IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 6, August 2014.
www.ijiset.com
ISSN 2348 – 7968

Monitoring Network for Smart Grid Using Smart Phone

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Abstract

This paper introduces a new approach to improve the power quality and reliability of power supply. The smart grid is used to measures the values for voltage, temperature, frequency in distribution side. A Smart grid is a technology which is used to monitor and collect the values from distribution side. The digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart. A smart grid is an intelligent, digitized electricity system providing an energy network that delivers electricity in an optimal way from source to consumption, enabling better energy management, minimizing power disruptions and transporting only the required amount of power. The microcontroller is communicating with Bluetooth server through the UART (serial communication) protocol. Bluetooth server is used to transfer the values from microcontroller to smart phone. The wireless connection is available between the Bluetooth server and smart phone while transmitting the values, if there is any problem occurs the reset button is used to reset the values. A buzzer is placed if any abnormal intrusion detected (over voltage and frequency), in distribution side. The power grids Consist of thousands of generators and substations linked across thousands of miles, in which the system's many components communicate among each other to improve the reliability and efficiency of electricity distribution.

Keywords: *Distribution System, Micro Controller, Smart Phone, Smart Grid.*

1. Introduction

Electric power systems are real-time energy delivery systems. Real time means that power is generated, transported and distributed to the customers. Distribution Transformers have a long service life if they are operated under rated conditions. The operation of these transformers under conditions such as overloading and voltage unbalance for a long time will reduce their life significantly. To be aware of occurring these conditions, the operation of this transformer should be monitored continuously.

Apart from restructuring and unbundling of the power sector there is a need for introduction of `smart grid' technology to increase the operational as well technological efficiency of the power distribution network to meet the growing energy demand. So with development of infrastructure of wireless communication, offer new and cost effective possibilities to monitor distribution transformer.

We propose structure of a cost effective method for monitoring the distribution transformer. Secure and efficient communication between human being and managed devices is critical for Smart Grid. SAG serves as the interface between the remote users and the managed devices, such that real-time secure monitoring and control of the devices can be achieved through a Smart Phone.

2. Power System

The basic design principle is essential in the operation of electric power systems. This chapter briefly describes and defines electric power generation, transmission, and distribution systems (primary and secondary). A discussion of emergency and standby power systems is also presented. Fig .1 shows a one-line diagram of a typical electrical power generation, transmission and distribution.

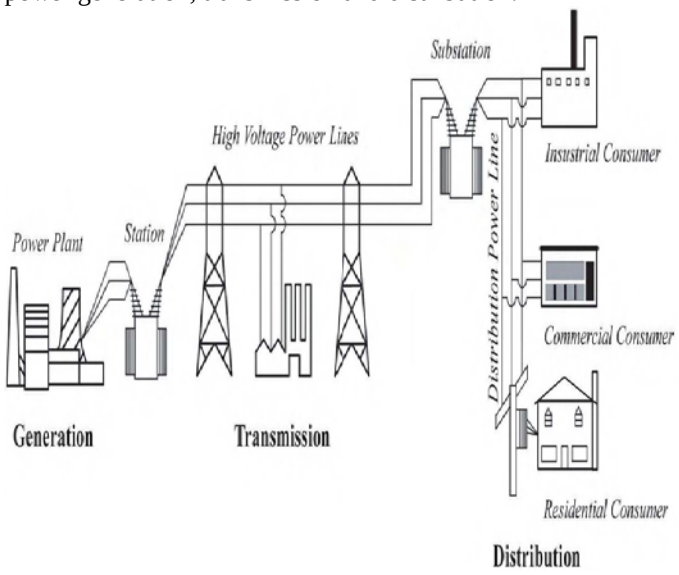

Fig .1 shows the basic building blocks of an electric power system

An interconnected power system is a complex enterprise that may be

1. Generation Subsystem
2. Transmission and Sub transmission Subsystem

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3. Distribution Subsystem Utilization Subsystem

2.1 Interconnected System

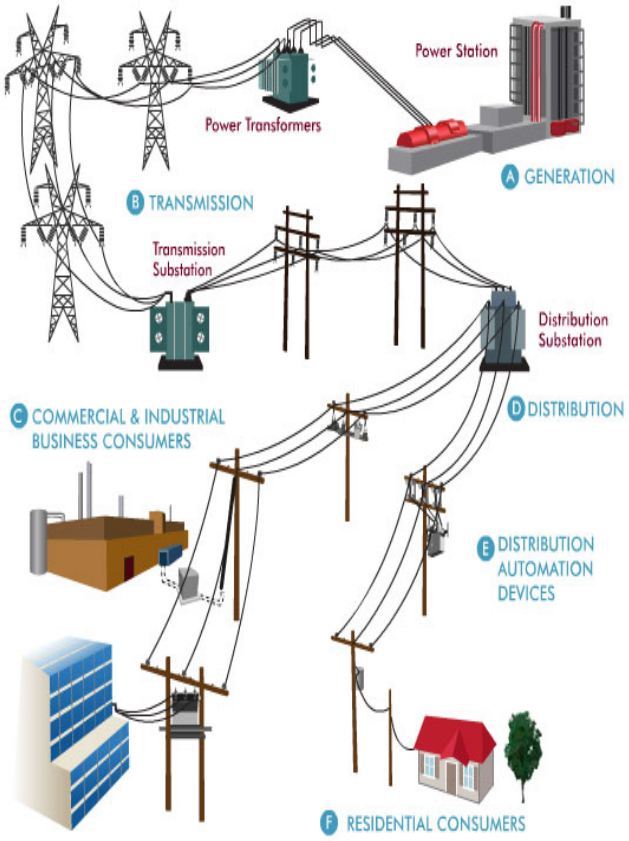

Fig .2 shows the interconnected system

When the feeder is energized by two or more than two generating stations or substations, it is called inter-connected system. Fig .2 shows the single line diagram of interconnected system where the closed feeder ring ABCD is supplied by two substations S1 and S2 at points respectively. Distributors are connected to point of the feeder ring through distribution transformers.

2.2 Merits of Interconnected System

1. Optimal Utilization of Unevenly Distributed Natural Resources

Transmission of bulk electrical power is cheaper than transporting natural resources. Thus interconnection of grids provides an attractive option for optimal utilization of unevenly distributed natural resources. After interconnection, the least costly generating units within the interconnected area can be dispatched first, providing an overall cost savings that can be shared among the operating systems.

2. Exploitation of Regional Diversity

The regional grids are spread over large geographical areas with diversity in time, weather, crop pattern, industrialization, population density, economic growth etc. This leads to diversity in the power requirements. Grid interconnections help in sharing the available generation capacity in different regions and thus reducing the requirement for installed capacity in each region. Interconnections help to achieve the economies of scale and thus provide the opportunity to invest in generating units of higher capacity and better efficiency. The diversity available across such a vast interconnection brings with it energy security also.

3. Improvement in the Plant Load Factor

Grid interconnections facilitates transfer of power from surplus to deficit areas resulting in greater utilization of installed generation capacity and thus improved Plant Load Factor for generating Stations. If the grids having peak demands at different times of the day are interconnected, then base load generation plants having low fuel cost per unit of electricity produced can run continuously and result in savings on account of fuel and efficient operation.

4. Improved Reliability

Any interconnection invariably increases the reliability of the whole system and the load demand can be met with a greater certainty. Further, interconnections in general provide flexibility to meet unforeseen energy demand; hence support each other under contingencies.

5. Increased Economic Efficiency in System Operation

With cross-border exchange, the generation of each of the interconnected countries has access to a larger market. This results in merit order operation on large scale and extends opportunity to promote operation of efficient power plants as far as possible, to achieve overall economic efficiency in system operation.

2.3 Demerits of Interconnected System

In this system the grids are interconnected with the entire distribution network. Because of this structure the construction cost for interconnected system is very high. The grid consumes some amount of power while

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transmitting a power from one distribution station to another station. So the interconnected system is not suitable for long delivery purpose. If any fault occurred in one grid, due to its interconnection all the grids are affected. The problem in one grid also affects all the grids in an interconnected network. So all the distribution systems are affected by the faulted grid. Due to this reason the cost for solving this problem is very high. To overcome this problem the smart grid has been introduced in distribution side.

2.4 Smart Grid Interconnected Network

Now days smart grid has been placed in inter connected areas. Smart grid has been used to avoid the problems in distribution area. Because of smart grid if any problems occurred in interconnected area, the entire grid area only affected. The other grids are work properly and transmit the electrical power from one distribution station to consumers. It reduces the problems in interconnected system. It increases the reliability of power supply and power quality of supply.

3. Smart Grid

A smart grid is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviours of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. The Smart Grid represents an unprecedented opportunity to move the energy industry into a new era of reliability, availability, and efficiency that will contribute to our economic and environmental health [4].

A Smart grid is a technology which is used to monitor and collect the values from distribution side. The digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart.

A smart grid is an intelligent, digitized electricity system providing an energy network that delivers electricity in an optimal way from source to consumption, enabling better energy management, minimizing power disruptions and transporting only the required amount of power.

Like the Internet, the Smart Grid will consist of controls, computers, automation, and new technologies and equipment working together, but in this case, these technologies will work with the electrical grid to respond digitally to our quickly changing electric demand.

3.1 Purpose of Smart Grid

During the transition period, it will be critical to carry out testing, technology improvements, consumer education, development of standards and regulations, and information sharing between projects to ensure that the benefits we envision from the Smart Grid become a reality. The benefits associated with the Smart Grid include:

1. More efficient transmission of electricity
2. Quicker restoration of electricity after power disturbances
3. Reduced operations and management costs for utilities, and ultimately lower power costs for consumers
4. Reduced peak demand, which will also help lower electricity rates
5. Increased integration of large-scale renewable energy systems
6. Better integration of customer-owner power generation systems, including renewable energy systems
7. Improved security

Today, an electricity disruption such as a blackout can have a domino effect—a series of failures that can affect. It is widely agreed that energy conservation and renewable energy are critical to securing our energy future, but smarter electricity systems - smart grids - are imperative to tap the full potential of modern energy solutions. A smart grid can also serve as a platform for innovation in energy services, which gives customers more information about their energy footprint and ways to manage their electricity consumption. There is a carbon emission reduction potential, directly through more optimal production and transmission of electricity, and indirectly through influencing of consumer behaviour.

4. Hardware Implementation

A graphic representation of an electric circuit in which actual circuit components are represented by standard symbol circuit diagrams are used in studying the work of electric circuits and in calculating their operating conditions. The standard symbols for the circuit components are arranged in correspondence with the operational principle of the device, as well as to facilitate the reading of the diagram. Fig .3 shows the circuit diagram of proposed method.

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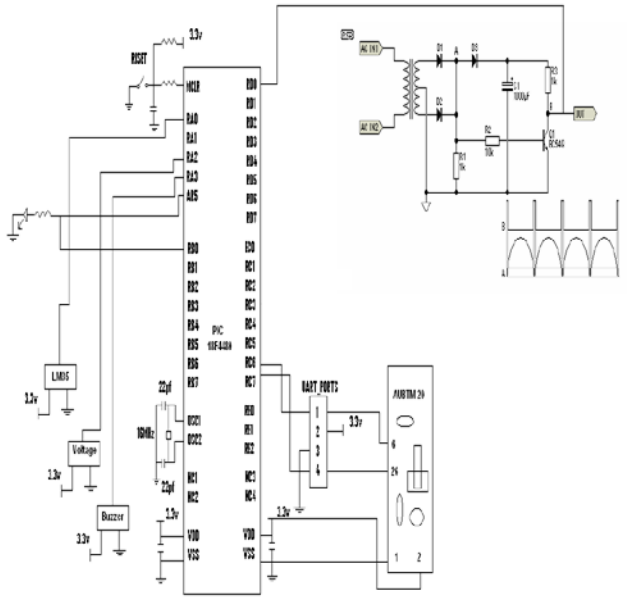

Fig .3 Circuit Diagram

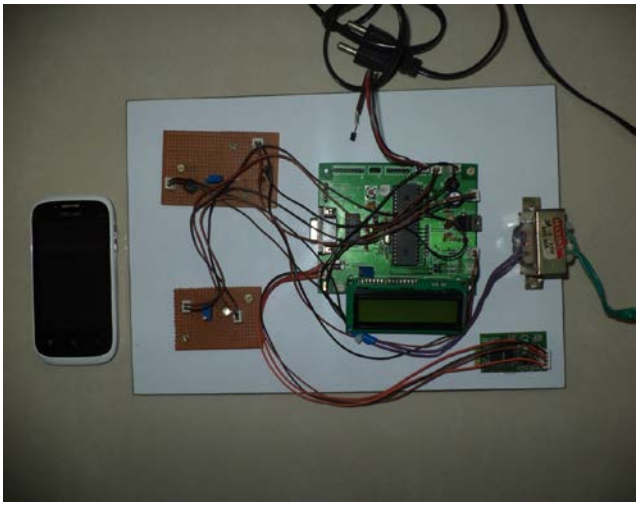

Fig .4 Hardware Module of Monitoring Network for Smart Grids

Fig .4 shows the hardware arrangement of monitoring network for smart grids using smart phone. The power supply is given to the microcontroller through A.C step down transformer.

By using the regulator the 12v supply is converted to 5v and it is applied to the microcontroller. The pic microcontroller is interfaced with sensors and UART. By using a voltage regulator the input voltage to the distribution side can be changed to vary the voltage level. With the helping of LM35 the temperature of microcontroller can be noticed. The temperature sensors sense temperature between 25 to 135 degree celcious.

To measure the frequency from the supply the zero cross detector circuit can be formed. It produces the clock pulses at every zero crossing position. By counting these clock pulses the frequency of the supply can be noticed. The zero cross detector is used to display the frequency of supply from the line. While transmitting the values if any problem occurred, the reset button is used to reset the values.

The LED is used to know the proper working of the smart grid. To avoid the short circuit between positive supply and ground, the decoupling capacitor can be used. The microcontroller is communicating with Bluetooth server through the UART (serial communication) protocol.

UART contains 4 pins. The receiver pin receives the values from microcontroller and transmitter pin transmits the values to Bluetooth server. With the help of Bluetooth server the obtained data's are sent to smart phone or tablets or any other android devices. Bluetooth SPP application is used to receive the data's from the Bluetooth server. A buzzer is placed if any abnormal intrusion detected (over voltage and frequency), to distribution side.

5. Conclusions

We have implemented the monitoring network for smart grid using smart phone. Reliable and efficient communication between human being and devices play a key role for smart grid and smart home. In this article, we discussed the design of a secure access gateway (SAG) for home area network. The SAG serves as the interface between the remote users and the managed devices, such that real-time secure monitoring and control to the devices can be achieved through a Smart Phone. The major challenges for the design and deployment of the SAG lie in the ever-increasing demand on security and capacity. We enhance the security from both the network layer and the physical layer. We also provide a framework on how to improve the system security, capacity, flexibility and scalability through cognitive networking. Potentially, secure monitoring and control of home devices through wireless communications will gradually penetrate into the world surrounding us and bring great changes to our daily lifestyle.

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