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Transformer Load Management by Internet of Things (IOT)

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ABSTRACT

With the quick changing innovations in the power business, new references handling new advances are going to the market. In view of this reality, there is a critical need to monitor universal encounters and exercises occurring in the field of transformers. Transformers are significant for the electrical vitality. An ongoing tremendous enthusiasm for Machine to Machine correspondence is known as the Internet of Things (IOT), to permit the likelihood for self-decision gadgets to utilize Internet for trading the information. This work presents design and execution of real time monitoring and fault detection of transformer and record key operation indictors of a dispersion transformer like load current and voltage. LCD screens will be provided in which the consuming current, voltage and set current for each point will be displayed. Keypads are used to set the threshold limit in means of watts for each consumer individually and to be loaded into the IC. The Input current will be continuously monitored and when any of the parameters goes above the set point level automatically the that particular load will be tripped off so that it ensures that the consumer point will run only at a defined limits. IOT module is used to indicate EB department of each process through internet regular basis. The threshold limit can alter dynamically by the remote user based on the situation. The complete system is password protected.

Keywords: Real time monitoring, IOT (Internet of Things), Distributed transformers.

1. INTRODUCTION

Transformers are important types of equipment in the power system network. The important factor that necessary to consider is the inspected information regarding the distribution transformer should be transmitted properly by considering the coverage to the electrical network. If we consider the solutions like smart inspection system of the distribution transformer frequently, may lead to an increase in the life span of the distribution transformer. The monitoring and control of distribution transformer is an important procedure for diagnosing the rapid alerts of the electrical network and also for the proper functioning of the electrical network. The monitoring of distribution transformer is done by an electronic system with the capacity of sampling, storage, prosecution and mailing of information [5]. If there is real-time monitoring or inspection of the system so that we can prevent the sudden breakdown of the transformer that may lead to stop serving the electric power to several charges and produces serious affectations to the functioning of the electrical network. So it's necessary to select an energy efficient, reliable, low-cost technology for the advanced monitoring of distribution transformer. The compiled information is very useful for studies of the electrical network and the planning of future enlargement, in fact, the common procedure is to substitute the transformer due to the aging of the transformer, which is a huge loss for the government. At present, there are several methods for the monitoring of distribution transformer due to the advancement in electronics and communication technology [4]. The monitoring of distribution transformer includes the measurement of transformer parameters like voltage, current, power, and frequency. Healthy power supply at the customer end mainly depends on the performance of the distribution transformer. The processing element leverages the connection between data thing and people to deliver the right information. It allows for thing to accessible from the internet that historically has not been.

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The internet of things is able to improve the quality of life for everyone by taking advantage of these connected thing and data produced. The internet of things is about connecting the unconnected things. To the right thing or person, at the right time, it is these billions of connection that add value. The billions of m2m connection make possible everything in IOT.

However, their life is essentially decreased if they are overloaded, resulting in unexpected failures and loss of supply to an expansive number of customers hence affecting system unwavering quality. Distribution Transformers have a long life if they are operated under appraised conditions. Most power companies use Supervisory Control and Data Acquisition (SCADA) system for web-based monitoring of power transformers yet amplifying the SCADA system for online monitoring of distribution transformers is a costly suggestion. Overloading and ineffective cooling of transformers are the major significant reasons for failure in distribution transformers.

It leads to Online monitoring of key operational parameters of distribution transformers can provide useful information about the health of transformers which will help the utilities to optimally use their transformers and keep the asset in operation for a longer period. This will also help identify problems before any catastrophic failure which can result in significant cost savings and greater reliability. According to the above requirements, we need a distribution transformer real-time monitoring system to detect all operating parameters operation and send to the monitoring center in time.

2. RELATED WORK

The hardware required for this system includes; Controller: programmable logical controller, PC as a monitor device, Sensors: current transformer, potential transformer, and temperature sensor. In this type of monitoring, the system is connected to a distribution transformer and is able to record and send the abnormal values of the transformer parameters to a mobile device using a GSM network. This technology is used by many of the monitoring systems. Abdul Rahman Al-Ali [1] deals with the recording of transformer load currents, transformer oil, and ambient temperature by implementing a mobile embedded system. The large data about the transformer condition can be processed by using the devices like GSM modem, programmable logic controller and PC as a monitor device and sensors like a current transformer and potential transformer.

Viswanath [2] presented a paper uses a temperature sensor , pic microcontroller, LCD display ,GSM board and Xbee which is used for send the message to the electricity board. This system is capable of detecting multiple faults in the three phase transmission lines. Mohamed Ahmed Eltayeb Elmustafa Hayatiet [3] have designed decision support system to grid operation engineers with information helps to estimate the loads, fix problems and identify week points in the grid. Distribution transformer monitoring is very important in the grid in fact its abnormality adversely affects the smooth functioning of the smart grid. In this paper they suggested and implemented a method to remotely monitor a group of distribution transformers. Here the microcontroller is used for data acquisition and transmission.

3. TRANSFORMER SIDE FUNCTIONAL UNIT

The main power supply will be given to the load through CT and step down transformer. The 230 volt AC supply will be Step down to 12v by using step down transformer this 12V AC supply will be converted in DC by using bridge rectifier and it will be regulate up to 5V by using 7805 regulator for working of microcontroller.

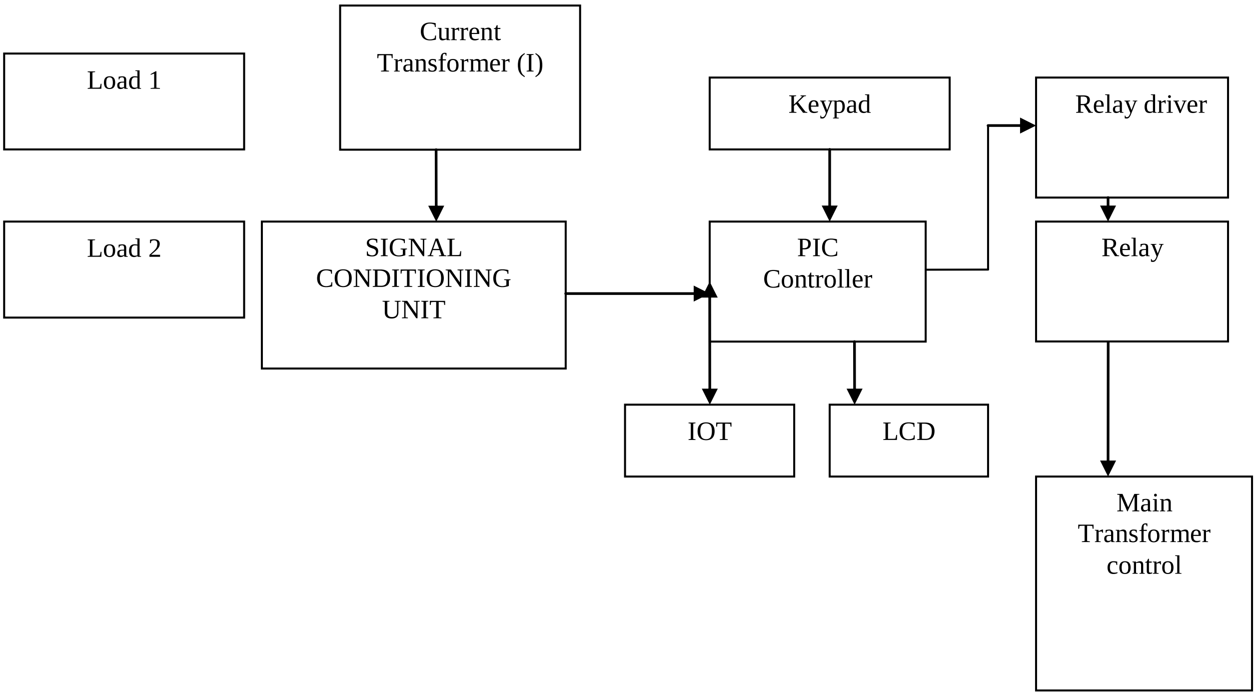

Figure No: 1 Block Diagram

Capacitor filters are used to remove any ripples present in the DC voltage. The current flowing through the load is sensed by CT and output of CT is analog form. It will be given to ADC pin of PIC microcontroller for converting analog to digital form. The current sense the load current according to preset inbuilt value in the microcontroller, if the current sense is less than preset inbuilt value no operation takes place, if we increase the load, if the current drawn is more than threshold value relay will be trip particular load. LCD should be used to indicate the real status of three different loads. The block diagram is given in figure 1.

IOT system is used interface between the trip status and consumers. The message will be given to the interfacing media according to coding system [7]. The microcontroller is programmed in embedded C language in MP LAB software. An LCD interfacing program is also in built in microcontroller. If any abnormalities occur it will be displayed on LCD [6]. The AC supply to the load is thus cut off from the load and the load is tripped. Once the circuit is tripped it must be reset for further use using reset button as shown in Fig.1. In either case, the microcontroller is programmed so as to show the status of the output on the LCD interfaced to it.

In case of normal operation microcontroller pin will receive 5v dc from regulator and accordingly displays the status on the LCD. In case of any abnormalities, the microcontroller pin doesn't receive the 5V input signal and the related status is accordingly displayed on the LCD.

4. MATERIALS AND METHODS

This circuit is designed to monitor overloading and to protect transformer from damage by overloading. Here, Reference value of load is set. If load exceeds reference value then microcontroller send trip signal to transistor and relay will trip within microseconds. As relay will trip, transformer will be disconnected from load. The overall circuit diagram is shown in figure 2.

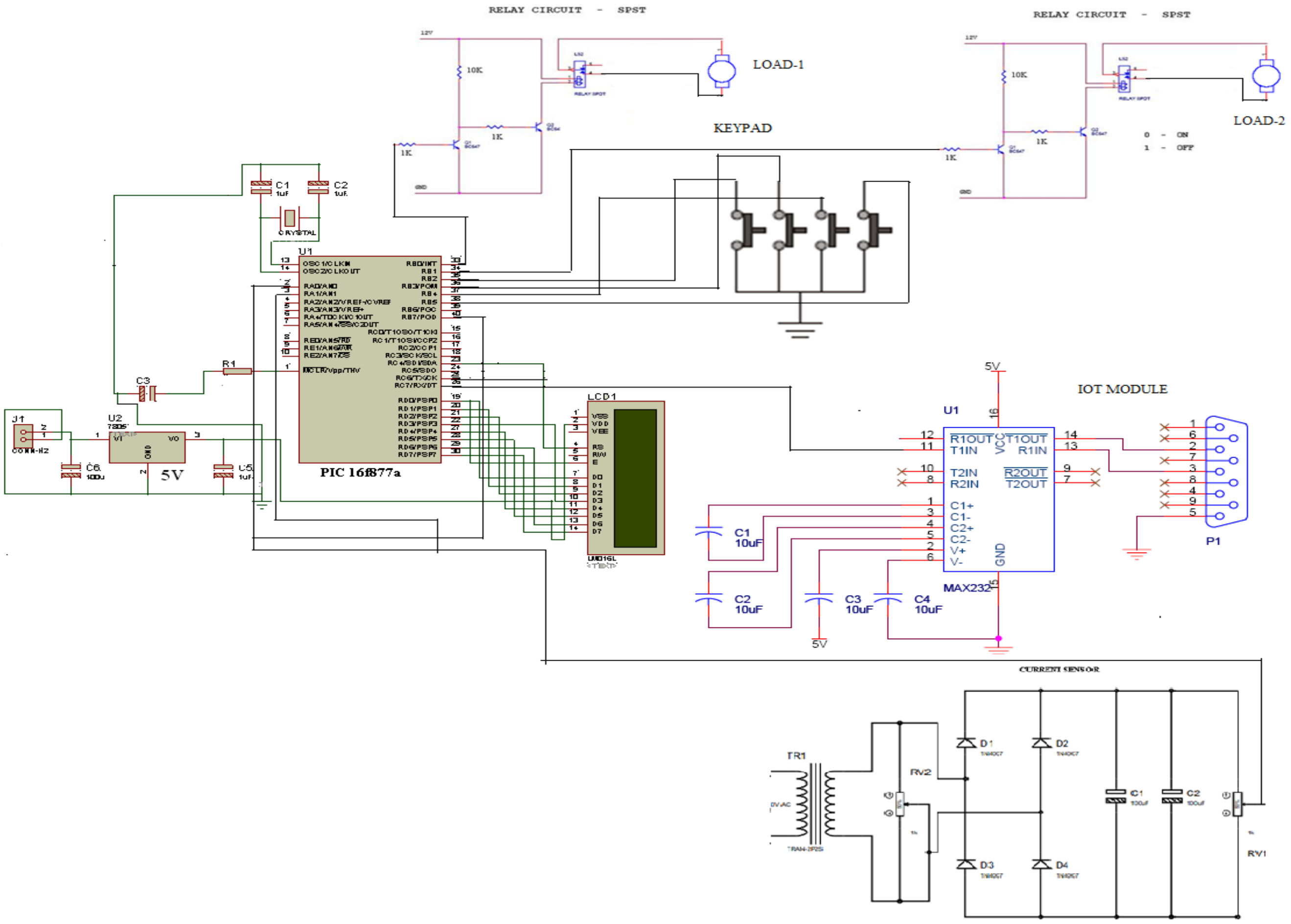

Figure No: 2 Overall Circuit Diagram

4.1 Microcontroller

PIC16F877A is the brain of this protection circuit. This microcontroller has on chip ADC which converts analog values to digital values. This sampled value compared with pre-set values and decision is taken according to programming; hence microcontroller is decision making device. As compared to microprocessor microcontroller have simple structure and fast responding capacity. Power consumption is less for PIC16F877A microcontroller. It has wide range of temperature so it can be used in most of the systems.

4.2 Current Transformer

This transformer is designed to monitor the supply current. The supply current that has to monitor is step down by the current transformer. The step down current is converted by the voltage with the help of shunt resistor. Then the converted voltage is rectified by the precision rectifier. The precision rectifier is a configuration obtained with an operational amplifier in order to have a circuit behaving like an ideal diode or rectifier.

4.3 Voltage Sensor

The voltage sensor which will be using will give the voltage consumption of the load. Voltage sensors are employed to the consumed voltage. In our project we will be employing a step down voltage transformer of range, 10v. The output of these voltage sensors will be given to the appropriate rectifier circuit to convert ac to dc. Since the voltage output will contain some dc components after rectification we will employ a simple filter circuit and the signal will be fed into the analog to digital control channels of the microcontroller.

4.4 Shunt Resistor

A shunt can also be used to measure current. In this case a resistor of accurately-known resistance, the **shunt**, is placed in series so that all the current to be measured will flow through it. Since the resistance is known, by measuring the voltage drop across it, one can calculate the current flowing. In order not to disrupt the circuit, the resistance of the shunt is normally very small. Shunts are rated by maximum current and voltage drop at that current, for example, a 500 A/50 mV shunt would have a maximum allowable current of 500 amps and at that current the voltage drop would be 50 millivolts. By convention, most shunts are designed to drop 50 mV when operating at their full rated current and most "ammeters" are actually designed as voltmeters that reach full-scale deflection at 50 mV.

4.5 Precision Rectifier

The full wave rectifier is the combination of half wave precision rectifer and summing amplifier. When the input voltage is negative, there is a negative voltage on the diode, too, so it works like an open circuit, there is no current in the load and the output voltage is zero. When the input is positive, it is amplified by the operational amplifier and it turns the diode on. There is current in the load and, because of the feedback, the output voltage is equal to the input.

4.6 Relay Operation

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

4.7 IOT – Internet of Things

The Internet of Things (IoT) is an environment in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT has evolved from the convergence of wireless technologies, micro-electromechanical systems (MEMS) and the Internet. The concept may also be referred to as the Internet of Everything.

A thing, in the Internet of Things, can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low -- or any other natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network.

Product Description:

Lumisense IoT board designed to meet a variety of online application needs with distinct advantages that enable the embedded system designer to easily, quickly and seamlessly add internet connectivity to their applications.

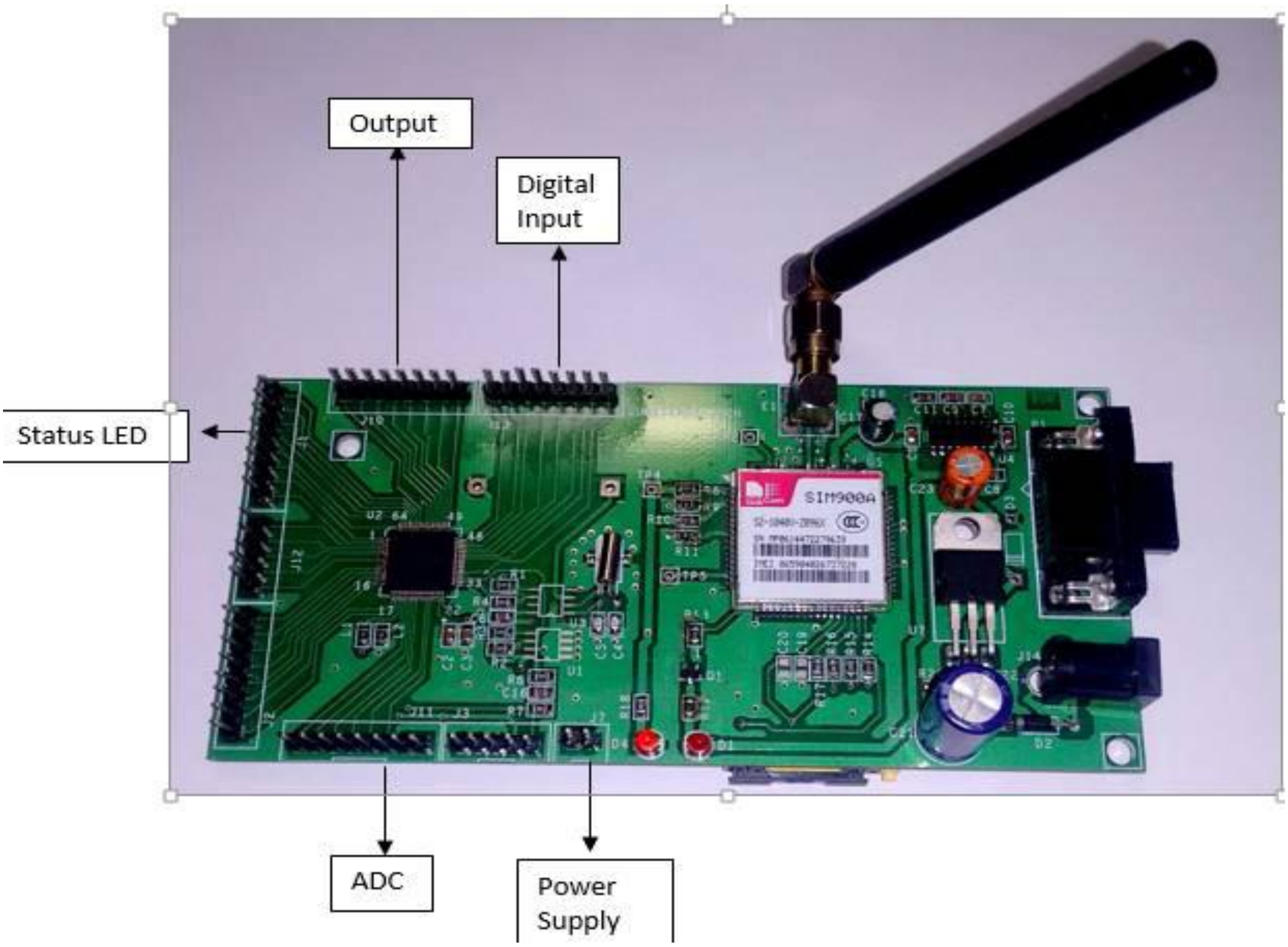

Figure No: 3 IOT Module

The module's UART update feature and webpage control make them perfect for online wireless applications such as biomedical monitoring, environmental sensors, and data's from portable battery operated wireless sensor network devices. A numeric keypad, or numpad for short, is the small, palm-sized, seventeen key section of a computer keyboard, usually on the very far right. The numeric keypad features digits 0 to 9, addition (+), subtraction (-), multiplication (*) and division (/) symbols, a decimal point (.) and Num Lock and Enter keys. Laptop keyboards often do not have a numpad, but may provide numpad input by holding a modifier key (typically lapelled "Fn") and operating keys on the standard keyboard. Particularly large laptops (typically those with a 17 inch screen or larger) may have space for a real numpad, and many companies sell separate numpads which connect to the host laptop by a USB connection.

Lumisense IoT board featured with SIM900 GPRS modem to activate internet connection also equipped with a controller to process all input UART data's to GPRS based online data.

5. CONCLUSION

An IOT based transformer monitoring system for power transformer was designed, implemented and tested. It is quite useful as compared to manual monitoring and also it is reliable as it is not possible to monitor always the load voltage and load current manually. A server module can be added to this system to periodically receive and store transformer parameters information about all the power transformers in a database application. After receiving message on any abnormality we can take immediate action to prevent any catastrophic failures of power transformers. We need not have to check all power transformers and corresponding phase currents and voltages and thus we can recover the system in less time and faults before any uncertain failures thus resulting in significant cost saving as well as improving system reliability.

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