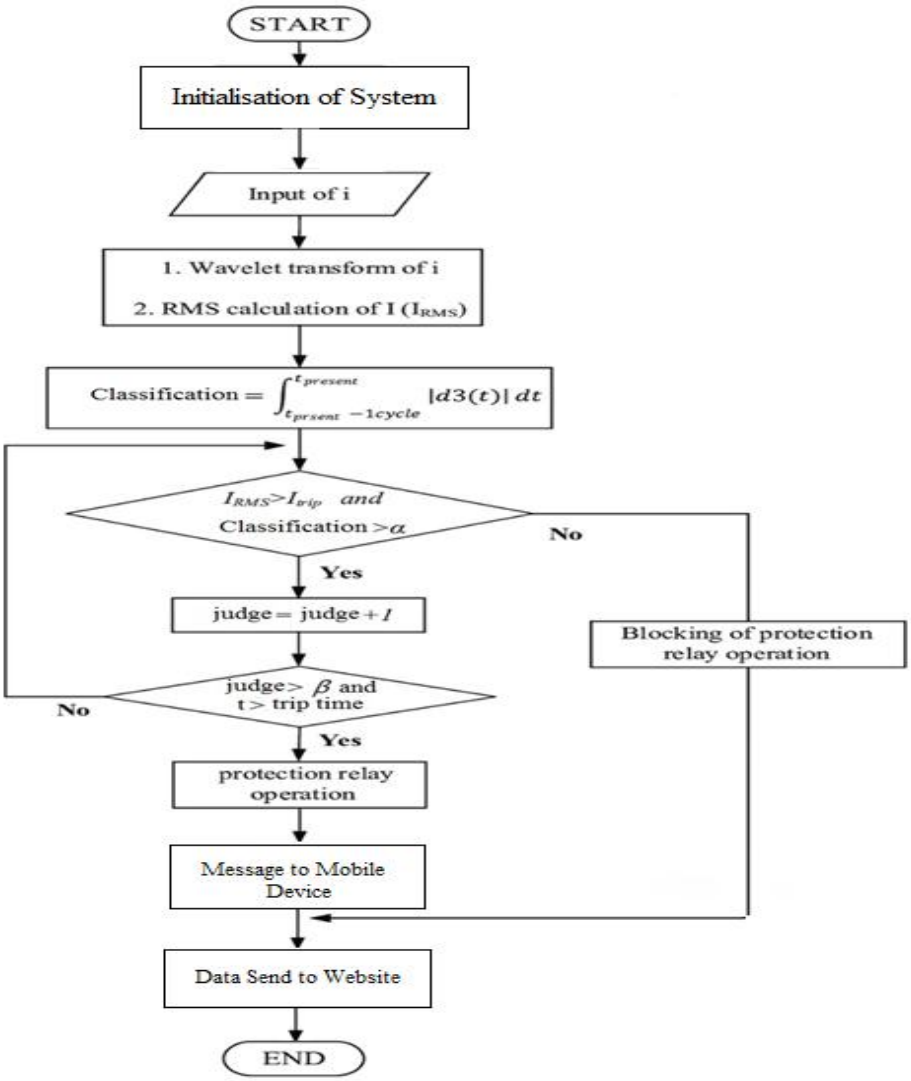
The following parameters are show on LCD screen.

- Voltage
- Current

FEATURES OF 16×2 LCD MODULE:

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

FLOW CHART:



RESULT:

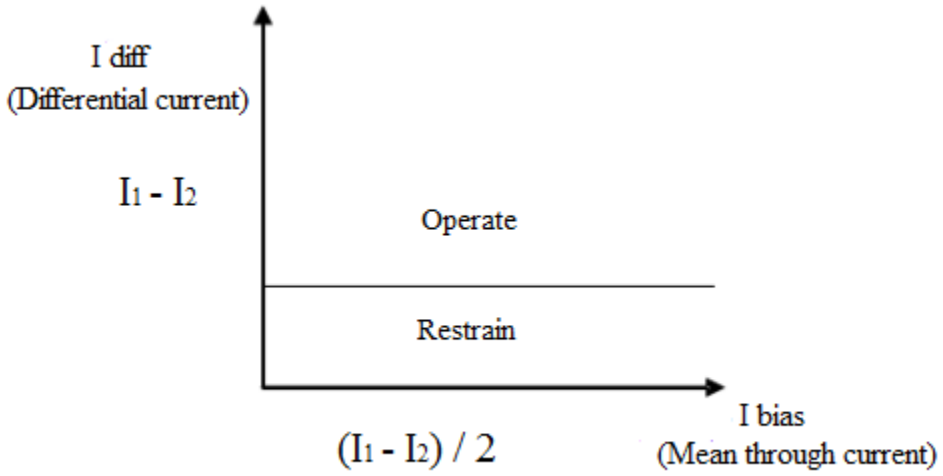
We can calculate current,

$$\text{Operating current} = \frac{\text{smallest current in operating coil to cause operation}}{\text{rated current of the operating coil}} \times 100\%$$

% minimum pick up current = 10 – 30% nominal current

$$\text{Slope} = \frac{\text{current in operating coil to cause operation}}{\text{current in restraining}} \times 100\%$$

$$\% \text{ slope} = \frac{I_1 - I_2}{(I_1 + I_2)/2} \times 100\%$$



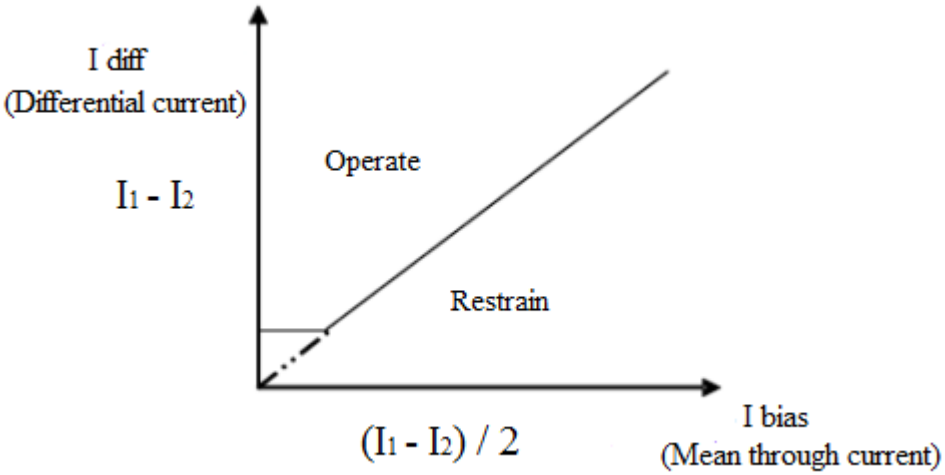


Table 1. effect of voltage variation

Sr. No.	Voltage	Relay
1	<190V	OFF
2	Between 190V – 265V	ON
3	> 265V	OFF

Table 2. Effect of load variation

Sr. No.	Difference	Relay
1	I1-I2	LOW
2	I1-I2	HIGH

CONCLUSION:

The proposed project system operates with GSM module based hardware. Arduino uno based control system is meant and develop likewise which will results fault identification also because it may be won't to clearing all faults in system. The general cost of this proposed project system is that the more beneficial in regards to the standard system and in IOT.

FUTURE DEVELOPMENT FOR THE PROJECT:

1. Using IOT, power theft detector kit has been implemented
2. We can connect temperature sensor and voltage sensor

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