A System For Substation Parameters Monitoring

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Abstract- *Nowadays lots of advancement happen in power system management due to technology drift. Collaborating software with electrical equipments has become a new trend in recent days. Maintaining the quality of power at the receiver end plays a major role in power system management. Moreover faults occur at various parts inside and outside the substation. In order to reduce faults, to maintain the continuity of supply, to increase the efficiency at its maximum, the proposed system uses Internet of Things for real time monitoring the substation parameters. The controller used is Arduino Uno and is connected to the transformer which senses the input parameters. The real time values are sent to the mobile application through ESP8266 wifi module. The Arduino is programmed in such a way that it is fed with normal operating conditions like voltage, current and power factor. If there is any change in the normal rated conditions, i.e, abnormal condition like over voltage, over current and any change in frequency or power factor, the relay connected to the load is activated and the type of fault is detected using Arduino through IoT and displayed in the mobile application. This system will be effective system for the power system workers and lineman, reducing manual labor and protecting the appliances.*

Keywords- Power system parameters, substation monitoring, Internet of Things, Relay, Arduino Uno.

I. INTRODUCTION

A substation is a place which deals with high voltages coming in line and stepping down and dividing it into various feeders. Proper maintenance and quality of power should be kept in a sustained manner for the conventional working of a substation. Various types of faults occurs in a substation can be monitored is really helpful for maintenance. In early times small amount of power is generated and transferred to the nearby substation. Now the concept of nationalized grid has been introduced and each and every substation is interconnected with each other. So faults can occur at various places. The cause of fault occurring at substation is substantially high. Over voltage and frequency based issues may damage substation components as well as the load connected. Monitoring the substation means collecting significant parameters, analyzing the faults, diagnosing the conditions, provides proper decision making scheme along with reducing failures and breakdowns. The distribution transformers are the transformers which have been directly connected to the domestic or industrial purpose. Any faults occurring in this system may degrade the load connected to it. So a system which continuously monitors the real time values are important for the protection of appliances. This can be achieved effectively using Internet of Things. The inputs are sensed properly and the processed outputs are continuously monitored using this technology. This technique saves manual labor and provides a new chapter in the maintenance of substation[1].

II. LITERATURE SURVEY

According to Dirman Hanafi et al, 70% of accidents in substation occurred because of lack of power system management and carelessness of the line man which was published in the year 2009.

Daponte et al. have developed wavelet transform and wavelet networks, and adopted for the automatic classification and measurement of disturbances in the power system in the year 2013.

The process of monitoring a distribution transformer by Humberto Jimenez et al, 2017 identifies that the power factor at the transformer attained strange low levels when it is connected with the photovoltaic system during a period of 18 months.

Johan Driesen et al. have discussed the model of an flexible energy measurement system, 2015 which describes different features of the system relating to signal processing, communication and dependability for the quality of electricity delivery.

Till now, in substation monitoring system manual fault detection requires more time to identify the fault. Optical fibers have been used for communication in which maintenance issues occurred. Another system is designed which can monitor and control the substation using wireless technology using GSM which cannot give real time operating conditions. Later a system which used various sensors to sense the electrical parameters was found which created problems when it goes beyond a nominal range. Sensors were limited to a certain range or cross sensitivity which became a major drawback of the system. RF technology has been infused in

substation monitoring. But it created lots of noise problems in case of long distance transmissions.

III. CONSTRUCTION

The proposed system consists of an Arduino Uno to control the entire system. The model also consists of a current sensor, voltage sensor and frequency detector to sense the signals of current, voltage and frequency of the ac input distributed from the distribution transformer which is of 23KV/415V, 230V. The Arduino is supplied with the 12 V dc. It also consists of the LCD display to monitor the electrical parameters connected to the controller. The buzzer is also connected with Arduino Uno which alerts the lineman incase of any faults in the line. Two relays are used which are directly connected with distribution line along with two loads. The ESP8266 module integrated with the mobile application is also connected to check the real time condition of electrical parameters using IoT[4].

IV. BLOCK DIAGRAM

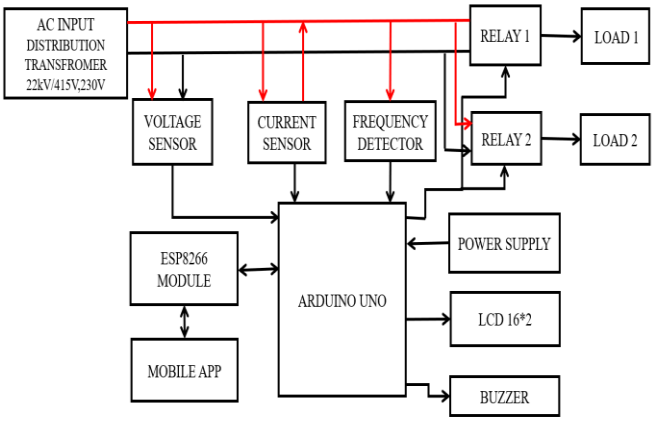

Fig1: Block diagram of substation monitoring

V. WORKING PRINICIPLE

An input of 230 volts from the transformer is sensed using voltage sensor, current sensor and frequency detector and given to the controller. The controller is powered up using a power source of 12V and fed with normal rated operating conditions of the transformer. Change in input parameters are continuously monitored by the controller for any kind of fault detection. The real time operating conditions are sent to the lineman using IoT. The real time values of the ac input can be checked through mobile application. The two relays connected to different loads are operated when this system detects any abnormal change in the load side as well as input side and cut off the load from the supply. A buzzer connected to the controller also alerts the lineman when there is any faults in the line. The LCD also displays the voltage, current and frequency of the ac input line[3].

VI. COMPONENTS DESCRIPTION

Arduino Uno:

Arduino Uno is a open source microcontroller. The ATmega328P provides UART TTL serial communication and is equipped with sets of digital and analog I/O pins that is interfaced with various components. The board has 14 digital I/O pins, 6 analog I/O pins and it is programmed with Arduino IDE. It is powered with USB cable or external 9v battery.

LCD display:

Liquid Crystal display is a electronic display device which operates by applying varying electric voltages to a layer of liquid crystal which results changes in the optical properties. It has 16 pins which consists of data lines, power, ground, controls the operation of LCD, adjusts LCD screen brightness and powers the backlight.

Voltage sensor:

Voltage sensor is allow-cost sensor for measuring voltage. It is based on the principle of resistive voltage divider. The pin Vcc is connected to the positive terminal of the external voltage source (0-25V). Gnd pin is connected to the Negative terminal of the external voltage source. It can provide a resolution upto 0.00489V.

Current sensor:

A current sensor is a device that detects electric current in a wire and generates a signal proportional to current. The generated signal can be analog voltage or current or a digital output. The generated signal can be used to display the measured current in an ammeter, or can be used for the purpose of control.

Relay:

Relay is a electromechanical switch that is used to make or break the electrical connection. The electromagnet is activated by a low-power signal from a micro controller. The electromagnet pulls to either open or to close an electrical circuit when it is activated.

ESP2866:

The ESP8266 WiFi Module has integrated TCP/IP protocol stack that provides microcontroller access to the WiFi network. It is mostly used for development of Internet of Things (IoT) embedded applications. It has a powerful on-boarding processor and storage capability that allows to integrate with the sensors and other devices through GPIOs with minimal loading during run time.

Frequency detector:

A phase detector is a mixer-like circuit that provides signal that is proportional to the phase difference between two input signals of the same frequency. The phase detector provides a series of output pulses whose width is proportional to the phase difference. Pulses are passed through a LPF which smooth them into a proportional DC voltage.

Transformer:

A distribution transformer is a transformer that transforms feeder voltage to domestic side voltage. These transformers are available near generating substation. Distribution transformers generally have ratings less than 200 kVA. It consists of magnetic core which is made from laminations of silicon sheet. Efficiency is about 98 and 99 percent.

VII. CIRCUIT DIAGRAM

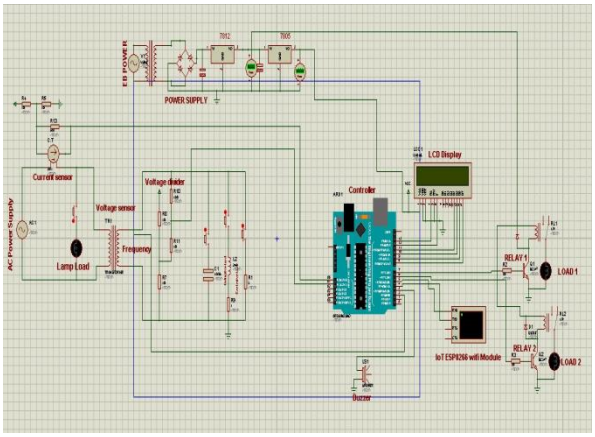

Fig2: Circuit diagram

VIII. ADVANTAGES

- The proposed system for substation monitoring provides the following advantages:
- The wireless monitoring of the substation parameters is user friendly.
- It is faster compared to GSM technology and manual operation.
- It enables automatic control using the controller and protecting the connected load by means of protective relays.
- It improves the quality of power remote sensing[6].

IX. RESULTS

This system detects the abnormal conditions and displays the type of fault, frequency, voltage, current, power factor in the mobile application as well as the LCD screen. It also alerts the user by means of a buzzer sound. If the voltage reaches above the threshold value i.e., 230V it sends the fault as over voltage condition. Thus the user can view the real time values at any instant.

X. CONCLUSION & FUTURE SCOPE

The acquired data is feasible to be used for analyses and diagnose the condition of the assets which is of great use for maintenance, scheduling, failure management and controlling system and this method minimizes time contact between human and high voltage device. This project can be extended by using GPRS technology, which helps in sending the monitored and controlled data to any place in the world. The temperature controlling systems like coolant can also use in places where temperature level should be maintained. By connecting wireless camera in industries, factories etc we can see the entire equipments from our personal computer only by using GPRS and GPS technology.

XI. ACKNOWLEDGMENT

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