

The wireless sensor network of the family environment monitoring system research

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Abstract. With the rapid development of all the modern IT and as well as people's living standards improve, there is higher requirements of their environment so that smart home emerged. At present ,air pollution is more and more serious, it has affected people's normal life. In this modern world, people pay attention to the green environmental, the intelligent home for good control of air humidity, temperature, etc, it check analysis of air composition, reassure residents to live in. This paper aims to achieve a lower cost, higher security and reliability family environment monitoring system to minimize the impact that residents living in the contaminated home environment. In order to achieve the goal, this thesis mainly do the tasks: design a family environment monitoring system, which set the ZigBee wireless sensor network technology as the core, combined with various sensors. Besides, in view of the family environment monitoring information, the feedback control scheme is designed.

Introduction

Since the world's first wisdom building built in Connecticut, such as USA, Canada, Europe and Japan, the economy is relatively developed countries have proposed a variety of smarter buildings solution. In the 21st century, the development of technology of smart home technologies reached its peak. In May 2000, the German Fraunhofer Research Society and other 11 companies collaboration, and build an electronic network control intelligence model house. In 2005, Bill Gates spent a lot of money to build a smart home system has been widespread concern, the building can be called today's smart home classic. In recent years, a few large companies and the media widely publicized, China's smart home industry evolved, intelligent home systems are constantly appear. For the shortcomings of wired communications, wireless sensor network technology selection design home environment monitoring system, it will be an inevitable trend. In wireless technology, Wu.Z.H [1] proposed a technique based on ZigBee wireless networking technology that is capable of low-power, low-cost premise of avoiding the cumbersome smart home wiring. In the remote control ,Cao.F H[2] presented a mobile platforms, in way of SMS smart achieve home remote monitoring. Simon M[3] put forward a model of anxiety, the dangerous state of the smart home monitoring. Yan S [4]proposed a wireless sensor network carrier of smart home system, which enables the smart home more flexible, it can be sensitive to the surrounding environment and control appliances. Byun J[5] proposed an adaptive ZigBee wireless sensor networks based on the smart home system that can provide automated services and home energy management for the smart home. The development of wireless technology for attaining wisdom monitor home environment has a significant role[6].

Based on the user needs, this paper design a smart home environment monitoring subsystem to achieve real-time monitoring of the family environment and a timely manner to provide users with reliable and comprehensive information on environment. The environmental monitoring subsystem

is a very important part of the intelligent home system[7]. In this system, people can obtain real-time information on the living environment, such as temperature and humidity, the concentration of harmful gases, light intensity, fire information. Meanwhile, the environmental parameters of this system obtained by sensor can be reference to make decisions to other home equipment, and ultimately to a family environment conditioned by intelligent smart home system[8]. For example, when measuring the light intensity is higher than a certain value set by the user, the system will start automatic curtain system, motor, automatically shut the curtains to a certain extent, in order to reduce the light intensity of the room that suitable for living. As another example, when the temperature is low, the system will start working air conditioning equipment, to increase the indoor temperature[9]. Therefore, intelligent home systems provide users with a safe, comfortable and convenient living environment, so that the environmental monitoring subsystem becomes a very important key part of the smart home system and basic aspects[10]. The key to have a good smart home system is designing a good environmental monitoring subsystem, which has a very important significance to improve the comfort of living environment.

Home environment monitoring system design

In this paper, using wireless sensor network technology, designed a family environment monitoring system. It is capable of real-time monitoring of the family environment, to provide users with comprehensive and reliable information on the family environment parameters. In this monitoring system, people can get real-time environmental information live, such as temperature, humidity, PM2.5 concentration, and the concentration of harmful gases, etc. Environmental conditions for the occupants of the family is very important, a comfortable and safe living environment can effectively guarantee the health of family members. How to achieve real-time monitoring of the family environment of this system is the most basic needs. Family environment monitoring system must have the following features as shown in Figure 1:

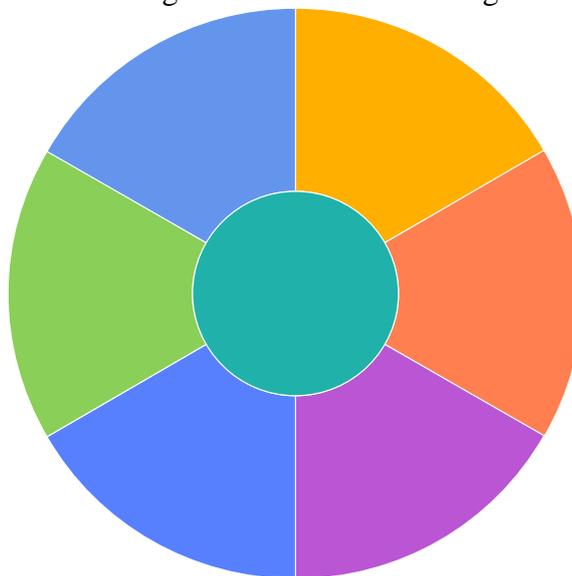


Fig. 1 System functional requirements

Data acquisition: the acquisition of various types of sensors inside the family various air quality parameters, such as temperature and humidity, CO2 concentration, PM2.5 and so on.

Data exchange capabilities: data collected by sensors requires the use of wireless network transmission to the management center.

Data processing function: management center for data collected by sensors for analysis and processing, and storing the results of analysis obtained uploaded to the server.

Terminal display function: a variety of parameter data of a family environment is ultimately displayed on the user's terminal equipment, the user can easily see the family in a variety of environmental data.

Alarm: When the monitored harmful environmental data (carbon monoxide, etc.) exceeds a set threshold, the system will sound an alarm to alert the user.

Feedback control: the home environment monitoring system to monitor environmental data uninhabitable, the user can operate the terminal equipment issue commands to control household appliances to improve air quality.

In this paper, the family environment monitoring system includes a central processing unit (data center management), human-computer interaction (terminal equipment), back-office support for application server, database server, WEB server, the external sensors (air quality parameter data acquisition), external control gateway to connect to other systems (data exchange). The design of wireless sensor networks based on family environment monitoring system consists of a variety of sensor node, routing nodes, central control nodes, management centers. In the sensor nodes and routing nodes, ZigBee respectively act as a network coordinator node and the terminal node. In order to achieve the management center communication of smart home environment monitoring system, the control center node also provides a serial communication interface. its system architecture as shown in Figure 2:

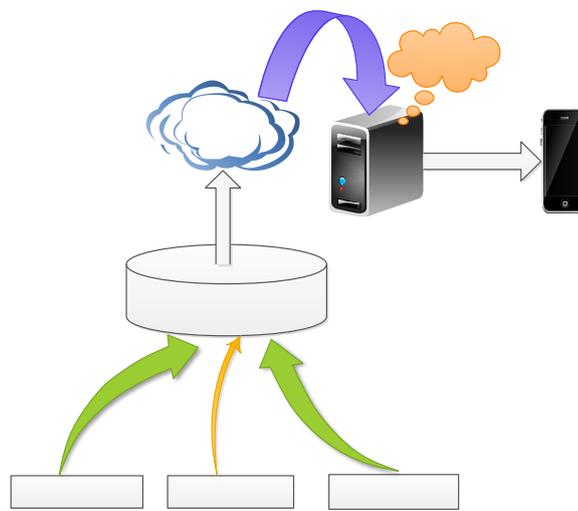


Fig. 2 System architecture

In this family environment monitoring system, the sensor node can achieve the basic functions of data acquisition and transmission; forwarding the routing nodes to achieve network management and communication of the data.

Family Environment Monitoring System Software Design

ZigBee Communication technology is a short-range communications technology, it has a low complexity, low power and low cost. It is mainly developed in the IEEE 802.15.4 wireless standard on the basis of networking, security and application software, communications technology, Comprehensive comparison of various wireless transmissions such as the table 1 show,

Table 1 Comparison of wireless transmission

| | Bluetooth | Wi-Fi | IrDA | ZigBee |
|----------------|-----------|--------|--------|------------|
| Network Node | 7 | 30 | 2 | 255/65000 |
| Physicals cope | 10m | 100m | 1m | 1-100m |
| rate | 1Mbps | 11Mbps | 16Mbps | 20/250kbps |
| medium | 2.4GHz | 2.4GHz | 980nm | 2.4GHz |

Wireless monitoring system in a home environment, we need different sensor networking pairing for fast data transfer. In this case, Zigbee technology has its unique advantages. In the practice, the number of sensor nodes depends on the size of the living environment and the variety of required data. In additions, the interfaces of CC2530 with its accessories are shown in Figure 3. RF Antenna is required to emit and receive radio signals, the power provides the energy to operate CC2530 and there

is an internal clock to synchronize the time with the system.

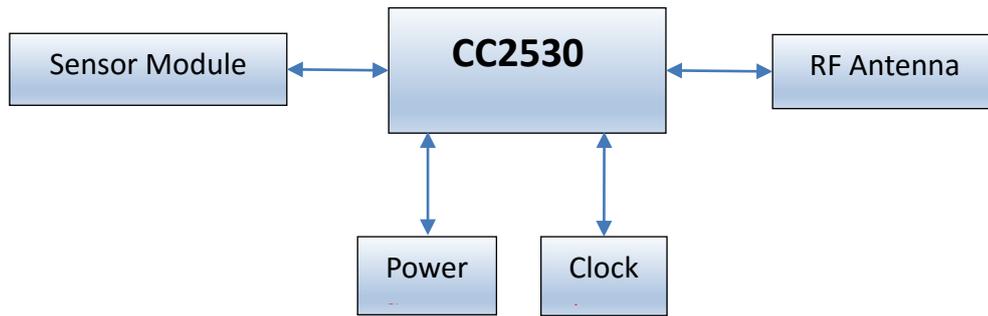


Fig. 3 Interfaces of CC2530 with its accessories

The module is currently wide range of applications and it can be easily connected to the master chip. Physical shown in Figure 4:



Fig. 4 ZigBee wireless communication physical module

In order to monitor the temperature of a family environment, in this paper, temperature and humidity sensors are used. It provides two-wire digital serial interface SCK and DATA, the interface is very simple, and supports transmission CRC checksum. The principle is shown as Figure 5

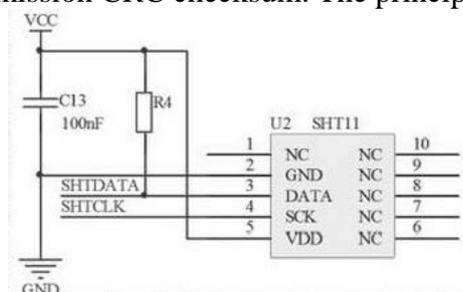


Fig.5 SHT11 Sensor

Its collection procedures are as follows:

```

void SampleApp_Send_P2P_Message( void )
{
    byte i, temp[3], humidity[3], strTemp[7];
    DHT11();           // Get temperature and humidity
    temp[0] = wendu_shi+0x30;
    humidity[0] = shidu_shi+0x30;
}
  
```

In the design of the system, user concerned most is the monitoring of temperature. It is possible to measure the temperature through the remote control, users get the most satisfactory of temperature. The continuous family of temperature compared statistically as shown Figure 6, so you can monitor the daily change of temperature.

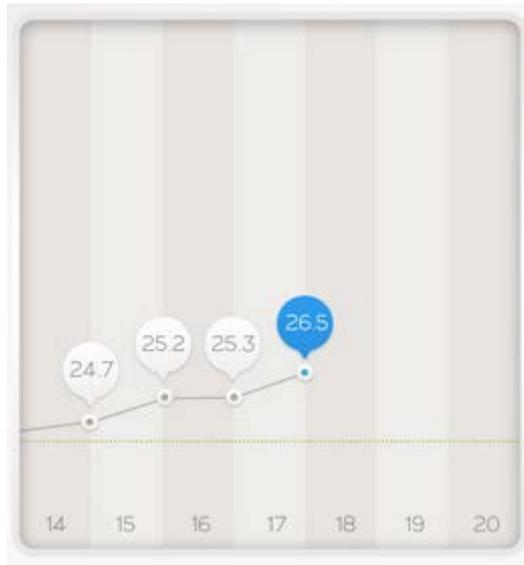


Fig.6 Temperature compared statistically

Now, there are many ways to change the temperature, air conditioning or switch windows are good choices, this system relies on two main methods to achieve temperature control. The first way to change the temperature of the room is controlling the air conditioning. The effect is obvious, but the energy consumption is relatively large. Phone send commands to the system through the cloud server, then the control commands are sent to the control management center and air condition opened so that the temperature of the room reaches the set value.

Summary

In this paper, it studies the wisdom of the family home environment monitoring system, according to the characteristics of the family environment monitoring system and the shortcomings of smart home systems that exist at present. We designed a smart home environment monitoring system that based on ZigBee wireless network technology. In this system, the sensor nodes can get the physical environment information collection, and then the collected physical information is sent to the network control center node over the wireless network, the control center node through serial cable data in accordance with the prescribed format issued to the management center. In order to allow users to read information on the family environment and manipulate on the management center, then we designed a user interface so that user can remote monitor family environment.

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