

# “HM2007 Based Home Automation using PIC and Zigbee”

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**Abstract**— Development view of this Project is to make an ease for the handicapped persons to operate different appliances in a room through speaking a single word. This Wireless Home Automation Unit is mounted in with the switch board which so as to lower down the wall unit cost. This unit comprises of a low power Xbee, a Voice Recognition unit called as HM2007 and a PIC microcontroller. Another development view is that Home automation system is having a rapid growth by introducing various wireless technologies. The competition in the wireless technology made an emergence to various standards, especially in the medical (ISM) radio band, industrial and scientific fields. The home automation system in actual is used to control all lights and electronic appliances in an office or home using voice commands. So in this paper our motto is to develop a speech recognition based wireless home automation unit using XBee.

**Key words:** HM2007, PIC Microcontroller, Zig Bee Module

## I. INTRODUCTION

This Wireless Home Automation System is an integrated system to make an ease for elderly and handicapped people with an ease to use home automation system that can be totally controlled through voice commands. This unit is portable and developed in a way that is easy to install, configure, run, and maintained. A commercial wireless home automation unit allows a person to control electrical or electronic appliances from a streamline control unit which is mobile. These units should be uniquely designed to be compatible with one another other and with the control unit for most frequently available home automated units. This project represents a system that can be integrated as a single portable & mobile unit and allows one to wirelessly operates lights, fans, air conditioners, television sets, security cameras, electronic doors, computer systems, audio/visual equipment's, etc. and operate any electrical or electronic unit that is interfaced into a wall unit and get the grade of different sensors and take decision appropriately. The complete system is operated from a microphone which is inbuilt with HM2007 speech recognition module. This module transmits the voice bits in binary order to microcontroller. The transmitter takes decision and transmits the commands to remote station by ZigBee transceiver. The receiver station receives the bits through ZigBee transceiver and performs the requested functions. The sensors is efficient of identifying when the user enters or exit the room by measuring the change in signals strength between the access Point and can accordingly turn off or on gadgets and synchronously sends its status back to transmitter station. The system should be reasonably cheap, easy to configure, and easy to run. How to make people's life more convenient, more comfortable and safer and how to save more energy will be the series of questions discussed in this paper.

## II. SYSTEM DEVELOPMENT

### A. System Analysis and Hardware Design

#### 1) Hardware Used

In this section will enlist the techniques happening in the design of the Voice Recognition Wireless Home Automation System which is Based On ZigBee. The project was divided into parts to make the automated process modular. In the prototype board fabricated by the authors, these parts replaced with their specifications are:

- Speech Recognition Unit: The heart of speech recognition system is HM2007 voice recognition IC. The IC can recognize 20 words, each word a length of 1.92 seconds.
- ZigBee It is a low-cost, low-power, wireless networking standard.
- The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and different networking topologies provides high reliability and larger range.
- Microcontroller: PIC 18FXX belong to class of 8-bit microcontrollers of RISC architecture. Features of PIC are 5 I/O ports, Interrupt sources 21, Timer4 etc.
- Power supply unit: For both station require 5v power supply each.

#### 2) Software Used

Software design includes voice recognition, transmission and reception of wireless signal using ZigBee transceiver, read the sensors, updates the status of relay switches and displays the status on LCD display accordingly. The main program for this system is written by using the embedded Programming language. The schematic diagram for this system which consists of all the components was designed by using the Proteus ISIS 7 Professional editions. The main program was developed in the Mplab Integrated Development Environment by using the embedded C programming language. The .c program was converted into .HEX in this IDE and burned into the ROM part of the PIC microcontroller. For ZigBee two ways to setting ID address which is using X-CTU software or using programming code to send specified command for ZigBee ID address setting.

### B. Overall Development

#### 1) Base Station

The base station will operate with a +5V power supply. This voltage will be used as the operating voltage for all of the circuit elements in the base station. The microphone in the base station will be picking up audio in a close range

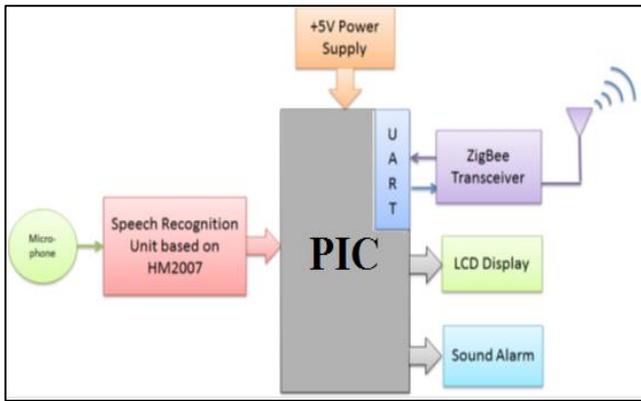


Fig. 1: Block diagram of base station

2) Remote Station

The remote station will operate with same +5 V power supply. The remote station CPU Receives the digital signal commands from the base station using the Zigbee wireless module and performs the request function. On the basis of command signals received it will update the status of relay switches board. It also read the sensors values and update the LCD status on the remote station. The sensors unit is capable of detecting when the user enters or leaves the room by measuring the variation in signals strength between the access Point and can operate electronic and electrical appliances and in the meantime send its status back to base station.

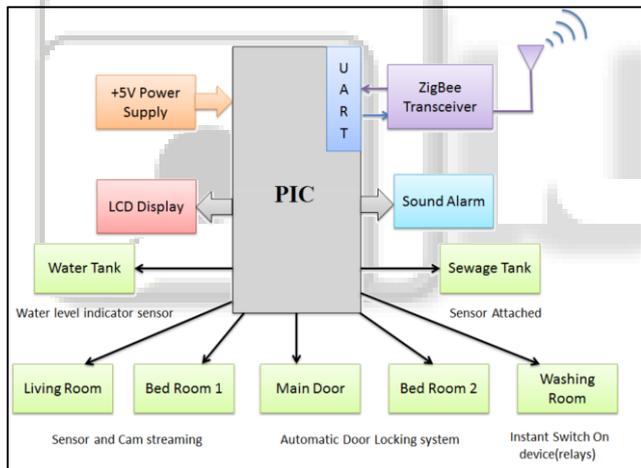


Fig. 2: Block diagram of Remote station

III. FLOWCHART

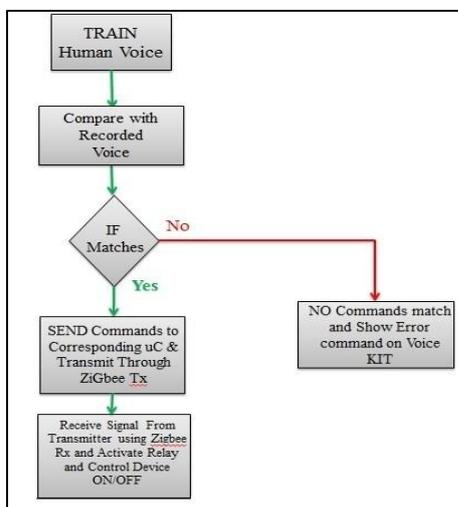


Fig. 3 Flowchart

IV. ALGORITHM

- 1) First TRAIN the Voice.
- 2) Then say commands for which device we want to turn ON/OFF.
- 3) If the Recognised word is ok then send data to uC and transmit through zigbee Tx and receive by zigbee Rx then activate relay using Microcontroller at receiver side.
- 4) If recognised word is wrong it shows ERROR commands on 7-segment display.

V. METHODOLOGY

A. PIC Microcontroller

Microchip Technology are the manufacturers of pic which are produced on a large scale. PIC is the series of microcontroller having some advance features then other series of microcontroller like 8051. Primarily is the speed that is fast as compared and we can also interface through it. Because of the following features used PIC controller. Any type of 8-bit microcontroller can be established with the system. Here we are using 40-Pin 8-Bit CMOS FLASH Microcontroller. In this we used two PIC Microcontrollers one at Transmitter side and other at Receiver side.

B. HM2007 Voice Recognition Kit

It is a single chip CMOS voice recognition LSI circuit with the on-chip analogue front-end, voice analysis, speech recognition process and system control function. A 20 isolated word voice recognition module can be composed of external microphone, keyboard, 8K SRAM and other components, combined with a microcontroller; an extraordinary recognition system can be built. There are two mode which are supported by this system, Manual mode and CPU mode.

1) Manual Mode

This mode is selected by connecting Pin 14(CPUM) to ground by using SPDT switch. When the circuit is turned on, "00" is on the digital display, the red LED (contacted with READY pin) is lit and the circuit waits for a command. Using manual mode we can do the following tasks:

- Training Words for Recognition:
- Testing Recognition:
- Error Codes Detection in 7-segment display. This happens when the voice command is too short or too long.
- Clearing Memory.

2) CPU MODE

This mode is used when we want to perform additional functions or want to make our system smart, this is done by connecting voice recognition system with the microcontroller. This mode is selected by connecting Pin 14(CPUM) to Vcc by using SPDT switch. The several function provide by CPU modes which are similar to manual mode are:

- RECOG
- TRAIN
- RESULT
- UPLOAD
- DOWNLOAD
- RESET

### C. Zigbee

ZigBee protocol is the communication protocol that is used in this automation model. ZigBee offers 250 kbps as maximum baud rate; however, 9600 bps was used for transreception of characters. ZigBee is a low power consuming wireless communication technology designed for monitoring and controlling various devices. Based on the 802.15.4 standard,

ZigBee environment provides a strong and a dependable solution in noisy radio frequency (RF) surrounding. ZigBee specification include energy detection, clear channel assessment and channel agility help devices pick the best available channel and restrict other wireless interference such as Wi-Fi, while message acknowledgement proves that the data is delivered to its destination. Multiple levels of privacy ensure that the network and data remain intact and secured.

#### a) Zigbee Hardware Interface Between Microcontroller

If we want to use encoding platform to send the command to ZigBee, we have to ensure that hardware connection between Zigbee to microcontroller is complete. Any microcontroller with UART feature can be used to interface with ZigBee as shown below:

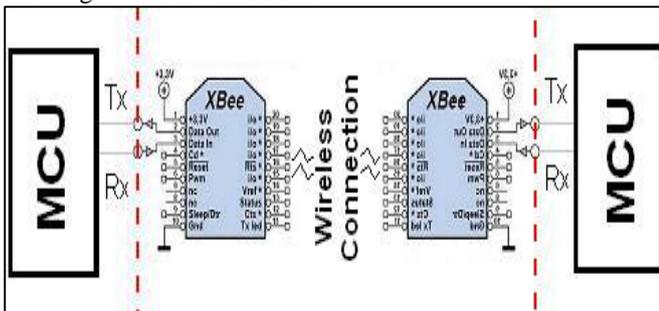


Fig. 4: Standard ZigBee wireless communication link with microcontroller

The way we will be using the Zigbee is far easier. Straight out of the box, the Zigbee is normally programmed for 9600bps serial communication and so to make things easier, we haven't change any of the configuration options. This means we will o be using only the Vcc, ground(GND), Din and Dout pins and keeping other pins uninterfaced. In Fig.4 we have connected RXD pin no.3of ZigBee to TXD pin of microcontroller and ZigBee TXD pin no. 2 to RXD pin of microcontroller.

### VI. EXPERIMENTAL RESULTS

The prototype of the system is implemented and tested. Eight different voice commands are TRAIN and used in it, the results for few commands is shown in below and also by pressing 01 to 08 on keypad control devices

- 1) A (01) for "LIGHTS1 ON"      5. E (05) for "LIGHTS1 OFF"
- 2) B (02) for "MOTAR ON"      6. F (06) for "MOTAR OFF"
- 3) C (03) for "FAN ON"      7. G (07) for "FAN OFF"
- 4) D (04) for "LIGHTS2 ON"      8. H (08) for "LIGHTS2 ON".

A specific character is sent only on recognition of a valid command, else no character is sent. The experimental results are shown in the figure below.

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RESULTS FOR VOICE COMMANDS
Say a command
SPEECH 'A' = LIGHTS1 ON
Recognised = Ok // LIGHT1 ON
Say a command
SPEECH 'AAA...' = LIGHT1 ON
ERROR 55 // 0x55 Word to Long
Say a command
SPEECH 'B' = MOTOR ON
Recognised = Ok // MOTOR ON
Say a command
SPEECH '...B' =MOTOR ON
ERROR 66 //0x66 Word to Short
Say a command
SPEECH 'C' = FAN ON
Recognised = Ok // FAN ON
Say a command
SPEECH 'CCC...' = FAN ON
ERROR 55 // 0x55 Word to Long
Say a command
SPEECH 'D' = LIGHTS2 ON
Recognised = Ok // LIGHT2 ON
Say a command
SPEECH '...D' = LIGHT2 ON
ERROR 66 //0x66 Word to Short
Say a command
SPEECH 'R'
ERROR 77 //0x77 No match Try Again
    
```

Fig. 5: RESULT

### VII. CONCLUSION

In this work, we have designed a voice operated Zigbee based home automation system. We used speech recognition module HM2007. The system is designed for elderly or handicapped people so that they can identify and control the house hold gadget with their available ability. The wireless part of the system has been installed by using Zigbee modules. Hence the system is highly adorable and consumes low power. This system can be easily widespread to control the home appliances or gadgets through smart devices like Android or iPhone and others phones so that one can frequently check the status of the home appliances and turn ON or OFF the gadget. The proposed unit has been tested with three home appliances. But, it can be easily expanded to include more home appliances. A WHAS based on voice recognition was built and implemented. Through this system we have been able to control the switching on and switching of two different devices solelythroughvoice commands. The proposed system therefore provides solutions for the problems faced by old or handicap persons in daily life and makes their life easier and more comfortable by proposing a cheap and reliable solution. The system developed can be used to control AC and DC appliances through speech. Voice recognition was successfully implemented using the low power HM2007 voice model.

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