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IOT Based Industrial Leakage and Safety Monitoring System

S. Arun mozhi
PG scholar, Dept. of ECE
PSNA College of Engineering
Dindigul, Tamilnadu, India.

Dr. P. Maniraj Kumar
Professor, Dept. of ECE
PSNA College of Engineering
Dindigul, Tamilnadu, India.

***Abstract*–In spite of security and automation in plants,industrial environmentis quiet critical for machines and humans. This paper contracts with a safety in industrial condition. A system has been designed to detect dangerous situations like breakdown which is the most important parameter for occurring leakage current in substation and help to avoid them. In addition safety scenes was created in order to verify the technique used in this method.This technique is designed to protect a human. This technique reveals harmful impacts of thermally dangerous areas and humans.Graphical interface has been created, which allows better configuration for more scenes. Reached outcome will be executed in IOT gateway design, to enhance industrial implementation with scalability. It consists of a transmitter module equipped with a data acquisition system associated with voltage sensor, a receiver module and leakage current for data processing and storageby connecting to a remote controller.Data processing is carried out at the receiving end so that the quantity monitored is shown regularly or at specified intervals of time. The operation of the system has been tested and proven resilient originated by surface discharge and corona which are the results of high-frequency interference signals.**

***Index terms*-IOT, leakage current measurement, data acquisition, continuous monitoring, LAN system, high voltage substation.**

1. INTRODUCTION

Electric power transmission and distribution systems are increasingly required to operate efficiently and reliably to guarantee both continuity and quality of supply. With many installations around the world using equipment that was installed decades ago and nearing the end of its service life, there is a need to monitor the condition of such equipment and possibly extend its service life without major system disruptions. This has prompted utilities to install plant and system monitoring devices in high-voltage substations, as well as in buried electric cables and on overhead power lines. Usually, such devices are used in conjunction with fiber optic links or hard-wired metallic cables to transmit information to a central monitoring point or SCADA system [1].

For upcoming smart grid applications, the number of such retrospectively-installed devices is expected to increase, and this poses the problem of large-scale deployment requiring considerable cost and installation effort. Among the practical challenges, for example, would be to ensure that such systems are immune from the effect of electric and magnetic fields generated in a high voltage installation, by providing appropriate insulation to withstand failure and breakdown. Wireless monitoring sensors, however, offer an attractive alternative to wired or fiber-optic systems for high-voltage equipment in substations, and have prospective application in wide-area monitoring of large power systems. Condition monitoring applications where data would be very expensive to acquire using traditional wired communication systems, could benefit from the use of wireless sensors. In this case, wireless sensors would help avoid effects of ground potential rise and reduce the difficulty and cost of installing wiring across substation yards. Wireless sensor systems can play a role in substation condition monitoring, but this role must take into account the realities of wireless vulnerabilities to EMI, path obstacles, scattering, congestion of the limited frequency spectrum, and other factors such as the number of access points (AP) required. A feasibility study on deploying wireless technologies in high voltage substations has shown that WIFI technology performs satisfactorily in terms of substation coverage, signal propagation, security and data rate [2]. High voltage substations present special challenges in this respect due to the presence of many metallic structures causing multiple reflections, diffractions and scattering. It has been argued [3] that WLAN, IEEE 802.11b/g and WPAN can be successfully applied for monitoring high-voltage substations, electric powerlines and plant. Some authors proposed wireless data acquisition systems for measuring high-frequency signals such as transient EMI signals [4] and partial discharge signals [5]. In [6], a wireless surge arrester leakage current sensor, based on the ZigBee protocol, capable of transmitting over a distance of 400 m was developed and tested in a 230kV substation. The authors of [7] propose a wireless capacitive sensor for monitoring voltage variations of MV/HV plant using ZigBee technology. Other monitoring solutions have also been proposed for use with electrical plant [8].

In addition to noise and external interference, wireless DAQ systems need to be immune to information loss errors and unauthorized access to data. This can be resolved with the selection of a wireless technology that provides robust security, both in terms of data encryption and network connectivity. Issues of overloaded bandwidth, disruption of the wireless signal due to electromagnetic interference need to be carefully examined. When sensors and wireless transmitters are mounted on or near high-voltage equipment, high-frequency noise and interference can affect their performance. For example, previous experimental results [9] showed a correlation between the breakdown events in vacuum and SF6 and a sharp decline in the data rate of 802.11b wireless devices. In [10], the authors demonstrated thatWLAN sensors can be used in substations for monitoring and metering applications, despite transmission delays incurred due to noise, which were within allowable limits. The authors of [11] investigated the effect of high impulsive transients on the wireless transfer performance of WiFi and ZigBee communications, and concluded that WiFi provides higher immunity to such transients compared with ZigBee. Impulsive noise effects on WLAN performance have also been reported in a laboratory environment [12].

This paper describes the design, development and testing of a microcontroller-based wireless data acquisition system for monitoring leakage current and voltage in high-voltage substation electrical equipment. The system is a solar-powered device with back-up battery storage. A design prototype was initially tested in the laboratory with relatively short transmission distances [13], and later improved as a self-powered device [14]. This work builds on this design by introducing improvements in data acquisition algorithms, extending the experimental validation to an outdoor test facility, and demonstrating its transmission performance with and without partial discharge interference. The results obtained using the proposed system are compared with those recorded directly through a wired data acquisition system. The device could find application both in line-mounted equipment monitoring such as line voltage, line current and temperature monitors and as well as ground-mounted equipment such as leakage current monitors in substations. The proposed method is easier to implement and provides a cheaper alternative compared with existing methods that use wired communication systems, while achieving similar data transmission performance. It is also expected to be less susceptible to high-voltage interference effects such as electromagnetic coupling and ground potential rise.

II. PROPOSED SYSTEM

The block diagram of the proposed system is shown in Figure 1.Now- a – days, the industrial monitoring field requires more manual power to monitor and control the industrial parameters such as temperature, humidity, gas etc. This is the most upcoming issues in the industrial sectors. if the parameters are not monitored and control properly, it leads to a harmful situation. Most of the industries are facing those kinds of situation because of some manual mistakes. To overcome manual mistakes we are using industrial automation with internet of things

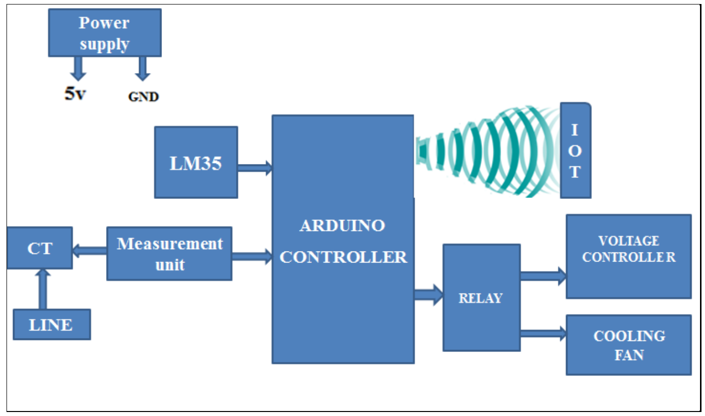

Fig. 1. Block diagram of the proposed system.

A.*Relay driver*

Relay Driver is used for drive the relay. ULN2003A IC is used as driver.

B. *Relay*

Relays are switching devices. Switching devices are the heart of industrial electronic systems. When a relay is energized or activated, contacts are made or broken. They are used to control ac or dc power.

C.*Potential Transformer*

The potential transformer works along the same principle of other transformers. It converts voltages from high to low. It will take the thousands of volts behind power transmission systems and step the voltage down to something that meters can handle. These transformers work for single and three phase systems, and are attached at a point where it is convenient to measure the voltage.

D. *Amplifier*

An amplifier is a circuit which can produce an output voltage, which is the product of input voltage with a value called voltage gain.

E. *Voltage measurement*

The load voltage is measured by using a potential transformer. The load voltage is stepped down to a low value by using a potential transformer. The output of the potential transformer is connected to an variable resistor. The variable resistor reduces the voltage to a required level.

F. *Temprature Sensor*

The temperature sensor is used to sense the temperature level. Thermistor is used to sense the temperature level.LM35, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 ^{o}C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ^{o}C rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/ ^{o}C.

G. *Current Transformer*

A current transformer (CT) is a measurement device designed to provide a current in its secondary coil proportional to the current flowing in its primary. Current transformers are commonly used in metering and protective relaying in the electrical power industry where they facilitate the safe measurement of large currents, often in the presence of high voltages. The current transformer safely isolates measurement and control circuitry from the high voltages typically present on the circuit being measured.

H. *Current Measuring Unit*

The current drawn by the load is measured by using current transformer. The primary of the current transformer is connected in series with the load. A resistance of suitable value is connected across the secondary of the current transformer. Here the current is converted into voltage. Now the voltage drop across the resistor is applied to variable resistor which reduces the voltage to a required level.

I. *Interface*

Level translators provide an interface between components that operate at different voltage levels.

J. *Internet Of Things*

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

K. *LAN*

A local area network (LAN) is a group of computers and associated devices that share a common communications line or wireless link to a server. Typically, a LANencompasses computers and peripherals connected to a server within a distinct geographic area such as an office or a commercial establishment.

III.RESULTS DISCUSSION

5.1 SIMULATION RESULT

The Proteus Design Suite is a proprietary software tool used primary for Electronic Design Automation.TheSoft ware is mainly used by Electronic Design Engineers and technicians to create Schematics and Electronic prints for manufacturing printed circuit board.

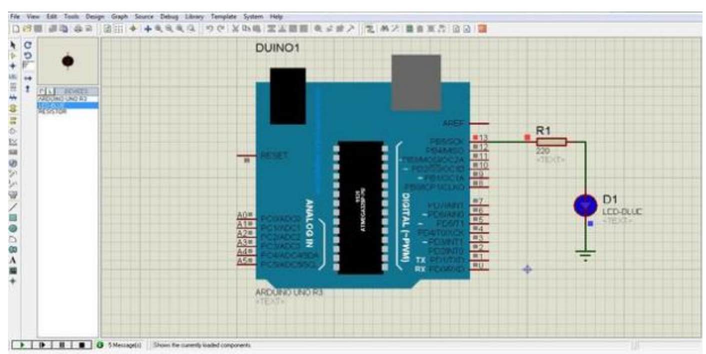

Fig 5.1.1 Simulation model of Arduino Micro Controller

Proteus Design suite is windows application for schematic circuit,simulation and PCB layout Design It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation.

All PCB Design products include an autorouter and basic mixed mode SPICE simulation capabilities.

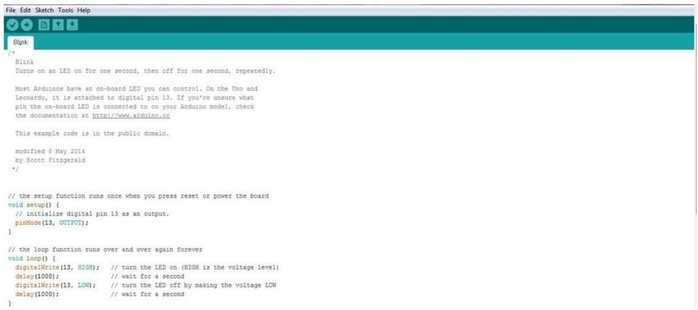

Fig 5.1.2 Program for Arduino Micro Controller

The output shown in figure 5.1.3 and 5.1.4 is obtained by using proteus software. It is a fully functional, procedural programming language.

Fig 5.1.3 IOT Computer Control (load ON condition)

It is especially versatile in dealing with strings having hundreds of dedicated function; this makes it one of the richest language. Transforming data from one form to another is the main usage of this language.

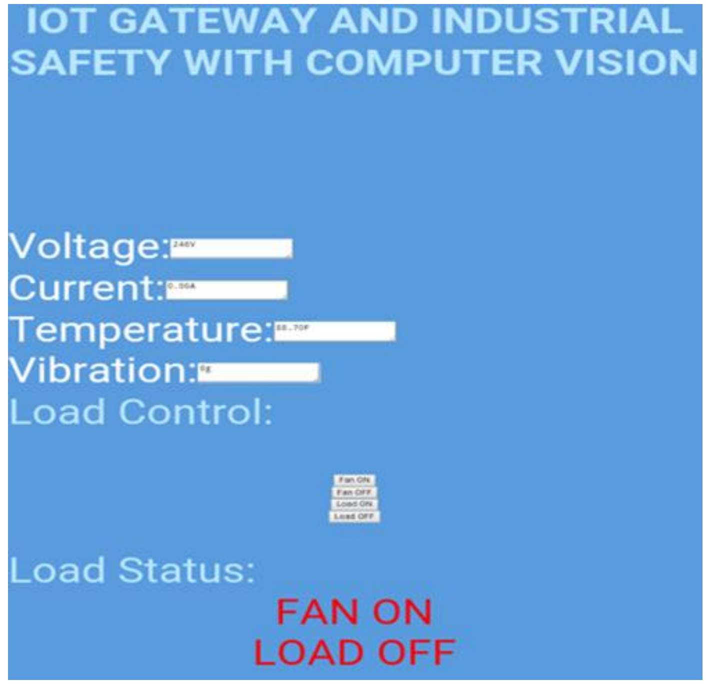

Fig 5.1.4 IOT Computer Control (load OFF condition)

5.2 HARDWARE RESULT

Fig 5.2.1 Load ON Condition

Fig 5.2.2 Load OFF Condition

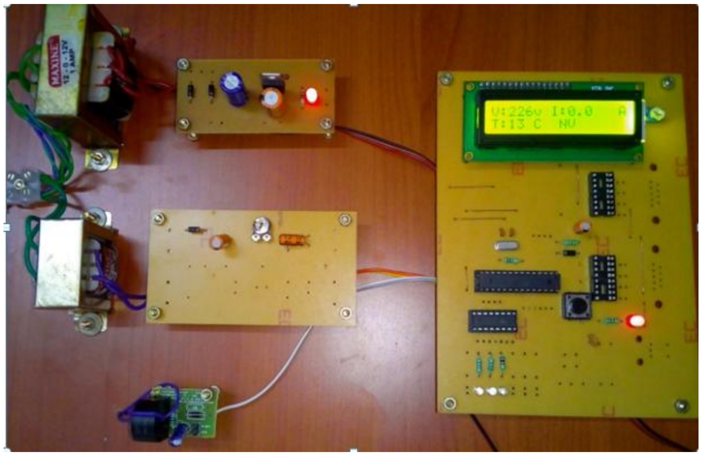

Fig 5.2.3 Hard ware implementation of Load current

CONCLUSION

This project has demonstrated the feasibility of a novel wireless condition monitoring system for application in high voltage electrical substations. The system can be used as a standalone device to measure leakage current and voltage in a variety of equipment. It has been successfully tested in three different monitoring applications: (i) for monitoring the leakage current of a surge arrester, (ii) monitoring the surface conduction current of polluted insulators and (iii) monitoring the earth current flowing through the footings of a high-voltage tower.Further work is required to improve accuracy, account for transmission delays, and extend the application to multiple sensors.

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