

The Water Quality Monitoring System Based on WSN

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Abstract—The water quality monitoring system is designed for the need of environmental protection department in a particular area of the water quality requirements. The system is based on the Wireless Sensor Network (WSN). It consists of Wireless Water Quality Monitoring Network and Remote Data Center. The hardware platform use wireless microprocessor CC2430 as the core of the node. The sensor network is built in accordance with Zigbee wireless transmission agreement. WSN Sample the water quality, and send the data to Internet with the help of the GPRS DTU which has a built-in TCP/IP protocol. Through the Internet, Remote Data Center gets the real-time water quality data, and then analysis, process and record the data. Environmental protection department can provide real-time guidance to those industry which depends on regional water quality conditions, like industrial, plant and aquaculture. The most important is that the work can be more efficient and less cost.

Keywords: Water Quality Monitoring; WSN; Zigbee; intelligence

I. INTRODUCTION

With the development of society, people have put forward higher and higher requirements on Environment Quality Monitoring System, especially like farmland irrigation, aquaculture and those which are closely interconnected with our daily life. Requested monitoring way has regional and real-time characteristics. At the same time, it must be low cost. Water Quality Monitoring System based on WSN makes up of many different nodes. Every terminal node has several water quality measurement modules, like the modules of PH value, Pollutant levels, temperature and turbidity value. With the help

of these nodes, WSN gets water quality data, and then sends the data to internet. Once Remote Data Center gets the data through Internet, it will analysis, process and record the water quality data. It is real-time, regional and low cost. Obviously it can meet people's outstanding requirements of environmental monitoring.

II. GENERAL DESIGN OF THE SYSTEM

The entire system consists of two parts: the WSN and Remote Data Center. First WSN collects water quality data, and then send the data to Remote Data Center with the help of GPRS DTU. System structure is shown in Figure.1.

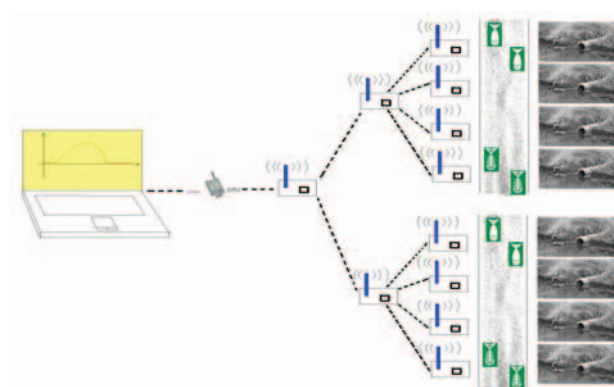


Figure 1. System structure

III. WATER QUALITY MONITORING SYSTEM'S CORE TECHNOLOGY

WSN system provides distributed network of sensor nodes and the control network access. It synthesizes kinds of technology in a tight system, like miniature sensor technology, perception, collection and treatment of low power consumption signal and wireless data transmission. [1]

A. Zigbee technology

IEEE802.15.4 standard is a low cost, low data rate (< 250 KBPS) and works in 2.4 GHz and 868/928 MHz wireless technology. It's used for personal area network and a peer-to-peer network. It is the base of ZigBee application layer and the network layer. ZigBee is a new kind of low complexity, low power consumption, low data rate and low cost wireless network technology. It's mainly used for close wireless connections. According to the standard IEEE 802.15.4, it can hold 64000 sensor nodes communicated with each other. The sensor node only needs tens of micro-ampere current to ensure network connection. Through radio waves, data will be transferred from one node to another one. So their transmission efficiency is very high [2]. The function of each sensor node is not completely identical. According to the function, they are divided into three types: coordinator, router and terminal node. Three typological nodes work according to the following three general topological structure in networking. Network mode is shown in Figure.2.

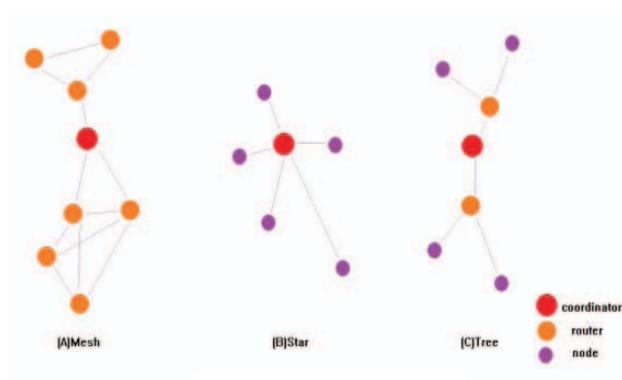


Figure 2. Network mode

This design works in mesh network which can be convenient to built an automatic network, and has a good expansibility.

B. hardware circuit

The nodes of WSN are divided into three categories: Coordinator, Router and Terminal node. Each node is responsible for their respective functions. At the same time, they are supported each other to complete network establishment and operation.

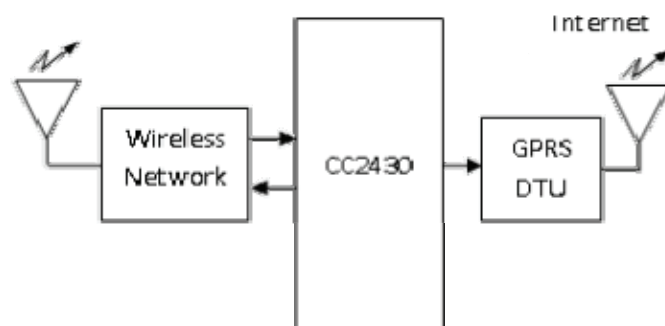


Figure 3. Hardware structure of Gateway node

Coordinator has responsibility to receive and comprehensive the water quality data from the WSN, and transfer the data to GPRS DTU. According to GPRS DTU, the data will be pack into TCP/IP protocol, and sent into internet. Through the Internet, Remote Data Center get the water quality data. Hardware structure of coordinator node is shown in Figure.3

Router node usually has no independent function of collection and actuators, But in a more complex WSN, it is an indispensable part of the network. It can transfer data from the terminal node to the coordinator one, and sent the commander from coordinator to the terminal. Hardware structure of the router nodes is shown in Figure. 4.

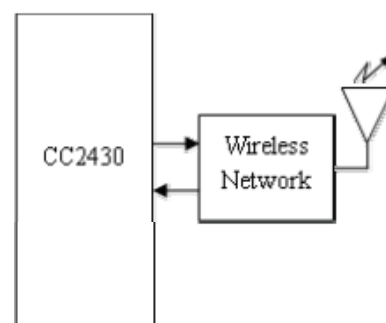


Figure 4. Hardware structure of the router nodes

Terminal node has four different sensor modules. They are the modules of PH value, Pollutant levels, water temperature, turbidity value. They will transform the corresponding information of water into voltage signal. Through the on-chip 12bit ADC converter, MCU CC2430 will transform analog voltage signals into digital quantity, then send the data in WSN according to zigbee agreement. The off-chip RTC decides

when to collect and transmit the Water Quality data. Hardware structure of terminal node is shown in Figure.5

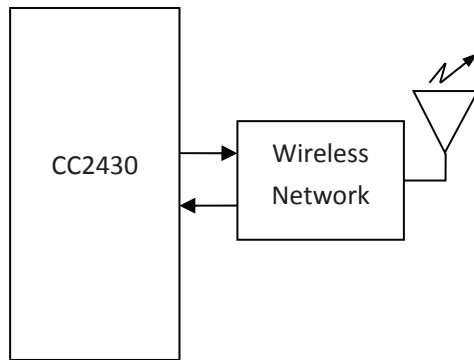


Figure 5. Hardware structure of terminal node

Node production made according to the hardware structure is shown in Figure.6

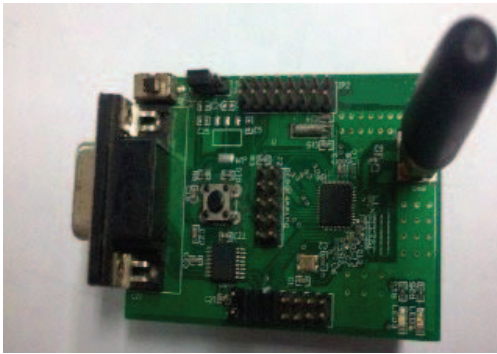


Figure 6. node production

C. Software system design

The WSN is based on zigbee protocol stack. Zigbee protocol stack includes physical layer, MAC layer, network layer, security layer and application layer. The physical layer and MAC layer is defined by IEEE802.15.4. Network layer, safety layer and application layer use Chipcon company zigbee 2006 protocol stack. The software of system needs to complete the following functions: initialize zigbee agreement, built network, control node collection, transformation water quality data, send and receive data about the Remote Data Center^[3].

1) *software design of coordinator node*: At the beginning of the network setting up, coordinator node is responsible for initializing and building a network, But after that, coordinator node will be the managers and defender. When a new node

joins or exits, coordinator updates its own node status table, at the same time, sends this change to remote data center [4][5]. Coordinator node also receives and integrates the whole network water quality data from sensor nodes. With the help of the GPRS DTU which has a built-in TCP/IP protocol, coordinator node sends the data to the internet. Main flow chart of coordinator node is shown in Figure. 7

2) *Router module*: The router module is only responsible for data transmission. It is the bridge between sensor node and coordinator node. The main function is to complete data accepting and forwarding.

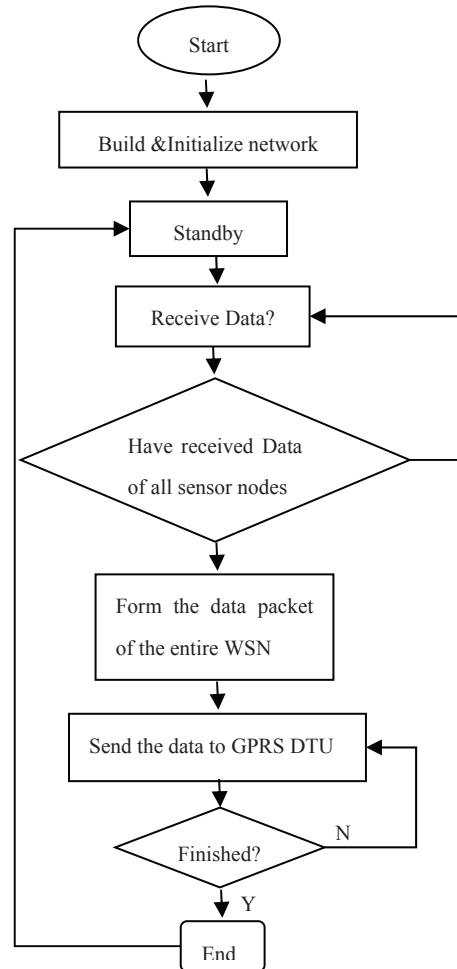


Figure 7. Software flow chart of Gateway node

3) *Sensor module*: Most of the time, the sensor node is in low power consumption mode. It will be wakened up by off-chip RTC per hour, and then will do the following actions: initialize the sensor modules of PH value, water temperature, pollutants and turbidity, transform the output voltage from the modules with the help of on-chip 12bit ADC

conversion, process and pack the data according to the zigbee agreement, and finally send the location water quality data to WSN. In the WSN, the vast majority node is sensor node. So the power consumption of sensor nodes directly determine the power consumption of the WSN. In order to get the least amount of power consumption of the sensor nodes, the sensor node software is designed to work in this way "standby mode -- wake up mode -- standby mode". In "standby mode", power consumption of whole nodes is below 100 uA. In "wake up mode", the RF module will be enabled. This is the maximum current consumption in the node working period. In this process, the current consumption is upto 30 mA. But this process will be last less than 1 second. In other words, the time of the sensor node working in large current state will be less than 1Sec per hour. The average current consumption can still less than 110 uA. So What is certain is that the system can work for long hours. Main flow chart of the sensor node is shown in Figure. 8

4) *Remote Data Center*: Remote Data Center includes the PC, application software and database. Application software gets water quality information from internet, then analyse, process and record the data. After that, the data will be helpful for industrial and agricultural production.

IV. SUMMARY

This design is expounded a new type of water quality monitoring system based on the WSN. The sensor nodes contain many different sensors modules, like the modules of PH value, water temperature, water quality, turbidity value. The system is always in standby mode until the off-chip RTC wake the nodes up. The whole nodes's average current consumption will be less than 110 uA in this way. Even though using two ordinary number 5 batteries, it can work steady upto six months or more.

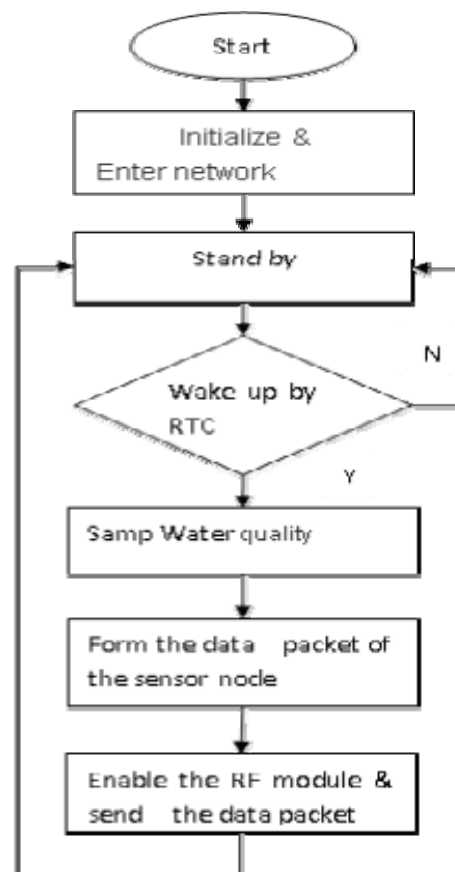


Figure 8. Main flow chart of the sensor node

At the same time, using the GPRS DTU which has a built-in TCP/IP protocol to connect zigbee network and Remote Data Center Simplify the design. Combining with controlling and processing of Remote Data Center, the system can be a long-term, stable and real-time regional water quality monitor.

V. THANKS

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