# Power Line Monitoring Using Smart Grid Based Sensor and ZigBee Communication Protocol

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**Abstract - Smart grid the next generation electric power system is effective way of digital transmission of electricity. It is a digital technology that allows two way communications between utility and customers. We provide a system model that will monitor critical asset parameters such as current, voltage and temperature. A smart grid sensor is a small, low cost lightweight node that serves as a detection station in a sensor network. These sensors enable the remote monitoring of equipment such as transformers and power lines. They are improving the performance and extending the life of grid components to ensure a safe and reliable operation of the electricity network. Use of ZigBee based communication protocol make system more reliable. A lot of research is now going on the various issues and challenges on the real monitoring of power line parameters using smart grid based sensors. The used of smart grid for real time monitoring of power line parameters is the now become interest of research. This paper discussed network architecture and different design aspects for implementation of smart grid based monitoring network using smart sensors.**

**Index Terms – smart grid sensors, low cost, ZigBee, real time monitoring, challenges**

## 1. INTRODUCTION

A smart grid is an electrical grid that uses computer and other information technologies to gather and act in an automated fashion to improve system's reliability and efficiency. The term smart grid was coined in 2005 [1]. The smart grid enables the information technology for effective communication with the used of smart grid based sensors. For our current society electricity is important, and in order to properly maintain and develop power distribution system, it is needed to understand and monitor the system behaviour [2]. Transmission line monitoring is very important aspects for reliable transmission of electricity. Previously used sensors are only used for particular monitoring that means temperature or current or voltage monitoring. It is unable to generate the power by its own because there is no boost converter. Due to used of smart grid based sensors system becomes more reliable and efficient in all ways. 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 control these conditions, the operation of this transformer should be monitored continuously [3]. Wireless communication continues to play a significant role in the modernization of the electric power system and Wireless communications provide both flexibility and cost savings in deployment and maintenance compared to wire line deployments. Wireless can be deployed anywhere and anytime; no trenches or conduits are required [4]. To monitor the status of the power system in real-time, sensors are used in various components in the power network. These sensors are capable of measurements of a variety of physical or electrical parameters and generate a lot of information. Delivering this information to the control center in a cost efficient and timely manner is a critical challenge to be addressed in order to build an intelligent smart grid [5]. Wireless interfaces are chosen because they are easy to organize and install. Furthermore, ZigBee has some technical advantages over Bluetooth, WiFi, infrared rays etc. ZigBee is a kind of low power-consuming communication technology for coverage area surrounded by 200m, with a data rate ranging from 20Kbps to 250Kbps, it is appropriate for use in home area networks, mainly for the remote control of electric home appliances[6]. Table shows the comparison of Traditional Grid and Smart Grid.

| Sr. No | Traditional Grid | Smart Grid |
|---|---|---|
| 1 | Centralized Generation | Distributed Generation |
| 2 | Electromechanical | Digital |
| 3 | Failures and Blackouts | Adaptive and Islanding |

| | | |
|---|---|---|
| 4 | Lack of real time monitoring | Extensive real time monitoring |
| 5 | Slow Reaction time | Extremely quick reaction time |
| 6 | Manual Restoration | Self healing |
| 7 | One way Communication | Two way communication |
| 8 | No energy Storage | Energy Storage |

Table 1 Comparison of Traditional Grid and Smart Grid

## 2. PROPOSED SYSTEM

The Hardware implementation divided into following sections:

- Microcontroller – PIC18F4520
- ZigBee – S1/S2 Series module
- Current Sensor
- Voltage Sensor
- 16x2 LCD Display
- Relay and driver IC ULN 2803

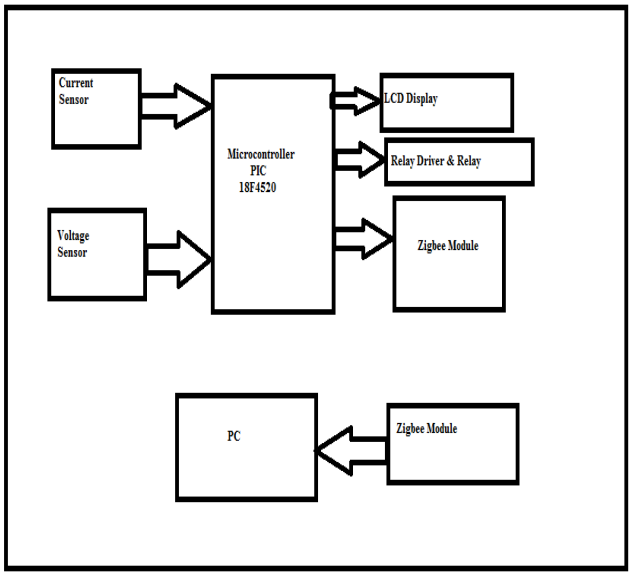


Figure 1.Proposed System

The hardware description as follows:

### 2.1. Microcontroller – PIC18F4520

The microcontroller is a complete microprocessor system built on a single integrated circuit. Microcontrollers were developed with the purpose to build a complete microprocessor system that substantially reduces the cost of building simple products. Microcontrollers are named as they perform control functions. The microcontroller is very commonly used in variety of intelligent products. For example, most personal computer keyboards are implemented with the microcontroller. From microwaves to automatic braking system, they are around us making our lives more comfortable and safer. Unlike our desktop computer, microcontrollers interact with other machines rather than humans. A microcontroller may be used to measure the temperature of our toast at breakfast and when the temperature reaches a pre-determined value, the toaster could be turned off. Using this small device we have developed a microcontroller based system development kit. We can program the EPROM according to the application needed. Once it is programmed it can be used as a dedicated system for that application. Electrically Erasable Programmable Read Only Memory technology supplies non-volatile storage of variables to a PIC-controlled device or instrument. That is variables stored in an EEPROM will remain there even after power has been turned off and then on again. Some instruments use an EEPROM to store calibration data during manufacture. In this way, each instrument is actually custom built, with customization that can be easily automated [7].

### 2.2. ZigBee – S1/S2 Series module

These are very popular ISM 2.4GHz ZigBee modules. These modules take the 802.15.4 stack (the basis for ZigBee) and wrap it into a simple to use serial command set. S1 series modules work on 802.15.4 protocol & S2 series work on ZIGBEE protocol. You cannot mix S1 with S2. ZigBee modules can give communication range of 30 meters indoor or 100 meters outdoor. This module is ideal for PC to Robot communication or MCU to control other devices wirelessly. This ZigBee wireless device can be directly connected to the serial port (at 3.3V level) of your microcontroller. By using a logic level translator it can also be interfaced to 5V logic (TTL) devices having serial interface. This module supports data rates of up to 115kbps. It has indoor range of 30 meters and outdoor RF line-of-sight range of up to 100 meters.

### 2.3. Current and Voltage sensors (Transmission line Monitors):

Get a complete, continuous picture of conductor behavior in real-time including actual conductor clearance-to-ground (not sag), conductor temperature, line current, and vibration TLM Conductor Monitor. Affordable, easily installed, self-powered, and self-communicating, the TLM conductor monitoring solution is suitable for live installation through 765 KV. The TLM conductor monitor provides the continuous data on conductor behavior required for facility rating, regulatory compliance, and dynamic line rating. Ensure electrical clearance compliance by continuously

measuring the distance from the conductor to the nearest object below it.

Software's used are as follows:

- MPLAB IDE
- Proteus Professional
- PCB 123

## 3. OPERATION

The sensors in the transmitter section consist of voltage sensor and current sensor. It senses the signal and sends it to the microcontroller unit for processing. The display unit displays the values of voltage and current received by microcontroller unit. ZigBee receives the sensed data through RXD of ZigBee interface from microcontroller and again same data is transmitted by TXD pin. In the receiver section, ZigBee module is used to receive the data from Transmitter. The received signal is feed on the Computer/Laptop and is viewed in the HyperTerminal mode in the computer/Laptop. The voltage and current of a transformer is monitored continuously using voltage and current sensors respectively. When the voltage or current is above the normal value, it indicates as High and if it is below the normal value it indicates Low. The relay used along with relay driver IC for switching of grid. The parameter values such as temperature, potential, gas and current values are monitored using the temperature sensors, potential sensor, gas sensor and current sensor respectively.

## 4. OUTCOMES FROM STUDY

In this paper, we have discussed the detailed architecture to monitor different parameters of power line like voltage, current and temperature etc. The outcomes are as follows:

1. With the use of smart sensors we can easily enable for remote monitoring of equipment such as transformers and power lines and the demand-side management of resources on an energy smart grid.
2. The working principles of smart sensors and wireless parallel communication protocol like ZigBee have been studied.
3. In this paper, we present a survey of electric transmission line monitoring system, highlight the key concept, and state of art implementation as well as investigate challenges.
4. The goal of this project is to provide a better understanding of the design challenges of electric distribution line monitoring system and identify important research in this increasing important field.

## 5. CONCLUSION

1. The stick on sensor will consists of the group of sensors such as asset temperature sensor, current sensor and voltage sensor to sense and monitor the various grid parameters.
2. The paper represents a novel approach for controlling and monitoring the electrical distribution line.
3. By using the ZigBee transceiver, information will be transferred to the co-ordination unit, when the value of various grid parameters exceeds the particular value above which break down will be occurred in the transmission line or grid. By the predetermination of certain increase of current, voltage, gas or temperature the damage in the grid will be avoided. This concept can be applicable to use in electricity boards and industries.

## 6. REFERENCES

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