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ROLE OF ZIGBEE TECHNOLOGY IN AGRICULTURE SECTOR

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Abstract— There are number of standards that address low to high data rates for voice, PC LANs, video, etc. However, there hasn't been a wireless network standard that meets the unique needs of sensors and control devices till now. Sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays. ZigBee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. The sensing technologies allow the identification of pests in the crops, drought or increased moisture. Having such information at a real-time interval, automated actuation devices can be used to control irrigation, fertilization and pest control in order to offset the adverse conditions. This technology can be applied for wireless applications in agriculture sector.

1. INTRODUCTION

Precision farming ensures quicker response times to adverse climatic conditions, better quality control of the produce and yet a lower labor cost. Precision farming also makes the use of completely automated machinery, a possibility. This form of highly automated agriculture requires intensive sensing of climatic conditions at the ground level and rapid communication of the raw data to a central repository. At the central server, with the availability of computational power, decision making and control of farm equipment is done. The Precision farming system has the following parts:

- Sensing agricultural parameters
- Identification of sensing location and data gathering
- Transferring data from crop field to control station for decision making
- Actuation and Control decision based on sensed data

Agricultural Sensors, positioning systems for detecting location of sensors, actuators like sprinklers, foggers, valve-controlled irrigation system, etc. are already available in market. However, very limited work has been done so far on the technologies to be used to transfer sensor data wirelessly from crop field to the remote server.

A Wireless sensor network (WSN) is a system comprised of radio frequency (RF) transceivers, sensors, microcontrollers and power sources. Recent advances in wireless sensor networking technology have led to the development of low cost, low power, multifunctional sensor nodes. Sensor nodes enable environment sensing together with data processing. Instrumented with a variety of sensors, such as temperature, humidity and volatile compound detection, allow monitoring of different environments. They are able to network with other sensor systems and exchange data with external users [1].

Currently two standard technologies are available for WSN: ZigBee and Bluetooth. Both operate within the Industrial Scientific and Medical (ISM) band of 2.4 GHz, which provides license free operations, huge spectrum allocation and worldwide compatibility. In general, as frequency increases, bandwidth increases allowing for higher data rates but power requirements are also higher and transmission distance is considerably shorter [1]. Multi-hop communication over the ISM band might well be possible in WSN since it consumes less power than traditional single hop communication [2].It is also possible to create a WSN using Wi-Fi (IEEE 802.11), but this protocol is usually utilized in PC-based systems because it was developed to extend or substitute for a wired LAN [3]. Its power consumption is rather high, and the short autonomy of a battery power supply still remains an important disadvantage [4].

1.1 ZigBee

The ZigBee standard is built on top of the IEEE 802.15.4 standard. ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices. ZigBee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. The IEEE 802.15.4 standard defines the physical and MAC (Medium Access Control) layers. The physical layer supports three frequency bands with different gross data rates: 2.450 MHz (250 kbs-1), 915 MHz (40 kbs-1) and 868 MHz (20 kbs-1). It also supports functionalities for channel selection, link quality estimation, energy measurement and clear channel assessment. ZigBee standardizes both the network and the application layer. The network layer is in charge of organizing and providing routing over a multi-hop network, specifying different network topologies: star, tree, peer-to-peer and mesh. The application layer provides a framework for distributed application development and communication. The specified maximum range of operation for ZigBee devices is 250 feet .Due to its low power output, ZigBee devices can sustain themselves on a small battery for many months, or even years, making them ideal for install-and-forget purposes, such as sensor based applications in agriculture. The goal of ZigBee is to provide the consumer with ultimate flexibility, mobility, and ease of use by building wireless intelligence and capabilities into every day devices. ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide.

2.ZIGBEE APPLICATIONS IN AGRICULTURE

The existing implementations of wireless data communication for agricultural engineering rely on an architecture composed of one or more sensors for environmental data (temperature, humidity etc), a signal conditioning block, a microprocessor/microcontroller with an external memory chip and a radio module for wireless communication between the sensor nodes and/or a base station. The applications using wireless sensor technology for precision agriculture are briefly explored below.

2.1. 'Smart Fields' Monitored by Wireless Nano-sensors [5]

Since many of the conditions that a farmer may want to monitor the presence of plant viruses or the level of soil nutrients that operate at the nano-scale, and because surfaces can be altered at the nano-scale to bind selectively with particular biological proteins, sensors with nano-scale sensitivity will be particularly important in realizing the vision of smart fields.

2.2 **SoilNet - A Zigbee based soil moisture sensor network [6]**

Soil moisture plays a key role in partitioning water and energy fluxes, in providing moisture to the atmosphere for precipitation, and controlling the pattern of groundwater recharge. Large-scale soil moisture variability is driven by space-time precipitation and radiation pattern. At local scales, land cover, soil conditions, and topography act to redistribute soil moisture.

2.3 Mobile Plants

Application in cooperation with the agriculture deals with the supervision of mobile plants. These plants are not located stationary in beds but in mobile planting bins which are positioned in varying greenhouses according to the vegetation phase. Sensors to measure air temperature and humidity, soil temperature and humidity, light intensity are attached to the modules in order to monitor the plants entirely. In the applications described above, the measured and digitized data are transmitted wirelessly to a base station, which is attached to a standard personal computer for visualization and storage. Due to the standardized interfaces the base station can be easily integrated into available climate control systems.

3.CONCLUSION

ZigBee is a new technology now being deployed for wireless sensor networks. A sensor network is an infrastructure comprised of sensing, computing and communications elements that allows the administrator to instrument, observe and react to events and phenomena in a specified environment. This technology seems to be the most suitable wireless technology for agriculture applications.

4. REFERENCES

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