The Distance Measurement by Using RSSI of Wireless Sensor Network

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Abstract
In this paper, the measurement of received signal strength indication (RSSI) is demonstrated by using wireless sensor network (WSN). This measurement is a basic technology which is varied according to distance of command device and client device. Many algorithms are developed based on this measurement of RSSI such as to develop many useful WSN's applications. The experimental results of WSN are demonstrated in this paper. Good effectiveness of distance measurements by using RSSI is achieved.

Keywords: *Wireless sensor network (WSN), ZigBee, RSSI, Distance measurement.*

I. INTRODUCTION

The low cost and low power consumption is main advantages of wireless sensor network (WSN). WSN is based on technologies of radio transceivers and receivers such as to achieve some useful information around the environment to develop many control techniques such as vehicle/building automation, home security, environmental monitoring, indoor location awareness/identification, etc. When many WSNs are deployed in large field, they can be automatically organized to form an ad hoc network to communicate with each other by means of some network topologies such as star, mesh and tree communication topologies [1, 2]. The standard of WSN is followed the standard of IEEE 802.15.4/ZigBee. So many people can also call WSN as ZigBee. The ZigBee builds upon the IEEE 802.15.4 standard which defines the physical and medium access control (MAC) layers for low cost, low rate personal area networks and provides a framework for application programming in the application layer [3, 4].

Many indoor applications of distance measurement such as monitors, identifications, etc. are based on ZigBee. Many distance measurement algorithms are developed such as to estimate the location of client device. Among some conventional distance measurement techniques, the received signal strength indication (RSSI) is most interested [5]. In particular, RSSI can be measured in the 802.15.4 physical standard which reports the signal strength associated with a received packet to higher layers. The RSSI values of the transmitted signals recorded at different client devices. In this paper, the good performances of distance measurement by RSSI of WSN are demonstrated. Meanwhile, the values of RSSI are shown in computer's screen.

II. INTRODUCTION TO WSN

The ZigBee Alliance is an association of companies working together to develop standards (and products) for reliable, cost-effective, low-power wireless networking. ZigBee technology will probably be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide. ZigBee builds upon the IEEE 802.15.4 standard which defines the physical and Medium Access Control (MAC) layers for low cost, low rate personal area networks. ZigBee defines the network layer specifications for star, tree and mesh network topologies and provides a framework for application programming in the application layer. In this paper, the subroutines are provided by *Jennic Inc.* to develop the distance measurement applications. All these subroutines include different type of application program interface (API). For example, the Queue API provides a queue-based interface between an application and both the IEEE 802.15.4 stack and the peripheral hardware drivers. The API interacts with the IEEE 802.15.4 stack via the *Jennic* 802.15.4 Stack API (which sits on top of the 802.15.4 stack). The most important part of APIs is Application Queue API. The Application Queue API handles interrupts coming from the MAC sub-layer of the IEEE 802.15.4 stack and from the integrated peripherals of the wireless microcontroller, saving the application from dealing with interrupts such as MAC Common Part Sublayer (MCPS) interrupts, MAC sub-Layer Management Entity (MLME) interrupts and Hardware interrupts [6, 7]. A variety of network topologies are possible with IEEE 802.15.4. A network must consist of a minimum of two devices, one is command device and some client devices. The basic type of network topology is the Star topology. A Star topology consists of a central personal area network (PAN) command device surrounded by the other client devices of the network [6, 7].

III. EXPERIMENTAL RESULTS FOR DISTANCE MEASUREMENT

The free Code::Blocks software is used in distance measurement of RSSI of WSN. At first, the program of command device is developed then the program of client device is developed consequently. Every network must have one and only one PAN command device, and one of the tasks in setting up a network is to select and initialize this command device. The personal area network identification (PAN-ID) must be set adequately in program. The development board can provide all the software tools and hardware required to get the first-hand experience with WSN.For the software, free Application Programming Interface (API) packages is provided to the peripheral devices on the single-chip IEEE 802.15.4 compliant wireless microcontrollers. It details the calls that may be made through the API in order to set up, control and respond to events generated by the peripheral blocks, such as UART, GPIO lines and Timers among others. The software invoked by this API is present in the on-chip ROM. This API does not include support for the ZigBee WSN MAC hardware built into the device; this hardware is controlled using the MAC software stack that is built into the on-chip ROM [6, 7]. In this paper, the ZigBee WSNs are used to design for the distance measurement by means of RSSI of WSN.

At first, the program of RSSI test is demonstrated and shown in Fig. 1. From the results, the values of RSSI will be varied according to the distance between the command and client device. In Fig. 2 (a), the near distance test shows the value of RSSI transformed into digital value of LQI as 255. In Fig. 2 (b), the long distance test shows the value of RSSI as 102. In the programs, the actual analogue to digital values are normalized from 0 to 255. From this example, it demonstrates that the RSSI based WSN is successfully established, meanwhile, the good distance measurement performance is also possessed.

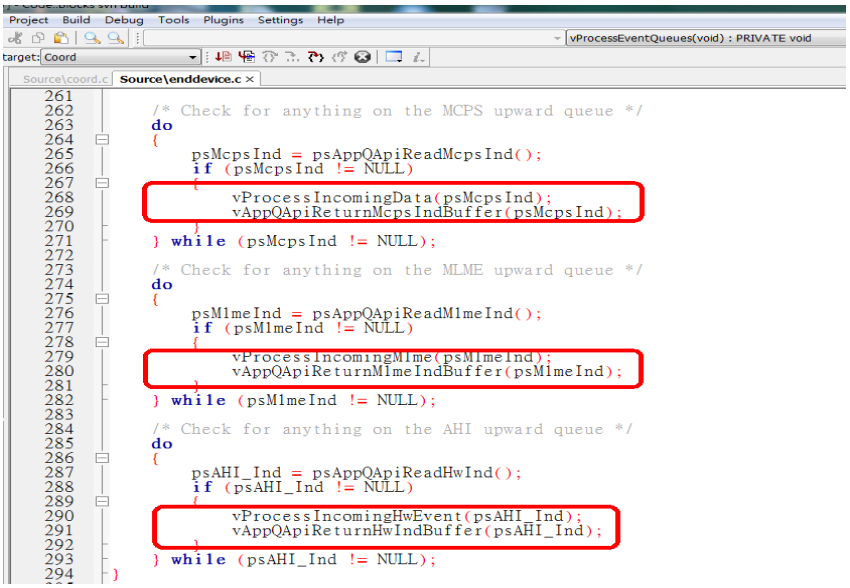

Fig. 1. The program of RSSI for distance measurement

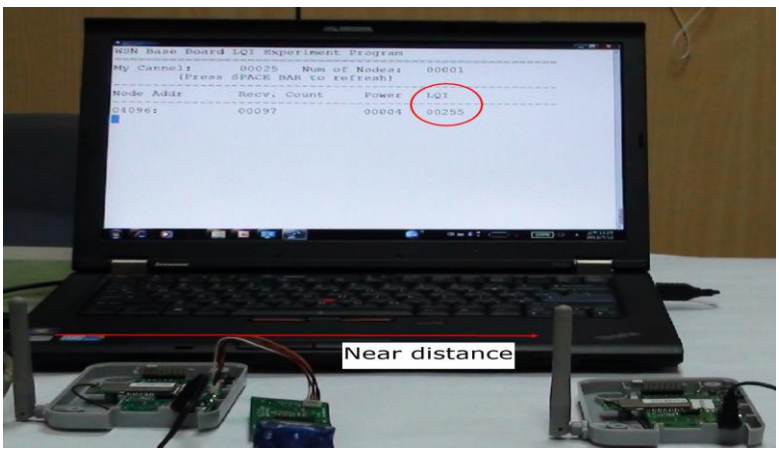

Fig. 2 (a) The near distance test of RSSI

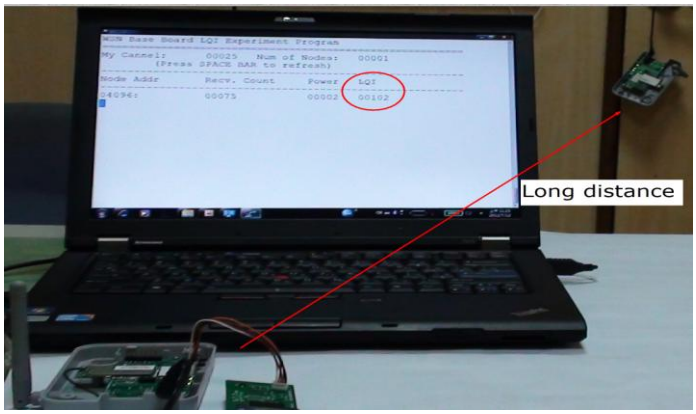

Fig. 2 (b) The long distance test of RSSI

IV. CONCLUSION

In this paper, the design method for the application of distance measurement is established by using the measurement programs of received signal strength indicator (RSSI) of IEEE 802.15.4/ZigBee wireless sensor network (WSN). It demonstrates that the RSSI based WSN is successfully established, meanwhile, the good distance measurement performance is also possessed.

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