

Home Automation Based on Arduino

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Abstract: Automation is a trending topic in the 21st century making it play an important role in our daily lives. The main attraction of any automated system is reducing human labour, effort, time and errors due to human negligence. With the development of modern technology, smart phones have become a necessity for every person on this planet. Applications are being developed on Android systems that are useful to us in various ways. Another upcoming technology is natural language processing which enables us to command and control things with our voice. Combining all of these, our paper presents a micro controller based voice controlled home automation system using smartphones. Such a system will enable users to have control over every appliance in his/her home with their voice. All that the user needs is an Android smartphone, which is present in almost everybody's hand nowadays, and a control circuit. The control circuit consists of an Arduino Uno microcontroller, which processes the user commands and controls the switching of devices. The connection between the microcontroller and the smartphone is established via Bluetooth, a widespread wireless technology used for sharing data.

Keywords: Arduino Uno, HC-05 Bluetooth Module, Home Automation, Smartphone, Voice Control.

1. INTRODUCTION

The foremost aim of technology has been to increase efficiency and decrease effort. With the advent of 'Internet of Things' in the last decade, we have been pushing for ubiquitous computing in all spheres of life. It thus is of extreme importance to simplify human interfacing with technology. Automation is one such area that aims that achieves simplicity whilst increasing efficiency. Voice controlled House Automation System aims to further the cause of automation so as to achieve the goal of simplicity [1] [4].

The primitive man realized that an effective way to communicate with one another is through voice. With minimum effort, ideas could be narrated with relative ease. When the first computers came around, achieving the level of sophistication so as to narrate commands using voice to a machine was only realized in science fiction. However with tremendous breakthroughs in the field, we are at the precipice of truly using voice to interface with devices. Using this effective yet ingrained form of communication we would humanize technology to a great extent. Voice controlled House Automation System deploys the use of voice to control devices [8].

The advantages of using voice as an interfacing medium are multifold. Firstly we would do away with or significantly decrease the need of training for operating technology. Secondly, the simplification of services would entail a wider adoption of existing technology and would help people with varied disabilities access the same technology. We have deployed an Android Application as user front end primarily because of the ease at which the platform provides us with means to use complex technology and due to the widespread adoption in the mobile industry. Android is being used as the operating system for over 80% of the smartphones.

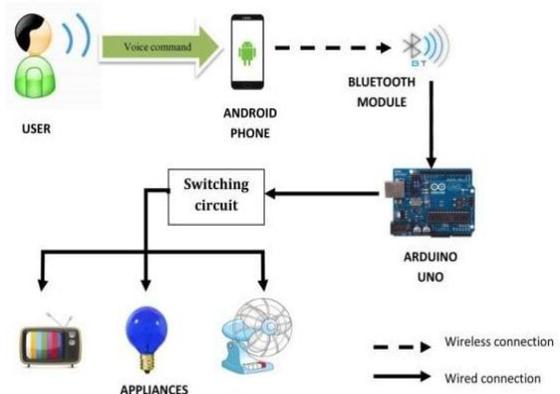
Voice controlled House Automation System leverages the power of Arduino to provide a holistic voice controlled automation system. Using Natural Language Processing and the available hardware in most smartphones, it translates voice to be used for controlling electrical devices.

2. SYSTEM DESIGN

2.1. System Components

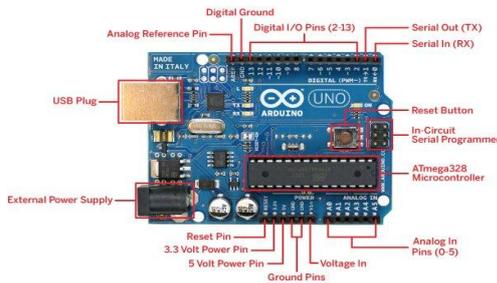
The Voice-operated Android and Arduino Home automation system uses an Android based Bluetooth enabled phone for its application and the Arduino Uno as the microcontroller. The key components of this system are:

- Arduino Uno
- Bluetooth module
- Opto Diac and Triac
- Android based phone



2.1.1. Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328p. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button [2]. It contains everything needed to support the microcontroller. We either need to connect it to a computer using a USB cable or power it with an AC-to-DC adapter. The Arduino circuit acts as an interface between the software part and the hardware part of the project.



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.

2.1.2 Bluetooth Module

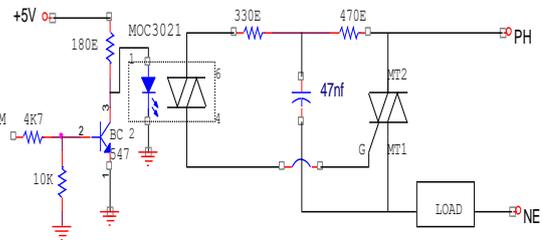
Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs) [7]. The Bluetooth module being used allows us to transmit and receive signals [5]. It receives the text from the Android phone and transmits it to the serial port of the Arduino Uno.



The Bluetooth module being used here is the HC-05 module. It is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has a slave default Baud rate of 9600. It auto connects to the last device on power as default. Pairing pin code is “1234” as default [3].

2.1.3. Opto Diac and Triac

MOC 3021IC acts as an optodiode. It consists of LED and diac. Load this opto coupler to provide isolation between control circuits and power circuits. An opto coupler allows signal transfer without coupling wires or capacitor. It transducers input voltage to proportional light intensity by using LEDs. Trip can be achieved by using applied voltage control methods. Here in our project, by varying the applied voltage, the SCR firing is varied, thereby the load is tripped. Triacs are used as a switching device to trip the load. Microcontroller with its loaded software acts as the triggering element to the triac. It consists of SCR is one of the family members of Thyristor. A silicon-controlled rectifier is a semiconductor device that acts as a true electronic switch. It can change alternating current into direct current and at the same time can control the amount of power fed to the load.



2.1.4. Android Based Phone

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 swiping, tapping, pinching, and reverse pinching 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 [5]. Applications on the Android phones extend the functionality of devices and are written primarily in the Java programming language using the Android software development kit (SDK). The voice recognizer which is an in-built feature of Android phones is used to build an application which the user can operate to automate the appliances in his house. The user interface of the application is shown below:



3. SOFTWARE DETAILS

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".^[21]

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures.

3.1. Program Used

```
#include <OneSheeld.h>
const char on[] = "on";
const char off[] = "off";
int lamp = 8;
void setup()
{
  OneSheeld.begin();
  VoiceRecognition.setOnError(error);
  VoiceRecognition.start();
  pinMode(lamp, OUTPUT);
  digitalWrite(lamp, HIGH); // Active Low
}
void loop ()
{
  if(VoiceRecognition.isNewCommandReceived())
  {
    if
    (!strcmp(off, VoiceRecognition.getLastCommand()))
    {
      digitalWrite(lamp, HIGH);
    }
    else
    if(!strcmp(on, VoiceRecognition.getLastCommand()))
    {
      digitalWrite(lamp, LOW);
    }
  }
}
void error(byte errorData)
{
  switch(errorData)
  {
    case NETWORK_TIMEOUT_ERROR:
      Terminal.println("Network timeout");
      break;
    case NETWORK_ERROR:
      Terminal.println("Network Error");
      break;
    case AUDIO_ERROR:
```

```
      Terminal.println("Audio error");
      break;
    case SERVER_ERROR:
      Terminal.println("No Server");
      break;
    case SPEECH_TIMEOUT_ERROR:
      Terminal.println("Speech timeout");
      break;
    case NO_MATCH_ERROR:
      Terminal.println("No match");
      break;
    case RECOGNIZER_BUSY_ERROR:
      Terminal.println("Busy");
      break;
  }
}
```

4. RESULT & FUTURE WORK

The Intelligent Home System is a voice-controlled home automation System which controls home appliances over a Arduino Bluetooth and a smart phone. Voice controlling enables users a sense of comfort as no direct operation with the home automation system is required. Arduino helps in achieving a rapid rate, low power consumption and low cost; Bluetooth Module to communicate with the devices. The future work for Intelligent Home System can be porting the system to the cloud so that any device eventually could be used to control and monitor the Intelligent Home System remotely over cloud.

5. CONCLUSION

The proposed project undertakes a viable solution the need of automation at the very basic level, that is, in our homes. The project will enable us to bring every appliance at every corner of our home under our control from a single point without having to get up and manually switch on or off the appliance. The use of a Bluetooth module assists the use of this system from various locations in our house. The system is further simplified by allowing appliances to be controlled by our voice. The user need not have to have to 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. Android applications are very simple and user friendly allowing the user to understand its functionalities in very little time. Hence, the use of android application in this system allows a user to easily learn the process and get accustomed to the functions. Moreover, the entire system is very flexible and scalable. Any number of appliances can be added as and when required. Hence, the systems finds use not only in houses but also in many offices where appliances such as fans or lights on multiple floors can be controlled by a person on any of the floors, saving manual labour and human effort to switch on or off the

electronic appliances, thereby saving time. This system, though primarily aimed to reduce human effort, will be of much importance to old aged people and physically handicapped people. It will enable them to control their home devices with ease, without going through much pressure or stress of moving about.

Due to the inexpensive materials used in the construction and further cost optimization if the device is taken to the market, it finds application in a wide area. Scalability of the project would be considerably easier as the device can be used in every building using electrical appliances and devices.

In addition, there have been many advertisements broadcasted by the Government of India promoting awareness to switch off household appliances when not in use and thus save electricity. Hence, such a project would assist the initiatives taken by the government, as most people forget to switch off home appliances and are too lazy to return and switch it off.

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