



The Design and Implementation of Voice Controlled Wireless Intelligent Home Automation System Based on ZigBee

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Abstract— Intelligent Home Automation Systems are gaining importance in today's technology dependent world. Home Automation Systems provide a sense of security and comfort. Using Wireless technology like ZigBee the cost of wiring of Home Automation System can be reduced as well as a reliable and secure communication can be achieved. ZigBee is a low data rate wireless network standard with added features like low-cost, low power consumption and fast reaction. ZigBee is most suitable for small area networks like homes. This System also allows controlling of devices using Voice commands which reduce user interaction with system directly. This System uses SAPI (Speech Application Programming Interface) a Microsoft Application to enable voice recognition when a user gives voice command to the system. This system contains of three main components: i) Intelligent Home Server with ZigBee module, ii) Intelligent environment detection sensor modules and iii) Voice command controlling module. The various features of the system include turning any home appliances or devices, playing media applications, downloading RSS feeds, sending mail, etc.

Keywords: Home Automation, ZigBee, Voice commands, SAPI, Sensors

I. INTRODUCTION

Employment to Population ratio has increased drastically with increasing living standards. Home Automation plays an important role in maintaining these living standards of employed population by providing a secure & convenient environment. The Home Automation Systems not only benefit the employed population but it also helps the disabled and elderly population. The aim of our system is to build a perfect companion for someone to be at home. Our system is a computer based system that can accept voice as well as direct commands and process them. The system provides us with features such as downloading RSS feeds, running any media application like Winamp, Games, etc. and switching any device ON/OFF.

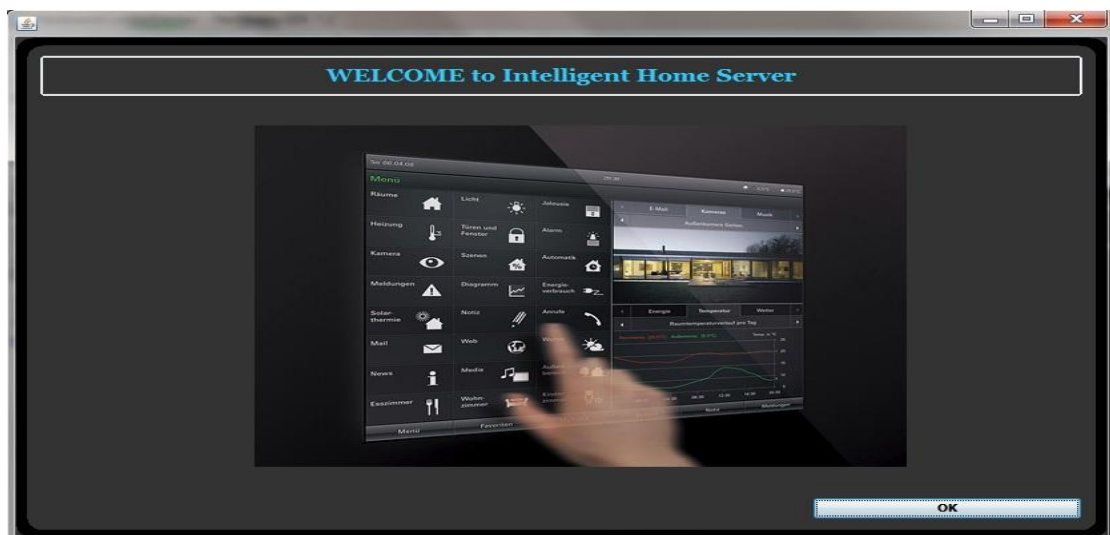


Fig. 1 Intelligent Home Server System's Welcome screen

Voice processing in home automation increased significantly in the recent years. With voice processing the user can communicate with voice rather than interacting with the machine. The performance of a home automation can be hampered due to ambient noise and signal distortion. If the voice signal recognition is poor the home appliances will not be able to switch ON/OFF. Another important aspect of our system other than voice processing is home networking where the home appliances will be connect to the server. The networking in our system will be done using ZigBee technology. ZigBee is a network standard for mainly used for remote monitoring and control. In ZigBee network the

nodes are connected to each other using peer-to-peer communication. ZigBee is cost-effective as it supports low data-rates, low power consumption, security and reliability. ZigBee is a robust wireless solution. The Voice controlled Intelligent Home Automation System we have implemented is called Intelligent Home Server (IHS). IHS main menu consists of Mail send test where we can send the simple plain text mail. Settings contain System password, SMTP server address, SMTP ID and SMTP password. Manage commands can add commands and the applications path. Help consists of IHS system help manual. Speech Interface Test consists of command scanner to check whether command is recognized properly by the system. About contains Information about IHS system. Manage feeds helps in managing feeds and setting their respective URLs. Feed Aggregation helps us to get the Information from the registered URLs. Manual control helps the user to set the threshold value for various devices and helps in controlling the functioning of those devices. Intelligent Control automatically controls the device by voice commands.



Fig. 2 Main Menu of Intelligent Home Server

The features provided by IHS system are as follows:-

- Download media (mp3/video) from internet on user demand.
- Playback user's favourite tracks on demand.
- Control household appliances and even their parameters or program them for timely start and stop operations.
- Give information to the user about sensor parameters from all the rooms. (E.g. Temperature, Light Intensity, Smoke, Gas Leakage, etc.)
- Generate alarm in case the sensor values increase beyond a specified threshold.
- Allow the user to control all the appliances using simply voice commands.
- Download news from internet and annotate it using Text-To-Speech conversion module.
- Download web content or RSS feeds from internet, parse it and annotate it for user.
- Inform the user whenever a specific information from web changes (e.g. stock report, cricket news, etc.)
- Allow user to send mails simply using voice.
- Download all the mails for user and annotate them one by one on users demand.
- Read all incoming messages from users mobile and annotate them on demand.
- Allow user to send SMS messages via GSM modem connected to the central PC.
- Allow the user to control the entire system using solely voice commands.
- To provide a state of the art GUI to control all the above mentioned features in case user wishes to interact with the system directly.
- Use multiple sensors like infrared proximity sensor, temperature sensor, gas sensor, smoke sensor, touch sensor to ensure the security of the house.

II. SYSTEM ARCHITECTURE

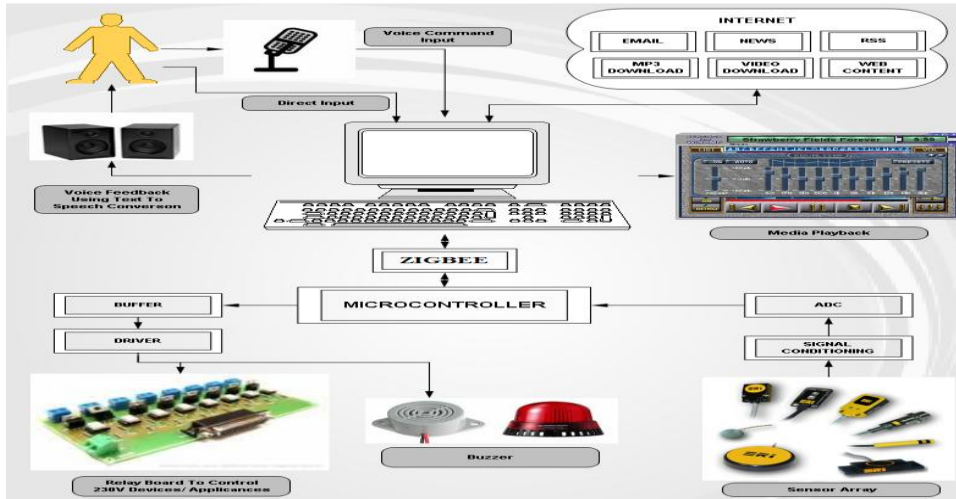


Fig.3. System Architecture

The figure above shows the IHS Architecture which consists of voice processing block, the server, the sensors, the microcontroller and the buzzer. The system begins with Sensors will sensing the various parameters like temperature, heat, pressure etc. of various home appliances. Analog to Digital converter will convert analog signals into digital signals for the computer to interpret it. Microcontroller is used to coordinate various actions and to control the appliances with the use of drive. Computer system will map commands to the required action and monitor the threshold values. It is also used for internet access to download email and RSS Feed. When an emergency situation occurs, firstly, home server records its time and what kind of emergency, following, field alarming module makes shout voices and flashing lights to warn the master who is at home, or to scare illegal intruder.

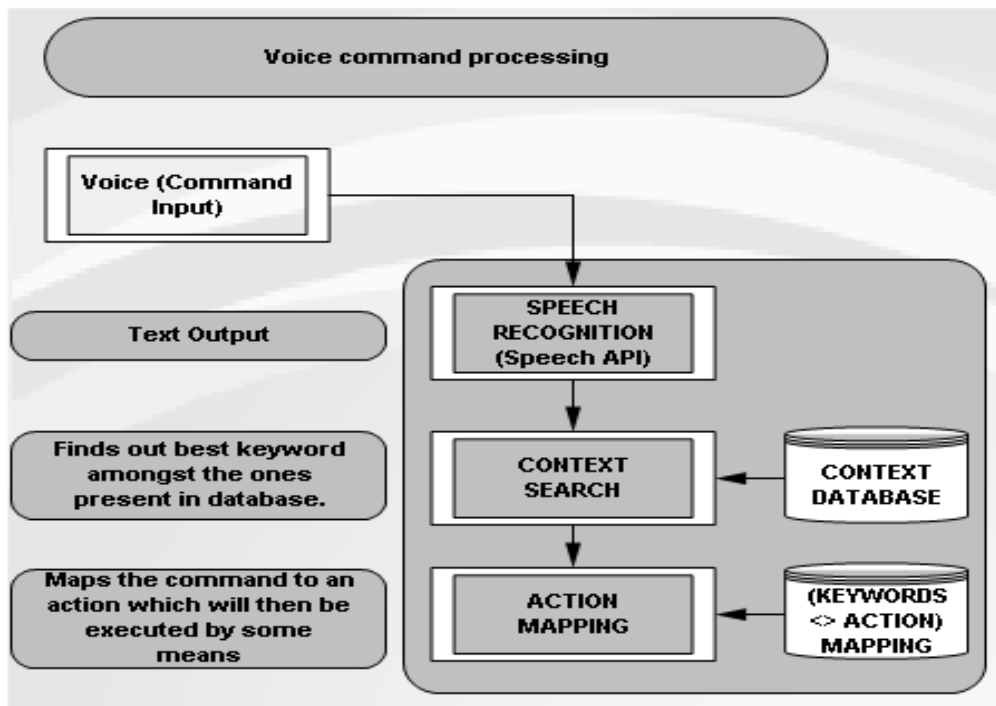
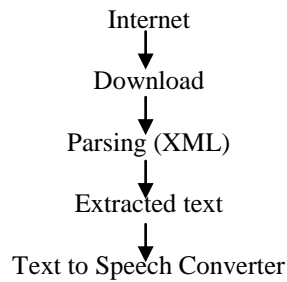


Fig. 4 Voice Command Processing

The voice command processing block is important part of IHS system. In this block the voice command is taken as input. Consider the command is FAN ON. The speech recognition API recognizes the command and gives it for context searching. In context search the database will match the command with the nearest word match. For example the command FAN ON will be matched with SWITCH FAN ON or TURN FAN ON whichever relates to switching the device Fan on. Then the command is mapped with corresponding action in the Action mapping block. For example the command FAN ON will turn the fan on which is an action. Here the microcontroller will control the device according to the action provided by the action mapping block.

An important feature of IHS System is downloading RSS feeds. RSS (most commonly expanded as Really Simple Syndication) is a family of web feed formats used to publish frequently updated works—such as blog entries, news headlines, audio, and video—in a standardized format. To download and parse news contents we are using RSS feeds and XML SAX Parser. Following is the procedure to download RSS feeds, email or internet content:-



The hardware of IHS consists of Microcontroller 89c51 which controls various devices. Analog to Digital (ADC) converts sensor sensed analog signals to digital signals for the server to process. Various sensors like Light Dependent Resistor (LDR) to sense light detection, Temperature Dependent Resistor (TDR) to sense temperature rise and Potentiometer to check rise in water levels. The stepper motor is used for Door movements like opening and closing of Garage door. The figure below shows the hardware used in IHS.

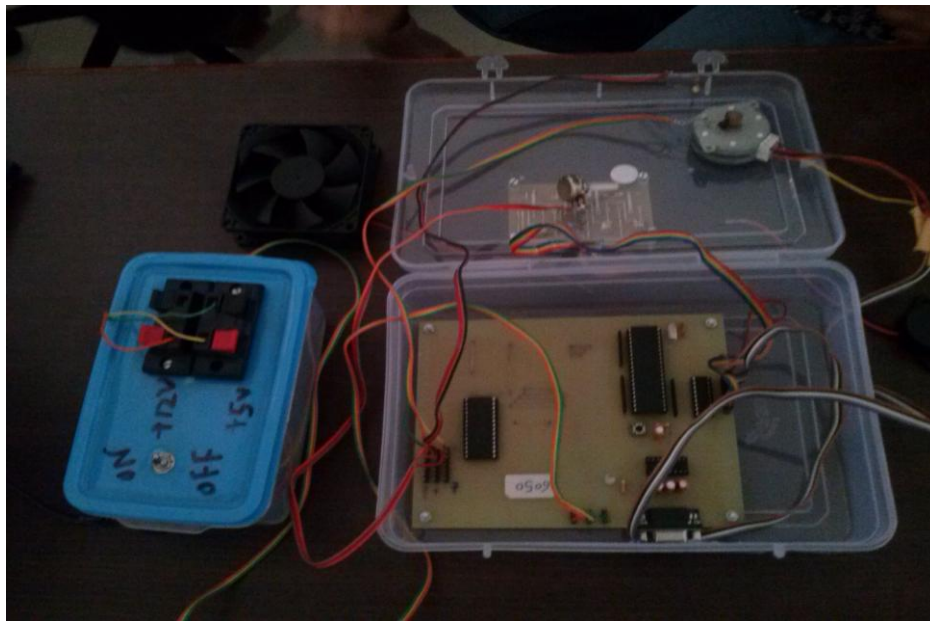


Fig. 5 IHS system Hardware

III. CONCLUSION AND FUTURE WORK

The Intelligent Home System is a voice-controlled home automation system which controls home appliances over a ZigBee wireless network. Voice controlling enables users a sense of comfort as no direct operation with the home automation system is required. ZigBee helps in achieving a rapid rate, low power consumption and low cost network for the server to communicate with the devices. The future work for Intelligent Home System can be porting the system to the cloud so that any device eventually could be used to control and monitor the Intelligent Home System remotely over cloud.

REFERENCES

- [1] Yang Li, Ji Maorang, Gao Zhenru, Zhang Weiping, Guo Tao, Mechanical Engineering Institute, Nanjing University of Science & Technology Nanjing, China, Design Of Home Automation System based on ZigBee Wireless Sensor Network, The 1st International Conference Science & Engineering (ICISE2009).
- [2] Fuxing Yang, Chan Yuan Liu, Zhongcai Pei, Zhiyong Tang, College of Automation, Beijing University of Posts and Telecommunication, Beijing 100876, China, School of Automation Science and Electrical Engineering, Beijing University of Posts and Telecommunication, Beijing 100191, China, The Design Of Wireless Remote Intelligent Home System Based On Zigbee And GPRS, Proceedings of ICCTA 2011.
- [3] Xiang Yang, Yuan Yi Zhang, Rong Yang Zhao, Department of Electronic and Computing, Guilin University of Technology, Guilin, P. R. China, Study and Design of Home Intelligent System Based on Embedded Internet, The 2008 International Conference on Embedded Software and Systems Symposia (ICISS2008).
- [4] R. Gadalla, "Voice Recognition System for Massey University, Smarthouse," M. Eng thesis, Massey University, Auckland, New Zealand, 2006.
- [5] Jinn-Kwei Guo, Chun-Lin Lu, Ju-Yun Chang, Yi-Jing Li, Ya-Chi Huang, Fu-Jiun Lu and Ching-Wen Hsu, "Interactive Voice-Controller Applied to Home Automation," 2009 Fifth International Conference on Intelligent Information Hiding and Multimedia Signal Processing