

Software Design of a Voice Controlled Home Automation System

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ABSTRACT

Technology is limitless, the more the problems, the more opportunities, and solutions it provides. In the Post COVID-19 pandemic world, one of the potential areas where companies are willing to invest is Automation, generating a huge Return-on-Investment. One such appealing area is home automation. The daily use equipment such as light switches are touched ever so frequently by the people in the houses and offices amounting to extra danger. Interaction with these areas can actually be avoided entirely by using home automation. Catering to the future needs, our paper presents an idea of home automation system where appliances can be controlled using speech recognition technology. It requires an android app to provide voice command to the control circuit. The control circuit comprises of Arduino Uno which acts as a user interface controlling the switching of appliances. Commands are fed into Arduino with the help of a Bluetooth model which receives voice commands from the android app.

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1. INTRODUCTION

As the world moves towards globalization, different ideas have also travelled across continents along with man and material. Cutting-Edge Technology is the most significant outcome of globalization. Automation is an emerging technology and a dynamic concept. It is one of the most advanced technology that has the potential to thrive in the modern world. Industry 4.0 has further attracted the world towards automation.

Home automation system, on the other hand refers to the automatic and electronic control of household features, activity, and appliances [3]. Post pandemic world is expected to experience an unhindered upsurge of this technology in the global market. The main motto behind the idea of home automation is to consume less electricity, reduce human efforts and to provide a contactless solution.

In this paper, we have designed a model of Home Automation System in Proteus 8 Professional software where we are controlling home appliances using voice commands provided through an android mobile application. Though any number of appliances can be controlled by the system, we are determined to control some home appliances like a tube light, a fan, and a night lamp using voice commands via a smart phone.

The status of the appliances will be shown in the mobile phone. In this project we have also used MIT App Inventor, Arduino 1.6.5 software.

2. SOFTWARE

Proteus 8 Professional, Arduino 1.6.5, MIT App Inventor

3. SYSTEM COMPONENTS

In the system design, we have a Bluetooth module, and relays interfaced with an Arduino Uno. The connections are made and all the appliances are attached to the respective relays. As a result, all the appliances are controlled by providing voice commands.

3.1. ARDUINO UNO (ARD-1)

The Arduino consists of both a physical programmable circuit board and a piece of software, or IDE that runs on the computer, used to write and upload computer code to the physical board [1]. In the proteus software, we have used Arduino UNO model (ATMEGA328P-PU). It has a clock frequency of 16Mhz.

We need to generate a hex file by compiling an Arduino code using Arduino IDE software. The hex file is inserted in the Arduino board.

The appliances are connected via the relay boards to pin numbers 11, 12 and 13 of the Arduino Uno. It compares the voice commands with its data and performs the required function. 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 [2].

3.2. BLUETOOTH (HC-05)

Here, we have used the Bluetooth Module HC-05 v1. It has 6 pins namely,

- Vcc - powers the module
- GND - connects to system ground
- RX - receives signal data. It is connected to TX of Arduino
- TX - Transmits serial data. It is connected to the RX of Arduino
- Key - Toggles b/w Data mode and AT command mode
- State - connected to onboard LED. Acts as a feedback

The Module will be connected to the android application and voice commands will be fed into it. It will transfer the commands to the Arduino Board for final processing.

3.3. RELAY

We have used single pole animated relay models in the system working at 12V. It works as an electromechanical switch which is operated by the signals provided by the Arduino board. Various appliances are connected to the respective relay models. The relay is used to toggle the appliances ON/OFF as per the signal from the Arduino. Any number of appliances can be connected to this model.[2]

Our system also contains various other components like Lamp, LED, Motor and few other connector components.

4. IMPLEMENTATION

The implementation would be done in four phases. In the *Phase 1*, the control circuit would be designed using the Proteus software. In *phase 2*, an Android app would be developed using the MIT App Inventor. In the *Phase 3*, the Arduino code would be developed using Arduino software. In *Phase 4*, the system designing is done by interfacing all the software.

4.1. PHASE 1

We did the project by using the Proteus 8 Professional software. The Arduino UNO is attached to the Bluetooth HC-05 module. The output pins of Arduino UNO are attached to the switches via relays. We have connected three output pins to three switches representing three different appliances.

- Pin11 - a tube light [LED-BIRY]
- Pin 12 - a fan [a DC motor]
- Pin 13 - a lamp, using 3 different relays [ACTVRLY]. All other connections are done as shown in the diagram.

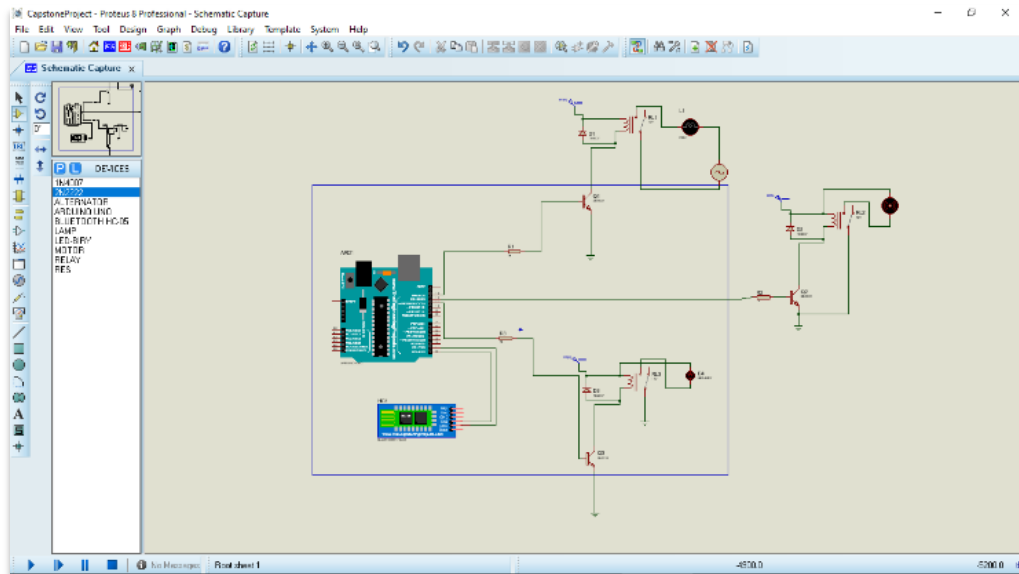


FIGURE 1. Proteus design of the system

4.2. PHASE 2

Now, with the help of MIT App Inventor, an android based app is designed which will ensure the connectivity to the Bluetooth. The app called *VoiceControlledHomeAutomation* is depicted below.

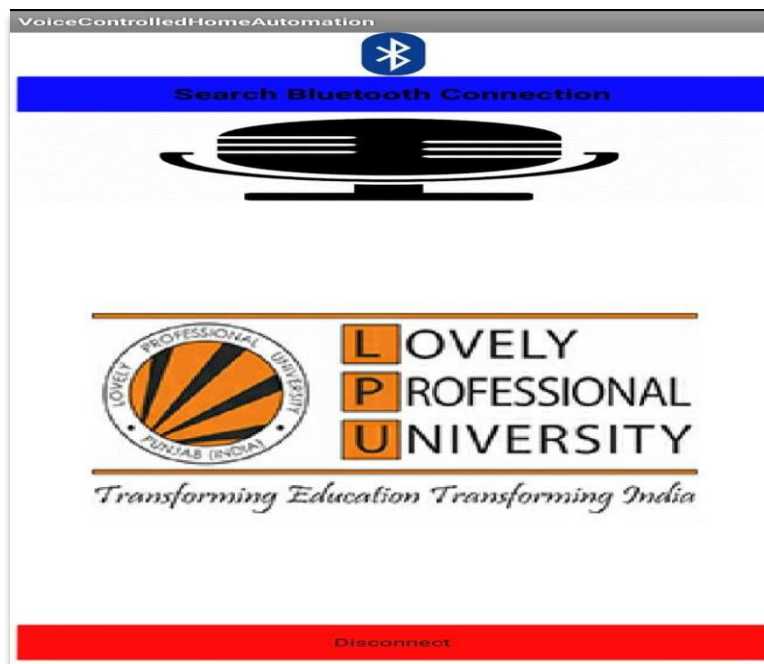


FIGURE 2. Android Bluetooth app

4.3. PHASE 3

We have used *Arduino 1.6.5* software for writing the code for Arduino. The code is written keeping in mind the respective output pins to which the switches are connected. Here, our paper provides a new paradigm by writing a smart code where we are providing 20 different sets of voice commands for the switching of the 3 equipment.

By using this code, we can:

- Switch ON and OFF any of the appliance.

- Switch ON and OFF any combination of two of the appliances.
- Switch ON and OFF all the appliance. The sequence of appliances doesn't matter.

4.3 PHASE 4

This is the last phase where we interface all the above-mentioned software to each other. Here, Firstly the Arduino code is compiled and its hex file is fed into the Arduino board in proteus. Secondly, the Serial port (COM) of Bluetooth is set as same as the laptop's. The proteus simulation is started.

Now, the Android application is launched on the smartphone and the required voice commands are given by the user. It converts the commands in the form of a string and this string is received by the Bluetooth model which converts it into text. The text is transmitted to the Arduino board and it processes the information and forwards the instructions to the respective relay boards.

The application searches for the Bluetooth device by clicking on the 'Search Bluetooth Connection'. It then shows the available Bluetooth devices where the user is required to select the Bluetooth of the laptop for connection. Once the Bluetooth client gets connected to the Bluetooth model the application shows, connection established'.

The user now, is required to click on the mic symbol and the application launches the voice recognizer. It reads the voice commands and converts the audio signal into a string. The string is received by the Bluetooth model in proteus which forwards to the Arduino board in the form of text. The Arduino board uses the port in serial mode. After analyzing the data, it decodes the input value and sends a signal to the relay circuit. The respective appliance gets switched as per the wish of the user.

The setup of the system is shown in the images below.



Figure 3. Scanning for Bluetooth connections

For establishing the Bluetooth connection, the correct Bluetooth module name is to be selected from the list. This part is very crucial for the system to work. The user needs to be attentive while choosing the correct Bluetooth device.

If the user's selection is correct, the app shall appear as in the following figure.



Figure 4. connection established

While providing the voice commands, sequence does not matter i.e., either it can either be 'lamp and fan' or 'fan and lamp', All commands would work properly. This is one of the unique features of our system. Various voice command strings in the application are illustrated below.

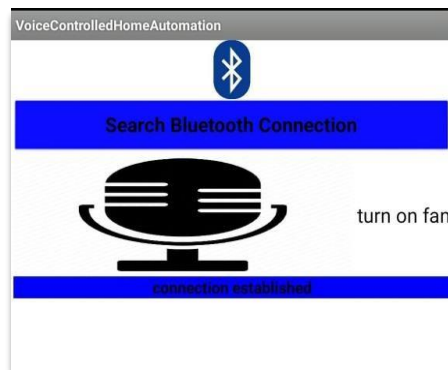


Figure 5. Turning on fan

As soon as this command is provided to the application, it sends the signal to the Bluetooth model in the proteus which reverts the message in string form to the Arduino. Here the processing of the command is done and the operation is performed.

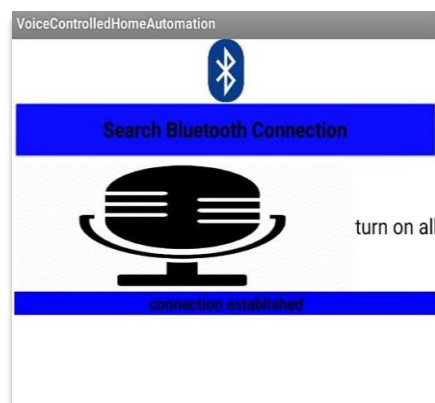


Figure 6. Turning on all

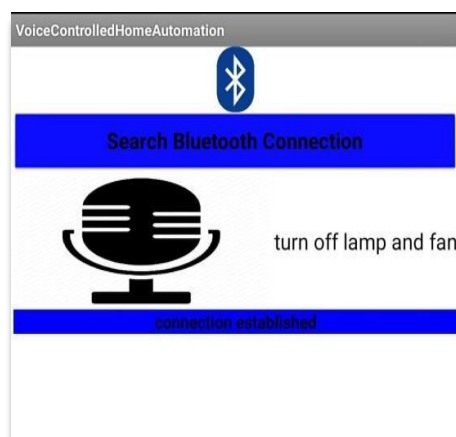


Figure 7. Turning off Lamp and fan

5. RESULT

Based on the commands, the system would automatically switch ON/OFF the respective appliances by toggling the appliance's relay board status to HIGH/LOW as depicted in the figure.

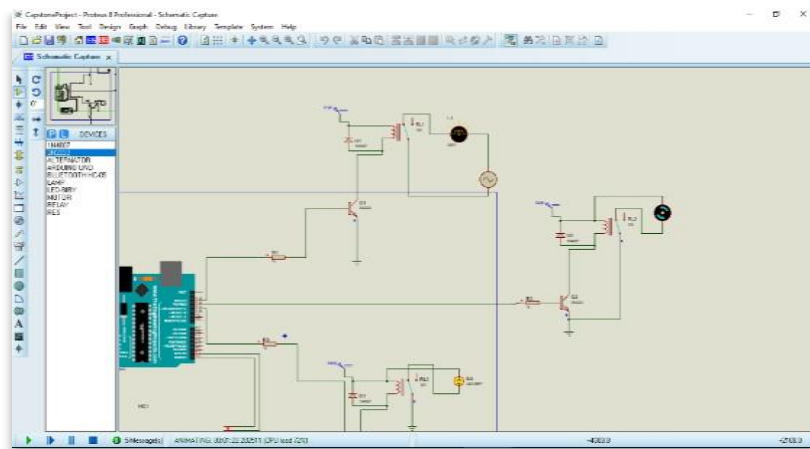


Figure 8. The working of the system

This is how the system gets implemented and works in the proteus software. The system can be implemented and used in the hardware mode at the houses, offices, and public areas

6. CONCLUSION

The traditional task of manually operating home appliances is tedious and can be fatal also. In this situation operating home appliances wirelessly adds a crunch of technology. Furthermore, controlling this web of connections through speech has a different aura altogether.

The existing Voice controlled Home Automation systems follow a particular trend of a fixed voice commands. However, if a different set of command is provided, the system becomes obsolete. Our project proposes a unique solution to this issue. In our project, the user can also provide commands by reversing the home appliance sequence and the system will respond positively.

The implementation of the system is done in software mode by using Proteus 8 Professional. The system is cost efficient and user friendly. It consists of components like Arduino UNO, Bluetooth module (HC-05), relay modules and other unique appliance modules. The project will enable us to control each and every appliance within the Bluetooth range in the house. The Arduino UNO controls the appliances through the commands from the user. The Bluetooth module is used to assist the software from various locations in the house. The system is designed to control appliances through our voice. The user need not to have a deep knowledge of language English, just by saying *Turn on/off appliance_name* like *Turn on/off Light*. Moreover, the entire system is easy to use and flexible.

We can add any number of appliances whenever required. It could be installed easily in any area. This technology has a potential to attract huge investment by big technical firms as, automation is the future of the world.

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