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Procedia CIRP 83 (2019) 394–397

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11th CIRP Conference on Industrial Product-Service Systems

A New Environmental Monitoring System Based on WiFi Technology

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Abstract

In order to measure environmental parameters in a better way, we use WiFi technology and design a new environmental monitoring system. This system uses humiture sensor and optical sensor to collect humiture and optical data, through wireless communication module in communication with the host computer. It accepts the collection instruction and sends real-time data to the host computer. This paper shows the structure diagram of system, the circuit diagram of control node and sensor node, the flow chart of programming and the user interface of PC. Generally, this system is easily-operated, rapid, and functional thus has the potential to be widely applicated.

Peer-review under responsibility of the scientific committee of the 11th CIRP Conference on Industrial Product-Service Systems

Keywords: WiFi; MCU; sensor; environmental monitoring;

1. Introduction

Recently, in some industrial and agricultural production, collecting accurate real-time environmental parameters is usually an important requirement[1-2]. In order to collect environmental parameters conveniently, we intend to use WiFi technology to transmit those information as it can help to save a lot of wiring and cover a wide range[3-4]. WiFi, called Wireless Fidelity, is a wireless network communication industry standard proposed by IEEE and developed by IEEE802.11 standard. It is a short-distance wireless communication technology and has a wide range of applications in the field of monitoring.

This paper designs a new environment monitoring system based on WiFi technology, which made up by control node, sensor node and host computer[5]. Humiture and optical data, gathered by humiture sensor and optical sensor, is transmitted by WiFi technology, which must pass by the handing of A/D conversion into digital signal and then can be sent to the MCU to deal. The host computer real-timely shows the data and graph bringing convenience to staff[6-7]. Specially, in museums, some unearthed cultural relics require precise monitoring of environmental parameters. Our system can provide convenient services for such applications.

2. System structure

The structure diagram of system is shown in Fig.1. The diagram model consists of sensor module, wireless communication module and the host computer. In this system, we deploy sensor nodes for each monitoring area and each sensor node with control node composes a star network through WiFi technology[8]. In each monitoring area, humiture sensor with optical sensor could collect data rapidly and accurately. The control node sends the received information to the host computer through Ethernet. The staff could monitor the environmental information of each area through host computer[9-10].

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10.1016/j.procir.2019.04.088

3. Hardware design

3.1. Control node

The hardware structure of control node consists mainly of MCU and wireless communication module. We use ATmega64 made by ATMEL company as MCU, which is an 8-bit CMOS microprocessor. It not only has ultra-low power consumption, but also has enhanced AVR RISC structure. We use USR-WIFI232-B2 as wireless communication module. It is an integrated 802.11b/g/n module with a frequency range of about 2.4-2.5GHz. The circuit diagram of control node is shown in Fig.2. Internet_port, representing Ethernet interface, is used for communicating with the host computer. TXD and RXD pins are connected to the RXD0 and TXD0 pins of MCU respectively, using serial port 0 of MCU to communicate. The switch RESET_B2 is a reset circuit to restart the wireless communication module.

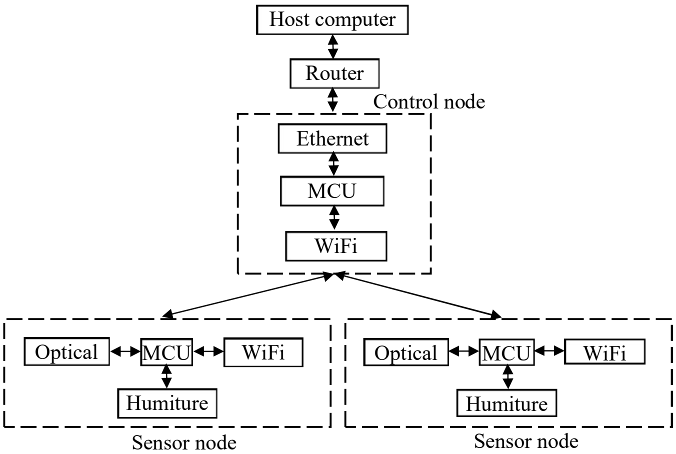

Fig.1. The structure diagram of system

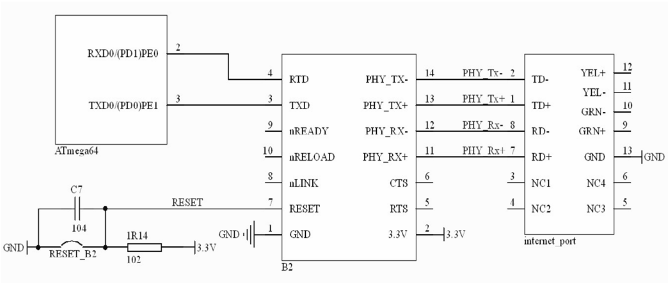

Fig.2. The circuit diagram of control node

3.2. Sensor node

The hardware structure of sensor node consists mainly of MCU, wireless communication module, humiture sensor and optical sensor. The type with circuit diagram of MCU and the wireless communication module is the same as that of the control node. The Ethernet I/O interface of wireless communication module does not need to be used. We use DHT11 made by ASAIR company as humiture sensor, which uses digital signal as output. Thus, the main feature of this humiture sensor is that the trouble of A/D conversion is avoided. We use LXD5506 photoresistor as optical sensor. When the light intensity is high, the resistance value is very small and with the decrease of light intensity, the resistance value increases nonlinearly to a maximum. The circuit diagram of sensor node is shown in Fig.3. Pin 2 of DHT11 as the output of humiture is connected to the pin PD6 of ATmega64 and the output pin of optical sensor module is connected to the A/D input pin ADC0 of ATmega64.

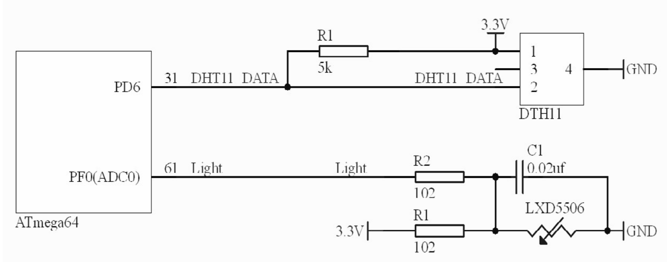

Fig.3. The circuit diagram of sensor node

4. Software design

4.1. Control node

The main function of the control node is to communicate with the host computer, receive the instructions issued by the user and make decisions. It also needs use the USR-WIFI232-B2 module to receive the data information from sensor node. After processing, the data is sent to the host computer by using the Ethernet interface. The flow chart of programming of control node is shown in Fig.4. After powering up, the control node begins to initialize program, such as the serial port 0 used for data transmission between ATmega64 and USR-WIFI232-B2.

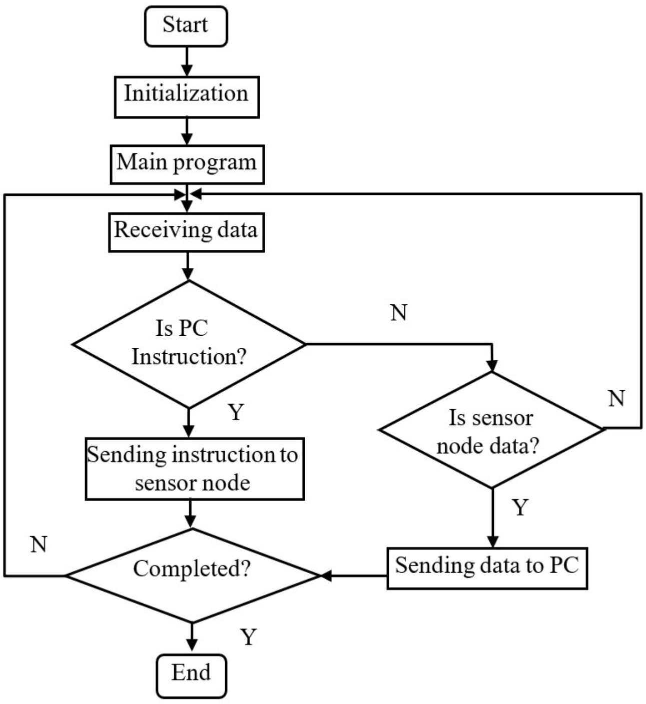

Fig.4. The flow chart of programming of control node

4.2. Sensor node

The main function of the sensor node is to collect data and send it to the control node through WiFi. The flow chart of programming of sensor node is shown in Fig.5. After powering up, the sensor node will also begin to initialize program, such as the A/D conversion interface and the serial port 0 on ATmega64. When the data is collected and the instruction is received, the data will be transmitted to the control node through the sending function.

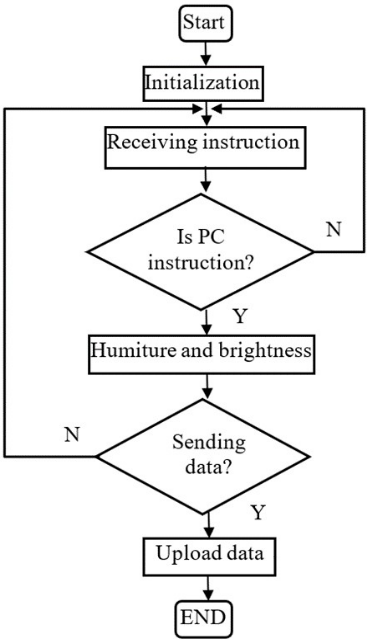

Fig.5. The flow chart of programming of sensor node

5. Software design of host computer

In this paper, we use Microsoft Visual Studio as the development software to design user interface. The data collected by each sensor node is sent to the host computer through the Ethernet. The host computer processes the collected data and displays it on the user interface to convenience staff's monitoring. The user interface is shown in Fig.6.

Fig.6. The user interface of PC

6. Experiment

In order to verify the performance of the system, we place three sensor nodes in three different rooms, collecting temperature, humidity and brightness data, and place control node, router and PC in other room to conduct a communication experiment. The experimental environment is shown in Fig.7.

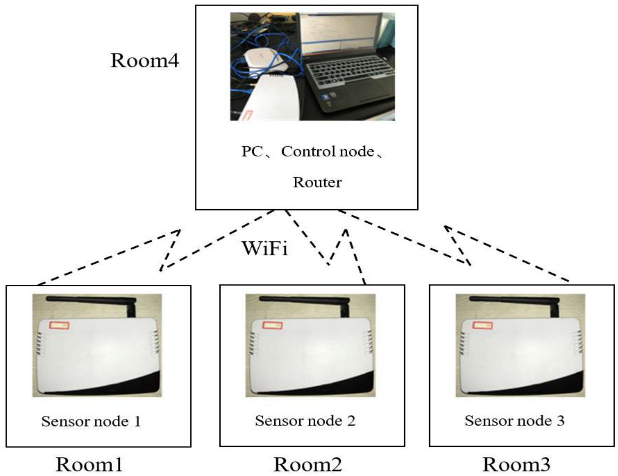

Fig.7. The experimental environment

Before debugging, we energize all devices, set the corresponding IP on the computer and start connecting, then we can see the collected information and graph in the user interface. The experimental result is shown in Fig.8. The graph shows the current temperature, humidity, brightness values of three sensor nodes and the curve diagram of temperature, humidity and brightness values with time of sensor node 3. We can click button 'Clear Chart' and switch graph of other sensor nodes. Specially, the air-conditionings in Node 1 and 2 are always open, and the air-conditioning in Node 3 is closed after opening for a period of time. The photoresistor of Node 2 is slightly blocked, and the photoresistor of Node 3 is completely blocked. After a period of time, we breathe to the humiture sensor of Node 3. Consequently, we can get these experimental results: Over time, on the graph of Node 3, the temperature curve increases slightly, the humidity curve dropped slightly and the brightness curve value is always zero as the photoresistor is in a dull state.

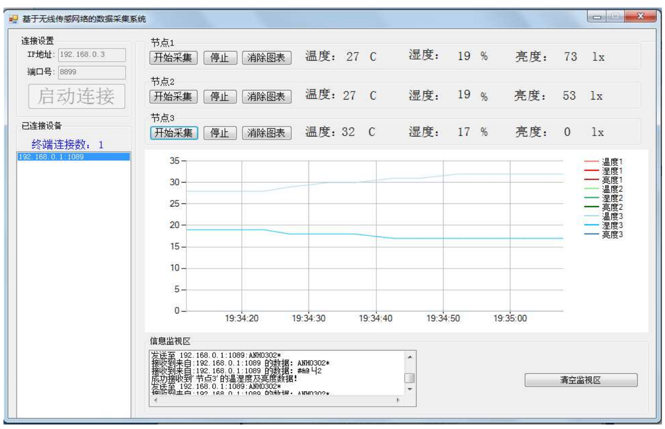

Fig.8. The experimental result

7. Conclusion

In this paper, we show a new environmental monitoring system based on WiFi technology. Control node conducts the work of sensor node. Humiture and optical data, gathered by humiture sensor and optical sensor, is transmitted by WiFi technology to control node and through Ethernet in communication with the host computer. Hence, we can get real-time information of temperature, humidity and brightness. This system has strong practical value and broad application prospects in industrial and agricultural production.

Acknowledgements

We would like to thank the supports by Research Project of Tianjin Education Commission (2018KJ104，2017KJ057).

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