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Wireless Communication for Networked Computer Systems using Zigbee

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Abstract
Wireless communication involves the transmission of information over a distance without the use of cables or any other forms of electrical conductors. The related technologies that are being used in wireless communication include Radio Broadcast, Global Positioning System (GPS), Wireless-Fidelity (Wi-Fi), Infrared, Satellite, Microwave and Bluetooth which use internet mode and not cost friendly except Bluetooth. This paper aimed at designing a wireless communication for networked computer systems using ZigBee technology. The architecture of the technology is divided into two sections: the master and the slaves, the sections would communicate with master acting as transmitter and slaves acting as receiver and vice-versa (but addressed to master). The transmitter is connected to the handheld device (Android Phone) via Bluetooth then the message is routed through the microcontroller to the ZigBee module with proper addressing wrapped with the messages then broadcasted. The receivers (slaves which are networked) got the message which is trapped by ZigBee module. Then decoded first by microcontroller if matches then post the packet for the main message and sent to PCs via RS232 protocol but if doesn't match it is discarded (every slave has a unique identification (ID). In terms of area of coverage, number of nodes connected and cost of installation, the ZigBee technology offered a better performance than other technologies such as Wi-Fi and Bluetooth. Hence, it would be recommended that it is used and applied in the field of Communication and Networks.

Keywords: Handheld device, microcontroller, networked computers, wireless communication, ZigBee technology

INTRODUCTION

Wireless communication system has become an important part of various types of wireless communication devices that permit user to communicate even from remote operated areas. This paper implements the ZigBee technology that incorporates all procedures and forms of connecting and communicating between two or more devices using a wireless signal through wireless communication technologies and devices. Meanwhile, ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection (Park & Yoon, 2006).

Files can be transferred correctly in the range of wireless network except when the base station encounters problem that may affect the network. ZigBee network could avoid this problem because it uses a Gateway node to enable other nodes to join its network directly or in a multi-hop way (Farahani, 2008).

Table 1: Comparison among Bluetooth, Wi-Fi and ZigBee

Standard	Bluetooth	Wi-Fi	ZigBee
Distance Covered	10m	100m	10-100m
Max Number of Nodes	8	2007	>65000
Cost	Medium	High	Low
Mode of Access	Gateway (No direct connection to Internet)	Internet	No Internet
Protocol	High	Medium	Low

According to Cheng, Hung and Chang (2007), ZigBee technology was reported in the integration of Power Monitoring System (PMS) with Direct Load Control Capabilities. In ZigBee wireless communication, the PMS utilises Digital Signal Processing (DSP) and Web services which was used for construction of a power management of a campus. The system demonstrated a good performance in direct load control and transmission of warning message (Javaid, Sharif, Khan & Mahmood, 2012)

Jui-Yu Cheng, Tao-Yuan, Min-Hsing Hung and Yen-Wei Chang (2007) opined that ZigBee communication has capacity to measure the currents drawn by electric outlets using an embedded board and ZigBee technology.

Zein and Khaleghi (2014) examined wave propagation of various emerging technologies such as Multiple-Input Multiple-Output (MIMO), Ultra-Wide Band (UWB) and Time-Reversal (TR) in wireless communication, the paper helps in choosing the most appropriate coding and modulation scheme for a given environment.

METHODOLOGY

Hardware and Software Requirements: Microcontroller (Arduino IDE), Handheld device (Android Phone), Personal Computers (PCs), RS 232 Converter, ZigBee Modules, C++ Programming Language (Open Source App), UART Terminal (Software Serial Terminal).

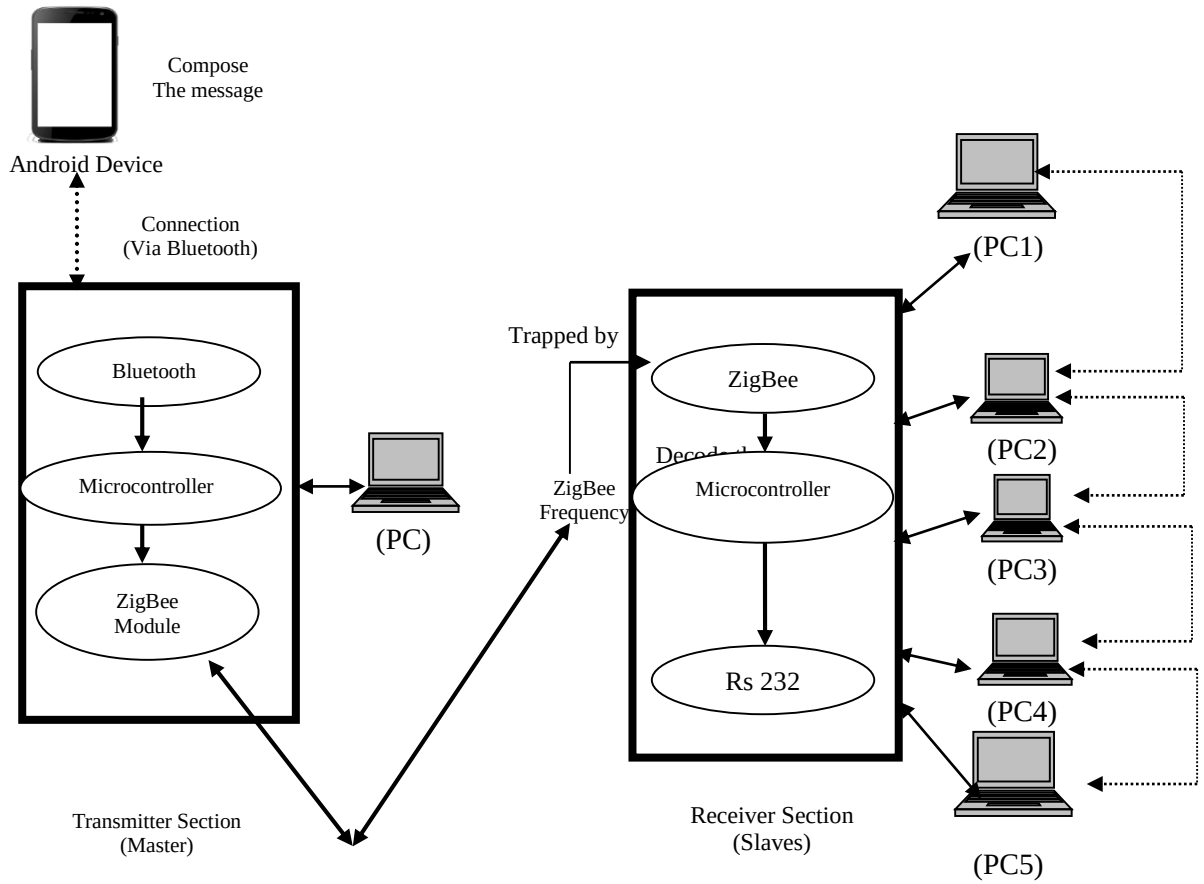

Figure 1: Architecture of the Proposed System

Figure 1 is categorized into two sections; the transmitter and the receiver. The transmitting section consists of a Bluetooth module, a Microcontroller and a ZigBee module. For instance, if a message is to be sent to an intending user wirelessly, a user via an Android phone connects to the Bluetooth module attached to the transmitting system, types his message and sends to the transmitting system through the Bluetooth connection.

The system receives this message, modulates it and then sends it to air using the ZigBee module. In the message there must be a recipient address and the message content. The second part of this design is the

receiving section consisting of a ZigBee module, a microcontroller, a Rs232 converter and personal computers. The message in air sent by a transmitting section at ZigBee frequency would be trapped by a ZigBee module attached to the receiving section into the microcontroller. The message is then decoded first for its address. If it matches the address of the receiver, the packet is posted for its main message content and then sent via the Rs232 converter to the personal computers. If the address in the received packet is not seen as the address of the receiver, the message is then discarded.

RESULTS AND DISCUSSION

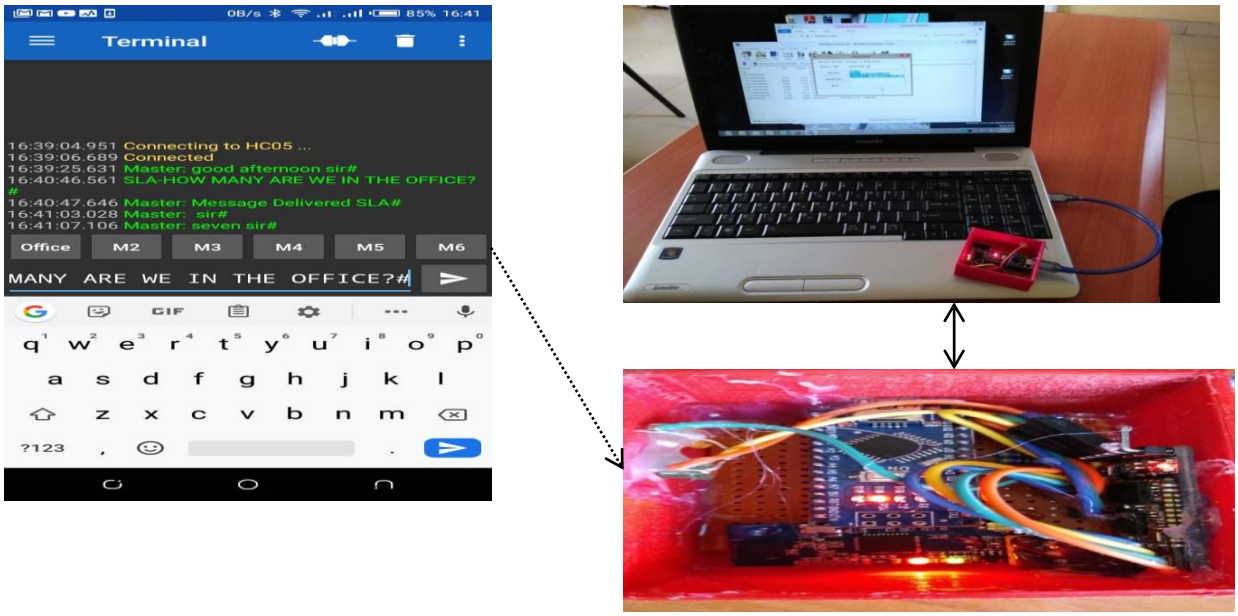

Figure 2: Transmitter Section (Master Page) for sending messages

Figure 1 shows that more than one receiving system are connected together, each with its unique identification, the implication is that when a packet is sent from Figure 2 that is, the transmitter section, all available receivers in Figure 3 within the stipulated frequency of a ZigBee network sees the message but only the receiver whose unique identity matches the identity in the packet displays the message via PC.

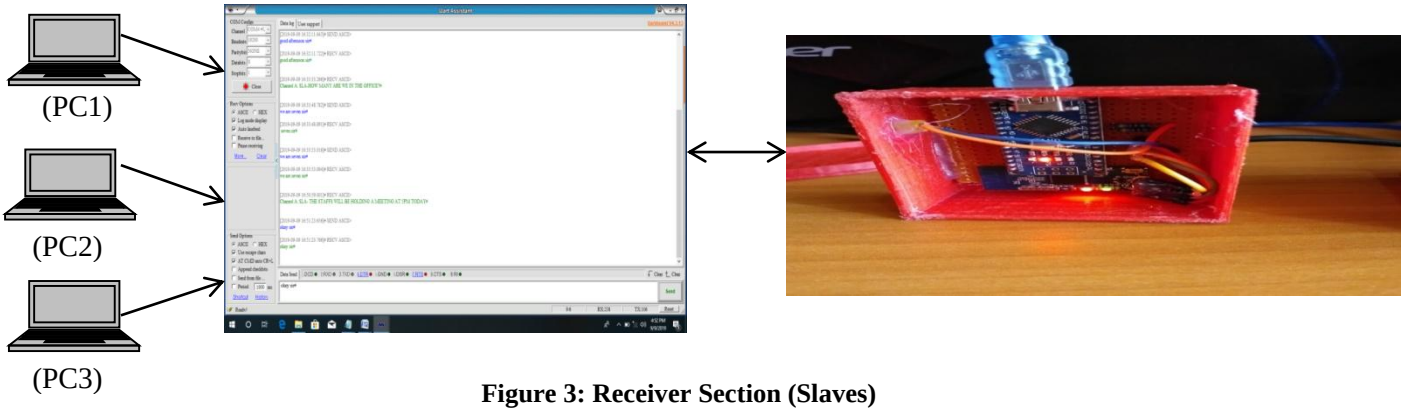

Figure 3: Receiver Section (Slaves)

The Figure 4 is a storage database for all records both incoming and outgoing messages, which enable the

administrator to monitor the process on the network and to be able to track and trace the message whenever need arises.

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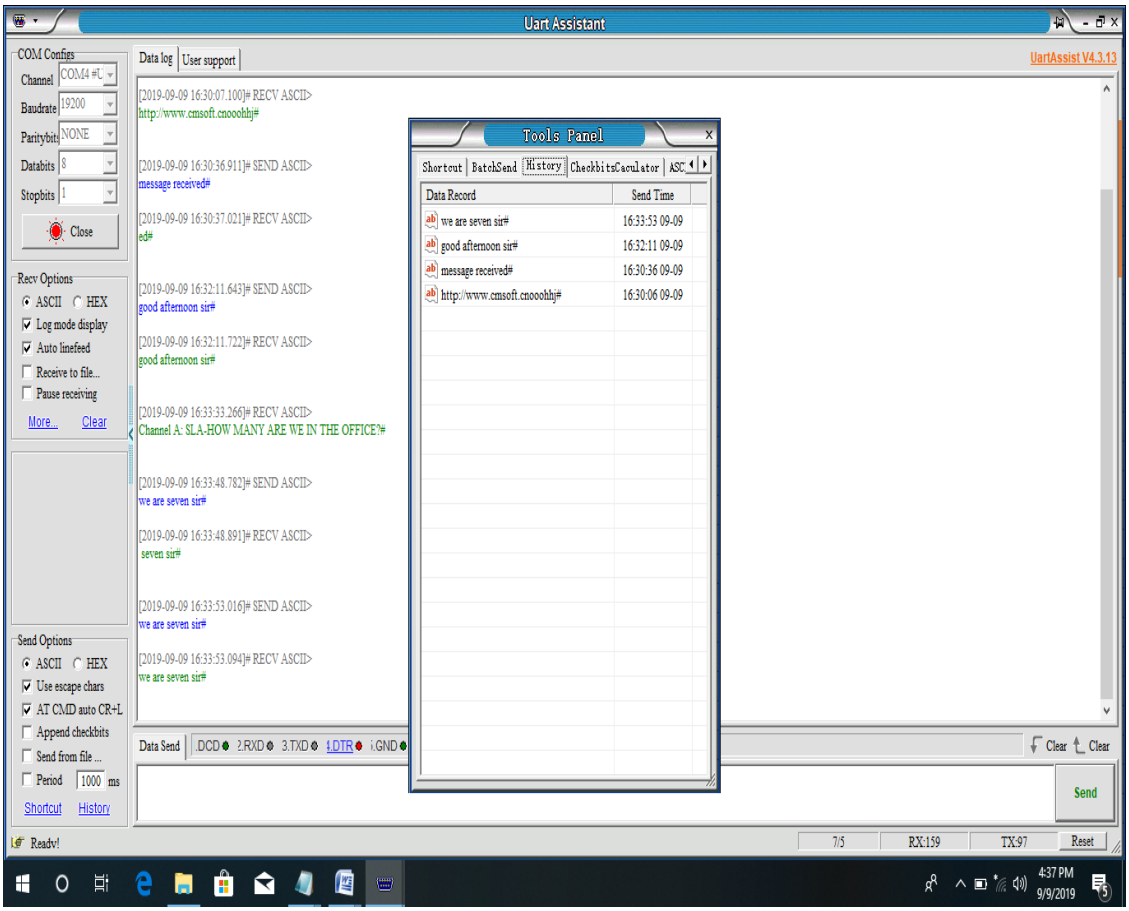

Figure 4: **A storage database for all records both incoming and outgoing messages**

Table 1 shows the comparison of various technologies in which ZigBee technology was seen as the best mode of communication in terms of area of coverage, number of nodes connected and cost of installation, the ZigBee technology offered a better performance than other technologies such as Wi-Fi and Bluetooth.

CONCLUSION

The design architecture is developed through analyzing the hardware composition principles and the software design methods based on the ZigBee wireless network node. In terms of area of coverage, number of nodes connected and cost of installation, the ZigBee technology offered a better performance than other technologies such as Wi-Fi and Bluetooth. Hence, it would be recommended that it is used and applied in the field of Communication and Networks. In communication, feedback is very necessary and the designed architecture provided a feedback. The medium used in the process, any sent packet with a valid receiver's ID is received by the intending receiving system and displayed. The receiver then via his own ZigBee module returns a feedback to air. This microcontroller via its attached Bluetooth module sends to a user's handheld device. Every successfully received packet sends a feedback to the m

master via same medium.

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