INDUSTRIAL AUTOMATION USING ZIGBEE FOR POWER MONITERING SYSTEM

Yogeshwari Bhatlawande, Prof. Ingle K.S.

Abstract— Industrial automations which are mostly depend upon the power systems & which requires distance controlled and regulated systems. Mostly voltage and current equipped parameters along with power and energy management system forms the industrial scenario for automations. Wireless technology which meets to cost, speed and distance scenario will always be a point of an interest for research. In this research work we mainly monitored power related parameters and enable remote switching devices for proper power management systems using ZigBee. This paper proposes a digital system for condition monitoring, diagnosis, and supervisory control for electric systems parameters like voltage and current using wireless sensor networks (WSNs) based on ZigBee. Its main feature is its use of the ZigBee protocol as the communication medium between the transmitter and receiver modules. It illustrates that the new ZigBee standard performs well industrial environments.

Index Terms— LM35 temperature sensor, Gas Sensors, Wireless control and Monitoring System.

1 INTRODUCTION

Wireless technology, which has boomed in the IT sector over the past years, can be suitable for industrial control networks as well, providing solutions with high ROI for diagnostics, control and safety. Wireless Sensor Networks (WSNs) have revolutionized the design of emerging embedded systems and triggered a new set of potential applications. In addition to building automation, environmental surveillance, or military operations Industrial automation is also expected to greatly benefit from WSNs in terms of faster installation and maintenance, cost savings, and easier plant reconfiguration. ZigBee is an emerging short-range, low-rate wireless network technology. ZigBee also presents some potentially interesting features for supporting large-scale ubiquitous computing applications, namely power-efficiency, timeliness and scalability. In managing the move to wireless, it is clear that common wireless protocols such as Wi-Fi and Bluetooth can be utilized on the factory floor [3]. The challenge is to understand how to utilize wireless solutions, developed for IT applications, as replacements for wired systems in time-critical scenarios typical of factory floor domains. To date, most wireless systems in production systems are focused on applications that require polling frequencies on the order of seconds or longer. However, the fundamental capabilities of these protocols allow support of much higher-speed applications such as motion control and closed loop distributed logic. To address this challenge, the following issues must be addressed in wireless technology for manufacturing:

- Determining the performance of wireless technology (data rate, transmission, jitter and link reliability)
- Developing best practices for wireless solution deployment and maintenance.

2 ABOUT ZIGBEE

ZigBee is the product of the ZigBee Alliance, an organization of manufacturers dedicated to developing a networking technology for small, ISM-band radios that could welcome even the simplest industrial and home end devices into wireless connectivity[4][7][11]. The ZigBee specification was finalized in December 2004, and products supporting the ZigBee standard are just now beginning to enter the market [6] [7]. ZigBee is designed as a low-cost, low power, low-data rate wireless mesh technology. The ZigBee specification identifies three kinds of devices that incorporate ZigBee radios, with all three found in a typical ZigBee.

- A coordinator, which organizes the network and maintains routing tables.
- Routers, which can talk to the coordinator, to other routers and to reduced-function end devices.
- Reduced-function end devices, which can talk to routers and the coordinator, but not to each other. To minimize power consumption and promote long battery life in battery-powered devices, end devices can spend most of their time asleep, waking up only when they need to communicate and then going immediately back to sleep. ZigBee envisions that routers and the coordinator will be mains-powered and will not go to sleep [10] [15].

A. ZigBee Protocol Stack Architecture:

As in figure 1, ZigBee Protocol Stack architecture shows, three areas of architectural responsibility are in a ZigBee engineering effort [12] [15]:

- The physical and MAC layers take full advantage of the physical radio specified by IEEE 802.15.4. The 802.15.4 specification describes a peer-to-peer radio using direct sequence, spread spectrum (DSSS). The specification also calls out the data rates, channelization and modulation techniques to be employed.

The ZigBee Alliance specifies the logical network, security and application software, which are implemented in a firmware stack. It is the ZigBee networking stack that creates the mesh networking capability. Each microcontroller/ RF chip combination requires its own ZigBee stack due to the differences in microcontrollers and RF chips. Typically, the ZigBee stack is included with either the microcontroller or RF chip. The stack may belong to the chip vendor, be provided by the chip vendor from a third-party source, or be provided by a third-party source for a specific microcontroller/RF chip combination.

■ The application layer is defined by profiles, of which there are two types: public profiles are those certified by the ZigBee Alliance for interoperability purposes, and private profiles are for use in closed systems.

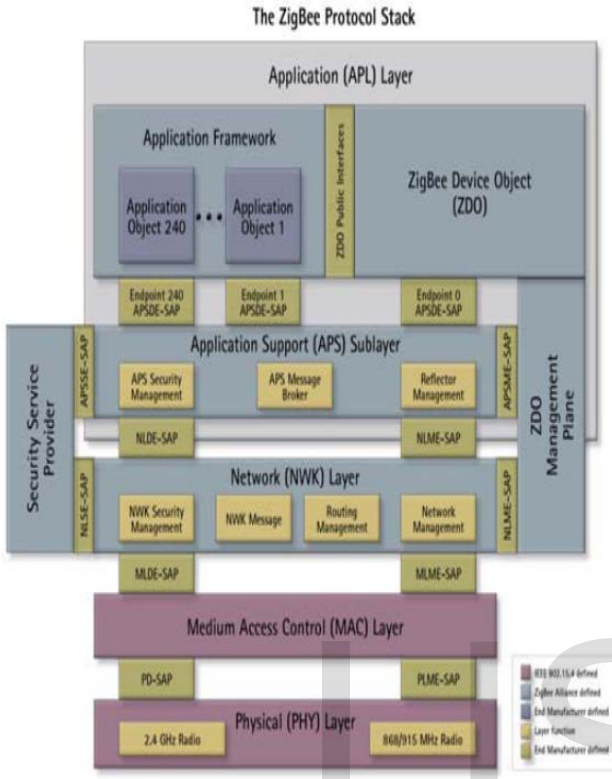

Fig. 1 ZigBee Protocol Stack Architecture

B. Network Topology for ZigBee :

The ZigBee network layer (NWK) supports star, tree, and mesh topologies. In a star topology, the network is controlled by one single device called the ZigBee coordinator [13]. The ZigBee coordinator is responsible for initiating and maintaining the devices on the network. All other devices, known as end devices, directly communicate with the ZigBee coordinator. In mesh and tree topologies, the ZigBee coordinator is responsible for starting the network and for choosing certain key network parameters, but the network may be extended through the use of ZigBee routers. In tree networks, routers move data and control messages through the network using a hierarchical routing strategy. Tree networks may employ beacon-oriented communication as described in the IEEE 802.15.4-2003 specification. Mesh networks allow full peer-to-peer communication. ZigBee routers in mesh networks do not currently emit regular IEEE 802.15.4-2003 beacons. This specification describes only intra-PAN networks, that is, networks in which communications begin and terminate within the same network [16] [17].

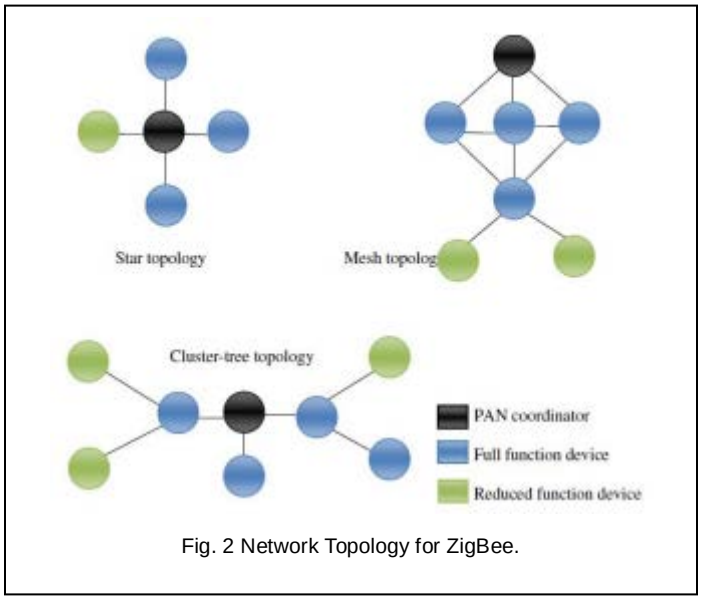

Fig. 2 Network Topology for ZigBee.

3 HARDWARE DESIGN

This section gives a hardware description of the elements making up the Power supply parameter measurement with ZigBee connectivity. Looking to the need of trustworthy power monitoring system for industrial environments, a ZigBee modeled system has to be designed which will comprise of the following modules:

- Transmitter module
- Receiver module.

The system consists of the hardware elements (end point device), microcontroller, LCD display and ZigBee module. In the application development, microcontroller mainly meant for the function of the data processing, data storage, human interfacing and interoperability with the external environment. The things that taken into account While developing application platform on microcontroller are:

a) To choose requirement specific microcontroller with further scope of up gradation.

b)To study development tools with their version specification.

c) To study and apply High Level Language specification for application development as per compiler variations.

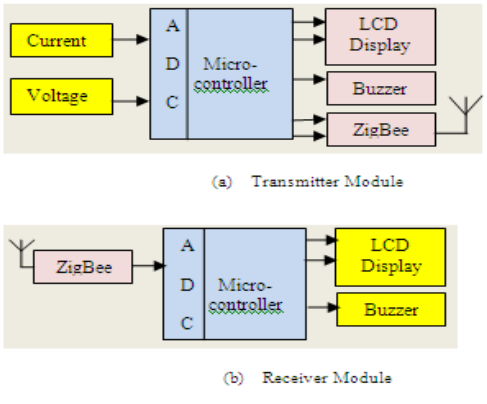

Fig. 3 Hardware System Architecture.

4 System Development

To record data we require following type of circuitry arrangements. Let us understand the working of above circuit. At input of ADC 1, 2, 3 we are going to connect the various sensors whose output are analog. For this purpose we take. LM35, Carbon dioxide sensor and PNP sensor respectively. Output of this field instruments are then given to ADC to convert analog input to digital output for controller. Controller takes this digital data from ADC and displays it on Computer to observe and store the data. There is S-Buff that is serial buffer in the controller which acts like the bus to move data. So at the output of computer or the process, we get the different reading from the field instrument. Here I focus only on 3 parameters but in case of requirement, we can also take 8 input as ADC has 8 pin inputs.

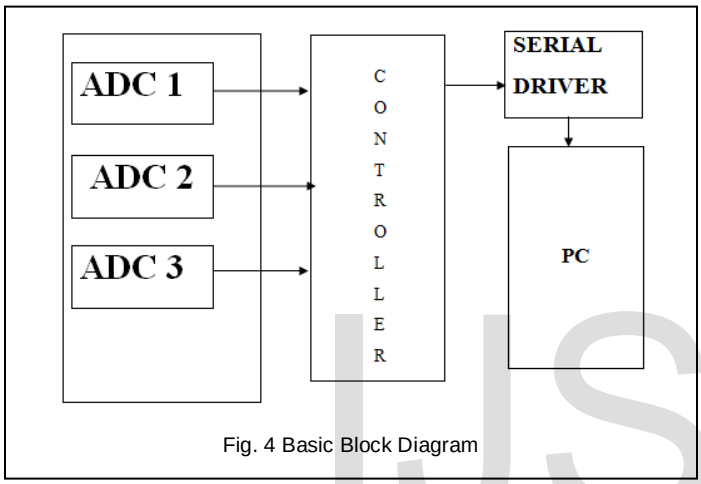

Fig. 4 Basic Block Diagram

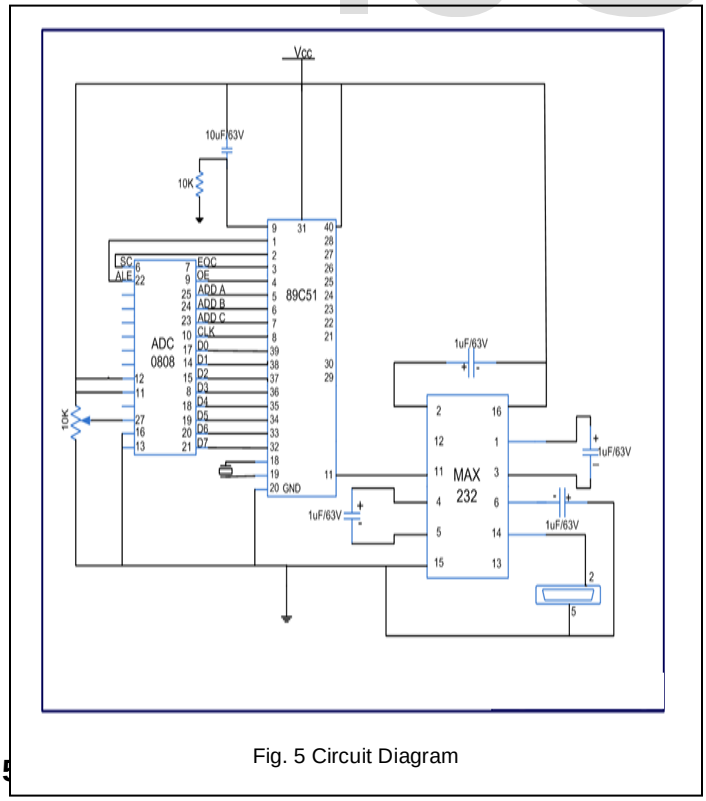

Fig. 5 Circuit Diagram

The proposed project research industrial machineries will be controlled & regulated by the switchingactions performed by FFD side. This FFD side also displays the status of the RFD side system on the LCDconnected on its panel. Alarm & Indications as shown that corresponds to status monitoring effects onserver side due to remote machine parameter dependency. Both the devices will be wirelessly linked by ZigBee with STAR topology. Industrial Automationprofile of the ZigBee will be implemented here. As the whole data is transferred via Wireless radio linksystem will eliminates the loopholes of the traditional wired system. In the proposed module, transmitter module receives the parameters from the device; displayparameters on the LCD display and send it to the receiver side through ZigBee connectivity. In the sameway receiver module receive data sent by the transmitter through ZigBee connectivity and display it onLCD display connected to the receiver side. Both transmitter and receiver side will generate the alarm ifany parameter exceeds its preset value. Thus, it avoids the malfunctioning of the devices due to thevariations in the current and voltage parameters and also avoids the system failure.

(a)

(b)

Fig. 6 Real Implemented System (a) Transmitter module with Zigbee base PCB (b) Receiver Module with Zigbee base PCB

6 Advantages Of Proposed System

1. All Zigbee compliant appliances are compatibly operate on the same network.
2. Setting up zigbee wireless home management system is relatively inexpensive.
3. Ability to manage home appliance network remotely.
4. Elements depends on infrared devices.
5. No central control point dispersal of workload.
6. Simple circuit design.
7. Range is higher than Bluetooth upto 100 meter.
8. Pairing between receiver and transmitter is not required.

7 CONCLUSION

It has been shown that even though most existing efforts are still in a very early stage, Parameter logging is a promising technology with a wide prospective applications. An ever-growing interest in parameter logging throughout the world can be expected to lead to real-world applications in the future. In some of application it poses a favorable alternative to conventional solutions (SCADA). The main goals for the future are increasing the transmission rate and improving standardization.

It is possible to improve the transmission rate through duplex communication completing standardization is challenging in that technical requirements and other regulations, such as safety and Operations constraints, have to be combined.

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