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PERSONALIZED SPEECH RECOGNITION FOR IOT

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ABSTRACT
With the rapid increasing of smart devices, there has been a growing interest in the concept of Internet of Things (IoT). Internet of things (IoT) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. While as a network of connected objects, IoT is created by enabling machine-to-machine interactions, another important factor of IoT is the human-machine interaction. By creating a connected life, people can interact with their devices, appliances, vehicles, etc. As one of the most natural ways of communication, using speech to interact with things adds value by enriching the user experience. As a subset of internet of things, smart/ connected home is a fast growing industry that includes automation of household activities for more convenience, as well as added security.

Keywords: *Android, Automation, Home Appliances, IOT, Speech Recognition*

1. INTRODUCTION

The Objective of this paper is to provide a personalized speech recognition application that can be used to control various devices connected in a network. As voice recognition is the best way to communicate as humans, we try to use that in building this paper. A simple and easy to understand user interface for both mobile apps to reduce the learning curve for the user is used. Popular and effective microcontroller boards are used so that new components are readily available and easy to add to the system. Designed low power utility systems, which take not more than 5 Volts of power making the system economic. Used real life voices to control all the home appliances connected to a network using Wi-Fi or cables.

Home automation or smart home (also known as domestics) [1] is for the building an automation home appliances residence. It involves the control and automation of lighting, heating (such as smart-thermostats), ventilation, air conditioning (HVAC), and security, as well as such as washer/ dryers, ovens or refrigerators/freezers. Android is a mobile operating system (OS) based on the Linux kernel and currently developed by Google. With a user interface based on direct manipulation, the OS uses touch inputs that loosely correspond to real-world actions, like tapping, to manipulate on-screen objects, and a virtual keyboard. We have used the Android platform because of its huge market globally and it's easy to use user interface. Programming language java [2] is being used here. Bluetooth [3] is a wireless technology standard for exchanging data over short distances from fixed and mobile devices, and building personal area networks. Bluetooth is required to connect to the Arduino to start the serial communication in between them. Google speech recognition[4] APIs are considered to be the best voice recognition software now a days. It has an accuracy of about 80-90% of guessing the word correct. The implementation of this API is likely to stream audio to remote servers to perform speech recognition. As such, this API is not intended to be used for continuous recognition, which would consume a significant amount of battery and bandwidth.

2. METHODOLOGY

The android app is installed into the mobile phone. That takes the speech input (command) and converts that into text. The Bluetooth of the android phone is connected to HC-05 Bluetooth module to transmission of data. The converted text is sent to the Arduino through the serial communication connection (Bluetooth). The Arduino sends back the command back to the android app. The Arduino sets the digital pins as one depending on the command given. If we want to control the bulbs, the Arduino is connected to the relay which is connected to the bulb. The bulb is connected to a normal switchboard. The relay acts as an electromagnetic switch, which closes or opens the bulb circuit. Figure 2 shows the overall Architecture of the personalized speech recognition of IoT. If we want to control the LEDs, the LEDs are fixed to the breadboard. The Arduino gives signal to the breadboard and the breadboard in turn sends the signals to the LEDs.

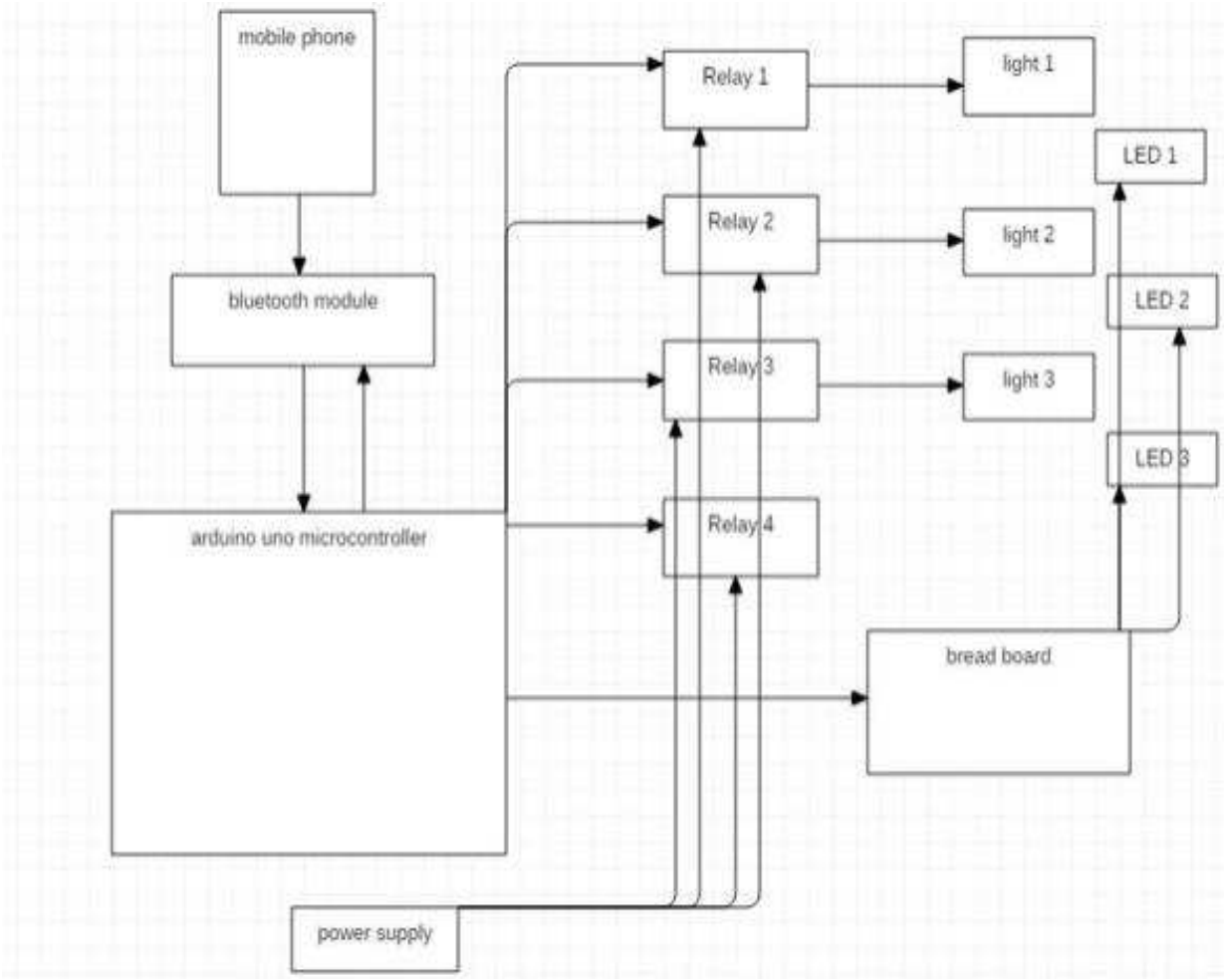

Fig. 1: Overall Architecture

3. IMPLEMENTATION OF PROPOSED SYSTEM IN MODULES

3.1 Hardware Module

The Hardware module consists of all the connections that are to be made. It has sub modules such as Connection of Bluetooth to the Arduino, LED module and Bulb Module.

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3.1.1 Connection of Bluetooth to Arduino

The Bluetooth Module has four pins, i.e. VCC (voltage), GND (Ground), TXD (Transmit Data), RXD (Receive Data) are to be connected to the Arduino as shown in the figure 8. The connections are: Connect VCC pin to the Power pin +3.3V side
of the Arduino pin to power on the Bluetooth, Connect GND pin to GND power pin, Connect TXD to digital output pin 10(As we specified 10,11 for serial communication) and Connect RXD to digital output pin 11(As we specified 10,11 for serial communication).

3.1.2 LED Module

In this case, a bread broad is used. Three LEDs are fixed on the breadboard. The connections are : Connect the anode(the longer side) of each LED to the digital output pins(2,3,4) and Connect the cathode of each LED to GND digital pin to complete the circuit. So whenever the digital pin of Arduino is set to 1, the current flows through led and led gets on.

3.1.3 Bulb Module

This has again two sub modules Connection of board to the relay and connection of relay to the bulb.

3.1.4 Connection of relay to Arduino

The four component relay has 6 pins to connect to the Arduino side that is VCC(Voltage in),GND(Ground),IN1,IN2,IN3,IN4(4 Input pins). The connections are : Connect the IN1,IN2,IN3 pins to the 2,3,4 digital output pins to the Arduino, Connect GND pin to the GND digital side pin on the Arduino and Connect VCC pin to the +5V power pin on the Arduino.

3.1.5 Connection of Relay to bulb

The connections are : Connect the 2 ends of the bulb holder to a 2 pin plug, Cut the wire that connects to the anode(+) of the plug, The wire connected to the bulb is connected to the COM port on the relay and The wire connected to the plug is connected to the ON port of the relay. Therefore, whenever the Arduino sends a digital signal to the relay the ON and COM port join and form a full circuit for the current to pass through the bulb. Therefore acting as an electrical switch1.

3.1.6 Upload the sketch to the Arduino

The Arduino IDE is used to write a sketch(program code) that is to be up- loaded on to the Arduino. The programming code is done in embedded C. The libraries SoftwareSerial.h and EEPROM.h are used. SoftwareSerial.h is used to send/receive data through Bluetooth (serial communication). EEPROM.h is used to save the values of the digital pins in the EEPROM so that they do not disappear when Arduino reboots. The text that comes from the app is compared with the predefined dictionary taken. If the word matches, then the following action is performed.

3.2 ANDROID APP MODULE

It has three sub modules: Integration of Bluetooth, Integration of Voice Recognition and User Interface

3.2.1 Integration of Bluetooth

Followings are the steps to build the application for Bluetooth in android studio:
1) Set up Bluetooth adapter
2) Find surrounding Bluetooth devices in the range
3) Establish Communication between Bluetooth devices
The Android Bluetooth APIs are available in Java SDK android. Bluetooth package.

3.2.2 Setting up Bluetooth adapter

The class Bluetooth Adapter of SDK package android. Bluetooth is used as an entry point for all Bluetooth interaction. By this, all the Bluetooth devices can be discovered. Then the Bluetooth devices are initialized according to their MAC address and finally a Bluetooth Server Socket is created to receive echo from the surrounding Bluetooth devices.

3.2.3 Finding surrounding Bluetooth modules

After setting up the Bluetooth adapter, the next step is to find the Bluetooth- enabled lighting devices by searching the matched Bluetooth modules. Before finding a device, it needs to query the list of the matched devices to make sure whether the server knows the demanded device. The following code is used to pair devices and fetch the device name The function get Bonded Devices returns a set of Bluetooth Device representing paired devices. When the query result is obtained, the coding is used to find all the Bluetooth modules.

3.2.4 Integration of the Speech recognition module

In the android app, the class intent. Recognizer is used to get the speech from the user. In MIT, app inventor 2 Speech Recognizer component is added to the app. On press of a button the google speech prompt dialog is opened. The user speaks and then that value is converted into text and is printed on a text input box and that is sent to the Arduino.

3.2.5 Graphical User Interface

In order to control the home lighting, a graphical user interface is necessary. First we need to click on Bluetooth to find paired devices. When we select one of the paired devices, the connection status is to be shown whether it is enabled or not. If the Bluetooth device is paired, then user should give his speech as input that gets converted to text and sent to Arduino. The Arduino sends back an acknowledgement that the required action is done.

4. RESULTS AND DISCUSSIONS

4.1 Android Apps

Figure 12 shows the android apps built for the application. The apps were built on android studio and MIT app inventor. This app takes speech as input signal and voice recognizer feature, which is in built in the android mobile phone converts speech to text. It shows number of devices on in the application.

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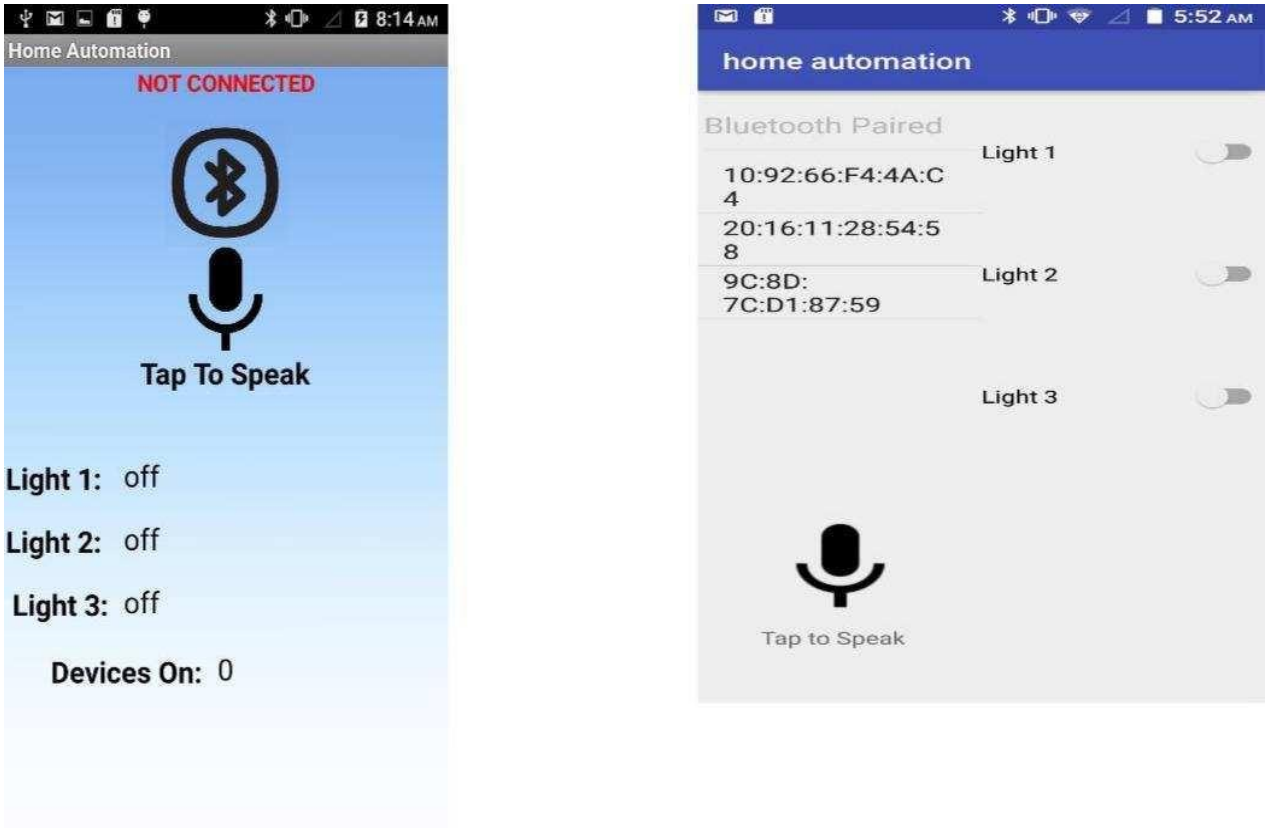

Fig. 2: Android App

4.2 When Bluetooth Is Paired

The Microphone button is tapped to send the voice input. Android mobile after receiving the voice signal converts it in to text and displays in the UI. Else, the voice input will not be taken. It will show an error message that Bluetooth is not connected.

4.3 APP when we say light on

The Figure 15 below shows app when we speak light on, the android app converts that into text to Arduino via Bluetooth through Serial communication. This app also displays number of bytes received when we speak light on. After speaking the sent button is tapped to send the signal and clear but can be used to remove the text.

4.4 The led after Arduino receives light on

The command is specified if we want to on the Orange LED. The mobile phone converts this voice command to text which is sent to Arduino. Arduino is connected to the LEDs using bread board .The Arduino sends signals to all the output pins to switch on the LED.

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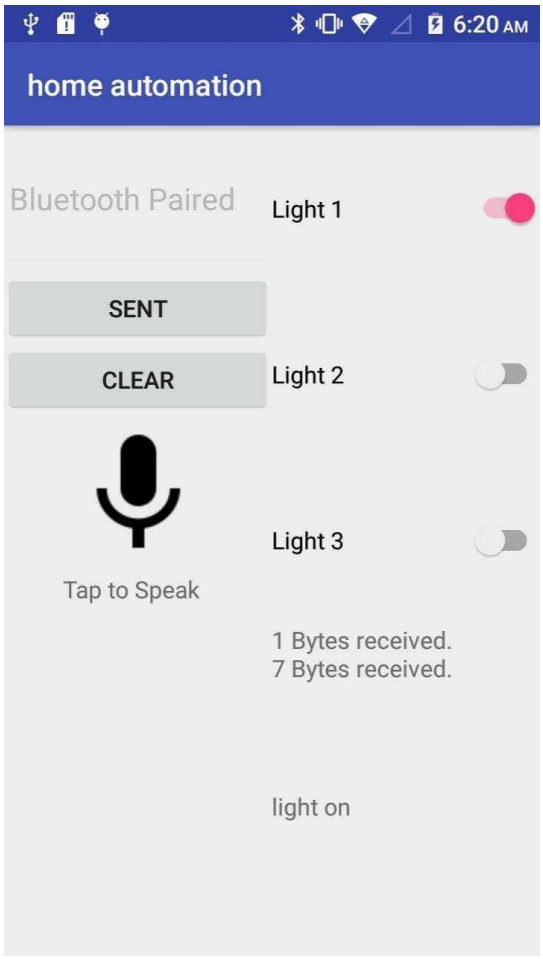

Fig. 3: light on speech command

5. CONCLUSION AND FUTURE WORK

This paper presents a Smart home automation. The paper uses the users' voice as an input as voice is the natural way of interaction in between the humans. An android app is been used as a user interface. Bluetooth module is used to send the data to the Arduino and receive data from it. Relay boards are used to connect the Arduino to the bulb circuit. Experimental work has been carried out carefully. The result shows that higher efficiency is indeed achieved android mobile. The proposed method is verified to be highly beneficial for the purpose of house hold purpose. We can interface sensors to Home Appliances Controlling using Android Mobile paper so that it can monitor some parameters. We can replace Bluetooth by GSM. So it will be SMS Based Home Appliance Control System We can also try to connect wireless devices using Wi-Fi module. The proposed system can be extended by connecting more electrical appliances like air conditioners, refrigerators etc. there by providing many choices to the user. We can also extend this to apply it on real time appliances like automatic doors, windows. By collecting the sensor readings, we can analyses them and send a notification as an SMS or an email.

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