PSOC Based Isolated Speech Recognition System For Appliances Control

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ABSTRACT: Speech Recognition Systems (SRS) have been implemented by various processors including the digital signal processors (DSPs) and field programmable gate arrays (FPGAs) and their performance has been reported in literature. The recognition of speech requires feature extraction and classification. The systems that use speech as input require a microcontroller to carry out the desired actions. In this paper, Cypress Programmable System on Chip (PSoC) has been studied and used for implementation of SRS. From all the available PSoCs, PSoC4 containing ARM Cortex-M3 as its CPU is used. Recognition performance is studied using three feature extraction techniques (Zero crossing, Zero crossing with end point detection and Zero crossing with end point detection and Cochlear filter) and minimum distance classifier. Here we are using speech recognition to recognize the speech and compare with data base speech if it matches one of the action will occurs either Device will be ON or OFF.

Index Terms: PSoC4, HC-05 Bluetooth Module, Automation, Smartphone, Voice Control.

I. INTRODUCTION

Speech recognition is the process by which a computer (or other type of machine) identifies spoken words. Basically, it means talking to your computer, and having it correctly recognize what you are saying. This is the key to any speech related application. When we say voice control, the first term to be considered is Speech Recognition i.e. making the system understand human voice. Speech recognition is a technology where the system understands the words (not its meaning) given through speech. Speech is an ideal method for robotic control and communication. The speech recognition circuit will outline, functions independently from the machine’s main intelligence [Controller]. This is a good thing because it doesn’t take any of the controller processing power for word recognition. The controller must merely poll the speech circuit’s recognition lines occasionally to check if a command has been issued to the control element. We can even improve upon this by connecting the recognition line to one of the controller’s interrupt lines. By doing this, a recognized word would cause an interrupt, letting the controller know a recognized word had been spoken. The advantage of using an interrupt is that polling the circuit’s recognition line occasionally would no longer be necessary, further reducing any overhead. Another advantage to this stand-alone speech recognition circuit (SRC) is its programmability. We can program and train the SRC to recognize the unique words we want recognized. The SRC can be easily interfaced to the controller. To control and command an appliance (computer, VCR, TV security system, etc.) by speaking to it, will make it easier, while increasing the efficiency and effectiveness of working with that device. At its most basic level, speech recognition allows the user to perform parallel tasks, (i.e. hands and eyes are busy elsewhere) while continuing to work with the computer or appliance. Robotics is an evolving technology. There are many approaches to building robots, and no one can be sure which method or technology will be used 100 years from now. Like biological systems, robotics is evolving following the Darwinian model of survival of the fittest. Suppose we want to control a menu driven system. What is the most striking property that we can think of? Well the first thought that came to our mind is that the range of inputs in a menu driven system is limited. In fact, by using an menu all we are doing is limiting the input domain space. Now, this is one characteristic which can be very useful in implementing the menu in standalone systems. For example, think of the pine menu or a washing...
machine menu. How many distinct commands do they require. Objective of this project is to Implement Isolated Speech recognition systems for voice operated application. In this project we are doing through voice commands we can control our devices. Here we are using speech recognition kit to recognize the speech and compare with data base speech if it matches one of the action will occurs either Device will be ON or OFF. The motivation for Isolated Speech Recognition is simple; it is man’s principle means of communication and is, therefore, a convenient and desirable mode of communication with machines. Speech communication has evolved to be efficient and robust and it is clear that the route to computer based speech recognition is the modeling of the human system.

II. PROPOSED FRAMEWORK

In this System input voice commands are taken from android application that compare with desired command and causes interrupt, holding the controller understand a recognized word had been spoken. The advantage of mistreatment associate interrupt is that polling the circuit’s recognition line often would not be necessary, further reducing any overhead. Another advantage to this android primarily based application is its programmability. We’ll be able to program and train the appliance to recognize the distinctive words you would like recognized. The appliance is often simply interfaced to the controller. To regulate and command an appliance by talking to it, can make it easier, whereas increasing the efficiency and effectiveness of operating the appliance with device.

Here the communication is done between android application and hardware using Bluetooth interface. Speech recognition application will receives voice commands from user and send text over Bluetooth and produces interrupt. At controller side, text will compare with set text command that will allow operating final control element. The advantage of this is that controller no longer to make pooling rxpin, now controller will occasionally need to poll that pin this will reduces any overhead.

The proposed method which uses the low cost automation systems which controls the devices remotely by using keyword matching which is shown in Fig. 2. The environment can be controlled and monitored using android app which will communicate to the receiving node through Bluetooth. The proposed system offers the control of lighting, DC motor, and fan.

![Fig.1 Hardware Block diagram of system](image1)

![Fig.2 Block diagram of functional unit](image2)

**A. Programmable System on Chip (PSoC4)**

Programmable System on Chip (PSoC) has and is being utilized during a variety of applications. They’re cost effective as a result of that they need restricted storage and process power. Programmable System on Chip (PSoC) has been designed and enforced by Cypress semiconductors. The Cortex-M0 CPU in PSoC 4200 is part of the 32-bit MCU subsystem, which is optimized for low-power operation with extensive clock gating. It mostly uses 16-bit instructions and executes a subset of the Thumb-2 instruction set.
This enables fully compatible binary upward migration of the code to higher performance processors such as the Cortex-M3 and M4, thus enabling upward compatibility. The Cypress implementation includes a hardware multiplier that provides a 32-bit result in one cycle. It includes a nested vectored interrupt controller (NVIC) block with 32 interrupt inputs and also includes a Wakeup Interrupt Controller (WIC). The WIC can wake the processor up from the Deep Sleep mode, allowing power to be switched off to the main processor when the chip is in the Deep Sleep mode.

**B. Android Platform**

Android devices are powerful mobile computers and they become more and more popular smart phones used worldwide. They becomes more and more popular for software developers because of its powerful capabilities and open architecture, also it’s based on the java programming language. For the communication of the receiving node with the mobile we are using the Bluetooth device. The Bluetooth device (HC-05) is attached to the node that receives the data from the mobile and also can transmit the data.

1. **Keyword Matching**: Keyword matching makes a context search with existing database for a nearest keyword. If a keyword is matched the action is performed.

2. **Speech Recognition**: A speech recognition program processes voice commands by using an Android SDK and the processed voice command will then send to a CSP.

3. **Control signal program**: Control signal program send a command to a microcontroller with its address and command in bytes. The system is further simplified by allowing appliances to be controlled by our voice. The user need not have to have immense knowledge over the language of English. Just by saying the appliance name and the corresponding number assigned to that particular appliance, and telling it to switch on or off will enable the user to have complete control over any appliance without any effort.

4. **Speech Recognition System**

The fundamental purpose of speech is communication, i.e., the transmission of messages. In the case of speech, the fundamental analog form of the message is an acoustic waveform, which we call the speech signal. Speech signals can be converted to an electrical waveform by a microphone, further manipulated by both analog and digital signal processing, and then converted back to acoustic form by a loudspeaker. The recognition of speech requires feature extraction and classification.

**Feature extraction**: It is the important step required for the representation and recognition of speech signals. It extracts the necessary information required for speech recognition from raw speech signal; this step has to be done for all the words in our dictionary. In this paper, ISRS is used for the recognition of the three words - 'one', 'two' and 'three'.

**ZCP (Zero Crossing Point)**: The speech samples ($s[n]$) at the output of the delta sigma A/D converter are blocked into overlapping frames of $N$ samples each, with adjacent frames being overlapped by $M$ samples of previous frame as shown in Fig.4.

**III. RESULTS AND DISCUSSIONS**

Using the above mentioned components we implement our system on a breadboard. The
microcontroller device with the Bluetooth module and relay circuit needs to be attached with the switch board. Then we need to launch the android based application-“AutoHome” on our Smartphone. Through the application we can instruct the microcontroller to switch on/off an appliance. After getting the instruction through the Bluetooth module the microcontroller gives the signal to the relay board. The application first searches for the Bluetooth device. If it is available then it launches the voice recognizer. It reads the voice and converts the audio signal into a string. It produces a value for each appliance which will be given to the microcontroller device. The microcontroller uses the port in serial mode. After reading the data it decodes the input value and sends a signal to the parallel port through which the relay circuit will be activated.

Some images to illustrate the working of the system have been given below.

Fig 5 Flow chart for Android application.

The Bluetooth module transmits the text to the Arduino Uno serial port. The text is matched against the various combinations of predefined texts to switch the appliances on/off. The appliance name and a command for on/off are stored as predefined command. For example, to switch on a television the user needs to say “bulb on” and to switch it off he needs to say “bulb off”. The appliances are connected via the relay boards to pin numbers 2, 3 and 4 of the PSoC4. When the matching text is detected the corresponding pin number is given a high or low output signal to switch the appliance on and off respectively.

Fig 6 Flow chart for PSoC.

Fig 7 Application connecting to the Bluetooth device

Fig 8 Turning ON Light 1
In this paper we are doing through voicecommands we can control our devices. Here we are using speech recognition kit to recognize the speech and compare with data base speech if it matches one of the action will occurs either Device will be ON or OFF. Isolated Speech recognition systems (ISRS) have been implemented using microprocessors, digital signal processors and FPGAs and have been reported in the literature. In this paper, the study and implementation of ISRS using Cypress Programmable System on Chip (PSoC) is presented. For the implementation, PSoC4 containing the ARM Cortex-M3 CPU is used. Recognition performance is studied using three feature extraction techniques (Zero crossing, Zero crossing with end point detection and Zero crossing with end point detection and Cochlear filter) and minimum distance classifier.

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