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Design and Implementation of WLAN Based ZigBee for Personal Identification

Abstract- *In this research, a novel Wireless Local Area Network (WLAN) that can be used for personal identification has been proposed in order to control the entering of any building or facility for safety applications. The network consists of three parts; node carrying by authorized persons, Base Station (BS) to control the entering and gate controller. A Personal Computer (PC), which represented the BS, will display automatically some information like picture and state about the person that entered when he/she becomes in BS coverage area. The gate controller of protected building is received a command of PC after matching the data onto entire person and open by a period to allow only one person to pass the gate after being sensed by Human sensor of controller. While preventing any other body by maintaining the gate in case of closure and show alarm. For the experimental purpose, the control of the gate is virtually assumed as Light-Emitting Diode (LED) to represent the opening and closing by lighting and closing the LED respectively. An Arduino Uno is used as microcontroller and ZigBee S2 is used for communication link, because of their simplicity, small size and low cost. Results of running the proposed model confirmed that it could effectively and accurately control the entry and exit of people authorized to enter the important formation and recording the date and time of entry and exit form the need for intervention by people. On the other hand, it can easily review any person files and show his/her daily attendance.*

Keywords- *controlling of authorized, Arduino Uno, ZigBee*

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1. Introduction

Since the advent of high-performance Wireless Local Area Network (WLAN) technology at relatively low cost, it uses for wireless control for many practical applications. When a number of mobile nodes are required to co-operate then, from a systems design perspective, the possibility that each one might be treated as a node on an LAN is particularly attractive [1]. ZigBee is a recently developed wireless technology used in many commercials and research applications. Based on the IEEE 802.15.4 specification [2], it has become a very attractive wireless connectivity solution due to its open standard, low cost and low power characteristics. ZigBee is suitable for low data-rate and low power consumption applications in comparison with other wireless technologies such as Bluetooth and Wi-Fi. ZigBee applications included home and building automation, industrial control, building management systems, environmental monitoring, and vehicle fleet management systems [3,4]. WLAN technologies are becoming increasingly popular and promise to be the platform for many future applications like home entertainment networking. Many researchers have been implemented WLAN for identification of various method. The researchers in [5] are proposed a wireless fingerprint security system based on ZigBee technology for authentication. This system is based on taking fingerprint of a user with the help of a fingerprint sensor module and matching it with the database details corresponding to the user fingerprint and displays it on the computer screen. In [6], a vehicular identification and authentication for campus security was proposed which requires identification of vehicle entering in a campus and authentication of person seating in the vehicle. Such proposed system uses the ZigBee technology for communication. The design in [7] has been realized the ZigBee as a Wi-Fi wireless gateway based on STM32W108 RF chip and embedded Wi-Fi module. The ZigBee was used as wireless gateways to collect the received data onto sensor nodes and interacts with them. In addition, the authors of [8] were implemented a WSN based Arduino and ZigBee protocol. Such network included four sensors used for monitoring and safety for any building. Finally, in [9] a smart real time meter was designed for smart electrical grid. The idea is to send the information about measurements wirelessly through ZigBee to the BS for managements and monitoring. This paper attempts to design and apply a WLAN based on ZigBee protocol to

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identify the personal and authentication for security of any office. The idea is to store all information about any person in such office and facility into a PC, which act as a BS. The date and time of entering and exiting such facility will be added to each authentic and can be reading only by the head of the facility or whoever authorizes them.

2. The Proposed System Model

This research proposes a system to control the entry any persons into building and record a sufficient information about arrival and departure of each person. The condition of this proposal is that such building has only one gait for entering and exiting. The mechanical opening and closing of such gate must be quick in order to prevent undesirable people from entering this building. The gate machine is controlled by programmable technology linked wirelessly to receive the command of a computer, which has a complete data onto each person. The block diagram of proposed system is shown in Figure 1. The proposal system needs three wireless units to insurance the link between all parts with such system. ZigBee protocol based IEEE 802.15.14 is suitable for this work because of its desired feature like low cost, low consumption of power, short time delay and reliable communications.

I. Authorized

Be a person that is authorized to enter the facility and must carry a device called identification node, which contains of ZigBee XBee S2, Arduino (Microprocessor) and power supply as shown in Figure 2, which is zoomed by 3 times. It is important to make it clear the power supply in this image can be replaced by a small battery by a size of at most one cubic centimeter but here for laboratory case. It has been allocated a unique special number for the XBee of this node, which is the key to the file of the person, authorized, stored in the BS and displayed using Visual Basic (VB) program. This file contains the complete information about the person as well as a private image. It is possible to open the file directly when the person carrying the node entering the coverage of the BS and soon the PC will display some information like picture and the state of the person. The usefulness of this technique is that it can dispense the equipment and records of registration the attendance and absence of staff at the facility. Note that each identification node has a special code number stored in the BS when programmed such node before delivered to the authorized person. In addition, for more safety, it can be add a small key board to this node which used by only the person who carrying such node to take precautions when it lost, but this point can be implemented in the future work.

II. Base Station

This unit having two parts, hardware and software. The first part is the XBEE connected as a coordinator device to the gate side of PC interfaced by RS232 as shown in Figure 3. The second part are a VB program interfaced by XBee program. The ZigBee device coordinator is connected to the PC to link the identification node of any person approaching the BS carrying such node. Then an immediately the PC will display some information and send a command to open the gate. Nevertheless, the door will not open until the person reaches the nearest point when Human sensor, which connected to the controller, enabled the gate to open when it receives the PC command and sensor enabling with a precise time limited previously. The interface between XBee and VB program is to employ its facilities to store complete information about authorized person and can be summoned at any time when such person is entry the coverage area of base station. The flowchart of interfaces between VB and XBee program is shown in Figure 4. The tools offered by VB are not limited to store the information, but also address the ability to record the time of arriving and departing for entities, which help to improve the security of the facilities. This technique can also be used to record the presence and absence of the authorized entities without the usage of any other tools.

Figure 1: The block diagram of proposed system.

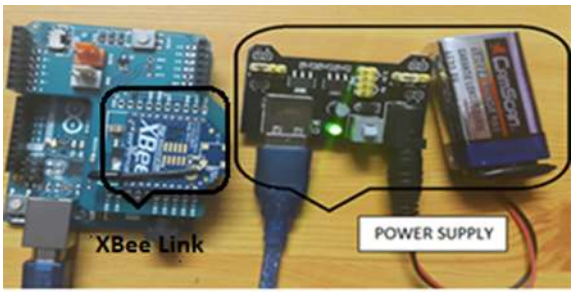

Figure 2: The hardware of identification node

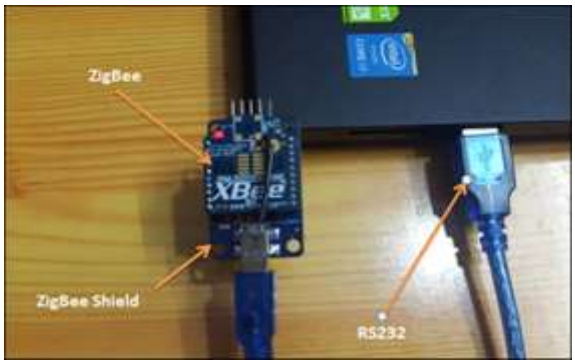

Figure 3: The hardware of base station.

Figure 4: The flowchart of interfaces between VB and XBee programs.

III. Controlled Gate

The gate was controlled using of Arduino boards with its software. It is connected to the server of DC motor to control its running and direction. It receives the command of the coordinator of PC through the ZigBee that connected to such board. The software of an Arduino is interfaced with VB in order to exploit its facilities as mentioned previously. It is necessary to clear out that LED represents the server and motor for the purpose of experimental. Figure 5 in the next page shows the block diagram of proposed control gate and its flowchart is shown in Figure 6.

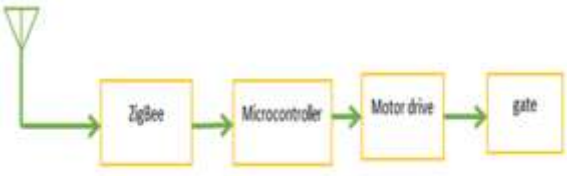

Figure 5: The block diagram of gate and its control.

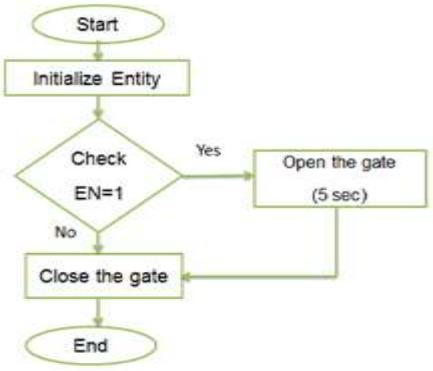

Figure 6: The flowchart of controls the gate.

3. Devices Used for the Proposed System

In this research, sophisticated techniques are used to implement the proposed model. Considering the simplicity, economy capacity, low cost and small size. These components, which used as a hardware in the proposed system, are:

I. Transceiver Unit

The system will use three units of ZigBee, the first one is within the authorized node, the second is connected with the computer via cable RS232 that will senses when a person enters its field area and the third unit is present in the gate controller to receive the command from BS. Each unit of ZigBee having a special serial number which differed from other unit. This number is exploited here as a key of the person profile that is in the list of peoples that can enter the gate of such building. The computer also will send a command of the third unit of ZigBee, which is connected, to the control system to open the gate after receiving the specific order. Figure 7 illustrates the ZigBee layout used in the proposed system, which is S2 types that can be used for network connection and differ from other type used for point to point. The specification and the parameters of such ZigBee are listed in Table 1.

II. Microcontroller Circuit

This unit is used with nods and control gate parts of proposed system; its layout is shown in Figure 8. It has 14 digital input/output pins of which 6 pints can be used as Pulse Width Modulation (PWM) outputs, 6 analog inputs, 1 ground, 1 reset button, a 16 MHz crystal oscillator, an USB connection, a power jack, an In Circuit Serial Programming (ICSP) header, and reset button. In addition, it contains everything needed to support the microcontroller; simply connect it to a computer with an USB cable or power it with an AC-to-DC adapter or battery to get started. Arduino Uno is a microcontroller board based on

the ATmega328 and the specification and the parameters of such Arduino are listed in Table 2. It worth to mention this Arduino has been used in its status for laboratory purposes, so that the practical size will be very small compared with current size.

Figure 7: The ZigBee Layout.

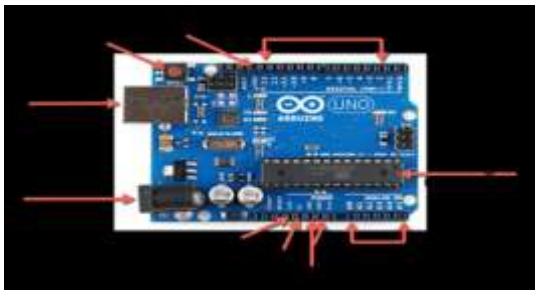

Figure 8: The Arduino Uno Layout

Table 1: The parameters of used unit of ZigBee

Model Code	XB24-BZ7WIT-004
Operating Frequency	ISM 2.4 GHz
Antenna type	Wire antenna
Supply Voltage	2.7 – 3.6V
Operating Temperature	-40 to 85º C (industrial)
Supported Network Topologies	Point-to-point, Point-to-multipoint & Peer-to-peer
Addressing Options	PAN ID and Addresses, Cluster IDs
No. of Channels	11 to 25
Receiver Sensitivity	-102 (dB m)

Table 2: The parameters of used unit of Arduino Uno

Microcontroller	ATmega328
Operating Voltage	5V
Supply Voltage (recommended)	7-12V
Maximum supply voltage (not recommended)	20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2KB (ATmega328)

4.Running and Results

In this section it has been running the propose network in real time using the combination of VB and XBEE programs. The following steps are applied for this running:-

1. By using VB program, it can be designed a panel window contains the person's information which includes employee ID, name, address, status, time of arrival and time of departure. As well as this interface contains the control part which includes refreshing and scanning buttons as shown in Figure 9. Refresh button is used to search for port number and scan button is used to start searching for nodes.The number of port will be displayed soon after refreshing in the control window of the panel automatically. To put the system in the monitor states i.e. searching for any authorized persons want to enter the facility, it must click to search bottoms. Now the system is ready to discover any user needs to enter the gate and will make control for such gates.

2.If anybody in the authorized list is arriving the coverage area of base station the identification node of such body will transmit a message to the coordinator automatically. The VB will display the panel window which some important information about such person which stored previously. For example if “Marwa Samir Ali” is entering the coverage area of base station, her information will be displayed in the panel window as shown in Figure 10. It is clear that only time of arrival is present and the time of departure well appears when she leaves.After two seconds the coordinator of BS will transmit a command to open the gate for 5 seconds which is enough for one person only to pass through such gate. The door will not open till the person approaches the nearest point of the gate when Human sensor enables the control gate in a regular sequence timeline with BS commands. The router connected to microcontroller of control gate will receive such command to enable the gate drive. As previously mentioned, it has been putting an LED connected to microcontroller to indicate that the gate is opened as shown in Figur11.

3.If a second authorized is reaching near the facility gate the same procedure will apply in step 2 and his information and time of arrival will display as shown in Figure 12, it has been suppose that “Ahmed Hassan Ali” is arrive the facility. It should be noted that all information about any authorized will be stored in the VB program for the purpose of returning to it at any time.

4.If any authorized want to leave the facility the base stations will add the departure time for the

previous information as shown in Figure 13.

Figure 9: The interface panel of VB.

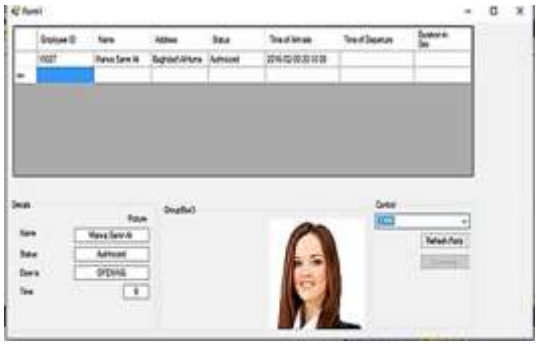

Figure 10: The nodes enter to facilities.

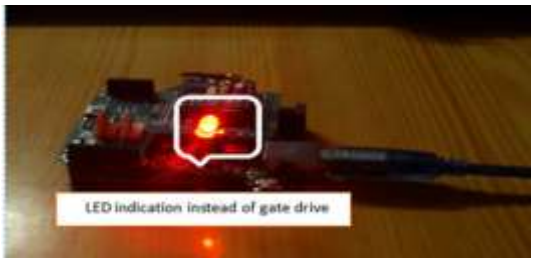

Figure 11: The gate control is enabled to open.

Figure 12: The second node enters to facilities.

Figure 13: The authorized is to leave the facility.

5. Discussions

The results of section 4 show that the proposed system can control the entry and record the time of an arrival, departure and duration for each person. This enables the facility management to control the entering of people and block unauthorized person to enter such facilities, which support the facility for security purpose. It is worth to mention that in [6], the system controls the gateway to campus after checking the vehicular that will enter such campus. The gateway will open the gateway when the vehicular become in the coverage area of gateway BS. Such system cannot record any information about the date and tome of entering. In addition, it can only be developed if the entire system is replaced, while the proposed system of this research has potential for future development.

6. Conclusion

In this paper it has been designed a proposed network to control the entering of a certain facility. It is supposed that all authorized persons must hold an identification node, which was designed in this research. The proposed system included two main parts, software and hardware. The software it has been designing a combination of XBEE, S2 technique with VB programs to enable the controlling and saving the wanted information for any authorized. The results confirm that the proposed network can control perfectly the entering of a facility with complete information about their arriving and departure times. All above information are stored as a file for each one in VB, which can be revised at any time. Also, in the case of needing to prevent anyone who was authorized previously and stopped his/her entering, it is easy to put a temporary or permanent blocking signal and display a note about the reason of preventing. In addition, for future work, it is possible to fallow the movements inside the building (where the Global Position System (GPS) is not active) by adding many routers to cover such facility and use a special algorithm for such purpose.

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