

## Implementation of Voice Recognized LED using Arduino Uno Micro-controller

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### Abstract

*This research paper explains how the user control electronic components like LED not in standard way but using text by speech. This system is flexible with variety of devices that can be controlled and is of low cost. In this scenario, text by speech is achieved without using any external modules. The system comprises of two segments, first one to process signals which is received by a microphone and second segment is to interpret the processed signal. System recognizes voice commands and converts them to desired data coordination and data transmission via microcontroller (Arduino Uno). Two different IDEs are used, first one is Microsoft visual studio and second one is ARDUINO IDE.*

**Index Terms**— Arduino Controller, Arduino IDE, Breadboard, Grammar Builder.

## I. INTRODUCTION

Voice is common form of communication method for daily life not in one way but in two-way communication there is transmission and receiving of data going on, same concept is applied in machines. Today speech technologies are commonly available for a range of task. These technologies enable machines to respond correctly to user voices by taking speech as text and provide services.

This correspondence can be cultivated by creating voice acknowledgment framework for example discourse to content that permits framework to make an interpretation of voice order to content and reaction in like manner. Voice acknowledgment is a procedure of changing over acoustic sign which is caught utilizing an amplifier to a lot of words [12].

A microcontroller is an integrated circuit (IC) gadget utilized for controlling different parts of an electronic framework, generally through a microchip unit (MPU), memory, and a few peripherals [14]. Arduino UNO is utilized in this framework and Arduino IDE is a cross stage application which is utilized to compose and transfer projects to Arduino compatible boards.

## II. RELATED WORK

Voice recognition is a concept worked on for some time now. To control electronic components using voice commands different external modules have been used among them HM2007 is one of the voice recognition module [6][7], which is a single chip CMOS voice recognition module. Another very popular voice recognition Arduino shield is EasyVR Shield 3.0 which provides feature of voice password. Some

innovations have been considered in writing for execution of home Automation frameworks. These consolidates : land line Telephone system (basic phone utility), power-line carrier system, Bluetooth advancement, infrared light, SMS, web strategy and voice controlled structure for utilization[2] [3]. The arrangement of voices/talk based applications is overpowered by the basic Asynchronous Speech Recognition (ASR) innovation [4][5]. From an inventive perspective, two broad sorts of ASR exist as demonstrated by [1] which is Direct Voice Input.

In [8] authors proposed a home robotization framework dependent on voice acknowledgment. The framework actualizes Automatic Speech Recognition utilizing discourse processor and MATLAB coding. The model created can control electrical gadgets in a home or office. In [9] authors proposed discourse perceived computerization framework utilizing speaker distinguishing proof through remote correspondence. proposed a voice controlled wireless smart home model which was for elderly and disabled people.

The rest of the paper is written in following way. In section-III we have discussed methodology. Section-IV tells us about system design. Section-V highlights the procedures of implementation. Research setup has been discussed in section-VI. Finally output analysis and conclusion with future research directions have been given in section-VII and VIII respectably.

### III. METHODOLOGY

**Arduino Controller:** It is an IDE that runs on a PC and permits client to compose programs for Arduino based on C or C++ language [11]. The projects are introduced in Arduino controller which is an open source devices stage subject to easy-to-use gear. Arduino can understand inputs – lights on a sensor, a finger on a catch – and transform into a yield starting a motor, turning on a LED. In this undertaking the Arduino board utilized as voice acknowledgment module [13]. It identifies and forms the voice orders, all the voice orders are spared in Arduino controller. Arduino controller looks at and matches voice orders on or off that the orders are coordinate, at that point play out the undertaking.



Fig 1 Arduino UNO Board

#### Hardware Used:

- **Arduino UNO:** Arduino UNO is a microcontroller board build by Arduino.cc and is based on ATmega328P microcontroller [13]. It consists of 13 digital pins (mostly for outputs) and analog pins used to connect inputs and sensors. A Power jack is present to provide power to Arduino (9W battery).

- *Resistor 221 ohm*: This is basically used to control the flow of current to the LEDs 221 ohm resistors are used.
- *LED (generic)*: These includes three different coloured LEDs.
- *Breadboard*: For electrical connection between Arduino UNO, resistors and LEDs breadboard is used.
- *Jumper wires*: Conducting wires used for connecting electrical elements in circuit.
- *Microphone*: A simple earphone with microphone can be used. Can be both wired or wireless.

#### Software Used:

- *Arduino IDE*: It is an open source software works with Arduino board. It is used to upload code in the Arduino board. It runs on Mac OS X, Windows and Linux. It is written in functions from C and C++.The Arduino IDE supplies a software library from the Wiring project [21].
- *Microsoft Visual Studio 2019*: For this project, Control software module was developed which was written in C# programming language and platform used was Microsoft Visual Studios 2019.

#### IV. SYSTEM DESIGN

Design consideration in this document is modeling a voice automation system that allows user to remotely control electronic components, which is LED in our case. Major modules of conceptual design are Sensor, Speech recognition module, Arduino UNO [19].

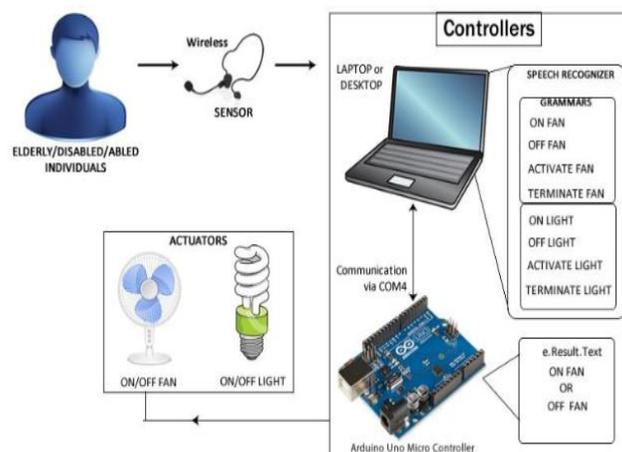


Fig. 2 Conceptual Model for Voice Recognition System

Earphone with microphone acts as sensor and acquires user's commands. Then these voice commands are transferred to Arduino UNO microcontroller via GUI software developed in Microsoft visual studio written in C# language. Commands are given through earphone connected to the PC (wired or wirelessly), the C# code developed takes audio command and compares it with predefined commands in system and sends its output which is now processed to the Arduino microcontroller. The GUI software program created serves as a filter to the commands by recognizing only speech that are found in the grammar library.

In this technology we don't need any external voice recognition modules rather we have used visual studio Speech Recognition Engine class. The controller of this system is a laptop connected using COM4 to Arduino servers.

A 5V power supply was connected to the Arduino UNO microcontroller via a USB cable. Arduino had 13 digital pins, mostly for outputs. In this system every pin outputs 5V to a bread board via a jumper wire. Relay switches are used to switch led to ON or OFF states.

This research work switches LED of different colors ON or OFF, so pre- defined grammars are used. They are:

- Blue On
- Red On
- Green On
- Blue Off
- Red Off
- Green Off
- Exit
- All On
- All Off

After transmission of voice signal from microphone to the laptop, framework synthesizer puts tokens whatever has been identified and advances it to the Arduino by means of Arduino IDE. A matching among this and library pre programmed in visual studio which provides positive for command, in this case Activate or Terminate LED of any color.

## V. PROCEDURE

### Step 1: Setting up the Hardware

Connect the Arduino and LEDs according to the Fig. 3 using wires. Depending on which channel light emitting diode we use, we need different power resistors for channel. For this we are using three 221-ohm resistors. A jumper wire is being used to send the 5V from the micro controller to the bread board. Likewise, from the bread board, another jumper wire is utilized to send the 5V to a pin called 'IN' on the transfer module. Connect the LEDs and resistors to breadboard as per Fig.3.

Connect breadboard to Arduino UNO which also powering the LED using the 5V source from Arduino as given in Fig. 3.

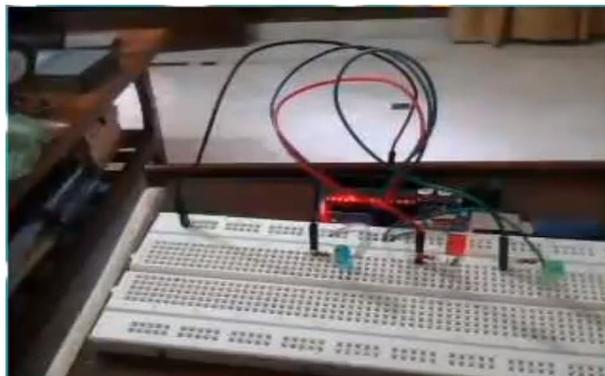


Fig .3 Arduino and Breadboard Setup

**Step 2: Setting up the IDEs**

After downloading Microsoft Visual Studio and Arduino IDE, ensure the following steps:

- Bits per seconds is set to 115200.
- Port Name in both Arduino and visual Studio is set same.
- Computer's default Microphone is set as Audio Input.
- Also Default Microphone is set to external USB microphone in microphone setting in computer.

**Step 3: Uploading Codes**

After setting up both the IDEs, code is written in Visual studios in C# programming language and Arduino IDE. A new project is created in visual studio. A form is created for receiving and displaying the commands received by user and to indicate the initialization and stoppage.

Libraries are included to enable for voice recognition:

- System.IO.ports: These ports included for connecting Visual Studio and Arduino IDE to transmit and receive data through ports.
- System.speech.recognition: This namespace is used to access and increment this basic voice recognition technology by defining steps for identifying specific phrases patterns. Speech Recognition Engine and Grammer builder is used in C# to add commands.

**Step 4: Commands**

A list of commands is added as per Table 1 depending of the functionalities it will perform.

Table 1: Commands added to grammar

Commands are added in Command.Add (new string[]){ }

Voice Input	Output
Blue On	Turns blue LED on
Red On	Turns red LED on
Green On	Turns green LED on
Blue Off	Turns blue LED off
Red Off	Turns red LED off
Green Off	Turns green LED off
All On	Turns all three LED on
All Off	Turns all three LED off
Exit	Exit the form

**VI. RESEARCH SET-UP**

For implementation, the following modules were developed:

**Control Software Module**

C# programming language is used to write control software programmable module and IDE used for this was Microsoft Visual Studio.

System.IO.ports library is included for connectivity with Arduino IDE to transmit and receive data through ports. Libraries imported for voice recognition are System.speech, System.speech.Recognition and System.speech.Synthesis.

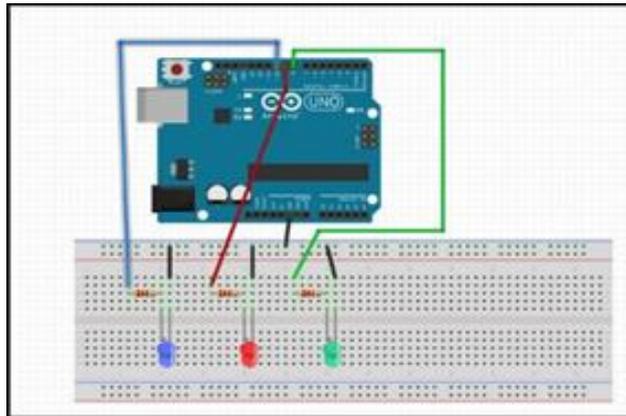
System.speech.synthesis is optional, used only if we want system to talk back. Commands were added to Grammar and GrammerBuilder class is being used.

### Micro Controller Programmable System Module

Arduino IDE was used as interface between Arduino and hardware to upload programs and transfer them. Arduino IDE includes a message zone, a text console, a toolbar with buttons for common functions and various menus. An Arduino code mainly have three parts of programming

- #define : To define the pins we will be using [15].
- Setup ( ): Here we define whether pin is input pin or output pin using pinMode() command.
- Loop ( ): This program commands written [16].

Switch case in void loop( ) to received from Visual with different cases. through



is the main where and logic are

statements were used synchronise the input studio and compare it Input is being received

incomingData-Series.read( ).

### Connectivity Module

Arduino UNO, Bread board, different LEDs, and 221 ohm resistors are connected through jumper wires as shown in Fig. 4. Then Arduino USB cable is plugged in to the laptop.

Fig. 4 Circuit Diagram

According to the Fig.4 commands are sent from the control programming to the small scale controller. The miniaturized scale controller is modified to acknowledge all contributions through COM4 and sequential port 1 under the arrangement control structure of the program; it at that point conveys a voltage signal which is 5V by means of pin 6 or pin 1.

A jumper wire was utilized to send the 5V from the small scale controller to the bread board. Likewise, from the bread board, another jumper wire was utilized to send the 5V to a pin called 'IN' on the hand-off module. The hand-off module has three pins which are 'IN', 'GND', & 'VCC', the 5V goes to the IN on the transfer.

Fig. 5 Flowchart of Voice-Controlled LED using Micro-Controller

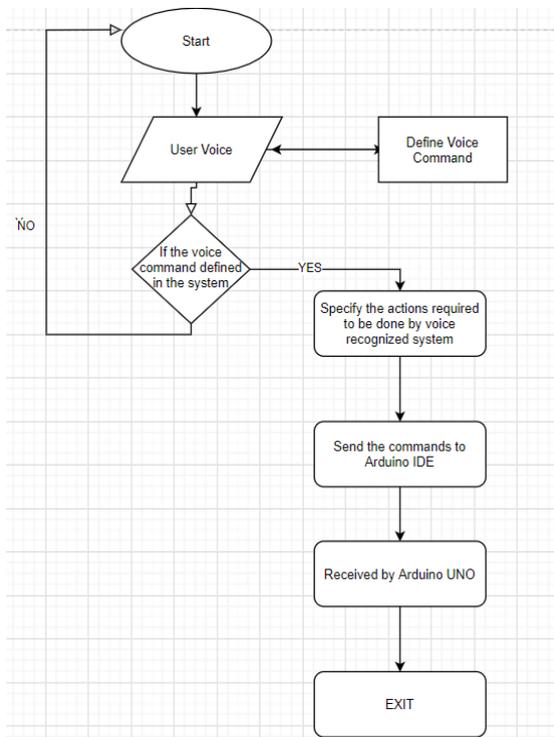
We used Arduino microcontroller for interfacing with LED. Instance of code is written in C# and Arduino IDE is used to configure C# code with Arduino UNO board for voice recognition without any external voice recognition module using `system.speech` library is used in visual studio C# code.

In this research simple microphone in earphone can be used for voice command. In addition to microphone generic breadboard is used to design circuit, generic jumper wires, resistors and generic led are other hardware requirements. Coding is done in two different platforms for voice recognition C# is used and Microsoft visual studio is used as ide and Arduino ide us used to configure Arduino UNO as well as sync C# code and Arduino UNO. COM port is the same in the properties of the Serial port tool which you have included in the form and in the Arduino IDE. Software used are Arduino IDE and Microsoft Visual Studio.

**VII. OUTPUT ANALYSIS**

As per the commands, the model provides the output depending on the speech input. All the software and hardware components and working together smoothly.

LEDs were controlled with voice commands without adding any external voice recognition modules.



This system is flexible with variety of devices that can be controlled and is of low cost.

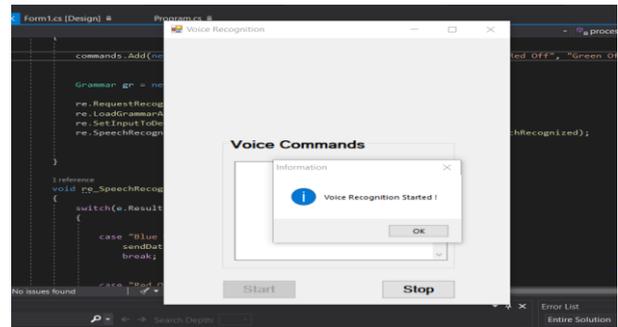


Fig.6 Command Form

As per the commands input, one output is reflected in Fig.7.

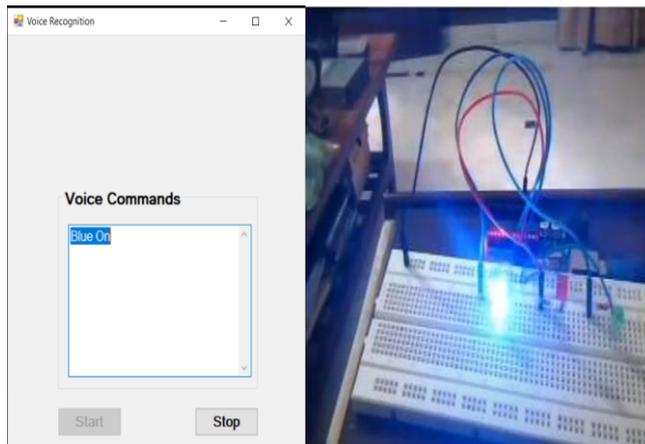


Fig. 7 Voice Commands and Results Output

### VIII. CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This research work has presented a model of a voice-recognised system for electronic devices. This solution is provided without using any external voice recognition modules. This work has a range to electronic appliances with maximum of 5V, further work can be done to implement it on devices with above 5V. Different set of instructions can also be added by integrate various control functions to improve system versatility.

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