

Voice Recognition Based Smart Home Control System

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Abstract:- In recent years, home automation systems have seen rapid changes due to introduction of various wireless technologies. The explosion in the field of wireless technologies has seen the emergence of many standards, especially in the industrial, scientific and medical radio band. RF is an IEEE 802.15.4 standard for data communications with business and consumer devices. RF is targeted at applications that require low data rate, long battery life and secure networking. This article is aimed to describe the method of testing the implementation of voice control over operating and technical function of smart home. The Smart Home System will be implemented in existing home environments, without any changes in the infrastructure. The automation focuses on recognition of voice commands and uses low-power RF wireless communication modules along with a microcontroller. This system is most suitable for the elderly and the disabled persons especially those who live alone and since it involves recognition of voice; it is secure. The automation system is intended to control all lights and electrical appliances inside a house or an office using voice commands. In this work a home automation control system based on voice recognition is designed. The system is implemented and satisfactory experimental results were obtained.

Keywords:- *Smart Home, Wireless Technology, RF*

I. INTRODUCTION

Due to the rapid advances in wireless communication and information technologies it is now possible to embed various levels of smartness in the home. These smart homes are ones that can interact intelligently with their inhibitors to provide comfort and safe living. This interaction may range from simple control of ambient temperature to context-aware and mobile agent based services. An example of that is delivery of particular information content based on the smart home inhibitor location inside the home and the activities that he or she is engaged with. Sensors, microcontrollers and Wireless networks are playing an increasingly important key role in enabling us emerging pervasive computing technologies that are required for the realizing smart homes. The wide spread of wireless networks is enabled by the communication standards such as WiFi, Bluetooth, Zigbee, Radio Frequency Identification (RFID), and cellular technologies. A combination of these standards is envisaged to be used in constructing the smart home. Effectively all wireless technologies that can support some form of remote data transfer, sensing, storage and control are candidates for inclusion in the smart home port. It includes a server/gateway/router that can be used as the central point of connectivity for devices within the home as well as allowing connectivity to the outside world. The setup also includes smart sensors as well as appliances that have either wired or wireless connectivity. Communicating with the smart home from the outside can be done using one or a combination of the following external networks such as phone lines, XDSL lines, cable of television (TV), Global System Mobile (GSM), and power line networks

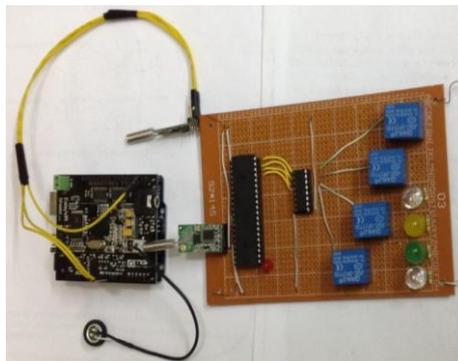
II. SMART HOME AND SOFTWARE CONSIDERATION

Smart homes are no longer design concepts of the future. A. T. Ganbutan discusses their direct impact on the life styles of people when intelligently designed and operated. Also they result in dramatic increases in worker productivity, energy cost savings and administrative savings [1]. Smart Home is the term commonly used to define home or building, equipped with special system that does some intelligent actuations according to situation. Integration of the home systems allows them to communicate with one another through the home controller in pre-programmed scenarios or operating modes. We call these kinds of systems as "Context Aware Systems" that are aware of where the person is and make decisions about what actuation should be done [2-4]. Smart homes can also be used to support disabled people, providing safe, secure and empowering environments. The system can allow the user to control many features or automate them. The environment can also be monitored by the smart home system to ensure safety and alert people when there is some dangerous situation. Its design a smart home control system which allows people control their home devices by voice command at home. This is a wireless, voice control system. People could control almost all the facilities at home including lights, fans or even back ground music. Right now, the basic function of lights control, fan control and music control has all been implemented. Except for basic turning on and off of facilities at home, also realize the function of fixed-time control, and error detection when some device is broken. The system is quick enough for

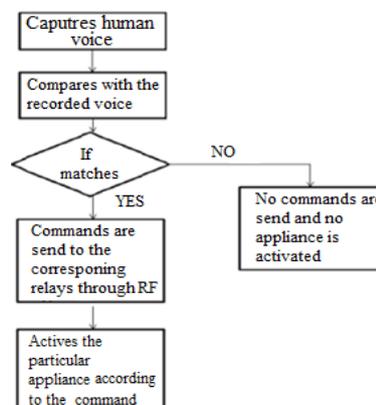
respond all the commands [5]. Smart home system is a simulation product for the future life. The purpose of it is to make people's lives more convenient. To replace turn on or turn off on switches by hand for current product, the system is controlled by voice. That should be a trend for the future 10 years which we believe that it is coming to real product soon. How to make people's life more convenient, more comfortable, and safer and how to save more energy will be the series of questions will be discussed. Software Design includes Voice Recognition Application and RF communication .The voice commands are trained and on the Easy VR2.0 voice recognition unit using the software named "Easy VR Commander". It gives an option of entering any custom voice command and then training the module to recognize the command typed. Also, that voice command can be tested for accurate recognition by saying it in the microphone and then the software indicates the command spoken on the screen. This software also has a feature of generating an ARDUINO-based code depending on the number of voice commands trained, which is compatible with "Energia". Here, the software "Energia" is used to program the Arduino UNO development board, which contains the Atmega328-IC [6-8].

III. HARDWARE CONSIDERATION AND IMPLEMENTATION

There are two microcontrollers in this project. Wireless communication is set up by two RF chips. One of them is connected to the first ATmega328 working as the transmitter to transmit the signal and the other one is connected to the second ATmega16 working as the receiver. ATmega328 is chosen at the transmitter part because the Easy VR 2.0 is most compatible with it and it has an inbuilt microphone which can receive and store voice signals from people. The sequence of activities in the voice controlled smart home system is illustrated in Fig. 1a. The system is activated when a user utters the trigger word or the password. Further the user is required to say his/her name in order to have him-self/ her-self recognized as a valid user of the system. When a valid user says a particular voice instruction, the microphone of the Easy VR 2.0 get sit first and then the ATmega328 at the transmitter receives it. By program controlling, the ATmega328 will send a particular character to the transmitter RF. When the RF is enabled, it will send the corresponding character to the receiver RF. The characters sent differ as per the voice instructions of the user. When the wireless communication is established successfully, it will send instructions for ATmega16. Consequently, the appliances can be turned ON or OFF or controlled like increasing or decreasing the speed depending on the control characters received. The system modules are shown in Fig. 1b.



1a: flowchart



1b: system modules

Fig. 1: sequence and module of smart voice controlled

IV. MODULES DESCRIPTION

4.1 Handheld microphone module With RF transceiver and a Voice Recognition unit the components of the microphone module are shown in the left side of Figure 3b and the block diagram in Fig. 2. The human voice is captured through the microphone. It is matched with the voice previously recorded in the Easy VR 2.0 as voice recognition unit. If it matches the corresponding character is sent through RF. The voice recognition unit along with Atmega328 constitutes the Speech Recognition System. It is an easy to use programmable speech recognition circuit. Programmable, in the sense that you can train the words (or vocal utterances) you want the circuit to recognize. It allows you to experiment with many facets of speech recognition technology.

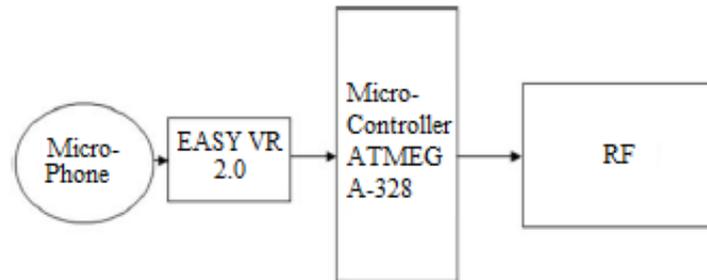


Fig. 2: Block diagram of voice controlled smart home system handheld

4.2. Appliance control module Once the speech commands are recognized control characters are sent to the specified appliance address through RF communication protocol. Each appliance that has to be controlled has a relay controlling circuit. The block diagram of appliance control module components is shown in Fig. 3.

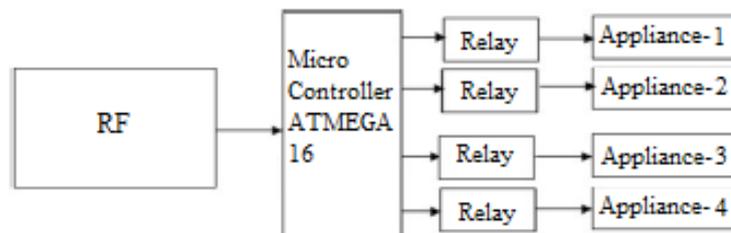


Fig. 3: Appliance control module components

V. EXPERIMENTAL RESULTS

The experimental part is done by making repetition of chosen command. After making repetition the percent is calculated for each situation. The repetition is done for 30 times for every subject testing. Fig. 4 shows success ratio of recognition (%) for different ages to men and women. that the achievable success of voice commands represents 100 % accuracy for three commands out of 10 and 99 % accuracy for the remaining seven commands. That means that in the second scenario, out of 100 spoken commands 99 were interpreted accurately.

Fig. 5 shows success ratio of recognition to different obstacles wood door, metal door, concrete wall, and mirror. The columns represent the success ration of recognition which they are calculated when repetition done for every obstacles.

Fig. 6 discusses the effect of noise on voice recognition when module is used in an indoor condition without any noise or people talking. The second column represents the success ratio of recognition when there are people talks in an indoor condition. The last column shows the success ratio of recognition in an outdoor condition. Because it is very likely that there will never be complete silence in the building, where the system will be installed, testing together with the presence of ambient noise was done. The TV set and radio were ON with the ability to recognize voice. In this test the programmable estimated reliability of voice recognition was significantly lower, mainly due to the ambient noise that was used during this test (radio and TV). It did not, however, have a great impact on the actual recognition of the voice command. Also the ambient noise could be like people talks, car noise, wind etc.

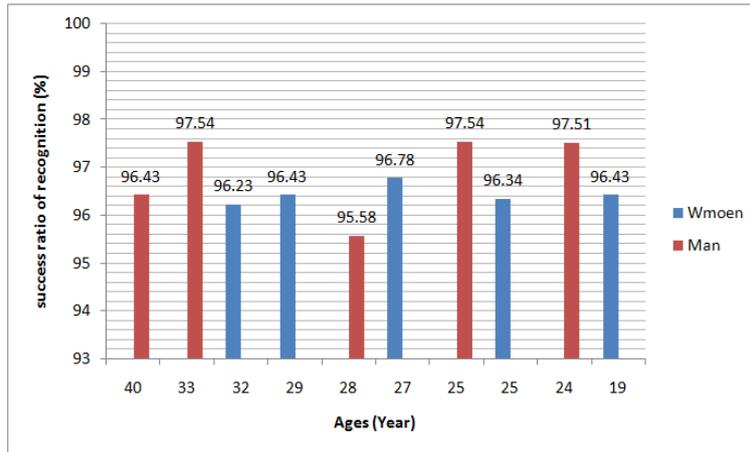


Fig. 4: Different ages for both men and women

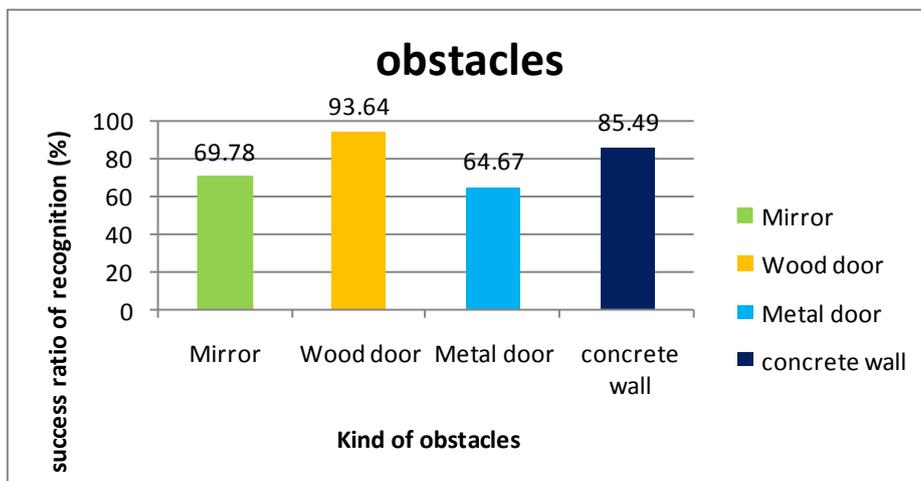


Fig. 5: Different obstacles

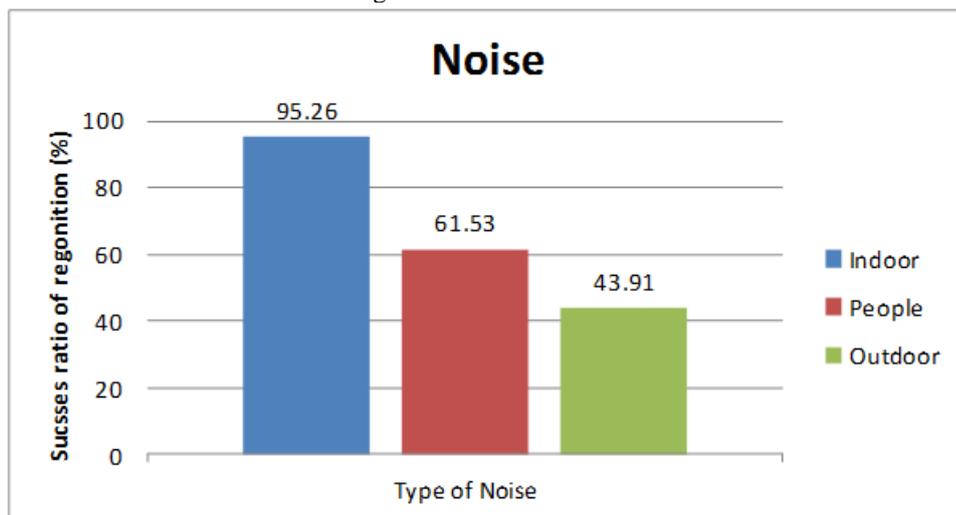


Fig. 6: Different types of noise

VI. CONCLUSION

This study was inspired from the problems that disabled people encounter in their everyday life while most of other people are not aware of their difficulties. One of the biggest needs required for disabled people is to continue their daily life activities when they are alone at home and there is nobody to help them. There are

many studies about smart houses but we observed that there is no enough smart home system that aims to help disabled people. A home automation system based on voice recognition is built and implemented. The system is targeted at elderly and disabled people. The proto type developed can control electrical devices in a home or an office. The system implements voice recognition using Easy VR 2.0 shield. Wireless communication is established using RF modules because of their efficiency and low power consumption. The preliminary test results are promising.

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