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Research Article

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Teaching Method and Experiment by Using Wireless Sensor Network (WSN)

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Abstract In this paper, the wireless sensor network (WSN) is used to teach students to understand the methods and experiments for monitoring temperature and humidity. WSN is based on Zigbee protocal which has benefits of low cost, low power consumption, etc. By using WSN's Application Program Interface (API), the environment conditions of temperature and humidity can be obtained easily. The teaching example of verifying the performance of WSN will be presented in this paper. The results reveal that the teaching method and experiments are good and satisfied.

Keywords Wireless sensor network (WSN), ZigBee, Temperature, Humidity, Monitor.

1. Introduction

By using the WSN's advantages of low power consumption and low cost, many perceived control network can be connected as a sensor network. The network can achieve good monitor technologies. In the past, many applications have been developed such as home security, vehicle/building automation, environmental monitoring, indoor location identification, etc. These results make many comfortable and convenient applications for human life. [1].

The WSN can be used to monitor the environment for many applications. A challenge is to reduce energy consumption such as to extend the using time of the WSN. The ZigBee Alliance is an association of companies. They work together to develop standards of reliable, cost-effective, low-power wireless network. The ZigBee technology is embedded in many ranges of products which across industrial, consumer, commercial applications [2]. The ZigBee defines the network layer specifications for star, tree and peer-to-peer network topologies and provides a framework for application programming in the application layer. The ZigBee is built on the so called IEEE 802.15.4 standard which defines the physical and MAC layers for WSN [3].

In this paper, the good teaching method and experiment for the WSN are presented. It is used to teach students to understand the methods and experiments for monitoring temperature and humidity. The performances of data measured by WSN will be shown in computer screen. The teaching example of verifying the performance of WSN will be presented. The results reveal that the teaching method and experiments are good and satisfied.

2. Teaching Methods for WSN

The main purpose of teaching for students are using application program interface (API) of WSN. This API can be developed to reduce the burden of program design. The Application Queue API is a very important tool to provide a queue-based interface to communicate application file and both the WSN stack and the hardware drivers. The develop environment is called Code::Blocks which can let all these APIs interacts with the IEEE 802.15.4 stack API. Meanwhile, it can interact with many Peripheral Hardware Drivers by Integrated Peripherals API. The Application Queue API handles interrupts between the Medium Access Control (MAC) sub-layer stack and integrated peripherals of wireless microcontroller to save the application time of interrupts [4].

A variety of network topologies have been developed. A star topology is used in this paper. A network must consist of a minimum of two devices. One is called Co-ordinator which is referred to as network commander. Others WSN are called End-Device which can be regarded as client or slave. Each End-Device node has a parent. The Co-ordinator node has one or many client nodes. Each node can communicate only with its parent and its client. Not all nodes may be within range of each other's but information can be transferred from one node to another node until the final destination is got. The data transfer methods between network nodes have two types: (1) Transferring data from a Co-ordinator to a node. In this method, request response should be given to the node to request data when it is able to receive. (2) Transferring data from a client node to Co-ordinator node. In this method, confirm response should be sent from a data frame directly. The two data transfer methods are shown in Fig. 1.

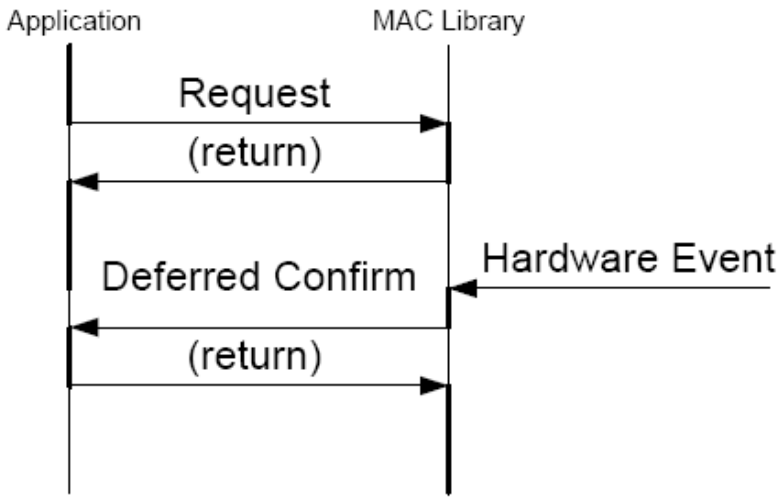

Figure 1: The diagram of WSN data transferring

3. Experimental Results

The program of WSN is developed on the free software called Code::Blocks. It can provide all the software tools and hardware required to get the first-hand experience with WSN. At first, the program of Co-ordinator is developed then the program of End-Device is developed consequently. Every network must have one and only one PAN Co-ordinator, and one of the tasks in setting up a network is to select and initialize this Co-ordinator. The network setup process is automatically started from stack initialization to data transferred. The entry-level kits contain one base development board (BDB) and one sensor development board (SDB). Each board is equipped with a high-power IEEE 802.15.4 RF module which provides much higher covering range with 2.4GHz RF antenna for easy mechanical design than normal-power RF module. For I/O expansion ports, it has 10 useful pins of GPIO include UART, ADC, DAC and Comparator. The sensor development board features temperature and humidity sensors. The development board is shown in Fig. 2.

The API software provides free packages to the peripheral devices single-chip compliant wireless microcontrollers. This is known as the Integrated Peripherals API. It details the calls that may be made through the API. This hardware is controlled using the MAC software stack which is built in the on-chip ROM. The sensor of temperature and humidity is shown in Fig. 3. The developed program is shown in Fig. 4. In this paper, the WSNs are used to monitoring. There have four nodes be used and every nodes has its number. All their monitoring results can be shown in computer screen which is shown in Fig. 5. All their real monitoring condition is shown in Fig. 6. The teaching example of verifying the performance of WSN has been presented in this paper. The results reveal that the teaching method and experiments are good and satisfied.

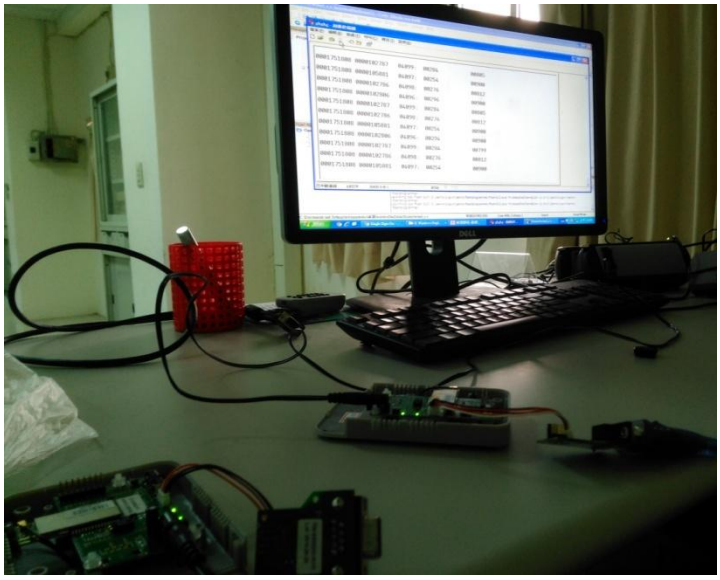

Figure 2: Development boards of WSN

Figure 3-1: Diagram of sensor on WSN for temperature and humidity monitoring

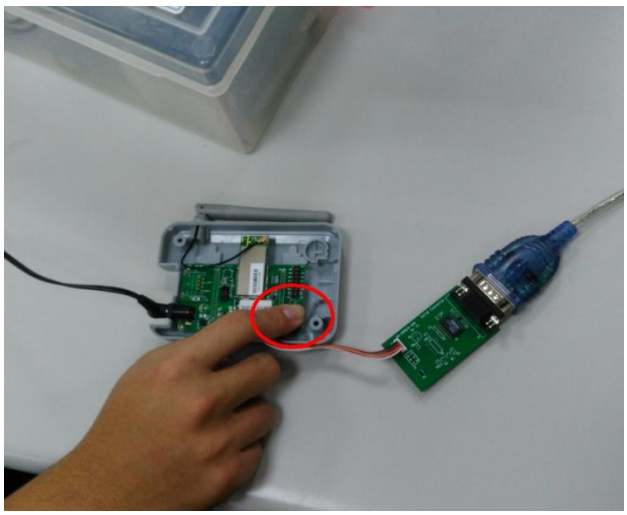

Figure 3-2: Diagram of finger temperature and humidity monitoring by WSN

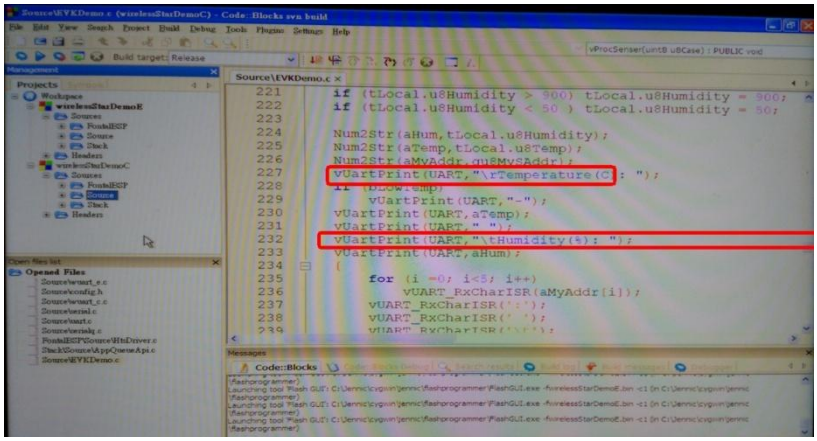

Figure 4: The program diagram of monitoring temperature and humidity

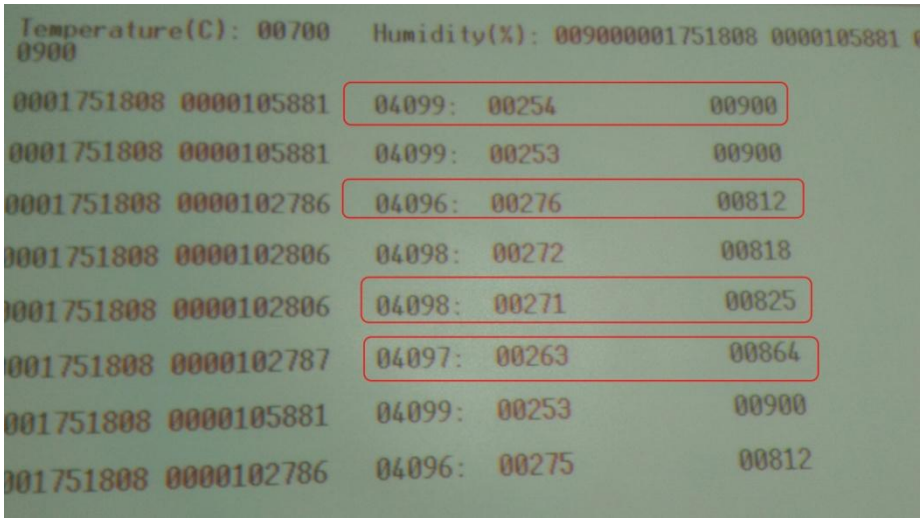

Figure 5: Monitoring diagram of every node of WSN

Figure 6: Real monitoring diagram of every node of WSN

4. Conclusion

In this paper, the teaching method and experiment for temperature and humidity monitoring by WSN are proposed. The teaching example and experiment result of verifying the performance of WSN have been presented. The results reveal that the teaching method and experiments are good and satisfied.

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