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Speech Recognition Based Wireless Automation of Home Loads- E Home

Amrutha S, Aravind S, Ansu Mathew, Swathy Sugathan, Rajasree R, and Priyalakshmi S

Department of Electronics and Communication Engineering,
Sree Buddha College of Engineering for Women, Kerala, India

Abstract— Each day we are aiming for a relaxing and more laid back home. Technology plays a major role in making our homes more automated and hence laid back. This research aims to design and implement a cost effective but yet flexible, adaptable, and secure Home automation system. Paper presents design and prototype implementation of a basic home automation system based on SMS technology and voice recognition. When automating a home load not available in the visible range, fault identification system in this design helps the user to ensure that their home appliances had gone exactly ON or OFF. Each home load will be having two commands ON and OFF commands. Automation of 2 loads such as fan and light has been tested by giving 4 voice commands through personal computer. When user creates his own profile and automates the load speech recognition accuracy of more than 90% is achieved. Other people who were allowed to automate the load by the user can use user profile and achieve a speech recognition accuracy of 75% in the same personal computer.

Index Terms— SMS technology.

I. 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. 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. In such applications voice recognition technology is used Wireless communication based home automation system has gained a high momentum for the last couple of years. Wireless communication reduces the complexity related to the installation and maintenance compared to its wired counterpart. A typical wireless home automation system comprises battery operated and low power wireless sensors and actuators. Bluetooth, Wi-Fi, and ZigBee are the popular choice for the backbone of such systems. Wireless network based smart home systems have become very popular as they provide comfort, security, and safety. Moreover, they support remote monitoring facilities. The availability of cheap wireless sensors, actuators, and modules has reduced the gap between the luxury and mass market segmentations of home automation technologies. However, wireless home automation system has some limitations too.

The home automation needs to make use of latest technological advancements. This project aims to design and develop a home automation system which is wireless and can be controlled in multiple ways to give more accessibility and control over the system. The purpose is to develop and design an automation system which is accessible remotely at the same time locally in a user friendly way. Yet cost effective, robust, portable and easily operable so that it could be widely accepted for multiple needs. Wireless communication in home automation is centered on low-power RF Zigbee wireless communication modules. Voice commands and GSM messaging are to be used to control the automation of household electrical appliances.

II. RELATED WORK

Home automation is the automatic or semi-automatic control and monitoring of household appliances and residential house features like doors, gate and even the windows. This is a demonstration of how to design and build a multi-purpose wireless system that can switch OFF and ON any electrical household appliance depending



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on the voice produced by the user. Thoraya Obaid et al. [1] proposed a voice controlled wireless smart home system for elderly and disabled people. The proposed system has two main components namely voice recognition system, and wireless system. Lab View software has been used to implement the voice recognition system. On the other hand, ZigBee wireless modules have been used to implement the wireless system. Based on the received data at the wireless receiver associated with the appliances desired switching operations are performed. The proposed system is a low cost and low power system because ZigBee is used. Additionally the proposed system needs to be trained of voice command only once.

Another home automation system was proposed by Dhawan S. Thakurand and Aditi Sharma [2]. That demonstrates a system that can be integrated as a single portable unit and allows one to wirelessly control lights, fans, air conditioners, television sets, security cameras, electronic doors, computer systems, audio/visual equipment's etc. and turn on or off any appliance that is plugged into a wall outlet, get the status of different sensors and take decision accordingly. The overall system is controlled from a microphone which is connected with HM 2007 speech recognition chip. This chip sends the voice commands in binary sequence to microcontroller. The base station unit takes decision and sends the commands to remote station by ZigBee transceiver.

Khiyal et al. [6] proposed a system for controlling home appliances remotely that is useful for the people who are not at home mostly. The main objective of the system is to provide security and control the home appliances such as AC, lights and alarms. The system is implemented by SMS technology that is used to transfer data from sender to receiver over GSM network. Also Haque et al. [7] proposed a system that controls the home appliances using the personal computer. This system is developed by using the Visual Basic 6.0 as programming language and Microsoft voice engine tools for speech recognition purpose. Appliances can be either controlled by timer or by voice command.

III. PROPOSED METHOD

a) SYSTEM MODEL

The system model is shown in Figure 1. The system consists of the following basic components (i) automatic speech recognition system, (ii) control units, (iii) wireless system and (iv) application and home appliances. Automatic speech recognition (ASR) system can be defined as an independent and computer-driven transcription of spoken language that allows a computer to identify the spoken words captured from a microphone or telephone and converts it into written texts. The main components of an ASR are (i) a microphone, (ii) speech recognition software and (iii) a computer. Through a speech recognition program/application, the computer is able to process words one says and turn them into text that is displayed on the screen. There have been many research activities on the speech recognition system. The fundamental reasons of these research activities are (i) accessibility for the deaf and hard of hearing, (ii) cost reduction through automation, and (iii) searchable text capability.

The control unit (CU) coordinates the components of a computer system. It fetches the code of all of the instructions in a program. It directs the operation of the other units by providing timing and control signals. There are different types of control program available including MATLAB, C++, and Lab View. In this work we choose MATLAB because of the following reasons: (a) it is easier to build a large program piecewise using small amounts of code, (b) it is easy to control the interfaces between hardware, (c) it is easy to find compatible hardware in the market, (d) it is simple to integrate with other hardware and software, and (d) it is easy to create the user-interface.

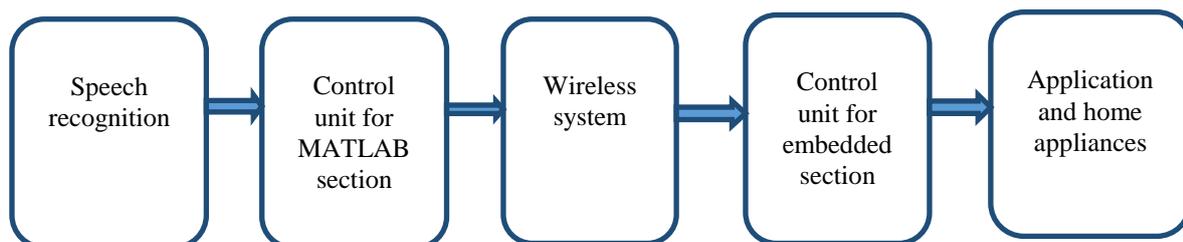


Fig 1: System model



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Wireless networks and sensors are playing important roles in emerging pervasive computing technologies that are required for the realization of smart homes. Effectively all wireless technologies that can support some form of remote data transfer, sensing, and control are candidates for inclusion in the smart home portfolio. In this work we used ZigBee wireless system. The control unit for the embedded section is any microcontroller. It co-ordinates all the functions that performed by the control part.

b) System Design

The proposed method is to use a PC along with MATLAB software for speech processing and recognition. The output of the PC will be sent, through the ZigBee transceivers, to the control part, where a microcontroller will select the required device according to the input voice command.

The system can be divided into 3 main parts:

1. Audio processing part → microphone and PC with MATLAB software
2. Transmission part → ZigBee transceivers
3. Control part → microcontroller, relays and GSM module

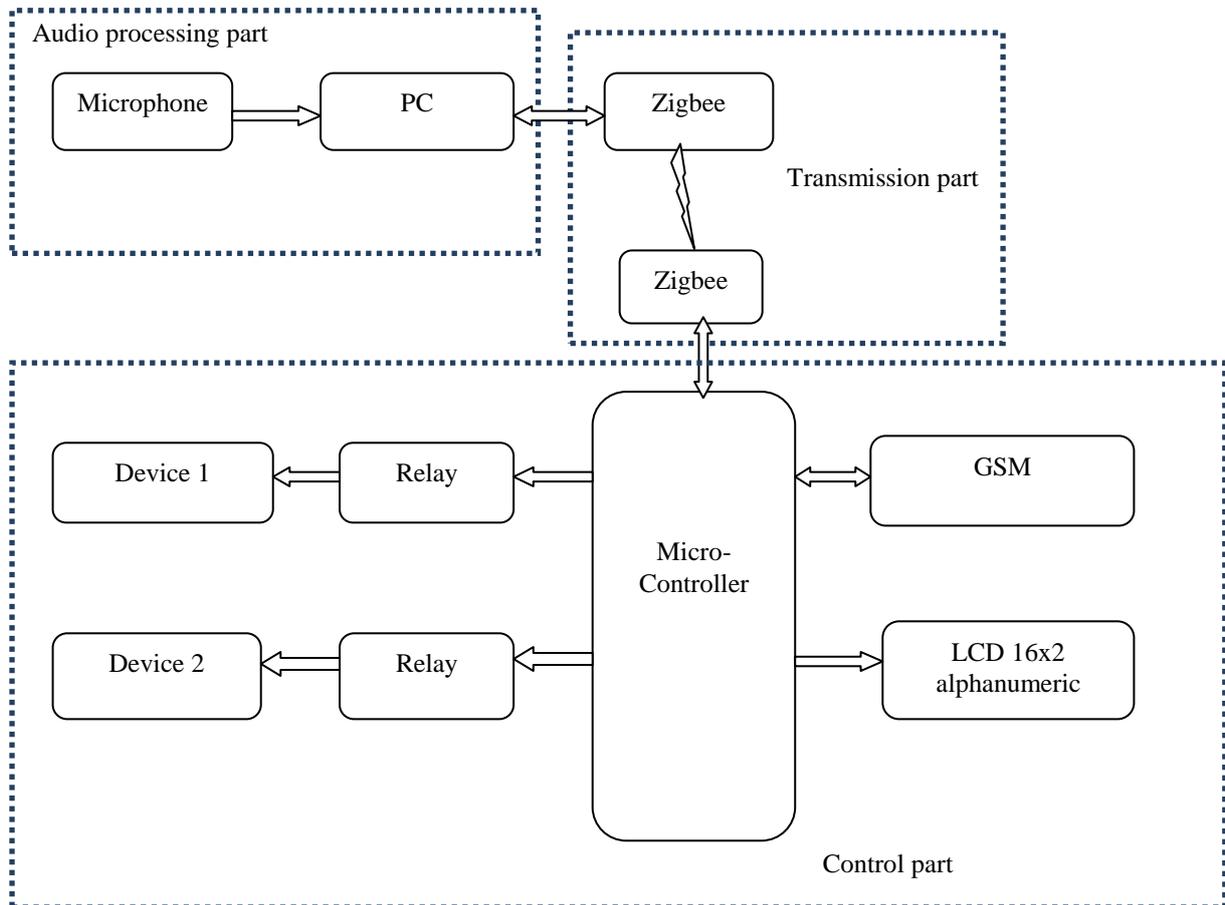


Fig 2: Block Diagram

Audio processing part

The voice commands will first be captured and processed in MATLAB according to the voice recognition method used. The captured the speech is compared with the previously trained words in the database and recognizes the speech using appropriate algorithm. After successful identification of the commands, control characters will be wirelessly sent through the ZigBee transceivers to the control part. The proposed system was implemented using



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two home loads such as light and fan. So, the database contains five words, they are fan on, fan off, light on, light off and noise. The control characters that send to control part are '*a', '*b', '*c', '*d' for fan on, fan off, light on, light off respectively. These control characters are given to the transmission part to control the home appliances.

Transmission part

The ZigBee transceivers constitute the transmission part. ZigBee transmitter is connected to the audio processing part and ZigBee receiver is connected to the serial communication port of control part. There are two different ZigBee kits one is USB compatible kit with PC and other one is RS232 protocol compatible. Using these ZigBee transceivers the control characters reaches the control part.

Control part

The control unit for the embedded section is any microcontroller. In this we use an ARM based LPC2148 microcontroller. Applications and home appliances are the last step of the proposed system. Each device connected with the network must have a switching circuit to turn it ON/OFF. The status of each device is monitored by using toggle circuit. The control part will on/off the device according to the control characters.

c) System Implementation

The proposed method is aimed at designing a voice controlled and GSM based smart home system. The system is designed in such a way that it is easy to install and use. The system has two main sections; they are MATLAB section and embedded section. MATLAB section uses a PC with MATLAB software for speech processing and recognition. The speech recognition is done with the help of MATLAB coding. After recognition, corresponding control characters are sent through the ZigBee transceivers to the control part. Microcontroller in the control part will select the required device according to the input voice command. The devices can also be controlled from distant locations through SMS. So, a GSM module is associated with the control part.

Table 1. Voice commands and corresponding control characters

Voice commands	Control characters
Fan on	*a
Fan Off	*b
Light on	*c
Light off	*d

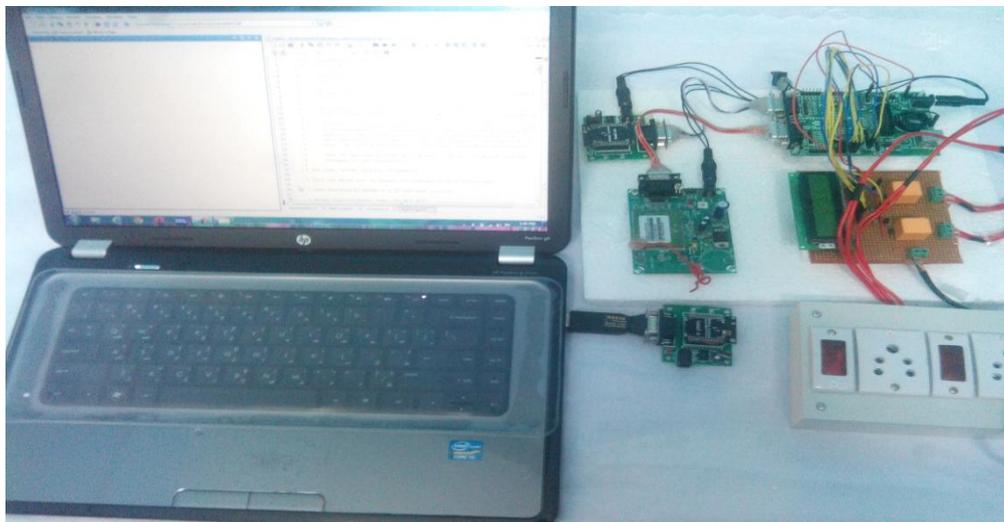


Fig 3. System implementation



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IV. RESULTS AND CONCLUSION

Here we implemented speech recognition based home automation system which can be controlled by voice as well as through SMS technology. Voice recognition based Wireless Home Automation Based on ZigBee is a very useful for the adults and physically disabled persons, who are not able to do various activities efficiently when they are at home and need one's assistant to perform those tasks. With the Voice Recognition along with ZigBee network we can eliminate the complication of wiring in case of wired automation and also it prevent to get up and down again and again to on/off appliances. ZigBee Home Automation provides operating range much higher as compared to Bluetooth and other wireless sensor module. On the other hand with voice recognition system, it provides secure access to home. So when we are living in a fast world where everything is changing with in no time such security is essential.

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AUTHOR BIOGRAPHY



Amrutha S. pursuing final year B.Tech degree in Electronics and Communication Engineering from Mahatma Gandhi University, Kerala, India.



Aravind S. Assistant professor in the Department of Electronics and Communication Engineering, Sree Buddha College of Engineering for Women, Mahatma Gandhi University, Kerala, India. He obtained M.Tech degree in **VLSI and Embedded Systems** with Distiction from Govt. College of Engineering Chengannur, Cochin University in 2012. He received his B.Tech Degree in **Electronics and Communication Engineering** with Distiction from the main campus of Cochin University of Science and Technology, School of Engineering, Kerala, India, in 2009. He has published nine research papers in various International Journals. He has presented three papers in National Conferences. He has excellent and consistent academic records, very good verbal and written communication skills.

He has guided nine projects for graduate engineering students and one project for P.G student .He has academic experince of 3 years and industrial experience of 1.6 years. For Post Graduate students he has handled subjects such as Electronic Design Automation Tools, VLSI Circuit Design and Technology ,Designing with Microcontrollers and Adaptive Signal Processing. He taught subjects such as Network Theory, DSP, Embedded Systems, Digital Electronics, Microcontroller and applications, Computer Organisation and Architecture , Microprocessor and applications, Microwave Engineering ,Computer Networks and VLSI for B.Tech students.



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Ansu Mathew, pursuing final year B.Tech degree in Electronics and Communication Engineering from Mahatma Gandhi University, Kerala, India.



Swathy Sugathan, pursuing final year B.Tech degree in Electronics and Communication Engineering from Mahatma Gandhi University, Kerala, India.



Rajasree R., pursuing final year B.Tech degree in Electronics and Communication Engineering from Mahatma Gandhi University, Kerala, India.



Priyalekshmi S., Assistant professor in the Department of Electronics and Communication Engineering, Sree Buddha College of Engineering for Women, Mahatma Gandhi University, Kerala, India. She obtained M.Tech degree in Applied Electronics from Anna university, in 2011. She received her B.Tech Degree in Electronics and Communication Engineering from Kerala University Trivandrum, in 2009. She has guided several projects for graduate engineering students. She has academic experience of 4 years. She is interested in DCT, Signal Processing and Control Systems.