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ZigBee-Based Communication System for Data Transfer within Future Microgrids

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***ABSTRACT*—A wireless data communication system for future Microgrids (MGs) is presented in thispaper. It is assumed that each MG has a central controller and each distributed generationunit in the MG has a local controller. The communication system is responsible fortransmitting and receiving data amongst these controllers. This communication system isbased on ZigBee technology, which is a low cost and low power consumption device.However, its main limitation is the low data transfer rate. To reduce the number of datatransactions, a data management scheme is presented in this paper. The required data tobe transferred are defined and a suitable coding is proposed. Finally, the number oftransmitted symbols and the processing time of the proposed data management schemeare numerically analyzed. In addition, the dynamic operation of an MG is evaluatedconsidering the delays that are imposed by this communication system.**

***Index Terms*—Communication system, data management scheme, data transmission delay, microgrids (MGs), ZigBee.**

INTRODUCTION

The increasing number of renewable energy resources such as photovoltaic, wind, and micro-hydro are leading to a substantial amount of electric energy generation in the form of distributed generation (DG) units within the electric networks. Integration of the DGs will benefit the electric networks by reducing the network expansion costs, minimizing the power losses in long feeders and increasing the reliability of the network. It may also be helpful to achieve faster recovery following a fault in the network [1]. Microgrid (MG) is a cluster of loads, DGs and energy storages interconnected by a network of feeders and located in the same geographical area. It can act as an independent power system whenever needed. In the presence of a utility grid, an MG can operate either in grid-connected mode or in autonomous mode. In grid-connected mode, the network voltage and frequency are dictated by the grid; hence the DGs are controlled such that the desired amount of power (based on maximum power point tracking or economic power dispatch) is supplied by each DG. Hence, any power mismatch between the power generated by the DGs and the load requirement will be met by the grid. In autonomous mode, the DGs are not only required to supply the MG load demand but should also regulate the feeder voltage and frequency within acceptable limits. Therefore, for proper operation and control of DGs within an MG, each DG should be updated with the information about the MG operating mode. This information is required to be transferred from the MG main circuit breaker (CB) that connects the MG and the grid (see Fig. 1), to all the DGs.

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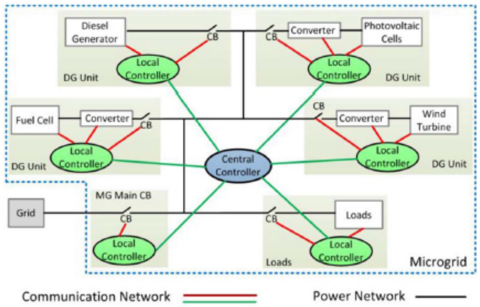

Fig. 1. Schematic of a MG system

Additionally, the MG requires the real-time power measurement of the grid, loads and DGs as well as the state of charge (SoC) of the available energy storage devices. Similarly, the root mean square (RMS) value, phase angle, and frequency of voltage as well as the active/reactive power at certain specific points in the MG are required to be monitored and given as inputs to the DG control systems. Furthermore, instantaneous values of voltages at the terminals of DGs and the feeder are needed for synchronizing a new DG with the MG. Fig. 1 shows a sample MG network along with the different data which need to be monitored and transmitted to the respective controllers.

In this paper, a suitable data payload code and a data management scheme is proposed for a ZigBee-based communication technology for MGs. In addition, the effect of the communication delay is evaluated on the dynamic performance of the MG. The main contributions of this paper are as follows:
1) Proposing a ZigBee-based data communication technology for MG applications;
2) Developing an organized data management scheme;
3) Developing a suitable data payload code;
4) Numerically analyzing the total data processing delay and number of transmitted symbols and evaluating MG dynamic performance in the presence of communication delays.

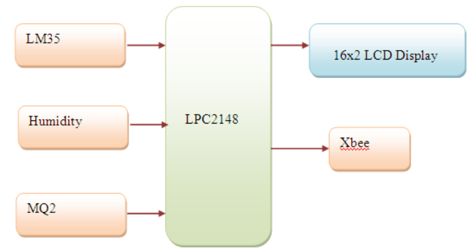

Fig 2 Block Diagram

LM 35

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range.

HUMIDITY SENSOR

Air humidity plays an important role in monitoring production, storage and transport conditions, determining thermal comfort levels and indoor air quality or in VAC systems. Checking material humidity in building materials and timber is also an essential part of everyday work in a wide variety of sectors, e.g. for mould analysis or diagnosis of building moisture damage.

Humidity is the presence of water in air. The amount of water vapor in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapor also influences various physical, chemical, and biological

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processes. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, **humidity sensing** is very important, especially in the control systems for industrial processes and human comfort.

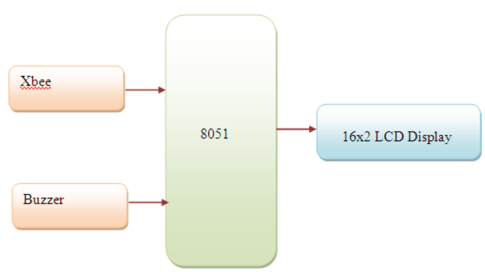
MQ2 SENSOR

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electrocircuit, Convert change of conductivity to correspond output signal of gas concentration.

XBEE

XBee is the brand name of a family of form factor compatible radio modules from Digi International. The first XBee radios were introduced under the **MaxStream** brand in 2005and were based on the IEEE 802.15.4-2003 standard designed for point-to-point and star communications at over-the-air baud rates of 250 kbit/s.

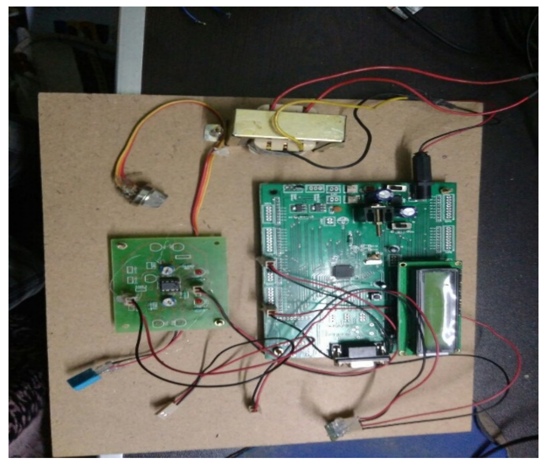
MONITORING SECTION:



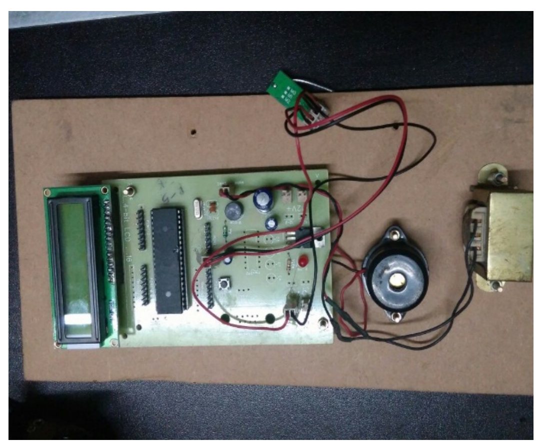
BUZZER

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relaymay be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made. The buzzer converts the electrical signal it receives into a vibration, which creates a buzzing sound. The higher the signal it receives, the more intense the vibration, and the louder the sound is.

RESULTS



MAIN GRID



MONITORING SECTION

CONCLUSION

The Implementation Of "Zigbee-Based Communication System For Data Transfer With In Future Microgrids" is Done Successfully. The communication is properly done without any interference between different modules in the design. Design is done to meet all the specifications and requirements. Software tools like Keil Uvision Simulator, Proload to dump the source code into the microcontroller.

Circuit is implemented on the microcontroller board. The performance has been verified. The communication between main grid and monitoring section is done through zigbee. Then we monitor the parameters like temperature, smoke and humidity by using sensors and if those parameters exceeding their limit means the data passed as high values and immediately the buzzer alert is activated.

It can be concluded that the design implemented in the present work provide portability, flexibility and the data transmission is also done with low power consumption.

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