Design and Construction of a Voice Control Automation System

Mahalsa Sai Dontha[1*], Maddala Srinivas[2], Mohammad Sameer[3]

[1,2,3]*Student, Department of Electronics and Communication Engineering, Sri Indu College of Engineering and Technology, Hyderabad, India*

Abstract*: Over the past few decades, home automation systems have become increasingly popular because they improve comfort and quality of life. An overview of existing and developing home automation systems is covered in this paper. The main benefit of an automated system is that it lessens stress and human error. Using a variety of communication methods, a smart phone application is used to monitor and control the home appliances. In order to assist users in making an informed choice regarding the technology they want to use to create home automation systems, this study compares the features of various wireless communication technologies, including ZigBee, Wi-Fi, Bluetooth, EnOcean, and GSM. Every person should now own a mobile smartphone thanks to technological advancements that have made this easier and more important. An Arduino Uno microcontroller, which is part of the control circuit, is used to translate voice commands from an Android smartphone running the "AMR voice" app. The control circuit is made up of an Arduino Uno microcontroller, which interprets voice commands from an Android smartphone running the "AMR voice" app. The Bluetooth Module shares signal data after establishing a wireless connection between the microcontroller and the smartphone, while the relay manages device switching. In addition, a survey of various home automation systems is covered in this research project, along with a discussion of their benefits and drawbacks.

***Keywords*: Arduino Uno Microcontroller, Android Smartphone, Bluetooth Module, Microcontroller, Relays, Voice Control Automation.**

1. Introduction

Home automation systems are expanding quickly and are used to improve residents' quality of life, comfort, and security. The majority of home automation systems in use today help the elderly and the disabled and lessen the need for human labor in the creation of goods and services. A single controller that has the capability to control and monitor numerous interconnected appliances, such as power plugs, can be used to design and develop a home automation system. wireless and internet technology. For controlling the appliances, others used remote controls, computers, etc. The main objective of our system is to design the perfect companion for someone who wants to use voice control to operate electronic appliances at home or at work. It uses Bluetooth and GSM technology and is capable of processing direct voice commands.

The microcontroller converts the voice command sent to the control unit into a binary sequence, turning the load ON or OFF as needed. The microcontroller unit accepts the command and makes the necessary choice.

The proposed system can be applied in several contexts. However, for the purposes of this paper, its use is only applicable to electric bulbs and fans.

2. Review of Related Empirical Studies

A. Implementation of Internet of Things for Home Automation

The paper focused on Internet of Things (IoT) coverage, which can create connections between different items like smartphones, tablets, cameras, sensors, and other devices, as well as create the transfer of enormous amounts of data and information. The paper also discusses cloud computing, which might easily strengthen connections between various items for practical access at a particular time and place. With a presented prototype model, the authors demonstrated cloud-based sensing as a service by using specific applications such as augmented reality, agriculture, environmental monitoring, etc. For the complex Internet of Things to be managed, society needs new solutions. The use of WiFi Wireless Equivalent Privacy (WEP) and Wi-Fi Protected Access (WPA) in the design allows the model to guarantee safety and security.

An application for voice recognition offers users a user-friendly interface and has the capacity to integrate more home appliances. This home automation system can be used in every building using electrical devices and appliances. The system's primary flaw is that it has a constrained range due to Bluetooth. Its range can be increased by using the internet in place of Bluetooth, but this will not be a financially viable solution. Additionally, this system performed poorly in a noisy setting.
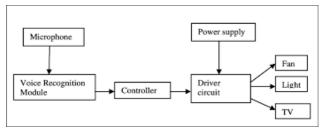

Fig. 1. Block diagram of the Voice control HAS

Figure 1 depicts the block diagram of a voice recognition-based home automation system (HAS).

*Corresponding author: mahalsasai333@gmail.com

Another home automation system that uses voice recognition was created using GPRS technology. Another voice-recognition-based home automation system was developed using GPRS technology. Support Vector Machine (SVM), a machine learning classifier, is used in this system to recognize speech.

B. Hand Gesture Based Home Automation for Visually Challenged

M. Smitha, et al. In a study on home automation for people with visual impairments, hand gestures were used. The intended system aims to make using household appliances a comfortable experience for people who are visually impaired. In addition to using radio frequency to transmit signals to a wireless protocol, they have used a MEMS (Micro electromechanical Systems) accelerometer to detect the accelerations of a hand in the corresponding three perpendicular directions (x, y, and z). By using the gesture stored in the microcontroller, the hand and the received gestures are compared. As long as the gesture matches the templates, the home appliances are controlled. The designed device is also suggested for elderly individuals.

For visually impaired and partially paralyzed people, a home automation system based on MEMS accelerometers has been developed. The system uses RF signals for communication and has an accelerometer, a microcontroller, an RF transmitter, and a receiver. The RF transmitter transmits signals to the receiver section after the accelerometer detects the hand gestures. When similar hand gestures are identified, the home appliances are only controlled after the RF receiver compares the transmitted signal to the gestures that have already been stored.
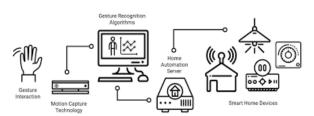

Fig. 2. Home automation for the visually impaired using hand gestures

C. Bluetooth Based Wireless Home Automation System Using FPGA

Thanks to the development of modern technology and smartphones, smart living has taken on greater significance in the contemporary era of human existence. Bluetooth has brought a revolutionary change as a result of the rapid advancement of technology. The goal of Bluetooth technology is to exchange data wirelessly over short distances while providing the necessary framework for comfort and controllability. Due to its wireless nature, it has many uses. In this essay, we discussed one of its practical uses: home automation, which is managed by an Android smart phone. The home appliances connected to the FPGA board are managed by a Bluetooth module (HC-05). The input/output ports of the FPGA board are wired to the household appliances that need to be controlled, and serial communication is used to establish communication between the FPGA board and Bluetooth device.

Home automation not only helps to minimize human effort but also saves time and energy. Home automation is primarily intended to assist elderly and disabled people by giving them access to home controls and emergency alert systems.
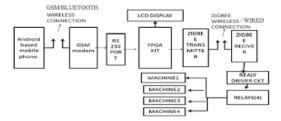

Fig. 3. Bluetooth based wireless home automation system using FPGA

D. Intelligent voice-activated home automation system design

In the twenty-first century, automation is a hot topic, so it's important to our daily lives. Any automated system's main selling point is its reduction of labor, effort, time, and mistakes brought on by human error. Smart phones have become a requirement for every person on the planet as a result of the advancement of modern technology. Applications are being developed on Android systems that are useful to us in various ways. Applications that benefit us in various ways are being created for Android systems. Natural language processing is a new technology that will allow us to control objects with our voice. Our paper introduces a micro controller-based voice-controlled home automation system using smartphones by fusing all of these. With the aid of such a system, users will be able to voice-control every appliance in their home. An Android smartphone, which is in almost everyone's hand these days, and a control circuit are all that the user needs. An Arduino Uno microcontroller serves as the central component of the control circuit, processing user commands and managing device switching. Bluetooth, a widely used wireless technology for data sharing, establishes the connection between the microcontroller and the smartphone.

A comprehensive voice-controlled automation system is provided by the voice-controlled House Automation System, which makes use of the capabilities of Arduino. Using Natural Language Voice commands are translated using processing and the hardware found in the majority of smartphones and used to operate electrical appliances.
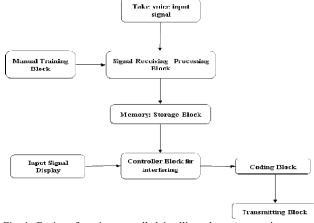

Fig. 4. Design of a voice-controlled, intelligent home automation system

E. GSM Based Home Automation System

This paper discusses the analysis and application of home automation technology using a Global System for Mobile Communication (GSM) modem to control home appliances like lighting, climate control, and security systems via SMS text messages. Using a Global System for Mobile Communication (GSM) modem to control home appliances like lighting, climate control, and security systems via SMS text messages is the topic of this paper's analysis and application.

Using the Global System for Mobile Communication (GSM), a smart home automation system was put into place. The system's hardware architecture consists of a smartphone, a PIC16F887 microcontroller, and GSM modem. The system used a GSM modem to use SMS commands to control electrical appliances. and smartphone. The system used a GSM modem to use SMS commands to control electrical appliances. Relays are used to connect household appliances to a PIC16F887 microcontroller. This device connects to a GSM modem. Relays are used to connect household appliances to a PIC16F887 microcontroller. Serial communication between the PIC16F887 microcontroller and GSM modem is accomplished using RS232. Less than 500 microseconds pass between requests in a GSM modem. The entire sending and receiving of commands is completed in less than two seconds. Users of this automated system will receive updates on the status of their home appliances via SMS on their smartphones, which is one of its benefits. The accuracy rate of this hardware-implemented system was 98%. Due to the GSM network's extensive coverage, users can access appliances from any location in the world. The use of GSM in the home automation system offers the highest level of security and dependability, it is concluded. The functional block diagram of the GSM-based home automation system (HAS) is shown in Fig. 5.

Mobile phone is a revolutionary invention of the cIt was primarily made for sending and receiving calls and text messages, but since the advent of the smart phone, it has evolved into the entire world. In this project we are building a home automation system, where one can control the home appliances, using the simple GSM based phone, just by sending SMS through his phone. In this project, no Smart phone is needed, just the old GSM phone will work to switch ON and OFF any home electronic appliances, from anywhere.
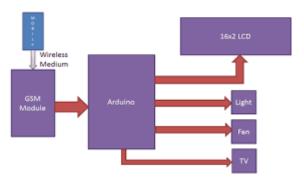

Fig. 5. A home automation system based on GSM

F. Internet of things (IoT) based home automation system

Developments in the field of telecommunications,

informatics and electronics have led to more comfort and safety inside homes.In this paper, we present a study on Google Assistant-based voice control for the home. With the aid of this phone app, voice commands can more easily be used to control home appliances because it makes it easier to understand human speech.

Rajeev Piyare presented a home control and monitoring system based on the internet of things (IoT) technology. A home control and monitoring system based on internet of things (IoT) technology was presented by Rajeev Piyare. It is created and put into use using a software program, a smartphone, a controlling device, and an embedded micro web server. The home environment, the home gateway, and the remote environment make up the system's architecture. The system's architecture is shown in Fig. 6. Using a smartphone that supports Wi-Fi, 3G or 4G, and an Android application, authorized users can remotely control and monitor the home appliances. Hardware interface module and home gateway are both included in the home environment. Data translation between the internet, router, and Arduino Ethernet server is the role of the home gateway. A micro web server that is constructed using an Arduino Ethernet shield is the most crucial component of the home gateway. Hardware interface modules are interfaced with actuators and sensors via wires. Actuators and sensors are connected by wires to hardware interface modules. This system has the capacity to regulate HVAC systems as well as energy management systems like power outlets, lighting, and security systems like gate and door locks. The need for electrical outlets, lighting, and safety features like gate and door locks cannot be overstated. temperature sensors, Power outlets, lighting, and security features like gate and door locks are all necessities.

Fig. 6. Internet of things (IoT) based home automation system

3. Background of Study

The concept of "Home Automation" has been in existence. The terms "Smart Home" and "Intelligent Home" were used to describe the idea of networking appliances inside the home. Centralized control and remote status monitoring of the lighting, security Centralized control and remote status monitoring of the lighting, security system, and other appliances and systems inside a home are features of home automation systems (HASs) house. HASs enables energy efficiency, improves the security systems, and certainly the comfort and ease of users. HASs are becoming more common in the current, developing market and have piqued users' interests. HASs has its own set of difficulties. Currently, despite

greatly benefiting from the system, end users, particularly the elderly and disabled, don't seem to accept it because of its complexity and high cost.

Traditional switches have been replaced with central control systems in modern homes and workplaces. Currently, it is challenging for the user to approach conventional wall switches that are dispersed throughout the home or office in order to operate them. Elderly or physically challenged people seem to have more difficulty doing so. With smartphones, remote-controlled voice automation systems offer the most cutting-edge solution.

A. Statement of Problem

Robotization has the potential to be particularly important today with the real goal of improving our quality of life. The voice-controlled automation system offers a modern way of life where someone can have complete control over all of his home or office appliances. In this area, numerous research projects have been conducted. However, the circuit and schematic diagrams of the systems described in the literature, as well as the coding of the microcontroller (Arduino), have not been made clear enough for a thorough understanding.

B. Aims and Objectives of the Study

The aim and objectives of this research work is to design, implement and develop a reliable and scalable prototype of a well detailed "voice control automation system" that will remotely switch ON/OFF any household or office electronic devices, such as bulbs, fans, television etc., using a microcontroller, voice dial on phone via Bluetooth based Android application.

The prototype aims to wireless control over home appliances with the technology of IOT. The prototype enables wireless control of home appliances through IOT technology. IOT, as previously mentioned, supports a number of wireless communication protocols, including Bluetooth, Z-Wave, and Zigbee. This prototype establishes remote access over home appliances using the Wi-Fi wireless communication network. Wi-Fi has distinct advantages over other wireless communication protocols, which is the reason for this.

C. Significance of Study

Home-based automation has received a lot of attention in recent years with the aim of incorporating crucial software applications that meet the comfort and security needs of the elderly and the disabled. Since the device can be used in any building that uses electrical appliances and devices, scaling the research work would be much simpler.

Discussions about the project's essential equipment took place during this phase. The examination of related, already-completed projects, gathering the necessary theoretical knowledge. It also involved learning how to code by creating straightforward algorithms and flowcharts to design the entire process.

D. Scope of Study

Although the proposed system has numerous applications in a variety of settings, for the purposes of this paper, its uses are limited to electric bulbs and fans.

The circuit diagram was used to build the experimental model, and the outcomes were as predicted. The home appliances could be remotely switched over a Wi-Fi network. Both the switch mode and the voice mode control methodologies were successfully achieved. The Blynk application successfully displayed the status of each application. The Blynk application successfully displayed the status of each application.

4. Theoretical Framework

The term "IoT" has advanced significantly as a result of the fusion of numerous technologies, machine learning, embedded systems, and common sensors. As a result of the blending of numerous technologies, machine learning, embedded systems, and common sensors, the term "IoT" has advanced significantly. IoT is a system of UIDS-equipped, networked devices that enables data transmission and device control. It reduced the need for direct manipulation to use a device IoT is an advanced automation and analytics system that uses big data, artificial intelligence, networking, sensing, and sensing technology to deliver complete systems for a good or service. Any industry or system can use these systems to achieve greater transparency, control, and performance.

The Bluetooth module, relay circuit, and microcontroller device must all be attached to the breadboard. The commands to turn a device ON or OFF are sent to the microcontroller when the Android base application "Smart Voice" is launched. The microcontroller signals the relay board after getting the order via the Bluetooth module. The app starts by looking for the Bluetooth device. The voice recognizer is launched if the application finds the appropriate Bluetooth that is readily available. Before turning the voice into a string, the application reads the voice from the audio signal. For each appliance, a value is generated and sent to the microcontroller. When the input data is read and decoded, a signal is sent to the parallel port with the intention of activating the relay circuit.

A. Android Based Phone

The Android OS's open-source features are adaptable. The built-in sensors are easily accessible. The system's control application has the following features. Android Phone acts as a client and data are sent via sockets programming. The application accepts user commands in two different ways.

1. *Switch mode:* The radio buttons that are used to operate household appliances are used in switch mode. The switch's status is sent via the radio button.
2. *Voice mode:* Voice Mode enables voice commands to be used to operate home appliances. The application creates an intent to fetch speech data from the smartphone's built-in microphone and send it to the Google server, which returns string data in response. string data are further analysed and then processed.

The majority of Android phone applications are created using the Java programming language and the SDK. An application that enables users to automate control of appliances in their homes or places of business has been developed using the voice

recognition technology built into Android smartphones. The "AMR Voice," an Android-based app that can be downloaded from an open-source website using a Google search, is used to conduct the research. For speech recognition, the application makes use of the Google voice recognition system.

Fig. 7. AMR Voice Application Interface

B. Bluetooth

The short-range IoT communication protocol and technology known as Bluetooth is widely used in the computing and consumer goods industries. It is anticipated to be crucial for wearable products in particular, connecting to the IoT once more, albeit frequently via a smartphone. The new Bluetooth Low-Energy (BLE) standard, also known as Bluetooth Smart, is an important protocol for IoT applications. Importantly, it has been designed to offer significantly lower power consumption even though it has a range that is comparable to Bluetooth.

Fig. 8. HC-05 Bluetooth module

Wi-Fi's bandwidth can reach up to 150Mbps, which is ideal for video transmission. Bluetooth is typically used for point-to-point networks and operates at a much slower rate of around 720 Kbps, which is very small for video transfer or moving large amounts of data like the image captured from a camera.

There are so many Bluetooth modules available in the market, but the HC-05 Bluetooth module is used in this design. Depending on the level of environmental interference, it has a coverage range of 9m and is an intuitive serial port protocol module. Depending on the level of environmental interference, it has a coverage range of 9m and is an intuitive serial port protocol module. A fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps modulator with a full 2.4GHz radio transceiver and baseband is available as a serial port Bluetooth module. A single chip Bluetooth system with adaptive frequency hopping is called the HC-05. It connects automatically to the last device on power as default with a slave default band rate of 9600 and pairing pin code of "1234" as default.

C. Microcontroller (Arduino)

An open-source electronics platform called Arduino is built on simple hardware and software. Using an Arduino board to read inputs like light on a sensor, a finger on a button, or a tweet allows you to start a motor, turn on an LED, and publish something online. Turn it into an output by publishing something online, starting a motor, or turning on an LED. You can tell your board what to do by sending a set of instructions to the microcontroller on the You do this by using the Arduino Software (IDE), which is based on Processing, and the Wiring-based Arduino Programming Language. the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Arduino has been used for different engineering projects and applications. The Arduino software is very user-friendly for beginners, but it is also flexible enough for more experienced users. Beginners will find the Arduino software to be very user-friendly, but advanced users will find it to be flexible enough. It runs on windows, Linux and Mac. For use in physical computing and engineering, the Arduino family offers a variety of microcontroller models, including the Arduino Nano, Arduino Uno, Lilypad Arduino, Red Board, Arduino Mega, and Arduino Leonardo. However, Arduino Uno is employed for the needs of this study due to its usefulness and affordability. The ATmega328p-based Arduino Uno microcontroller board has 14 digital input/output pins. it has USP connection port, 16Mhz ceramic resonator, a power jack, 6 analog input and ICSP header, and a reset button [9]. It contains everything needed to support the microcontroller. It can be connected to a computer using a USB cable or powered with an AC-to-DC adapter. The Arduino circuit serves as an interface for the system's hardware and software components.

A microcontroller is a single integrated circuit meant to perform a particular task. To carry out a specific function, an individual integrated circuit known as a microcontroller is designed. To ensure signal supply to the relays and to receive signal from the HC-05 Bluetooth module, this design uses an Arduino Uno microcontroller. It requires a 5V DC power source. The Bluetooth module sends text to the Arduino Uno serial port, and different text combinations are matched to turn on and off the appropriate appliance. For example, to switch on a bulb the user needs to say "bulb on" and to switch it off he/she needs to say "bulb off". The appliances are connected via the relay boards to pin numbers 4 and 7 of the Arduino Uno, but for this design, a two-channel relay device is used. The appropriate appliance is switched either ON/OFF if the matching text is detected to give the corresponding pin a high or low output signal.

Fig. 9. Arduino Uno Microcontroller

D. Relay Boards

The 2 Channels Relay Module is a handy piece of equipment that can be used to manage high voltage, high current loads like motors, solenoids, lamps, and AC loads. It is made to interface with microcontrollers like the PIC and Arduino.

A relay is defined as an electromechanical switch. By definition, an electromechanical switch is a relay. Historically, the first relay was used in long distance telegraph circuits as amplifiers, and they were also used in early computers to perform logical operations. There are various kinds of relays operating at different voltages. When designing circuits, a trigger voltage is always taken into consideration. The voltage that will cause a circuit to activate must be taken into account when designing it. The relay circuit is used in this paper to turn the appliances ON and OFF. . The relay receives its high and low voltage signals from the Arduino Uno microcontroller. When an appliance is connected to a relay, high and low voltage signals indicate that the appliance should be turned ON or OFF, respectively. As depicted in figure 4, the relay circuit powers two appliances in the voice-activated automation system. The designer can change the number of loads that need to be connected to the relays as needed.

Fig. 10. 5V DC Tongling Two (2) Channel Relay Module

E. Jumper Wires

Fig. 11. Jumper wires

The DC power supply uses jumper wire. A jumper wire is an electric cable used to link distant printed circuit board electric circuits. It is possible to short-circuit and jump to the electrical circuit by connecting a jumper wire to the circuit.

F. Power Supply

This paper proposes an optimization of home power consumption based on PLC (Power Line Communication) for an easy to access home energy consumption. In order to track the energy production of renewable energies, this also suggests a Zigbee and PLC-based renewable energy gateway. Power Line Communication). This also proposes a Zigbee and PLC based renewable energy gateway to monitor the energy generation of renewable energies.

The power supplies are designed to convert mains AC voltage electricity into a suitable DC voltage supply for electronic circuits and other devices. A power supply can be divided into a number of blocks, each of which serves a specific purpose. In spite of changes in the load or variations in the AC mains, a regulated DC power supply keeps its output voltage constant. The regulated DC output voltage must be steady, without noise or ripples. All electronic circuits can use it.

5. System Analysis and Design

These programs transform data or input from various devices into actions that can be taken or into distinct patterns that can be examined by humans. In order to carry out automation-related tasks or provide the data needed by industry, they analyze information based on a variety of settings and designs.
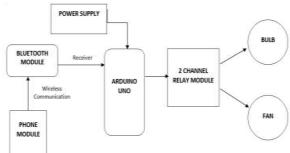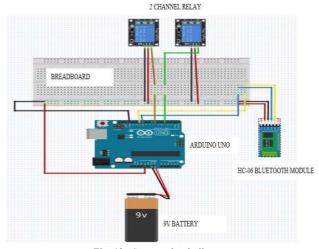

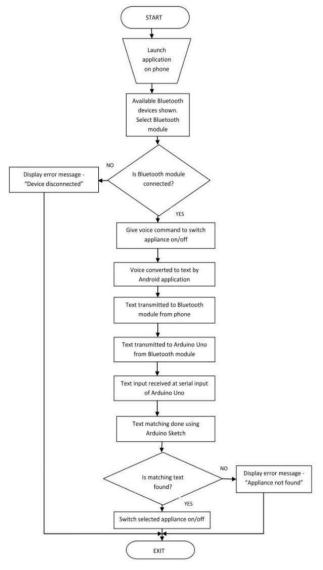Fig. 12. System block diagram

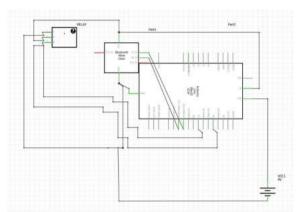Fig. 13. System circuit diagram

Fig. 14. System flow chart

Fig. 15. System schematic diagram

A. Working Principle of the System

The above components are used to implement the system. These components are used to activate the system. The core component of this system is the Arduino Uno which has a microcontroller that is, Atmega 328p. To download Arduino sketches, a boot loader must be written to the Atmega 328p's

32KB flash memory. The ISP program controller is used to program the boot loader. The Arduino voice control system's input power source is a 9V adapter power supply.

The loads are switched by relays connected to an Arduino Uno's output pin. Google created the Android mobile operating system, which is based on the Linux kernel. Android phones have an inbuilt feature called 'voice recognizer' which the user uses to control an appliance. The "voice recognizer" feature found on Android phones can be used by the user to operate a device. For wireless communication system, a

The Android voice application uses the Bluetooth HC-05 module as a remote to sense signals sent by the control unit.

The Bluetooth module and relay circuit are connected to the microcontroller while the android-based app is running on the smartphone. The user can verbally instruct the application to turn a device ON or OFF. As soon as the microcontroller receives instructions via the Bluetooth module, it sends a signal to the relay board. The application looks for a Bluetooth device first when attempting to establish a wireless connection. As soon as a connection is made, the voice recognizer starts up. The audio signal read from the voice is converted into string. Value is assigned to each of the appliances and fed to the microcontroller. The microcontroller decodes the sends data signal and activates the relays for appropriate loads switching.

6. Construction, Testing and Results

A. Construction and Testing

Bread board performance test and measurement were carried out for every stage. Some of the procedures carried out during constructions are:

1. Every component was attached to the bread board in the appropriate circuit position.
2. The microcontroller was mounted with care to pin output to input as programmed, and then it was programmed and checked to see if everything was "OK."
3. The system as a whole was tested after component mounting on the bread board, and outcomes were evaluated.

A digital multimeter was used to measure the battery power supply's 9V in order to ascertain the amount of power available for the circuit. This was done to make sure the Arduino Uno had enough power. The laboratory implementation of Fig. 16 illustrates how the entire system was constructed
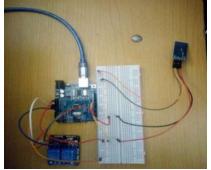

Fig. 16. Bread board diagram

B. Results

This device has been trained with several words. Each word is stored through programming the Arduino Micro controller making it possible to communicate with the relay to either switch ON/OFF any appliance connected to relay. List of trained words using Bread Board for Testing is shown below.

Train words with Description
1. Bulb ON means ON THE BULB
2. Bulb OFF means OFF THE BULB
3. Fan ON means ON THE FAN
4. Fan OFF means turns OFF THE FAN

7. Conclusion

In this paper, we have successfully implemented a "Voice Control Automation System" made of three components which include; Bluetooth module HC-05, Arduino Uno Microcontroller and Relay Circuits. The main function of the Bluetooth module is to establish wireless link between the microcontroller and the android smart phone. The concept adopted in this paper can be used for controlling nth number of input control by simply increasing the number of relays. This paper proposes a low cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution which is reliable and flexible in order to control any load. The approach discussed in this project is novel and has achieved the target to control home appliances remotely using the Bluetooth technology to connects system parts, satisfying user needs and requirement. Hence, we can conclude that the required goal and objectives of "Voice Control Automation System" have been met. This research paper is relevant in so many automation applications in the areas of transportation, healthcare. process control, industrial automation, military, etc.

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