Digital Relay Protection of Generator Transformer in Mettur Thermal Plant Using Microcontroller

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ABSTRACT: The main aim of this project is to design a microcontroller based system which may be utilized in generator transformer protection. The system monitors the operating parameter of the transformer like current, voltage and temperature, if it goes beyond the reference value, the system is in a position to detect and isolate the power transformer from the distribution line. This isolation process is to make sure that the transformer is safe from excess current levels, voltage level and temperature level which make it to overheat and get damaged. It gives information to the net application using IOT and ensures the uninterrupted supply to the consumers. Relay is operated   during fault and makes the Circuit Breaker to open and isolate the system. In our project   MSP430 is the microcontroller used for its   low power consumption which act as the heart of the protection system.

KEYWORDS: Transformer, sensors, digital relay, MSP430G2, LCD, IOT module.

I. INTRODUCTION

Power System protection is very essential and necessary for power supply. It confirms that the system is protected and consumers will be safe from electrical power supply.It consists of various components like Generators, Transformers, Transmission cables, Capacitor banks and other components. C.Nagarajan et al [2,5,7] Fault in Power system is unpredictable, so it cannot be operated without protection device. These conditions may include short circuit, over current, overvoltage, high temperatures and other abnormal condition.

HARDWARE TRANSFORMER:
 A transformer is a device used for step up and step down the AC voltage level. It consists of two coils on common iron core. The voltage on these two coils are related by turns ratio. A varying current in any coil of the transformer produces a varying magnetic flux   which, in turn, induces a varying across any other coils wound round the same core. Current can be transferred between the (possibly many) coils, without a metallic connection between the 2 circuits. Transformer sizes vary from tiny one used in microphones to hundreds of tones used in system grid. It is very essential in transmission, distribution and consumption of power.

VOLTAGE SENSOR :
 Voltage sensor is the sensor used to calculate the amount of voltage in an object. Voltage sensor can be used to determine both AC voltage or DC voltage level. This sensor is employed to observe, calculate and estimate the voltage supply. Application of this sensor include detection of power outage, safety switching, detection of fault.. etc.

CURRENT SENSOR:

A current sensor could be a device that detects electric current in a wire.When a current is just too high to measure directly or the voltage is too high,a current transformer can be used to provide separate low current in secondary that's proportional to current in primary The interfacing circuit converts AC current into AC voltage and converts into DC voltage. The DC voltage is given to ADC inside the microcontroller that calculates the exact current flowing through the line.

TEMPERATURE SENSOR :

LM-35 is a temperature measuring device within which output voltage is proportional temperature. The sensitivity is 10mV/degree Celsius. It gives precise output than thermistor output. Its operating voltages is 4 to 30 volts. It can measure temperature from -55 to 150°C.It is small, low self heating and providing thermal shutdown for the circuit.

LEVEL SENSOR:

Level sensors are used to measure the liquid level. The level measurement   may be either   continuous or point values. Continuous   level sensors give specified range of values to know exact value of oil level, e.g. Optical, Ultrasonic. Point level sensors are used to measure variation in liquid levels at various points in tank, e.g. Horizontal float, Vertical float, Ultrasonic. The type of sensor is chosen on the basis of shape of vessel or tank, viscosity of liquid, insulating property , corrosiveness etc.

II. MICROCONTROLLER

The MSP430G2 could be   low cost board called Launch pad   may be a complete development solution. The integrated USB based emulator offers all the hardware and software necessary to develop applications in MSP430G2XX series devices. It is used with Integrated Development Environment or Code Composer Studio to   write, develop and debug

applications. It includes mini USB cable (0.5m), two 10-pin PCB connectors female, 32.768-kHz clock crystal. The current drawn in idle mode is <1µA. The CPU speed is 25 MHz.. It is often throttled back for lower power consumption. The MSP430 also uses six different low-power modes, which could disable unneeded clocks and CPU.

BUZZER
A buzzer or beeper is an audio signalling device, which might be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input like a click or keystroke.

RELAY
The relay is utilized to de-energize the coil just in case of fault within the transformer and isolate from the healthy system. The relay used in this project is SPDT(Single Pole Double Throw) relay. It consists of 5 terminals points (i) two coils (ii)common terminal (iii)NC terminal (iv)NO terminal.When the coil isn't energized, the common terminal and NC have continuity. When it's energized the common terminal and NO have continuity. The relay coil is rated up to 5V and speak to rating is 30A.
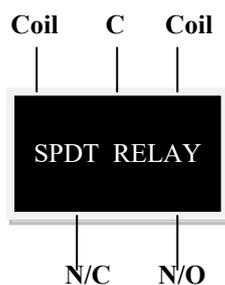
III. CIRCUIT BREAKER

 A fuse   is a automatically operated electrical switch designed to safeguard an circuit from damage caused by excess current from an overload or contact. Its basic function is to interrupt current flow after a fault is detected. Unlike a fuse, which operates once so must get replaced, a fuse may be reset (either manually or automatically) to resume normal operation.

LCD
LCD (Liquid Crystal Display) may be a sort of flat panel display which uses liquid crystals in its primary form of operation. LEDs have an outsized and ranging set of use cases for consumers and businesses, as they'll commonly found in smart phones, televisions, computer monitors and instrument panels.

IOT MODULE:
ESP8266 is the low cost Wifi microchip. It is very user friendly to provide internet connectivity. It works with 3.3V only. It has 16 GPIO pins and an analog inputs,10-bit ADC,a transmit only UART can be enabled on GPIO2.
The Pin Outs are VCC-Voltage, GND-Ground, RX-Receive data bit TX,-Transmit data bit, X,CH_PD-chip power down, ,RST-Reset, GPIO 0,GPIO 2-General Purpose input/output 0,2.
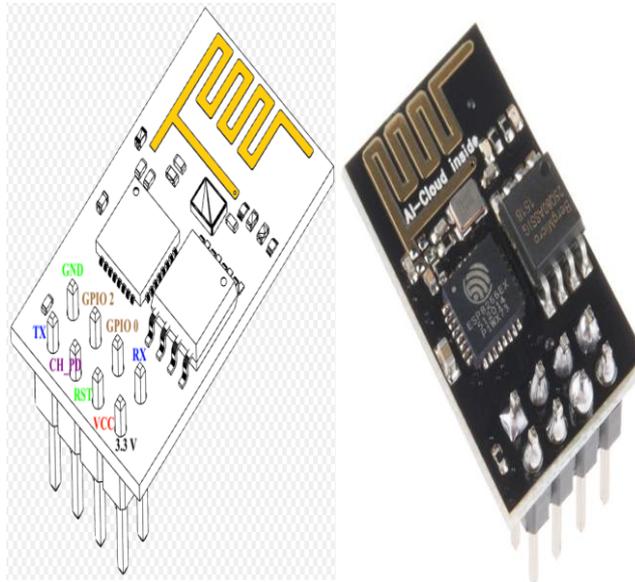
SOFTWARE

Energia is an open source electronics platform which is supported on Mac OS, Windows and Linux. It is a portable layer. It allows global variable for inter task communication. It will automatically find setup/loop pairs and turn into individual task. Setting multitask application is so simple. In order to use this CCS version 6.1 is needed. The code lies inside void setup() will be executed only one time and Loop() will be executed forever. The first line of the program is macros. It is smart enough to understand words like RED_LED,TEMP_SENSOR,GREEN_SENSOR. With Launchpad, Energia can be used to develop interactive objects, inputs from sensors and switches and controlling lights and motors. Programming techniques include variables, Functions, Libraries and Multitasking. Energia sketches are C/C++ related and compiled with MSPGCC.The Energia language comes from Wiring.
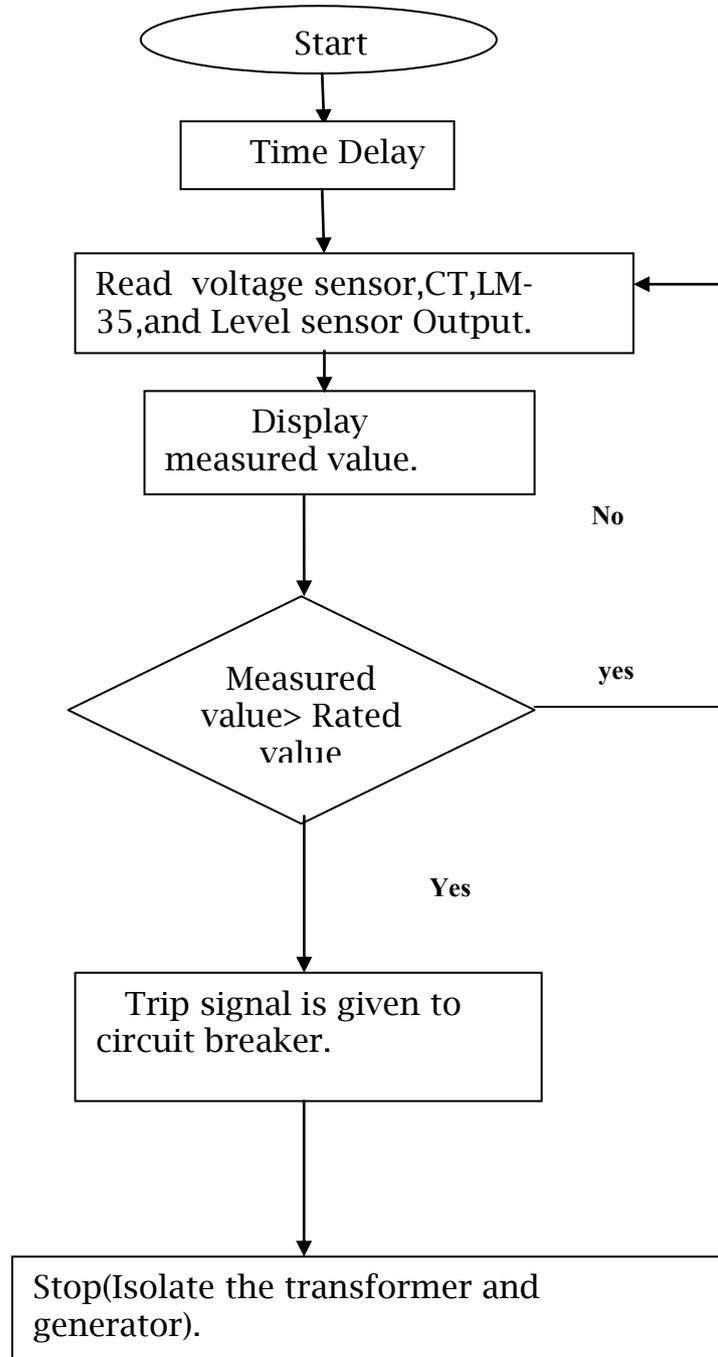
Flow chart for the program is

```
              Start

          Time Delay

    Read  voltage sensor,CT,LM-
    35,and Level sensor Output.

           Display                        No
       measured value.

           Measured                      yes
         value> Rated
            value

                Yes

       Trip signal is given to
       circuit breaker.

     Stop(Isolate the transformer and
     generator).
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IV. BLOCK DIAGRAM
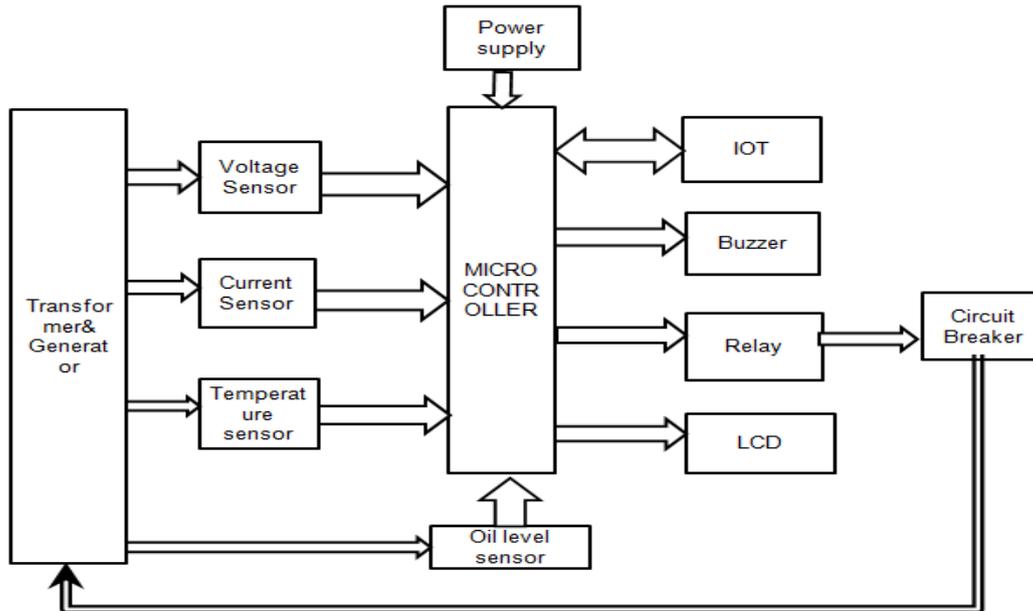
WORKING

In our project the voltage, current, temperature and oil level is sensed by voltage sensor, current sensor,LM-35 temperature sensor and level sensor. These above signals are given as input to the microcontroller MSP430G2.Referance signal is already fed in the microcontroller. If the sensed values goes beyond the reference value, the microcontroller sends signal to the web application IOT and also makes the relay to get energised and makes the circuit breaker to trip for isolating the transformer from generator output, so there will be no damage caused to healthy parts of the supply system. The values are displayed in LCD display.

V. RESULT

The reference signals are compared with rated signals continuously using microcontroller, if it goes beyond the limited value the relay gets energized which makes the circuit breaker to open and isolate the faulty transformer or generator from healthy part of the system

VI. CONCLUSION

In this project generator side transformer protection using MSP430 is Proposed. For Transformer the parameters like voltage, current, oil level and temperature sensing units are designed. Arduino is replaced by MSP430 because of its low power consumption. The protection scheme implemented in this project gives proper protection from getting damaged. Damage to the transformer interrupts the continuous supply to the consumers. It has some advantages over the existing system (i)Fast response (ii)Better isolation (iii)Low power Consumption of Microcontroller (iv)Accurate monitoring of fault values.

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