ZigBee(2.4G) Wireless Sensor Network Application on Indoor Intrusion Detection

Hsien-Wei Tseng[1], Yang-Han Lee[2*], Liang-Yu Yen[2], Su-Yi Yu[1], and Yi-Lun Chen[2]
[1]Department of Computer Science, Ningde Normal University, Ningde, Fujian
[2]Department of Electronic Engineering, Tamkang University, New Taipei, Taiwan

Abstract--In this paper, it discusses and performs lab experiment of detecting LQI value from ZigBee wireless sensor network and from the variation of LQI values to determine is there any intrusion. In closed and no one existence indoor area it has a steady LQI value while it changes when someone intrudes into the area. An intrusion detection system is developed by using the variation in LQI values. After the system is validated we further develop an in house intrusion monitor system that when someone intrudes into the house the system will alarm or send a message to the house owner's cell phone to alarm the house has been intruded so as to attain the in house security protection effect.

Keywords：Zigbee, LQI, Indoor detection

I. INTRODUCTION

Over many years, it has installed many monitoring videos around public areas and traffic heavy corners it is mainly to protect people to prevent them from being attacked. People are not only to pay attention of their safeties in the public areas but also they consider their safeties at home living of how to prevent any possible intrusions. To get immediately notification when the house in intruded is the most important issue; it becomes more important ever since to have the safety at home to prevent intrusion.

In this paper it proposes a measure of using ZigBee wireless transmission to monitor the possible house intrusion; it measures the Link Quality Indicator (LQI) between the terminals of Coordinator and the End-Devices and monitor the LQI variations to determine is there any intrusion.

II. SYSTEM ARCHITECTURE

A. Hardware Deveopment

The laboratory development board is the ZigBee Sensor Development Board as shown in Fig. 1. It has two boards one is the Base Development Board (BDB) with model number FT-6250 while the other is FT-6251, the Sensor Development Board (SDB) .

The main difference between BDB and SDB is that it includes a digital temperature/humidity sensor in SDB and therefore it can monitor temperature/humidity in SDB.

B. Development Program

It uses Jennic Code:: Blocks and Jennic Flash Programmer as the development program; Code::Blocks provides IDE development tool in editing, assembling and error detection

while the Jennic Flash Programmer will burn the assembled files onto the tool programs of the hardware platform .

Fig.1 SDB (red circled area is the temperature/humidity sensor)

C. System Demonstration

ZigBee End-Device is setup at the door and across from it is the the ZigBee Coordinator their distance is limited within 75 meters. When someone enters into the room the power between the terminal transceivers will induce some variations and from this power variation to determine is there any intrusion (Fig.2)

D. System Structure

The system structure is shown in Fig. 3. When the network is setup at ZigBee Coordinator (Terminal C) and after the ZigBee End-Device joins the network (Terminal E), terminal E starts sending data packets and after the terminal E Coordinator receives the transmitted packets that will be automatically converted into LQI values and displayed at the computer terminal[1].
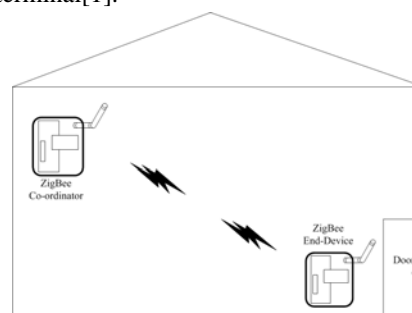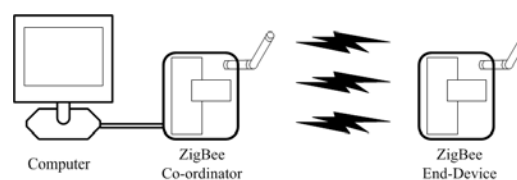

Fig. 2 System Demonstration

Fig. 3 System Structure

III. STUDY MEHOD

A. Test Introduction

In this test it is to study the effect on LQI values when door

is open/close and in intrusion, the setup of the system in the laboratory is shown in Fig. 4, it takes and fixed at five minutes in every test and LQI is taken every second; three environments are considered as discussed in the following[2]:

Environment I:

A person from outside opens the classroom door and enters into the classroom and then closes the door; and then he opens the classroom door and walks to outside and closes the door after 30 seconds stay. The person stands still after he enters into and walks outside of the classroom.

Environment II:

The person from outside opens the classroom door enters into the classroom and then walks pass through the mid-place between Coordinator and the End-Device terminals and then walks outside and closes the door.

Environment III:

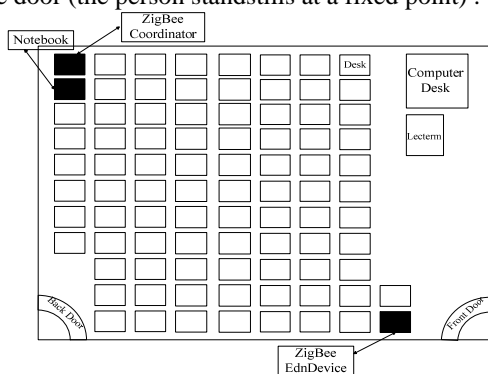In the classroom he opens the door and after 15 seconds he closes the door (the person standstills at a fixed point) .

Fig 4. The system setup in the classroom

B. Test procedures

It begins to turn on the ZigBee Coordinator computer, then turn on the power of the ZigBee Development Board (terminal C), turn on computer (notebook) terminal and then turn on the power of the ZigBee End-Device Development board (terminal E). When the network between two terminals is established it will start transmitting data and the terminal will display the data transmitted from terminal E that includes the short address of terminal E, number of packets, power level and LQI value [3].

IV. TEST RESULTS

When no one is walking and no any activities the LQI will maintain at a constant level. But if it has any environment changes, it will have disturbance in the LQI value. The test results for the above three environments considered are as follows:

Environment I: When it has no any activities the LQI will keep at a constant level. When the classroom door is open or close and when it has persons entering or walking out of the room the LQI value will change. More specifically when it has some one enters into the classroom the LQI value will be lower on the other hand the LQI will go higher when someone walks out of the classroom. When the door is open the LQI

may be higher or lower and therefore the LQI will have some effects if there is any person in the classroom.

Environment II: As shown in Fig. 5, when a person opens the door and enters into the room and passes through the path between the Coordinator and the End-Device terminals and then walks out the room and close the door the LQI has significant variation since it has persons moving and it has some disturbance in the environment. If it has people walking in the room the LQI value will have quite change. When a person walks out of the room the LQI value becomes stable and this phenomena is quite obvious and therefore it can use the LQI variation to determine is there any intrusion into the room.

Environment III: The person is standstill and he only opens or closes the door the LQI does not have any specific variation; it has significant variation at the instant the door is open or close the LQI value will have variation and it is affected by the door is open or close and the angle in the open of the door and therefore if it has only door open or close the LQI value will not have obvious effect.
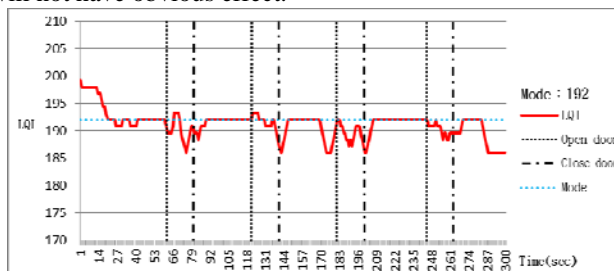

Fig. 5 Test result of environment II

V. CONCLUSION AND FUTURE STUDY

In this paper we studied the LQI variations in three environments.From the test results of these three environments it concluded that the LQI value would not have obvious variation and only if it had door open or close the LQI would have significant varied. It then could be concluded that if it has no any person in the room and the room is not affected by the outside environment the LAI value will have a constant level and when it has someone enters and intrudes the room the LQI value varies and from the extent of the LQI variation we can determine is the room has been intruded.

REFERENCE

[1]. Zhang, Jun, et al. "An indoor security system with a jumping robot as the surveillance terminal." Consumer Electronics, IEEE Transactions on 57.4 (2011): 1774-1781.

[2]. Kaltiokallio, Ossi, and Maurizio Bocca. "Real-time intrusion detection and tracking in indoor environment through distributed RSSI processing." Embedded and Real-Time Computing Systems and Applications (RTCSA), 2011 IEEE 17th International Conference on. Vol. 1. IEEE, 2011.

[3]. Oksar, Irfan. "A Bluetooth signal strength based indoor localization method."Systems, Signals and Image Processing (IWSSIP), 2014 International Conference on. IEEE, 2014.

[4]. Benkic, Karl, et al. "Using RSSI value for distance estimation in wireless sensor networks based on ZigBee." Systems, Signals and Image Processing, 2008. IWSSIP 2008. 15th International Conference on. IEEE, 2008.