

Chapter 5.10

The Outdoor Wireless Healthcare Monitoring System for Hospital Patients Based on ZigBee

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ABSTRACT

Advances in embedded computing systems have resulted in the emergence of Wireless Sensor Networks (WSNs), which provide unique opportunities for sensing physical environments. ZigBee-compliant WSN platforms have been proposed for healthcare monitoring, smart home, industrial monitoring and sensor, and other applications. In this chapter, the authors, using TI CC2430 and CC2431 chipsets with Z-Stack, designed an outdoor patients' healthcare monitoring system for tracking patients and helping doctors and nurses to keep tabs on patients' health remotely. Furthermore, several important techniques are elaborated, including reliable communication, localization algorithm, and backup power, which can enhance the system performance. Finally, some suggestions for future development are presented.

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INTRODUCTION

Wireless Sensor Networks (WSNs) platforms (Yang, 2006) for remote healthcare monitoring are hot research topics in recent years. A number of systems have been reported for wireless healthcare monitoring. The CodeBlue (Lorincz et al. 2004) project creates a WSN system for per-hospital and in-hospital emergency care, disaster response, and stroke patient rehabilitation. Scalable Medical Alert and Response Technology (SMART) (Waterman 2005) is an easy deployment system for monitoring and tracing patients.

In this paper, we design an outdoor wireless healthcare monitoring system with ZigBee WSN technology. ZigBee is the first industrial standard WSN technology based on IEEE 802.15.4 (ZigBee, 2006) that provides short range, low power and low data rate communication, and supports mesh networking and multi-hopping. Compared with Bluetooth, ZigBee has less transmission rate, but it has longer communication range and less power consumption. Hence, ZigBee is more convenient for outdoor healthcare monitoring system.

In the outdoor monitoring area, numerous ZigBee-based WSN nodes are deployed, collecting and transmitting information from multiple subjects. Yet, they are inevitably interference by other types of radio devices, such as Bluetooth, WiFi, etc. The ambient radio interference will affect the communication between ZigBee nodes. In this case, some data inevitably lost during the communication between two nodes. But in our outdoor patients' healthcare monitoring system, these data, especially the physiological data mustn't be lost. So, in this paper we will propose a reliable data transmission method to prevent data from losing in our healthcare monitoring system.

Patient tracking is very important in our outdoor healthcare monitoring system. When emergency occurs, it is necessary to identify the patient's position. Although, a location engine is embedded onto the TI CC2431 chipset, it is not suitable for our application. Hence, we mix the

location engine and localization algorithm based on Manhattan distance to locate our patients.

Power supply is the third key point in our system. Typically, when a ZigBee device wore by a patient exhausts its power, doctors and nurses may loose tab on the patient. However in our system when this case happens, the backup battery will be activated that can provide power to keep the basic monitoring on the patient.

BACKGROUND

Zigbee

The name of ZigBee comes from the zigzagging path a bee (a data packet) takes to get from flower to flower (or node to node) (Niagara, 2005). ZigBee is primarily intended low power and low duty-cycle sensors. ZigBee nodes can active for less than 1% of the time. For instance, an off-line node can connect to a network in about 30 ms. Waking up a sleeping node takes about 15 ms, as does accessing a channel and transmitting data. Our healthcare system will get benefit from this technology. In large outdoor monitoring area, not all of nodes should work all the times. These nodes could go to sleep, and wake up until a new task coming.

As an IEEE 802.15.4 based standard, ZigBee is described by referring to the 7-layer OSI model for layered communication systems. But not all of the 7 layers are defined, ZigBee Alliance only specifies four layers (Physical, Data Link, Network, and Application), as well the Application Layer (APL) that allows end-developers design custom applications that use the services provided by the lower layers. It should be noted that the ZigBee Alliance choose to use an already existing data link and physical layers specification. These are published IEEE 802.15.4 (IEEE Standard 2003) standards for low-rate personal area networks. The network and application layer are defined by the alliance itself.

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