Zigbee Based Home Appliances Controlling Through Spoken Commands Using Handheld Devices

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Abstract

Home automation is a wide and varied field that involves devices as small as temperature, light and motion sensor, and as powerful as modern home appliances. In today's world technology is available for home automation but these technologies are incompatible with each other and addresses only communication and physical media, the main objective of this work is to facilitate the user to control appliances by two ways one is remotely via voice command, second is using remote control to control the appliances which is also an override control.

Keywords: *Home Automation, Short Messaging Service, Spoken command, Global System for mobile Communication and ZigBee Network*

1. Introduction

The world has become a global village due to revolution in the technology; in this revolution the IT (information technology) played an important role. Similarly the revolution in IT makes mankind dream come true to have an automated home. Home automation use microprocessor-based intelligence to integrate or control electronic products and systems in the home. The incentive behind home automation is efficient utilization of electricity. So a variety of research and many solutions had proposed on home automation. These systems use PC, mobile internet, GSM Bluetooth and ZigBee network etc. [1-2].

Generally, home automation research targeted many needs; some applications fulfill the sophisticated and luxury requirements; other focuses the special needs like elderly and the disabled etc. [2]. In such applications voice recognition technology is used such as in [3-4].

In this paper a method is devised which control the home appliances through voice commands. For that purpose a mobile application is developed that convert the user voice command into SMS and send through GSM network. Such application is developed using java for mobile technology and MPLAB for microchip family of controller. This proposed system is affordable to everyone, cheap and easy to install.

2. Related Work

In [2] authors present the low power RF ZigBee based voice control system for home automation. In this method ZigBee receives the voice command as input and then send that data to ARM9 controller which converts the input data in required format. After the conversion ARM9 controller send data to microcontroller via ZigBee where devices are attached. In proposed system voice command is simply converted into the digital data and sends serially as a packet of binary data. At receiver side digital data is again reconstructed into the voice and pass it to the computer through a sound card. In computer Visual Basic programming is running which use the Microsoft Speech API library for the voice recognition. After voice recognition, system generates the control characters which than used to switch OFF/ON the appliances. Control characters are sent wirelessly to the specified appliance.

[3] presents the client server based voice control system for home automation in wireless environment. Client system is used to capture the voice command and send that data to server via Wi-Fi wireless network. Server system is equipped GUI manager for implementing the speech recognition system. GUI is developed using Microsoft Visual Basic.net and speech recognition system is developed by using Microsoft Speech (SAPI). Server system converts the incoming voice data into the form which can used to handle home appliances. Results depict that the proposed system performance heavily relay on the wireless network coverage, distance, voice input type etc.

[4] discuss the mobile based voice command control and monitoring system. In the proposed architecture multi layer feed forward neural network is used for recognizing the suitable words. Authors develop an algorithm which converts the spoken input into text message after extracting the features such as; Cepstral coefficients, short time energy and zero crossing rate etc. For experimentation they used mobile phone model 6610. Results show that their proposed system accuracy is about 84%.

In [5] the prototype design of ZigBee based integrated remote control is discussed. Such architecture scheme has ability to control all appliances without additional hardware. Generally, connecting all appliances through a single home network is difficult because communication protocols are different. The integrated remote control is composed of three components; integrated remote controller, ZigBee to infrared converter, and ZigBee power adapter. ZigBee power adapter is used for those appliances that even do not have infrared remote device in order to connect with the home network.

A cell phone based home appliance control system is presented in [6]. In proposed system architecture authors used the J2ME language to program client cell phone. Master phone when receive commands from clients and perform action according to it via sending request to PIC microcontroller. Opto-coupler and static power switch (TRAIC) is used to interface the devices between the PIC and the home appliances.

[7] Authors present home controlling method through PC. In this paper they discussed two controlling procedures methods; time and speech. User interface is developed using VB 6.0 language and for voice recognition they used Microsoft voice engine tools. Moreover they used parallel ports in order to transfer data from computer to specific device which to be controlled. They test their proposed scheme on eight different appliances and got satisfactory results.

3. Proposed Methodology

In this paper main aim is to propose model for home automation system. Proposed system architecture is shown in Figure 1.

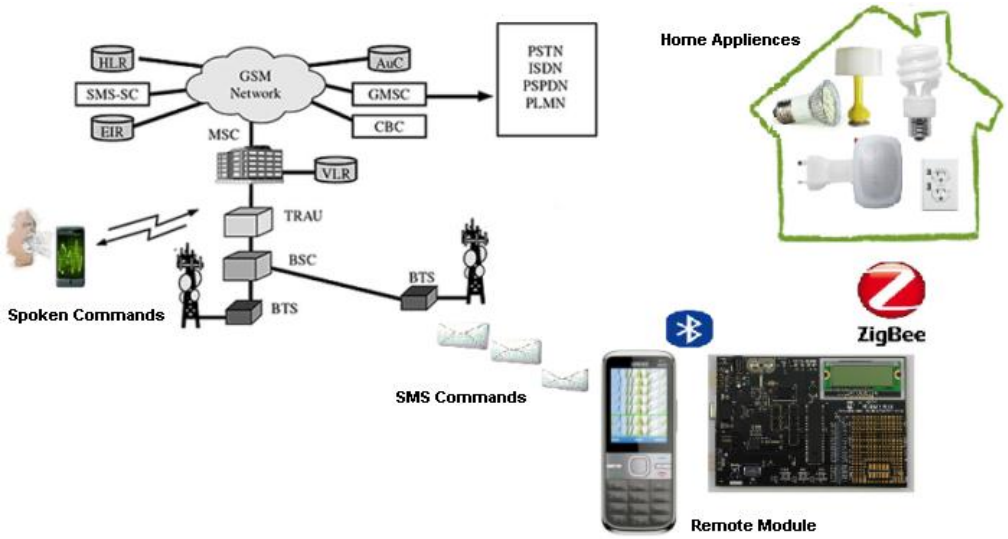

Figure 1. Proposed System Architecture

In the proposed method the user with android OS based Mobile speaks voice commands, the mobile application covert the voice command in to text and payload the command on GSM network via SMS. Table 1 shows basic command which is appended in SMS.

Table 1. Basic Commands

VOICE COMMANDS	SMS COMMANDS
Main console on	'MCONE'
Main console off	'MCOFFE'
Zone 1 appliances on	'Z1ONE'
Zone 1 appliances off	'Z1OFFE'
Zone 2 appliances on	'Z2ONE'
Zone 2 appliances off	'Z2ONE'
Light zone 1 on	'LZ1ONE'
Light zone 1 off	'LZ1OFFE'
Fan zone 2 on	'FZ2ONE'
Fan zone 2 off	'FZ2OFFE'

On the receiver side these commands are received and transfer to the controller using Bluetooth medium which is further precede. A snapshot of proposed system algorithm is given in Figure 2.

```
Begin
Check connected hardware
If hardware test fails
Return
End
Else if hardware tests succeed then
Successful communication
If system gets a voice to text SMS  command
Check the authenticity
If voice to SMS command  not from the preconfigured number
Abort
Else
Receive the voice to  SMS command
If command is about controlling the appliances
Send the command  to remote unit through control unit
wait for acknowledgment
if acknowledged
Else retry
End
If command is about knowing the status of appliances
Check the status of  appliances and
sends the status
End
```

Figure 2. Proposed System Algorithm

3.1 Hardware Design

The Hardware design is subdivided in to three parts due to different functionality of the proposed system, the main purpose of the system is to receive the commands and apply action according to it. In the first part which is the heart of this work is the control unit; it initialize the devices which were attached to the control unit which is Bluetooth Device and Zigbee transceiver, after this it looks for the command when it is received it simply transfer the command to the remote unit. At the remote unit checks for the incoming command when it is received it applies action and sends a feedback to the user for the completion and the proper operation of the command. The override control is a simply remote control which is programmed to check for the user entered key, when key is pressed it decode the pressed key and send the authorized command to the user.

Control unit: The heart of this hardware is PIC16F877A [9], when the command is completely received it is transferred to the microcontroller PIC16F877A through Bluetooth Module BTM 222 [11], as shown in Figure 3, which uses AT commands serially to communicate with the mobile.

Figure 3. Shows BTM 222

After the complete reception of command it is transferred to remote unit through ZigBee transceiver of MC13211 ZigBee Compliant Platform 2.4 GHz Low Power Transceiver for the IEEE 802.15.4.[10], MC13211 is shown in Figure 4.

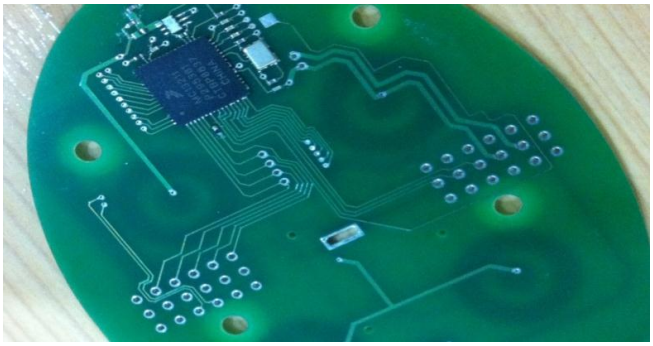

Figure 4. MC13211

Remote unit: The remote unit consists of a micro controller PIC16f877A and ZigBee transceiver MC13211. These transceivers are programmed to communicate with the main controller using serial communication protocol to acknowledge for data transmission and reception. When the command is completely received the controller switch on the concern appliance. The circuit which is used to switch on the device consist of MOC3021 an optical triac and BTA16 triac as shown in Figure 5.

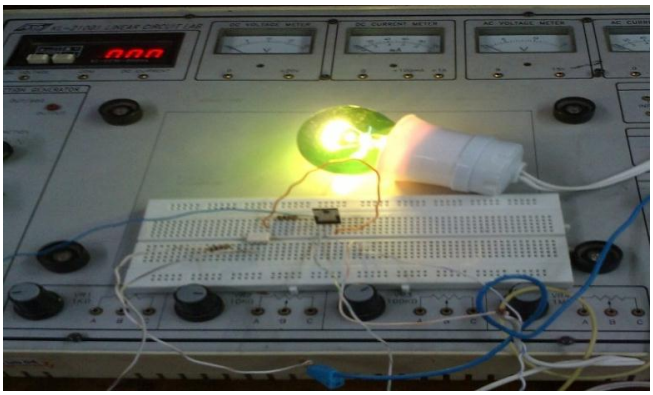

Figure 5. MOC 3021

When the device is ON the current transducer HX-05P use to sense the current for the proper operation of the appliance and send back the acknowledgment to the main feedback to control unit about the proper operation of the command.

Override control: This section describes the override control for the appliances to facilitate the user by using a remote control to switch ON/OFF the device.

3.2 Software Part

Another important aspect of the proposed system is software part which contains a procedure that converts voice command into text. As showed in proposed architecture that for voice commands mobile phone is used. To convert voice command into text an application is developed using android intent API 2.01. Voice to text conversion procedure is as follows;

- First, convert the input voice into signed ByteOutputStream.
- After that, converts that signed ByteOutputStream into unsigned integer array.
- Now converts the unsigned integer array into their respective Extended ASCII characters. But before that conversion add 255 to all those values in array which falls in the range of 0-31 in order to move that range up to 255-287 respectively.
- Now append that ASCII characters as payload text of SMS and send via GSM network.

At receiver side, when mobile phone receives such SMS, first it extracts the payload text and then it converts that text into the format which can easily readable to the microcontroller. After that mobile phone send that text to microcontroller via Bluetooth component for further processing.

4. Results and Discussions

The proposed system has a tendency to convert voice commands in to text. To enable such feature we installed the software in the android OS based mobile phone. After that we test the working of our proposed system on different appliances as shown in Figure 6.

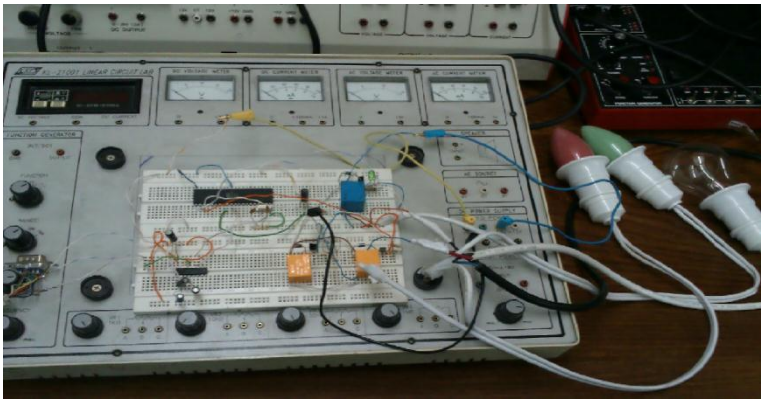

Figure 6. Voice Command Tests for Home Appliances

When the user speaks the command 'Zone 1 appliance on' it convert the voice in to SMS command 'Z1ONE' and append the given command in to the SMS payload. The given table 2 shows the commands for appliances control. After the reception of the SMS on the receiver end the command is transferred to the Controller module using Bluetooth interface. When that command is completely transferred than controller send the command to the remote unit through ZigBee interface, ZigBee provide the advantages of interfacing multiple points to one control unit. Remote unit apply the action on the received command and send a feedback to the control unit.

Table 2. Voice Commands and SMS Commands with Acknowledgement

VOICE COMMANDS	SMS COMMANDS	SMS COMMANDS ACKNOWLEDGEMENT	
		SUCCESS	FAILURE
Main console on	'MCONE'	'Main console on K'	'Main console on N'
Main console off	'MCOFFE'	'Main console off K'	'Main console off N'
Zone 1 appliances on	'Z1ONE'	'Zone 1 appliances on K'	'Zone 1 appliances on N'
Zone 1 appliances off	'Z1OFFE'	'Zone 1 appliances off K'	'Zone 1 appliances off N'
Zone 2 appliances on	'Z2ONE'	'Zone 2 appliances on K'	'Zone 2 appliances on N
Zone 2 appliances off	'Z2ONE'	'Zone 2 appliances off K'	'Zone 2 appliances off N'
Light zone 1 on	'LZ1ONE'	'Light zone 1 on K'	'Light zone 1 on N'
Light zone 1 off	'LZ1OFFE'	'Light zone 1 off K'	'Light zone 1 off N'
Fan zone 2 on	'FZ2ONE'	'fan zone 2 on K'	'fan zone 2 on N'
Fan zone 2 off	'FZ2OFFE'	'fan zone 2 off K'	'fan zone 2 off N'

5. Conclusion

This paper presents a wireless based home automation system which can be controlled through spoken commands. In the proposed architecture, wireless component is added by GSM and for home networking ZigBee technology is used. For voice command processing an application is developed and installed in the mobile phone.

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