WIRELESS SENSOR WITH DATA LOGGER USING ZIGBE: A REVIEW

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ABSTRACT

Wireless sensor network consist of sensor node, which are nothing but bundle of Adriano board, Sensor shield and ZigBee module. A wireless network used for home, building and industrial control. It conforms to the IEEE 802.15.4 wireless standard for low data rate networks. Sensor nodes can reconfigure remotely over a wireless network and most of the processing done in software on computer side in order to reduce memory space at sensor nodes. This process also reduces communication load. Ecological parameters monitoring at a remote component based on Adriano competent of transmitting the parameters to the main part which later processes for further ecological prediction. In this paper we are presenting an introduction of ZIGBEE with the help of wireless sensor using data logger management.

Keyword : - *Wireless, Data, Logger, ZigBee, Ecological etc.*

1. INTRODUCTION

A wireless network used for home, building and industrial control. It conforms to the IEEE 802.15.4 wireless standard for low data rate networks. With a maximum speed of 250 Kbps at 2.4 GHz, ZigBee is slower than Wi-Fi and Bluetooth, but is designed for low power so that batteries can last for months and years. The typical ZigBee transmission range is roughly 50 meters, but that can vary greatly depending on temperature, humidity and air quality. Zigzag Like a Bee Although ZigBee networks can be configured in star, peer-to-peer and mesh topologies, it is the mesh network from which ZigBee was named. A ZigBee mesh provides multiple pathways from device to device (like the Internet) and eliminates a single point of failure. If nodes go down or are removed, ZigBee devices can "zig" and "zag" through the network to their destination like a bumblebee. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer. Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics.[2] ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device. The primary aim of this paper is recording the environmental parameters such as temperature, humidity and flammable gas monitoring of its variations. A Wireless Sensor Network is an embedded, intelligent infrastructure for sensors. The processes to collect, analyze and store the data for later use is called logging. This entire work is about the development of a prototype of Microcontroller based data logging system which can work on wired and wireless network. The testing has been done on wireless network using ZigBee technology.

2. RADIO HARDWARE

The radio design used by ZigBee has been carefully optimized for low cost in large scale production. It has few analog stages and uses digital circuits wherever possible. Though the radios themselves are inexpensive, the ZigBee Qualification Process involves a full validation of the requirements of the physical layer. All radios derived from the same validated semiconductor mask set would enjoy the same RF characteristics. An uncertified physical layer that malfunctions could cripple the battery lifespan of other devices on a ZigBee network. ZigBee radios have very tight constraints on power and bandwidth. Thus, radios are tested with guidance given by Clause 6 of the 802.15.4-2006 Standard. Most vendors plan to integrate the radio and microcontroller onto a single chipgetting smaller devices. This standard specifies operation in the unlicensed 2.4 GHz (worldwide), 915 MHz (Americas and Australia) and 868 MHz (Europe) ISM bands. Sixteen channels are allocated in the 2.4 GHz band, with each channel spaced 5 MHz apart, though using only 2 MHz of bandwidth. The radios use direct-sequence spread spectrum coding, which is managed by the digital stream into the modulator. Binary phase-shift keying (BPSK) is used in the 868 and 915 MHz bands, and offset quadrature phase-shift keying (OQPSK) that transmits two bits per symbol is used in the 2.4 GHz band. The raw, over-the-air data rate is 250 kbit/s per channel in the 2.4 GHz band, 40 kbit/s per channel in the 915 MHz band, and 20 kbit/s in the 868 MHz. The actual data throughput will be less than the maximum specified bit rate due to the packet overhead and processing delays. For indoor applications at 2.4 GHz transmission distance may be 10–20 m, depending on the construction materials, the number of walls to be penetrated and the output power permitted in that geographical location. Outdoors with line-of-sight, range may be up to 1500 m depending on power output and environmental characteristics. The output power of the radios is generally 0-20 dBm (1-100 mW).

3. SECURITY AND SYSTEM ARCHITECTURE

ZigBee uses 128-bit keys to implement its security mechanisms. A key can be associated either to a network, being usable by both ZigBee layers and the MAC sublayer, or to a link, acquired through pre-installation, agreement or transport. Establishment of link keys is based on a master key which controls link key correspondence. Ultimately, at least, the initial master key must be obtained through a secure medium (transport or pre-installation), as the security of the whole network depends on it. Link and master keys are only visible to the application layer. Different services use different one-way variations of the link key to avoid leaks and security risks. Key distribution is one of the most important security functions of the network. A secure network will designate one special device which other devices trust for the distribution of security keys: the trust center. Ideally, devices will have the center trust address and initial master key preloaded; if a momentary vulnerability is allowed, it will be sent as described above. Typical applications without special security needs will use a network key provided by the trust center (through the initially insecure channel) to communicate. ZigBee wireless sensor nodes mainly consists the sensor unit, monitoring and controlling unit consists of microcontroller (MCU), ZigBee modules, and other components. Microcontroller is responsible for collecting environmental information (such as temperature and humidity) and does analog to digital data conversion if required. Microcontroller is also responsible for controlling and managing the entire nodes. ZigBee modules are responsible for the communication between different nodes.

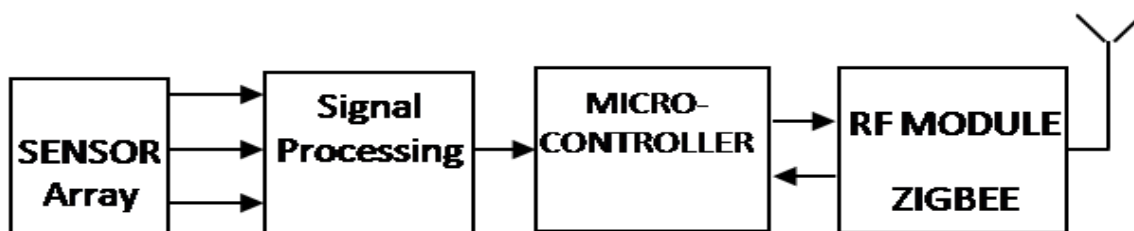## 4. A SYSTEM DESIGION OF WIRELESS SENSOR NODE AND BASE STATION GAATEWAY

Fig.1: Wireless Sensor Node

The hardware of one sensor node is described as shown in Fig.1. In order to monitor the values of environmental parameters observed at remote location of the room, a PC based Base station is developed and presented in Fig.2. As depicted in Fig.2. The base station consist of the ZigBee module as the wireless receiver. The parameter values which are already calibrated at the sensor node is read serially into the PC and displayed on the monitor on specifically designed windows.

Fig.2: Base Station Gateway

Sensor Node is nothing but combination of Arduino, sensor board & ZigBee module. It is part of wireless network and directly talks with coordinator and also with other routers. We have used high level data communication protocol and have specific frame structure for reliable inter-communication. Coordinator will broadcast this command packet using ZigBee wireless network. Wireless sensor network consist of sensor node, which are nothing but bundle of Arduino board, Sensor shield and ZigBee module. Coordinator will broadcast this command packet using ZigBee wireless network. Wireless sensor network consist of sensor node, which are nothing but bundle of Arduino board, Sensor shield and ZigBee module. Coordinator forward this data to computer through USB and GUI will either display it or saved it on disc as per user request.

5. DESIGN AND IMPLEMENTATION OF SENSOR NODE

The DHT-11 is a low cost humidity and temperature sensor with a single wire digital interface. The sensor is calibrated and doesn't require extra components so you can get right to measuring relative humidity and temperature. Interface circuit of sensor consists of resistor of 10KOhm as shown in Fig.3.
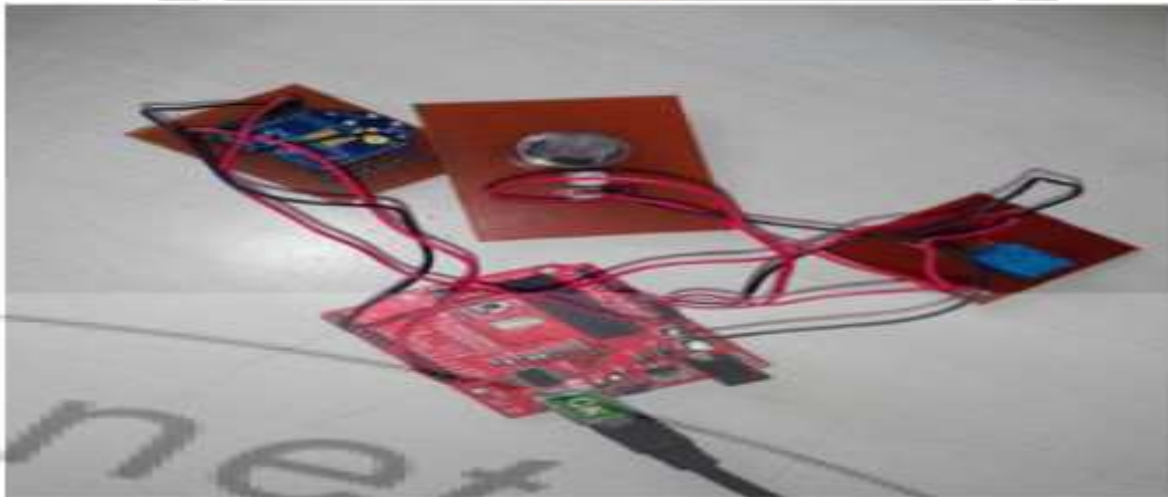

Fig.3: Sensor Node

MQ-2 is Semiconductor Sensor for Flammable Gas. Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target Flammable gas exist, the sensor's conductivity is higher along with the gas concentration rising. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

6. DESIGN AND IMPLEMENTATION OF BASE STATION

This is nothing but an Arduino board and ZigBee module. The Arduino board used at Base Station is MEGA 2560. Arduino connected to PC through USB port i.e. Serial 0. ZigBee module is connected to Serial 1. Data received on Serial port is stored and displayed on screen by use of Graphical User Interface (GUI) developed by VB.net. The interface circuit of Base Station is as shown in Fig. 4.
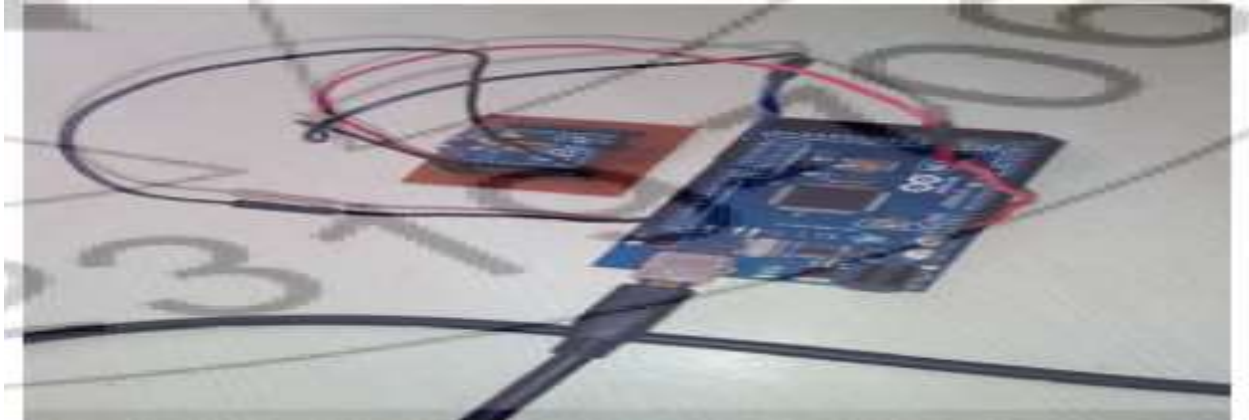

Fig. 4: Base Station GATEWAY

7.   MAJOR FACTORS AFFECTING INDOOR AIR QUALITIES

We know that various parameters affect quality of indoor air, so it is very important to learn origin of such parameters as well their effects on human health.
*   Effect of Humidity and Temperature
*   Effect of flammable gasses

8. MONITORING SYSTEM

The Monitoring system is:

*   Temperature
*   Flammable Gas
*   Humidity

9. COMMON DATA LOGGING APPLICATIONS

9.1 Building Performance

*   Track building electricity usage to understand energy profiles and manage peak demand
*   Verify energy cost savings to determine ROI of new equipment
*   Monitor equipment runtimes to ensure efficient operation
*   Monitor equipment for leaks to cut wasteful energy consumption
*   Diagnose causes of occupant comfort complaints
*   Ensure healthy indoor air quality
*   Track room occupancy and light use patterns
*   Optimize HVAC system performance
*   Better manage peak energy demand

9.2 Environmental Research

- Perform ecological studies that provide a detailed picture of the habitat
- Conduct agricultural research that reveals opportunities for improving yields
- Set up animal studies that verify the impact of climate on species
- Perform soil studies to understand the effects of climate on soil quality
- Gather essential data for more effective stormwater management
- Perform detailed water quality studies
- Conduct rigorous oceanographic research
- Run long-term climate change studies
- Study and measure environmental impact
- Do in-depth hydrology research that reveals the movement, distribution, and quality of water – even across a broad area

10. CONCLUSIONS

In the fields of building performance and environmental research, everyone seems to be using data loggers. But what are they, and why are they useful? Data loggers that utilize Bluetooth Low Energy (BLE) technology measure and transmit temperature and relative humidity data wirelessly to mobile devices over a 100-foot range. Some software allows for configuring large numbers of data loggers at the same time, which can be a huge time savings. In today's data-driven world of satellite uplinks, wireless networks, and the Internet, it is common to hear the terms "data logging" and "data loggers" and not really have a firm grasp of what they are. A low cost Environmental Parameter Monitoring System (EPMS) is developed to give clearer and more detailed view of indoor air quality and will be beneficial in many low cost applications. Also such system is in reach of all individuals irrespective of economical class.

11. REFERENCES

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