Grid Parameters Monitoring with ZigBee Communication

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Abstract

The grid is an innovative energy network that will improve the conventional electrical grid network to be more reliable, cooperative, responsive, and economical. Within the context of the new capabilities, advanced data sensing, communication, and networking technology will plays a significant role in shaping the future of the grid. The grid will require a flexible and efficient framework to ensure the collection of timely and accurate information from various locations in grid to provide continuous and reliable operation. This project presents a tutorial on the sensor data collection, communications, and networking issues for the smart grid. First, the applications of data sensing in the grid are reviewed. Then, the requirements for data sensing and collection, the corresponding sensors and actuators, and the communication and networking architecture are discussed. The communication technologies and the data communication network architecture and protocols for the grid are described. Next, different emerging techniques for data sensing, communications, with fire safety and sensor data networking are reviewed. The issues related to security of data sensing and communications in the grid are then discussed. To this end, the standardization activities and use cases related to data sensing and communications in the power grid are summarized. Finally, several open issues and challenges are outlined.

Keywords: grid, sensors, communication

1. Introduction

Electricity demand is rising faster than demand for any other form of final energy globally and intensifies around peak times because of the progressive shift in consumption from a steady industrial base load to variable household and commercial demand. As a result, grids are being increasingly stressed, making rapid expansion a necessity.

Infrastructure tends to compromise the reliability of power supply and exacerbate energy losses to the detriment of economies undergoing rapid electrification. In India, inadequate distribution networks results in the loss of 20% of transmitted electricity while, in the U.S., aging transmission network is causing a decline in the reliability of power supply.

In order to maintain continuous power supply without any interruption it should be automated. In the project, part of this automation tasks are considered, and a micro controller based proto type is developed. When there is any variation in parameters, current and voltage in the power grid. The data is sent through the ZigBee, after the acknowledgment from the user through the ZigBee communication the fault or problem is rectified it is series the load will be tripped.

2. Proposed system

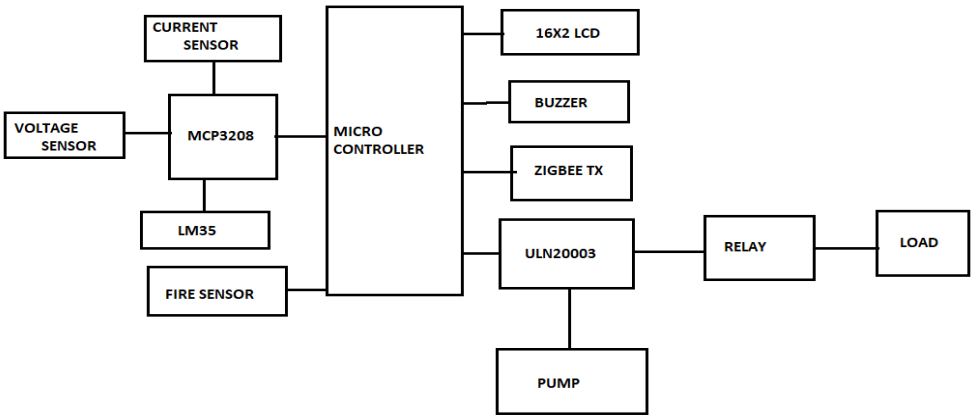

Figure 1 Block diagram of transmitter

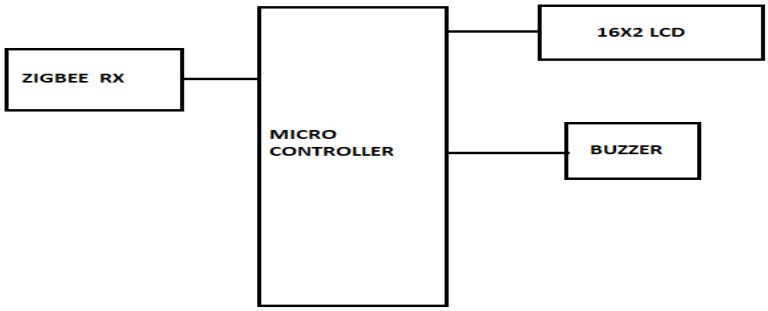

Figure 2 Block diagram of receiver

A grid is an electrical grid that uses computer and other information technologies to gather and act in an automated fashion to improve systems reliability and efficiency. This system used sensors for particular monitoring that means temperature or fire or current or voltage monitoring. The sensors module is used to measure the electrical parameters of transmission line such as temperature, potential and current values are monitored using the temperature sensors, fire sensor potential sensor, and current sensor respectively.

ZigBee is wireless Parallel communication protocol which transmits data related to parameter information over long distance. ZigBee is a kind of low power consuming communication technology for coverage area surrounded by 200m, with a data rate ranging from 20Kbps to250Kbps, it is appropriate for use in home area networks, mainly for the remote control of electric home appliances.

The measured electrical parameters are transmitted to a central controller via the ZigBee node. Thus this project presents system model for provided solution to avoid power loss in case of any electrical parameter which is in above normal value, then the grid will automatically switched to off position.

3. Hardware implementation

3.1 Working and operation

In a grid any fault occurs in the electrical parameters and if a fire occurs and temperature occurs increases if any of the above mentioned faults occurs in a grid the fault signal is transmitted using ZigBee to the receiver circuit which is in the control room.

In the voltage thee are low voltage and high voltage faults when the fault occurs the load is tripped and in the control room it is displayed as low voltage and high voltage fault.

When fire occurs the load is tripped and it is displayed as fire occurs. When the temperature increases it will show the increased temperature.

In this project we can reduce fault detection time.

3.2 Schematic Diagram

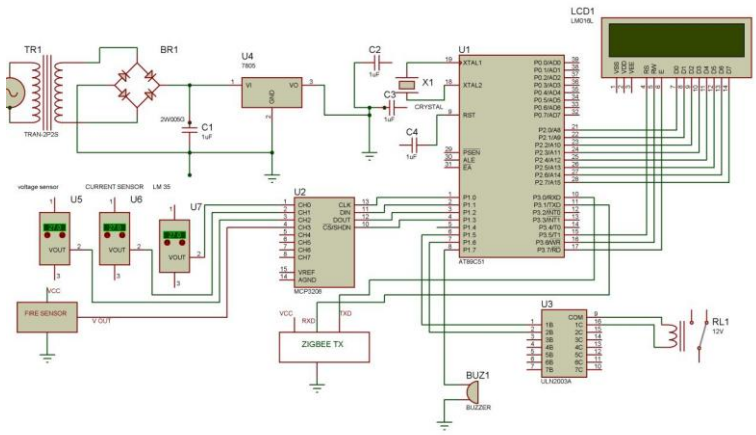

Figure 3 Transmitter circuit

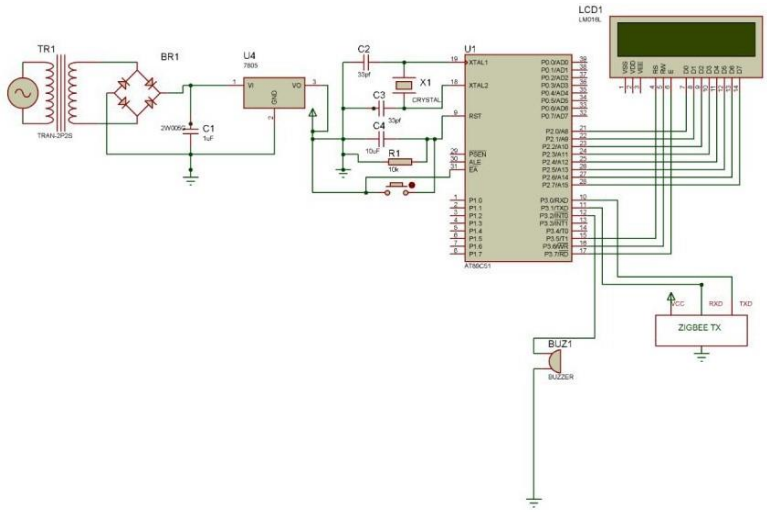

Figure 4 Receiver circuit

4. Results

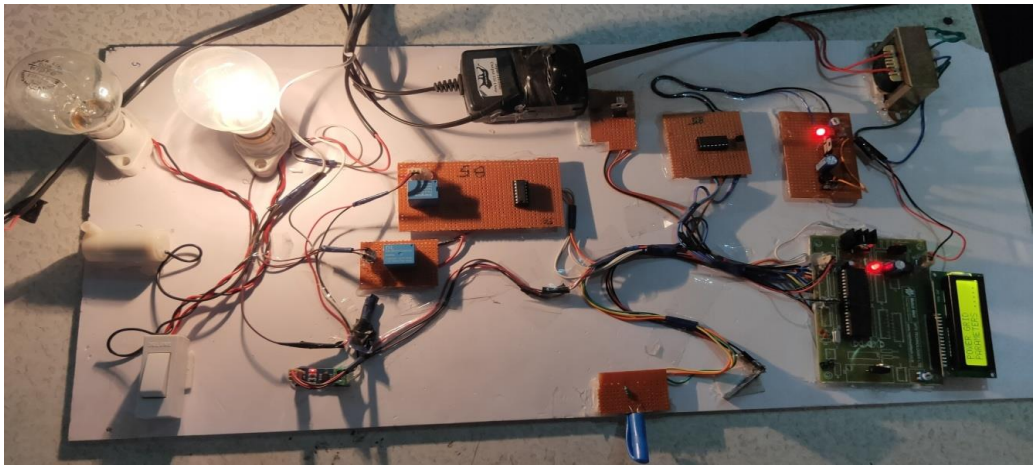

Figure 5 Grid Parameters Monitoring through ZigBee Communications

The above figure explains about GRID PARAMETERS MONITORING THROUGH ZIGBEE COMMUNICATIONS.

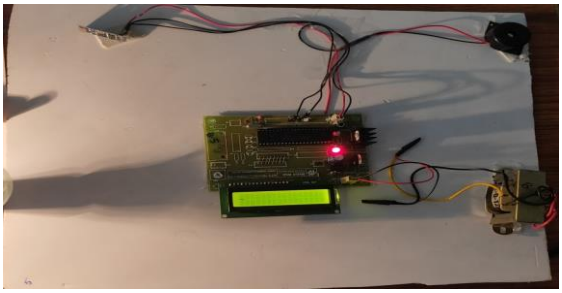

Figure 6 Control Room ZigBee receiver unit

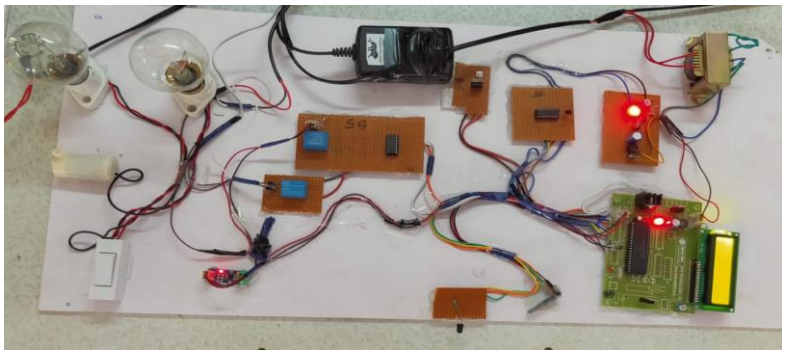

Figure 7 Load is tripped when fault occurs

Figure 8 Fire occur fault

Figure 9 Low voltage fault

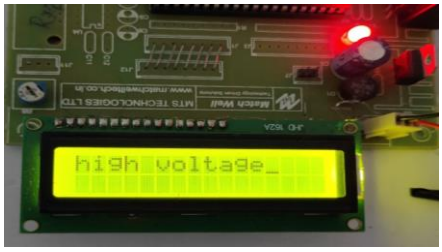

Figure 10 High voltage fault

Figure 11 Temperature fault

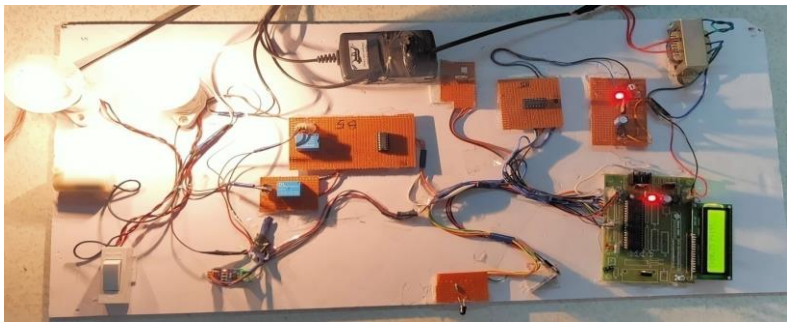

Figure 12 Overload condition

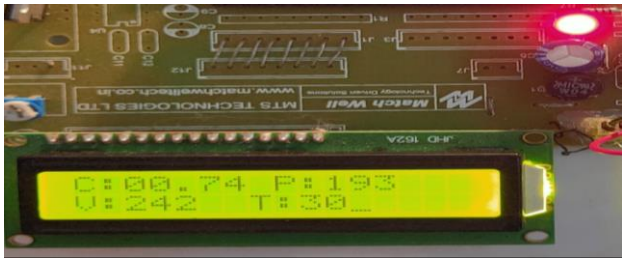

Figure 13 LCD Display shows overload power

In figure 6, shows the fault is displayed in LCD Display and the buzzer will horn.
In figure 7, shows the load is automatically tripped when there is any change in the electrical parameters. Then the load goes into off state. By this method we can protect the load from fault conditions.
The figure 8 represents fire fault occurs which is showed in the control room LCD display. When the fire occurs the load is tripped, pump is on and it will blow fire extinguisher gas, simultaneously the data is transmitted to the receiver circuit using ZigBee communication.
The figure 9 shows low voltage fault will occur when the voltage is decreased than the rated voltage. When the load is tripped and the data is sent to the control room, it is displayed as low voltage in the LCD display in the control room. Similarly, for high voltage fault, it is displayed as high voltage in the LCD display in the control room.
The figure 11 shows temperature fault, when the temperature increases beyond the rated value the increased temperature is shown on the LCD display in the control room then the external cooling is provided to the transformers in the Grid through cooling fans etc.
The figure 12 shows Overload condition, it means the load is high than the normal load, in this prototype if one lamp in on state it is normal load, when the second lamp is also on state it represents over load.
The figure 13 shows the overload power value on LCD display in the control room, when this overload fault occur the load is tripped and the data is transmitted to the receiver circuit in the control room.

5. Conclusion

In this paper, power sensing module was developed for monitoring single phase system. ZigBee wireless open standard technology is being selected in this project as the energy management and efficiency technology of choice. Implementing the system for real time monitoring of power line with an open standard such as ZigBee helps to keep costs down and reduced power consumption. It is clear from the experimentations that the sensor networks may be successfully employed to grids for monitoring purpose. By using this project the fault detection can be easily identified in the grid which saves lot of time.

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