

A Survey on Weather Monitoring System in Agriculture Zone using Zigbee

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Abstract: In agriculture zone it will be very difficult to check and monitor the weather parameter through wires and analog devices during some weather hazards. To overcome this problem here the wireless sensors are used to check and monitor the weather parameters. Monitoring the weather parameters in agriculture zone plays an important role in farming production processes. In this system, a wireless sensor network based on Zigbee/IEEE802.15.4 standard is utilized as a weather station network sending weather information or guideline to the farmers to plan their farm. The weather parameters which are measured by the system are temperature, humidity in the soil, wind speed and wind direction. The system takes advantage of wireless sensor networks which can send signals over far distances by using a mesh topology; this transfers the data and also consumes low power. Therefore, this system can be installed in locations that are difficult to hardwire or have no access to electricity.

Keywords: Zigbee, IEEE 802.15.4, Medium Access Control (MAC), Physical Layer (PHY)

1. Introduction

The Automation of Weather Station System can be used measure, check and monitor the weather parameters to prevent the enormous damage or hazards from natural disasters [5], [11], [12] in agriculture zone. A weather station provides the facility with respect to equipment to check, monitor and observe the weather conditions. The observed and monitored weather parameters information is useful to make weather forecast reports and to study the weather and climate. In this system the weather parameters measurements taken are temperature, humidity, wind direction, and wind speed. Wind measurements are measure as free of other obstructions as possible, while temperature measurements are taken free from direct solar radiation or insulation and humidity measurements are directly taken from the soil. The weather parameters measurements are taken through the weather sensors for different parameters placed in the agriculture zone.

The main aim of this proposed system is to design a wireless weather station monitoring system to develop an embedded system which enables to analyze and monitor the weather parameter in an agriculture zone by using Zigbee technology and also generate guideline data to the farmers using GSM SMS technique. The system uses the Zigbee technology in wireless sensor network. The basic use of the Zigbee technology is for the communication in the wireless sensor network. The Zigbee/IEEE802.15.4 supports the communication protocol between every Zigbee modules present in the network. It will provide proper and best guidelines to the farmers at their fingertips for planning their farms from current weather conditions and by checking and relating previously recorded weather conditions record of the last few years.

2. Zigbee / IEEE 802.15.4

In this research, the benefits to the weather monitoring system are from the advantages of the wireless sensor network using Zigbee technology. Zigbee technology is very advantageous in

this research because it is a cost effective, standards based wireless networking solution that supports low data rates, low power consumption, security, and reliability for fulfilling the market needs [1], [3], [5]. The Zigbee technology specification is intended to be less expensive and simpler than other Wireless Personal Area Networks (WPANs). The Zigbee network supports three types of network topologies that are star topology, mesh topology and hybrid (cluster tree) topology [5].

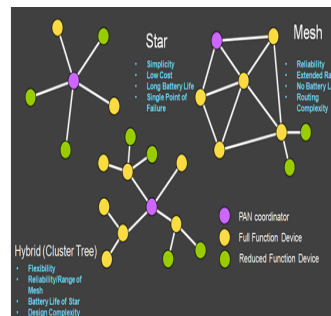


Figure 1: Zigbee Topology Models

2.1 Types of Zigbee Devices

A Zigbee network is divided into two types of devices Full Function Device (FFD) and Reduced Function Device (RFD) [3]. The Zigbee device specification is differentiated in three types which can either be used as End Devices, Routers or Coordinators. Routers can also be used as End Devices. The FFD has the full functionality in the network. It can act as a Coordinator, Router or even as the End devices or RFD. The RRD communicates only with its network coordinator or nearer router. It acts as the one of the networks end and it reads information from the end point device.

The Zigbee Coordinator is the only device which has the ability to works as a bridge to other networks and forms the root of the network tree. The Zigbee Router is as well as running an application function and it can act as an intermediate router which passing on data from other devices.

Zigbee End Devices has the enough functionality to communicate with the parent node (either the router or a coordinator). It cannot broadcast data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life and wakes up whenever it has to receive or send a message. Zigbee modules are configured to support Non Beacon and Beacon both types of communications.

2.2 Zigbee Operations

Zigbee is a software protocol that based on IEEE 802.15.4 Zigbee wireless interface. Zigbee is capable of forming large networks of nodes and boasts advanced features such as mesh networking, simple addressing structures, route detection, route repair, guaranteed delivery and low power operation modes.

Zigbee sensors offer the ability to provide real time data from a variety of sensors (e.g., temperature, humidity, wind) in a single solution for wireless communication across a Zigbee infrastructure. Zigbee uses the PHY and MAC layers defined by the IEEE 802.15.4 standard for short distance wireless communications. The network layer, the security service and the application interface have all been defined by the Zigbee alliance. The specific application is run in the upper stack level [3]. The Zigbee operates at 2.4GHz which is in the ISM (Industrial, Scientific, and Medical) frequency band at the data rate of 250kbps, 868 MHz European Band at the data rate of 20kbps and 915 MHz North American Band at the data rate of 40kbps [1], [3], [12].

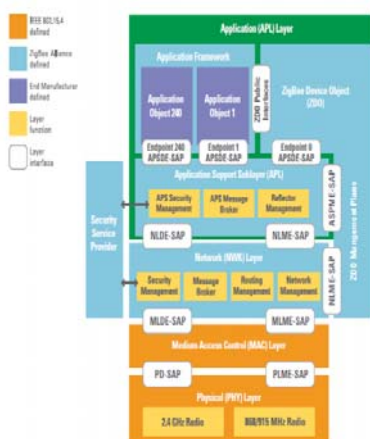


Figure 2: Zigbee Protocol Stack

Zigbee Wireless Module is configured with either an XBee or XBee-Pro transceiver. The difference between these two modules is the amount of power consumed (1mW vs. 60mW) and signal range. For the XBee the urban range is 100 feet (30m) and outdoor range is 300 feet (100m) and for the XBee-Pro configuration, the indoor and urban range is up to 300 feet (100m) and outdoor line-of-sight is up to 1 mile (1500m). Selection of the antenna type and placement has a major impact on the range.

3. Literature Survey

The research on target markets of Zigbee technology that have been implemented for the different applications like Home Automation, Personal Healthcare, PC Peripherals, Industrial and Commercial etc. Applications include wireless electrical

meters, light switches within home displays, and other consumer and industrial equipment that require relatively low rates at the short-range wireless transfer of data.

The Zigbee (IEEE 802.15.4) is a new technology that permits the implementation of Wireless Personal Area Networks (WPAN) [1], [3]. WSN using Zigbee is for emergency response notification for weather station monitoring system. The system is used to measure parameters such as sample temperature, air pressure, vibration etc. These parameters will vary depending on the requirement of the surveillance system [1]. In another system, the entire network using the Zigbee technology control and monitor by a single person. The combination of both wired and wireless technologies can be used in this system i.e. (Controller Area Network) CAN bus network with the Zigbee technology for controlling the different environmental parameters like temperature, humidity, light and gas [2]. The Zigbee technology is also used as an emerging technology for the building automation. The Zigbee protocol can manage the data messages routing, acknowledgments and retries within the radios. The network has the ability to self-heal using Zigbee and WPAN technology. The new path would be used for data message routing from source node to destination node in the network if any of the radio was removed because of some reason [3]. The one of the system works on to check and control the greenhouse effect in agriculture with respect to temperature, humidity and light parameters [15], [16] and then record weather statistics for planning and development using the technology of Zigbee/IEEE802.15.4 with wireless sensor networks and Arduino microcontroller [5]. There are also some other techniques like SCADA system used with Zigbee for the weather forecasting, monitoring and control the different weather parameters like temperature, humidity, light, wind speed, wind direction and solar radiations [4]. In the research the one of the new method for measuring overhead conductor temperature and sag factors using GSM SMS and Zigbee technology [7]. Here the sag factor and conductor temperature monitored at real-time and also improves the transmission capacity of the dynamic regulations such as summer and winter, cloudy and sunny day and night under the different environmental conditions. The real time direct measurement of the parameters needed for the operation of the transmission system without intermediate measurement of conductor tension and ambient weather conditions, the raised temperature can be avoided and some accidents caused by the increased temperature can be avoided [8].

4. Related Work

The occurrences of weather disasters and uneven environmental changes have been continuing changing and affecting our lives, damaging property and life style in many different ways because the most of the basic needs of the human beings are depends on the agriculture and agriculture heavily depends on the good weather. It is very difficult to monitor different weather parameters through wired and analog devices in an agriculture zone during certain hazardous and critical situations. It is very important to measure the weather parameters in agriculture zone for the farmers which help to plan their farms according to the weather conditions. To overcome the problem of monitoring the weather parameters using wired devices, the wireless sensors network devices may take certain steps even in worst case for monitoring the weather parameters. In the research of the

different weather parameter monitoring applications works for different weather parameters like temperature, humidity, wind, solar radiations, vibration and light. The farmers basically know the basic information about the weather parameters like temperature, humidity, wind directions and wind speed for planning their farms. So the system using WSN to check and monitor the agriculture zone effect from temperature, humidity, wind directions, wind speed and record weather statistics for planning the farm to the farmers.

In the implementation of monitoring and measuring systems using the Zigbee radio technology is represented by flexibility in topology, redundancy and robustness of the wireless sensor network [1],[3]. The Zigbee mesh networks having number of sensors in the network which can operate over years, without changing the original battery. The Zigbee technology had been also used in other different types of emergency conditions like fire detection in forest, Wireless internet information system in disaster areas for medical responses and many more [1]. There are some applications also available of automation of weather stations different area like to monitor, check and control the greenhouse effect [2], [5], [15], [16] and provide weather forecast accuracy at center and sector levels [6]. So the work of the automation of weather station is useful for different application area and here the proposed system is for the automation of weather station in agriculture zone using Zigbee. The system will be inherited from the Zigbee/IEEE 802.15.4 standard. The system overcomes the problem of low transmission speed and the existence of a single point of failure during the communication between Zigbee/IEEE 802.15.4, and also emergency service could not respond to false emergencies so their time can be better utilized to fight or manage real emergencies [10]-[13]. Monitoring and checking the environment of agriculture zone plays an important role in the production process of the farming. If the weather or climate condition information provides to the farmers then it directly effects on the improvement of crop growth performance, but it also normally improves the cost of the required equipment.

5. Conclusion

The proposed system is use to construct the automation in the weather station for providing the best guideline to the farmers for best crop growth production using Zigbee/IEEE802.15.4. The proposed system include WSN of weather station monitoring overcome the problem that inherited from IEEE 802.15.4 having low transmission speed. Zigbee supports the mesh, tree & clusters topology in the wireless sensor network. The existence of single point or node of sensor failure is removed by the proposed system. The proposed system is very cost effective. The system can help to decrease the false services. The existence of single point or node of sensor failure is removed by the proposed system. The system focuses on the monitoring and checking the weather parameters through weather sensors and provides the proper guideline for planning their farms to the farmers according to the weather conditions using Zigbee/IEEE802.15.4 and GSM SMS technology.

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