IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)
e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 10, Issue 5 Ver. II (Sep-Oct 2015), PP 162-167
www.iosrjournals.org

Wireless sensor network applications in surveillance of the a gricultural environment

Mohini Prasad Mishra[1], Archana Panda[2]
1(Department of Computer Science & Engineering, Gandhi Engineering College, India)
2(Department of Computer Science & Engineering, Gandhi Institute For Technology, India)

Abstract: *With the advancement of sensor innovation, MEMS,wireless communications and the wide use of remote sensor, Wireless Sensor Networks have been given extraordinary consideration in industry field and our day by day life. So as to acknowledge farming modernization and rural condition security, this paper plans Agricultural environment monitoring framework dependent on remote sensor systems, and gives the equipment structure of sensor hubs and the flowchart of programming. Analyses have demonstrated that the framework is low force utilization and has stable running and high exactness, which can understand remote ongoing checking for unattended agribusiness condition observing.*
Keywords: *Agricultural environment monitoring, wireless communications, MEMS;*

I. Introduction

As we all know, monitoring point of agricultural environment is remote, individually and widely distributed. In the past, it is very inconvenient for the staff to collect information at the scene. Traditional agricultural environmental monitoring system supplies power and transmits data by cable. Therefore it is very difficult to obtain the real-time information on environmental monitoring, because of laying lines hardly, high investment cost and man-made destruction and so on. In order to solve the problems, we designed a wireless agricultural environmental monitoring system based on wireless sensor network, and the system is mainly used to monitor temperature and humidity.

Wireless sensor network is composed of a large number of micro-sensor nodes which have small volume and low cost. It possesses self-organizing capability by wireless communication. Data acquisition is the central task of the network to obtain information. Compared to the traditional means of environmental monitoring We adopt wireless sensor networks to monitor agricultural environment, it has three significant advantages: (1) It is unnecessary to lay wire, the network is only deployed once, the man-made impact on the control environment is small; (2) the nodes are dense, data acquisition has high accuracy; (3) sensor nodes with a certain calculation, storage capacity, enabling collaboration among nodes is ideal for unattended remote monitoring. Therefore monitoring parameters of agricultural environment is feasible through wireless sensor network it is a direction for environmental monitoring based on wireless sensor networks in the future [1] [2].

II. System architecture

Monitoring system is mainly made up of four parts: sensor node, the sink node, transmission networks and monitoring terminal, the system architecture is shown in figure 1.

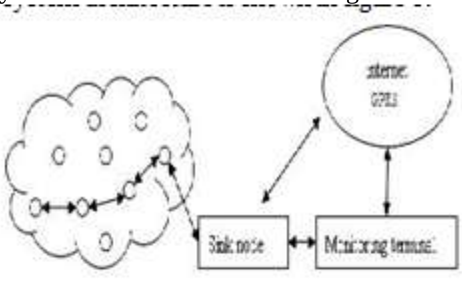


Fig.1. Wireless sensor network system architecture

Environment monitoring system consists of large numbers of dense wireless sensor nodes which are distributed in agricultural environment in order to ensure high precision and reliability of data acquisition. Sensor nodes are responsible for collecting temperature, humidity and other parameter, the collected data is transmitted to sink nodes by multi-hop. Sink nodes which are the core of nodes have more powerful functions of collecting data and storing data ,computing and data integration in a certain than common nodes ; in addition ,wireless sensor network can connect with transmission network and client terminal by sink nodes. The collected data is sent to client terminal through GPS, GPRS, WIFI and other radio transmission or directly sent to client terminal by cable, and then terminal client analyzes data to make a decision.

III. The hardware design of sensor nodes

Sensor node is the basis unit of wireless sensor network, node stable running ensure the reliability of the whole network. Sensor node is comprised of data acquisition module, data processing module, wireless communication module and the power module.

The hardware structure of sensor is shown in fig.2. According to the need for measurement and monitor of environment parameters in different kind of applications, we can use other kind of sensors. The data acquisition module is used for sensing, collecting information and A/D conversion. The processor module is responsible for control the operation of the sensor nodes, storing, processing the collected data, implementation high network protocol and switch the power work pattern. The wireless communication module mainly communicates with other nodes. We adopt solar battery system as power supply .solar battery system is comprised of solar energy panel, solar charge control and accumulator. Power consumption of the wireless sensor network is low, so solar energy and accumulator can ensure the whole system work normally. The designed system is mainly used for real-timely monitoring agriculture environment information, such as the temperature, humidity and so on so as to realize agricultural environment protection or the precision agriculture.

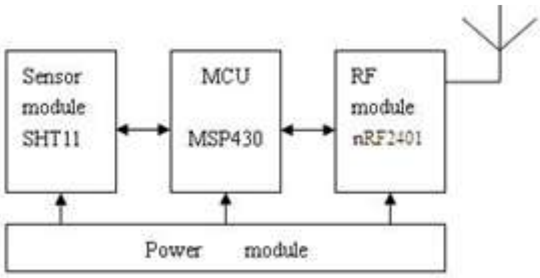


Fig.2. The hardware structure of sensor

3.1. Data acquisition module

In this paper, we need monitoring many parameters of agricultural environment , temperature and humidity are mostly needed to monitor in the design, we set measurement humidity and temperature as an example of data acquisition. SHT11 temperature/humidity intelligent sensor from Sensiron company is chosen, which integrates the temperature and humidity sensors, signal processing, A / D converter and I2C bus interface in one single chip and has digital signal output, good anti-interference and excellent long term stability. Digital temperature and humidity sensor SHT11 measures temperature in a range of-40 to +125 and with the accuracy of ±0. 5 ; when the environmental temperature changes from - 40 to + 120 , it measures humidity from 0% RH to 100% RH and with the measurement accuracy of
± 3.5%RH (20% RH ~ 80% RH). The default measurement resolution of 14bit (temperature) and 12bit (humidity) can be reduced to 12 and 8bit, it leads to be wildly used for high speed or extreme low power application [3]. So the chip SHT11 is very suitable for the system.

3.2. Data processing module

The microprocessor plays a core role in the node of sensor networks which generally requires a small, low power, high speed and high integration MCU. This paper chooses a 16-bit ultra-low power microcontroller MSP430F149 which works on five power modes including one active mode and four low power modes. Its operating current is 400μA (1 MHz) and can be driven by 1.8 V to 3.6V. It takes less than 6 μs to wake up from Standby mode to normal working status. When off mode, its current is only 0.1 μA, Standby mode requires 1.6uA of current, and it is very suitable for mobile sensor nodes which can only be powered by battery.

3.3. Wireless communication module

This design adopts nRF2401 chip working at the 2.4GHz ISM which is manufactured by Nordic Inc. The address decoder, FIFO stack areas, demodulation processors, the clock processors, GFSK filters, low-noise amplifiers, power synthesizers, power amplifiers and other functional modules are integrated inside Yingli Zhu et al. / Procedia Engineering 16 (2011) 608 – 614

the chip which makes it only need few external components to obtain stable performance. Its maximum transceiver rate reaches 1Mbps.Its service voltage is 1.9V~3.6V, and power is very low especially in the power-down mode and send the data 100m away.

Table 1. NRF2401work modes

Mode	PWR_UP	CE	CS
Active(RX/TX)	1	1	0
Configuration	1	0	1
Stand by	1	0	0
Power down	0		

NRF2401 connects with MSP430F149 by SPI serial programmable port which is mainly used for expanding peripherals and data exchange, data can be received through MISO port and data is sent through MOSI with the PWR_UP, CE, CS, DR1 and CLK1 working. The interface between nRF2401 and micro-controller MSP430F149 is shown in Figure 3. After MSP430 writing the data which will be sent to the data register of SPI, it can execute other programs, and needn't waste precious time to encircle the data transmission. The nRF2401 has two active (RX/TX) modes: ShockBurst™ and direct mode, this system configure s nRF2401 work in ShockBurstTM mode. When the nRF2401 working in ShockBurst™, it transmits data at a very high rate thus enabling extremely power reduction, system cost lower and risk reduction of 'on-air' collisions due to short transmission time which can ensure the effectiveness and reliability in communication.

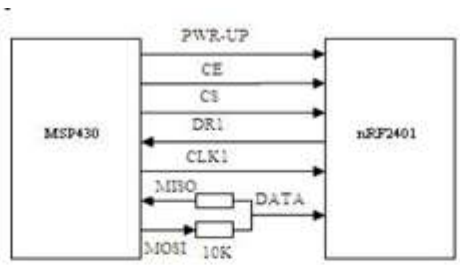


Fig.3. The diagram of interface between nRF2401 and MSP430F149

IV. Software architecture

4.1. Data frames format

Data frames format is an important part of the communication protocol, which consists of four parts in the ShockBurst™ transfer mode: Preamble, address, payload and CRC. Data frames format of nRF2401 is as following table 2.

Table 2. Data frame format

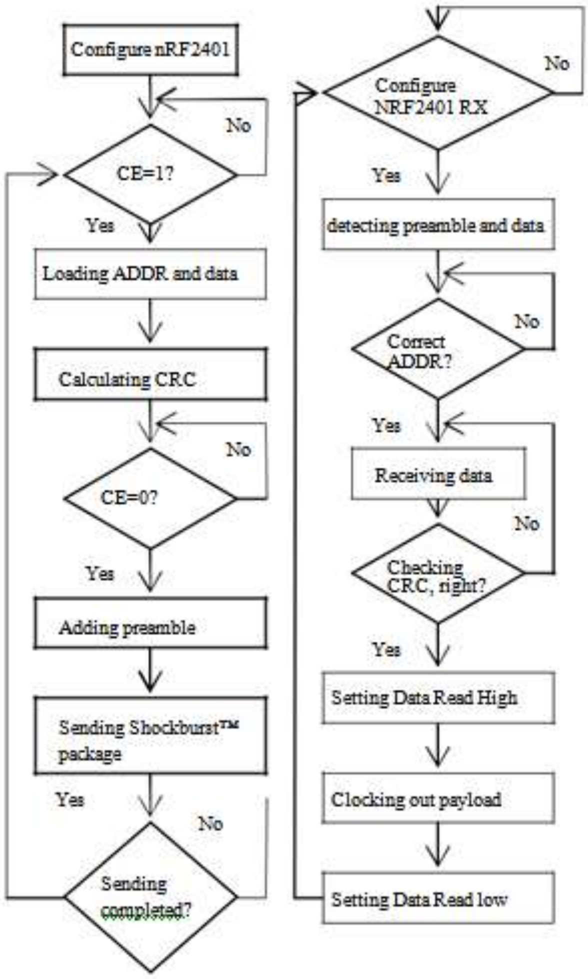
Preamble	ADDR	PAYLOAD	CRC

Preamble is data header. ADDR is destination address for received data, only the data frames according with local hardware address will be received. CRC enables nRF2401 on-chip CRC generation and de-coding. PLYLOAD is data section, the total number of bits in a ShockBurst™ RF package may not exceed 256 bits, maximum length of payload section:

DATAx _W(bits) = 256 - ADDR _W - CRC

Shorter address and CRC can leave more room for payload data in each package which can improve the transmission efficiency, but it will make reliability reduction. When a valid package has been received (correct address and CRC found), nRF2401 removes the preamble, address and CRC bits, and saves valid payload data [5]. Workflow of nRF2401 is shown in Figure 4.

Fig.4. Workflow Chart ShockBurst™ mode of nRF2401



4.2. Software design of the node

In order to make transplantation convenient and resource sharing, the system software is developed by C Language with the development of IAR Embedded Workbench, and adopts module program structure design. System software mainly includes data collection and memory module, wireless communication, alarming module, and wire communication module, etc. The main task of sensor node includes real-time detecting parameters of agricultural environment, gathering information and sending them to the monitoring center. Workflow diagram of nodes is shown in Figure 5.

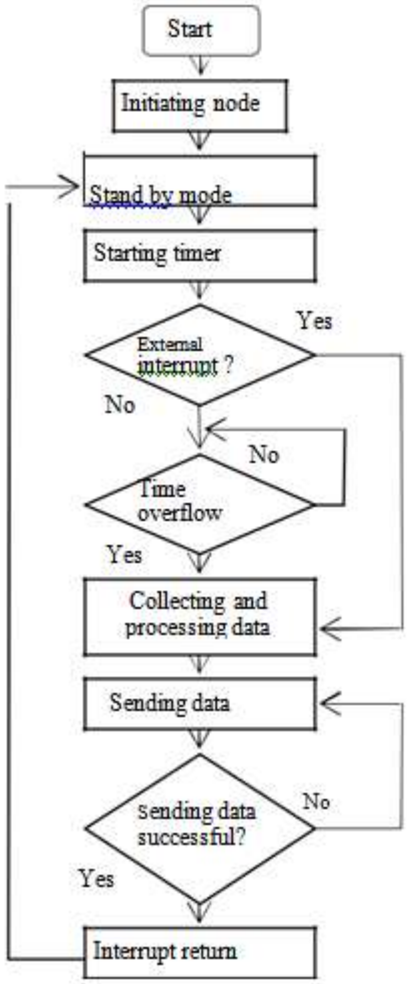


Fig .5. workflow diagram of nodes

When the program starts, sensor nodes will initialize, then enter into low power consumption work mode and wait for being awakened, the processor is in the idle state, but SPI port and interrupt system will still continue to work, and is always ready to accept system interrupt request. When the time of collecting data arrives, system will transmit signal of acquisition request, and nodes will enter into work, collect data and send them out. After finishing Sending data, the system will return to low power consumption mode. In low power consumption mode, if the allowed interrupt request occurs, MCU will be awakened and enter into work, implement the interrupt service routine. After interrupt returning, the system will return to low power consumption mode again. System monitors parameters of agricultural environment like this cycle repeatedly [6].

4.3. Software design of monitoring

Software design mainly programmed with C language combining Labview is responsible for the collected data display, analysis and storage etc. When the collected data exceeds the warning limitation, monitoring system will send out a warning message, and adopt the effective measures to eliminate the trouble.

Test result

Real temperature tested by thermocouple thermometers is regarded as standard temperature. Temperature measured by sensor of the node will be transmitted to monitoring terminal. Compared with the real temperature, the temperature error is less than ±1 , which meets the requirement of the design. The test result is as table 3.

Table 3. Test result

Node Nr.	Real Temperature( )	Measured Temperature( )	Error( )
1	-15.1 0	-15.80	0.70
2	-9.30	-9.00	0.30
3	0	0.30	0.30
4	14.30	14.10	0.20
5	22.50	22.80	0.30
6	38.65	39.15	0.50

V.Conclusion

This paper presents a design of agricultural environment monitoring system based on wireless sensor networks, the system is low power consumption and has stable running and high precision, which can realize remote real-time monitoring for unattended agriculture environment .monitoring. Wireless sensor networks applied in monitoring agriculture environment breaks through the traditional methods and ideas for agricultural environment monitoring, which improves the level and reliability of monitoring system. According to different kinds of monitoring requirements, it can be realized by changing the type of sensors to monitor different environments such as forest fires, precision agriculture and so on [7]. Therefore, the wireless sensor network applied for environment monitoring plays an important role which leads to strengthen the protection of the environment in the future.

References

[1]. Li Bin, Tian Ya-ping. Application of ZigBee Wireless Sensor Networks in the Industry Realm [J]. Journal of Shanxi university of science and technology . Oct.2008.110-113

[2]. Mettam GR, Adams LB. How to prepare an electronic version of your article. In: Jones BS, Smith RZ, editors. Introduction to the electronic age, New York: E-Publishing Inc; 1999, p. 281–304

[3]. Datasheet of MSP430F1x, http://www.ti.com

[4]. Datasheet of SHT1x, http://www. sensirion.com

[5]. Nordic VLSI ASA. "nRF240x ShockBurstTM technology". http://www. nordicsemi.com/, 2003-02.

[6]. Xingqiao Liu, Yijing Liu, Chengchun Li and Guohai Liu. "A New Multi-parameter Monitoring System Based on Wireless Sensor Network". 2009 International Conference on Networks Security, Wireless Communications and Trusted Computing, Vol. 2, 755-758, April 2009.

[7]. Ding Yonghong ,Sun Yunqiang. Design of wireless data transfer system based on nRF2401 [J]. Foreign Electronic Measurement Technology. 2008, 27(4): 45-47(in Chinese)