

A Design and Implementation of Voice Controlled Smart Home Automation System with Android Phone

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Abstract — With increasing technology, Automation has become a need whether it is home, office or some other place. At home we come across many appliances be it Fan, AC, TV, Lights, etc. This Project aims to incorporate android phone control over electrical appliances. We use Bluetooth communication between Android phone and a Receiver (control unit) that is connected to the appliances. This project is not a prototype and can be used practically in daily life. 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). IN our project we used the HC-05 Bluetooth module but HC-06 can surely be used. HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. HC-05 is 6-pin Module. The module has 6 pins labeled on the back, but most modules only have 4 of those populated with pogo pins. KEY & STATE seem to be not required, as KEY is used for flashing the device and STATE simply indicates if the device is awake or not. So that leaves only GND, VCC, TXD, RXD.

Keyword— *Microcontroller; Relay Module; Bluetooth Module; Android Phone.*

I. Introduction

Automation or automatic control, is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. With home automation, we dictate how a device should react, when it should react, and why it should react.

The biggest benefit of automation is that it saves labor, however, it is also used to save energy and materials and to improve quality, accuracy and precision. The term automation, inspired by the earlier word automatic (coming from automaton), was not widely used before

1947, when General Motors established the automation department. It was during this time that industry was rapidly adopting feedback controllers, which were introduced in the 1930s.

Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques.

Engineers can now have numerical control over automated devices. The result has been a rapidly expanding range of applications and human activities. Computer-aided technologies now serve as the basis for mathematical and organizational tools used to create complex systems. Information technology, together with industrial machinery and processes, can assist in the design, implementation, and monitoring of control systems. One example of an industrial control system is an Arduino. It is a very simple to use open source microcontroller and can be easily programmed according to the need. Arduino is specialized hardened computer which is frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events.

Controlling machines and equipments from android phone has never been easier. With the right app and devices like Relay Module, Bluetooth Module, Microcontroller etc we can control any appliance from far or near .As android phones are cheap and available, their use in automation have increased rapidly over the years. Over the past few decades many companies have entered the home automation sector. In this paper we present a low cost secure cell phone based, flexible home automation system. Appliances at home are connected to the Arduino BT module HC-05.

The communication between the cell phone and the Arduino BT board is wireless. Additional devices can be connected into the system with little modifications. The android application is available in play store and uses googles voice recognition to recognize voice command .The app basically uses the android phone as voice synthesizer and after determining the voice command it sends the command to BT module which is connected to the phone

using phones Bluetooth. The Bluetooth antenna in our module picks up the packets sent from the cell phone. Subsequently, these packets containing the appliance status commands are pipelined through microcontroller and the designed analogue circuitry according to the definition of each output. Different home appliances are connected to the digital output ports of the Arduino BT board via relay module to provide sufficiently high current and voltage compatibility. i.e. 220-240 volts and up to 10 ampere current.

Sending commands from software to turn ON/OFF a device may guarantee the successful operation of the devices.

This paper is specially focused on domestic use of a low cost smart home automation system and prepared considering aspects like cost, efficiency, reliability, accuracy, simplicity in design and ease of use.

II. METHODOLOGY

The project basically consists of two parts. One is the hardware part and another is the programming.

A. Hardware part-

1. **Arduino** : Arduino is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields"), modules and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which lets users connect the CPU board to a variety of interchangeable add-on modules.

2. **Relay Module** : Relay module is a kind of customized shield or device to operate from Arduino. It has channel pins which are connected to the digital I/O pins of the Arduino. It requires 5 volts to operate which it draws directly from the Arduino board. The number of channel pins and the number of appliance to use are same. Other to pins are vcc and ground pins.

3. **Bluetooth Module** : The module used for this project is HC-05. HC-05 module 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 the footprint as small as 12.7mmx27mm. It has typical -80dBm sensitivity and Up to +4dBm RF transmit power. It has a very low power operation. In the project we gave an input of 5 volts and it worked perfectly. It has six pins among which we only used vcc, ground, TX and RX.

4. **Load** : For testing the project we considered using a tube light and a fan used in households at rated voltage though any kind of home appliance can be used.

5. **Android Phone** : Any Android smart Phone will work perfectly.



fig : interface of voice control app

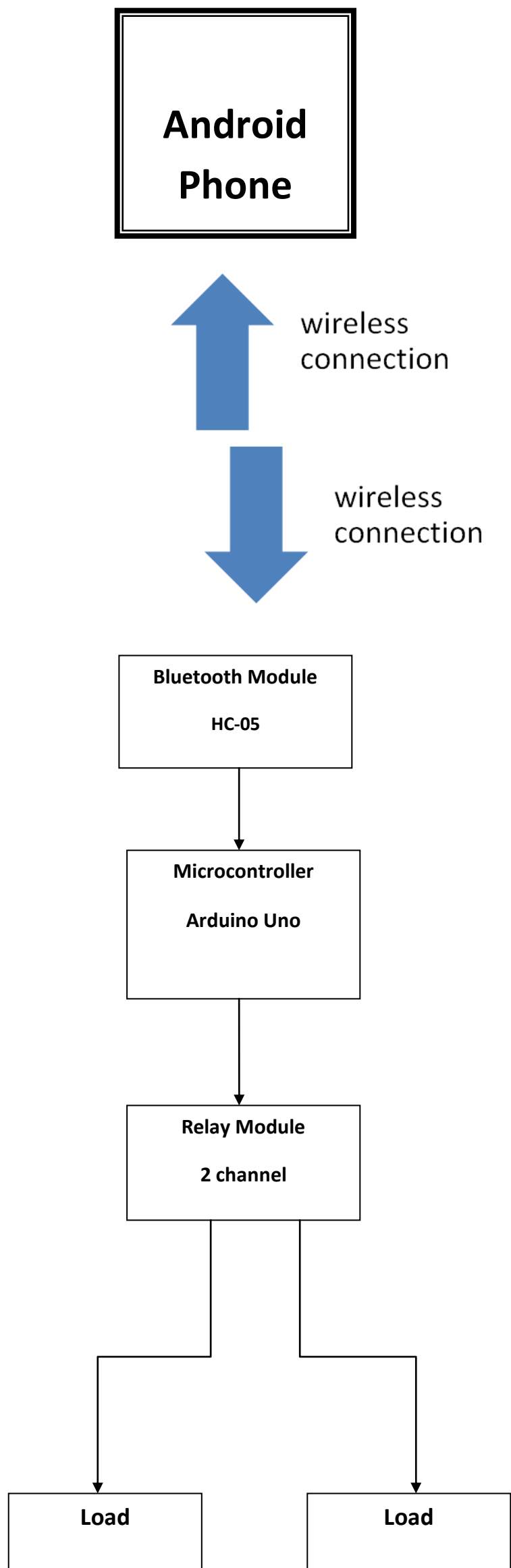
B. Programming Part-

The programming part only consist of programming the Arduino. The Arduino can be programmed using C, C++, JAVA. Arduino programs can be divided in three main parts: structure, values (variables and constants), and functions. First we defined the relays. We used "pinMode" to set both relays as outputs. We wrote different strings as command to operate the relays. The baud rate specifies how fast data is sent over a serial line. Serial data transfer is when we transfer data one bit at a time, one right after the other. The word serial means "one after the other." It's usually expressed in units of bits-per-second (bps). The devices connected to the arduino serial read pins must operate at the same rate. We used one of the most common baud rates which is **9600** bps. The asynchronous serial protocol has a number of built-in mechanism that help ensure robust and error-free data transfers. For this reason we just conducted a serial read for communication between Bluetooth module and Arduino, no hard coding was required for that. We used String comparison operators, mostly ==. The operator == and the method equals() perform identically. String comparison operators can be confusing when comparing numeric strings, because the numbers are treated as strings and not as numbers that is why we did not use any numbers. We programmed the Arduino to compare the strings in the code and the strings it receives from smart phone as commands. We did not have to use any mathematical equations in the programming.

III. SYSTEM DESIGN

The system design is described bellow in two parts. One is block diagram and another is the project circuit diagram.

1. Block Diagram :



2. Circuit Diagram : (without load)

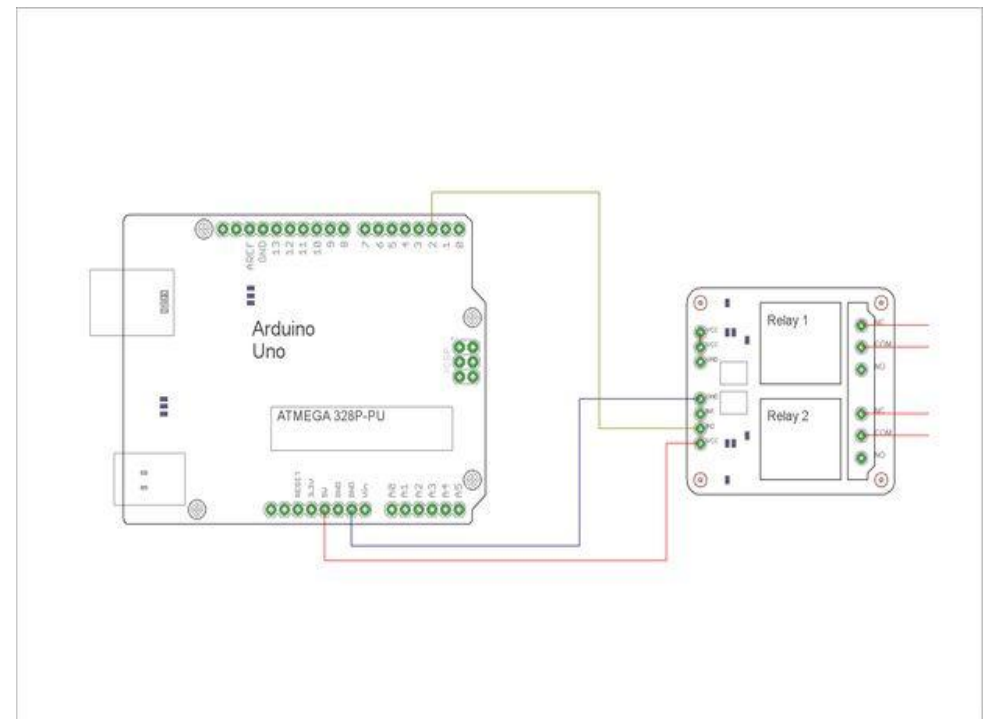


fig : connection of relay module and arduino

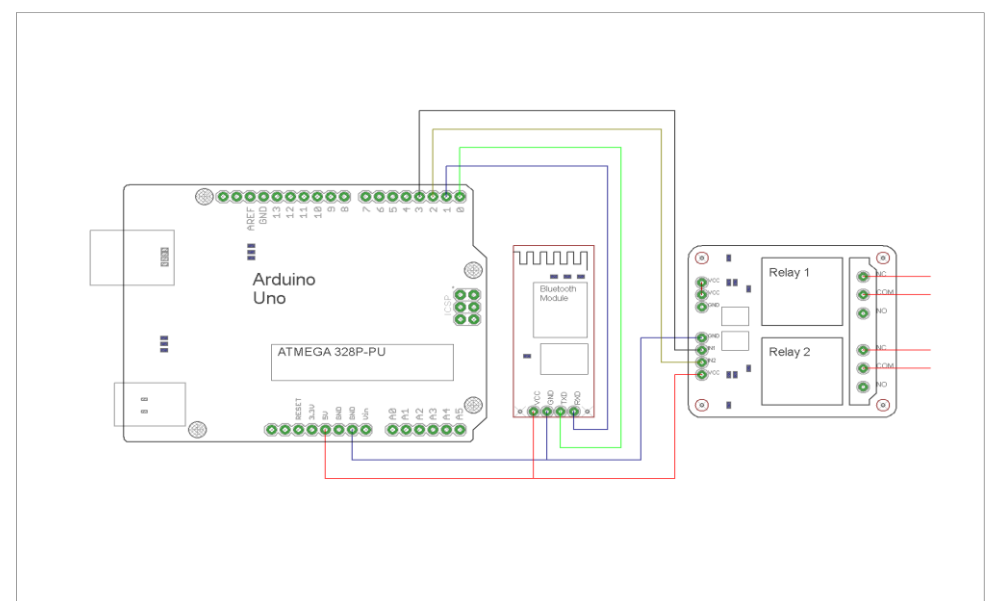


fig : connection of Bluetooth module ,relay module and arduino

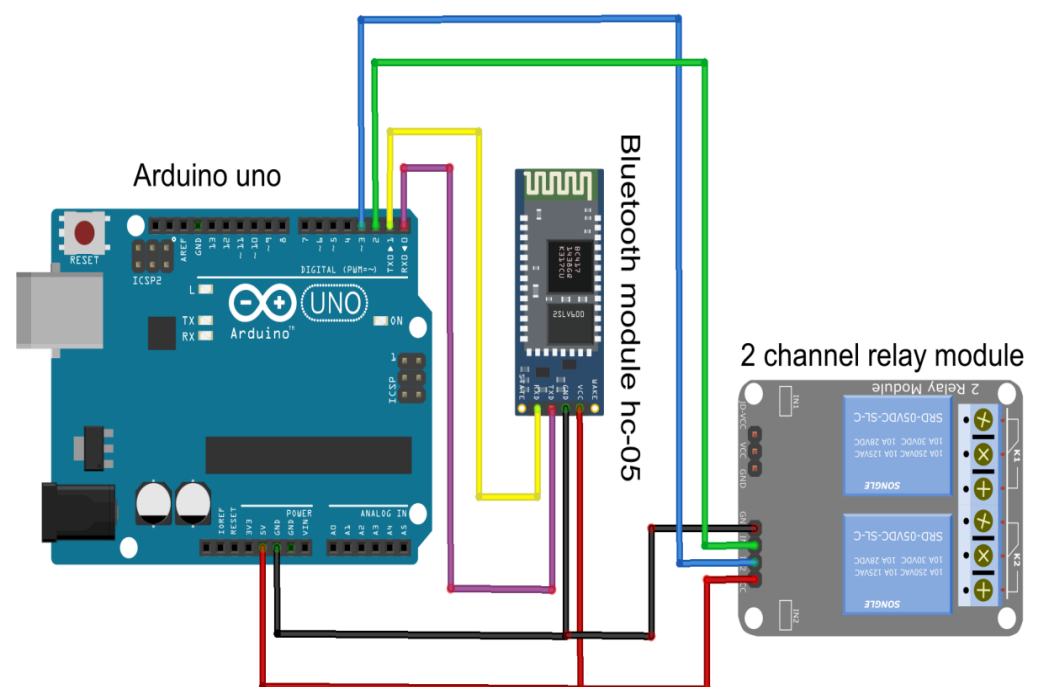


fig : software aided scetch

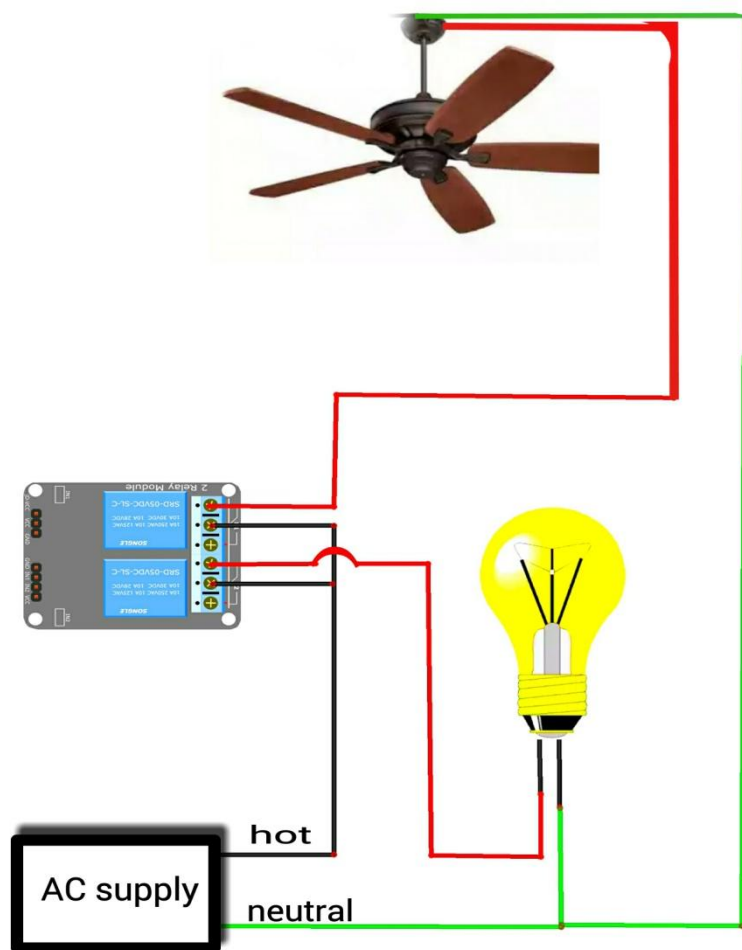


figure : connection of loads with relay module

IV. IMPLEMENTATION

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 relay module. The TXD and RXD pins on the Bluetooth module don't work when connected to the same pins on the arduino itself. The TXD pin on the Bluetooth module we have connected to the RXD pin on the arduino (pin 0), and the RXD pin on the Bluetooth module is connected to the TXD pin on the arduino (pin 1). Both modules vcc pins are connected to the arduinos 5 volt output pin.

Then we need to launch the android based application-“Voice AMR” 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.

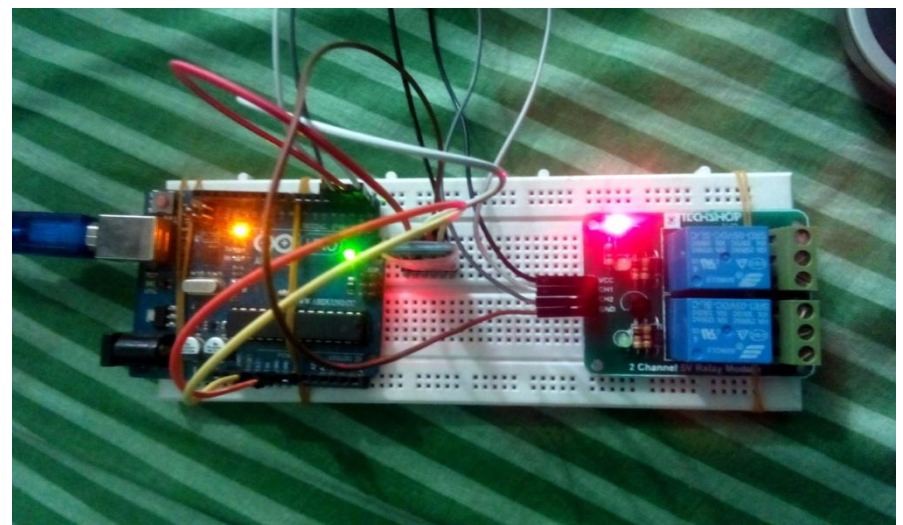


fig : circuit implementation in practical

3. Battery

The Bluetooth Module works on 3.6 volts but the relays need 5 volts to operate. We have used a 9 volt battery as the power supply for Arduino. Both relay module and Bluetooth module are powered by Arduino itself.

V. RESULT AND ANALYSIS

Here the tables show the voice commands that are programmed in the microcontroller and the time of operation after giving voice commands.

Voice command	Light on	Light off	Fan on	Fan off
Time of operation	6 seconds	6 seconds	6 seconds	6 seconds

Voice command	Switch on	Switch off	Fan on (light already on)	Light on (fan already on)
Time of operation	6 seconds	6 seconds	6 seconds	6 seconds

The time of operation may vary a little. As we use a smart phone that synthesizes our voice through an application, it may take a little longer to synthesize and recognize voice command if there is much noise around. The microcontroller works almost as soon as it receives command.

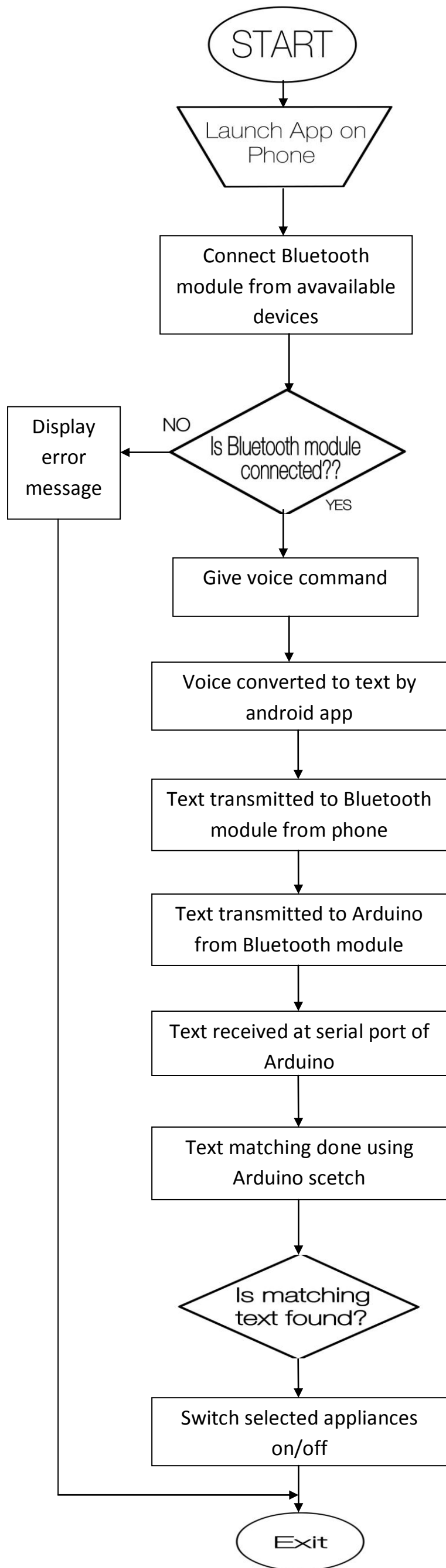


fig : flow chart of entire system

VI. EFFICIENCY

The efficiency of the project is good enough. A 9 volt battery is cheap enough and lasts for almost 3 weeks.

VII. 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.