DESIGN AND CONSTRUCTION OF A VOICE CONTROL SYSTEM FOR APPLIANCES USING ANDROID VIA BLUETOOTH

BY

TWIZERIMANA DANIEL

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JANUARY, 2021

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SN	NAME	TITLE	SIGNATURE & DATE	AFFILIATION
1	**Mr. Seruyange William**	**Assistant Lecturer**	01-JAN-2021	**KABALE UNIVERSITY**

ABSTRACT

This Project report represents/shows a detailed system of controlling appliances using voice commands.

The most common method of controlling appliances is by pressing the switches manually and this becomes very difficult for the elderly or physically handicapped people. This system is a solution to such problems. Bluetooth is interfaced to the arduino board using the transmitter and receiver pins for communication. The electrical loads are controlled by the relay which is connected to the arduino board, so the respective devices and appliances are turned on or off depending on the voice command.

This system is cheap, affordable and easy to use unlike the current systems which are not well embraced due to complexity, high costs and multiple incompatible standards.

ACKNOWLEDGEMENT

All thanks and praises be to God, for with His help and guidance, I was able to complete my final year project and write this dissertation with success. I would like to express my heartfelt thanks to the people whose help and co-ordination has made this project a success; especially my supervisor Mr. William Seruyange who I owe this project success to and I convey my special thanks to him for his full support. Iam also indebted to my friends and all those who have indirectly contributed in making this project successful. May the Lord God bless you all

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NOMENCLATURE.

V - Voltage

A - Amperes

I - Current

µF - Micro Farady

kA - Kilo Amperes

LIST OF ABBREVIATIONS

AC: Alternating Current

ADC: Analogue to Digital Convertor

CPU: Central Processing Unit

DC: Direct Current

DPDP: double pole Double Throw

DPST: Double pole Double Throw

HCI: Host Controller Interface

MHz: Mega Hertz

OS: Operating System

SDT: Software Development Kit

SPDT: Single Pole Double Throw

SPST: Single Pole Single Throw

USB: Universal Serial Bus

Vi: Input voltage

VO: Output Voltage

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE PROBLEM

Usually conventional wall switches are located in different parts of the houses, offices and often require persons for their operations; and thus, manual pressing is always done to turn them on and off. It becomes very difficult for the elderly or physically handicapped people to operate them. This system is enhanced to control the appliances by voice using android and Bluetooth. The design of the project enables the respective devices to be turned on or off depending on the voice command given.

1.2 PROBLEM STATEMENT

There are many methods of controlling Appliances the main one being manual switching which is not efficient to all people basing on individual differences.

The project seeks to eliminate the manual method of switching on and off of appliances and devices in homes and other desirable places.

1.3 OBJECTIVES.

1.3.1 GENERAL OBJECTIVE.

To design and construct a Voice control system for appliances using android via Bluetooth.

1.3.2 SPECIFIC OBJECTIVES.

1. To design and construct an appropriate power supply.
2. To design and develop a control circuit.
3. To develop a switching circuit for the loads.

1.4 PROJECT SCOPE.

The aim of this project is to design an open source, cheap, easy-to-use and affordable voice control system for appliances. The project is limited to a home model for prototyping purposes.

1.5 SIGNIFICANCE OF THE PROJECT.

The outcome of the project is to provide a flexible, safe and convenient mechanism of controlling appliances. It is also to enhance skills in automation which can be used to design and develop systems to be embraced by the societies for income generation to the ones involved.

CHAPTER TWO: LITERATURE REVIEW.

2.1 BACK GROUND.

This chapter discusses the literature about the components used in the project and the current techniques of controlling appliances in comparison with the one implemented in this project.

2.2 LITERATURE ABOUT THE COMPONENTS USED IN APPLIANCE CONTROL SYSTEMS

2.2.1 Low Voltage Transformer.

A Low voltage transformer or a potential transformer is a wire wound, static electromagnetic device that is used to transform the voltage level of input voltage. A Low voltage transformer has two windings; that is to say, the Primary winding that is to connected to the input and a Secondary winding from which the transformed voltage is obtained. The Input voltage is transformed (either stepped up or down) according to the turns ratio of the Primary and the secondary windings. The transformer used in the power supply here gives an output of +12 V or -12 V or a total of 24 V for an input voltage of 230 V.

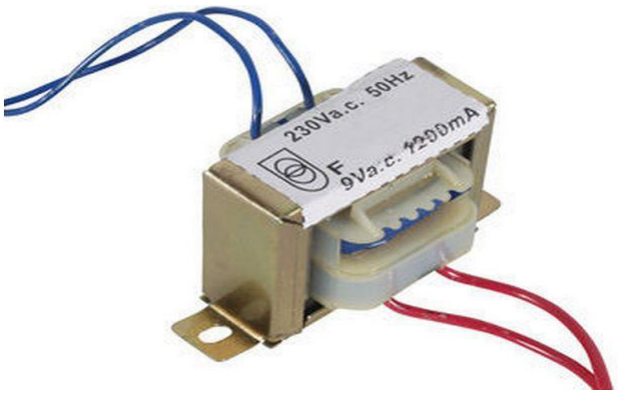

Fig 1: A diagram showing a Voltage Transformer.

(Source: M.H.Rashid)

2.2.2. Power Diodes. (Rectifier Diode)

A Rectifier diode is a type of diode that is specifically used in Rectification. It permits current to flow in only one direction, i.e. from Anode to Cathode. It has a much larger PN junction area compared to its similar signal diode, resulting in a high forward current capability of up to several hundred amps (KA) and a reverse blocking voltage of up to several thousand volts (kV) [2].

In the schematic symbol, the tip of the triangle with the line on top of it is the cathode. The cathode is marked on the body of a diode by a band as shown figure 2.

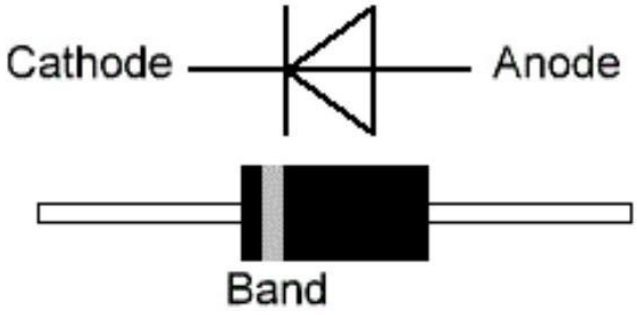

Fig 2: A Schematic Symbol of a Diode.
(Source: M.H.Rashid)

2.2.3. Electrolytic Capacitor

An electrolytic capacitor is a capacitor that uses an electrolyte (an ionic conducting liquid) as one of its plates to achieve a larger capacitance per unit volume than other types, but with performance disadvantages. All capacitors conduct alternating current (AC) and block direct current (DC) and can be used, amongst other applications, to couple circuit blocks allowing AC signals to be transferred while blocking DC power, to store energy, and to filter signals according to their frequency. Most electrolytic capacitors are polarized; hence, they can only be operated with a lower voltage on the terminal without damaging the capacitor. This generally limits electrolytic capacitors to supply-decoupling and bias-decoupling, since signal coupling usually involves both positive and negative voltages across the capacitor.

The large capacitance of electrolytic capacitors makes them particularly suitable for passing or bypassing low frequency signals and storing large amounts of energy. They are widely used in power supplies and for decoupling unwanted AC components from DC power connections [2].

Fig 3: An Electrolytic Capacitor

(Source: M.H.Rashid)

2.2.4. Voltage Regulators.

Voltage Regulator is an electric or electronic device that maintains the voltage of a power source within the acceptable limits. The voltage regulator is needed to keep voltages within the prescribed range that can be tolerated by the electrical equipment using that voltage. Such a device is used widely in motor vehicles of all types to match the output voltage of the generator to the electrical load and to the charging requirements of the battery. Voltage regulators are also used in electronic equipment in which excessive variations in voltage would be detrimental.

In motor vehicles, voltage regulators rapidly switch from one to another of the three circuit states by means of a spring loaded, double pole switch. Electronic voltage regulators utilize solid state semiconductor devices to smooth output variations in the flow of current. In most cases, they operate as variable resistances; that is, resistance decreases when the electrical load is heavy and increases when the load is lighter [2].

2.2.4.1 Different Types of Regulators

1. Linear Voltage Regulators.

In Electronics, a linear Regulator is a system used to maintain a steady voltage. The Resistance of the Regulator varies with both the input voltage and the load, resulting in a constant voltage output. The Regulating device is made to act as a variable resistor, continuously adjusting a voltage divider network to maintain a constant output voltage and continually dissipating the difference between the input and regulated output as waste heat [2].

How Linear Voltage Regulators work.

A linear Regulator employs an active Bipolar Junction Transistor or (MOSFET) pass device connected in either series or shunt controlled by a high gain differential amplifier. It compares the output voltage with a precise reference voltage and adjusts the pass device to maintain a constant output voltage [4].

Under these Regulators, we also have these classes of regulators:-

a) Fixed Voltage Regulators

The fixed voltage regulator has an unregulated dc input voltage (VI) applied to one input terminal, a regulated output dc voltage (VO) from a second terminal, and the third terminal connected to ground.

Fixed-Positive Voltage Regulator

The series 78XX regulators shown in figure 4 are the three-terminal devices that provide a fixed positive output voltage.

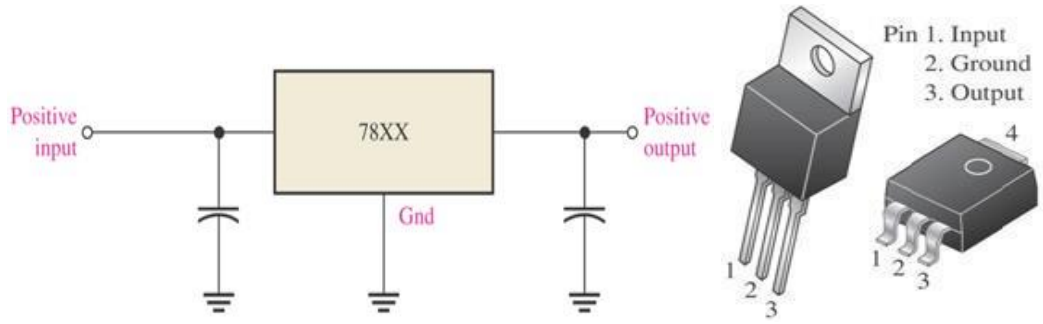

Fig 4: The schematic Diagram of a series Regulator

(Source: http://www.jameco.com)

How it works.

- An unregulated input voltage VI is filtered by a capacitor C1 and connected to the IC's IN terminal as shown in figure 5. The IC's OUT terminal provides a regulated +12 V, which is filtered by capacitor C2.
- The third IC terminal is connected to ground (GND.

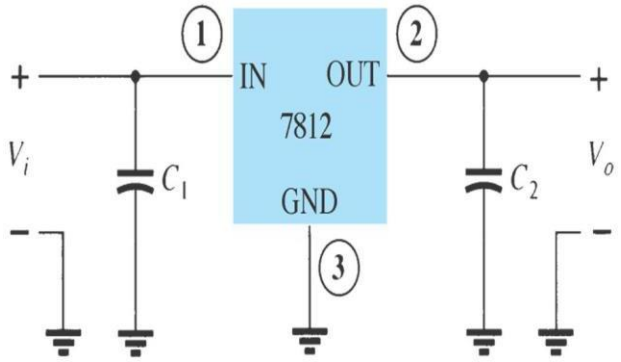

Fig 5: Showing fixed regulator connections

(Source: M.H.Rashid).

Table 1: Positive-Voltage Regulators in the 78XX Series.

IC Part	Input Voltage(V)	Minimum Voltage
7805	+5	+7.3
7806	+6	+8.3
7808	+8	+10.5
7810	+10	+12.5
7812	+12	+14.5
7815	+15	+17.7
7818	+18	+21.0
7824	+24	27.1

The table 1 shows the input and output voltage values of the regulators in the 78xx series.

b) Adjustable-Voltage Regulators

Voltage regulators are also available in circuit configurations that allow to set the output voltage to a desired regulated value. The LM317shown in figure 6 is an example of an adjustable-voltage regulator, can be operated over the range of voltage from 1.2 to 37 V.

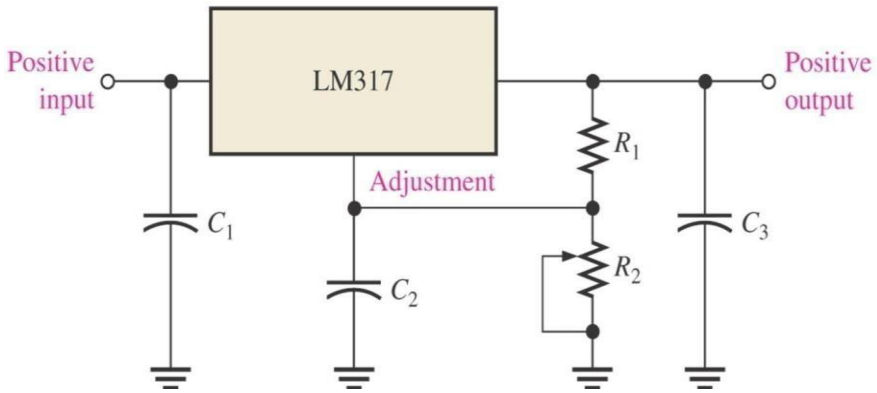

Fig 6: LM317 Adjustable Voltage Regulator

(Source: M.H.Rashid).

2. Switching Regulators.

Switching Regulators use an active device that switches on and off to maintain an average value of output voltage. It is a circuit that uses a power switch, an inductor, and a diode to transfer Energy from Input to Output. The basic components of the switching circuits can be rearranged to form a step down (buck) convertor, a step up (boost) convertor, or an inverter [2].

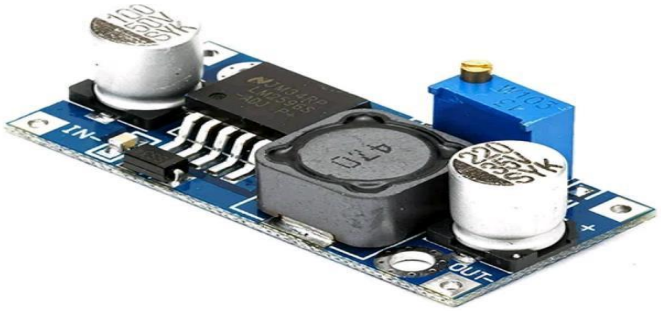

Fig 7: A buck convertor

(Source: http://www.jameco.com)

A buck convertor is a Dc to Dc convertor which steps down voltage (while stepping up current) from its input to its output load. Switching convertors such as Buck convertors provide much greater power efficiency as Dc to Dc convertors than Linear Regulators, which are simpler circuits that lower voltages by dissipating power as heat, but do not step up output current.

Linear vs Switching Voltage Regulators

- The Linear Regulator is conceptually simple with low cost, low noise, plus excellent dynamic response and load regulation. The efficiency, though, depends on the ratio between the Input Voltage and Output Voltage. If the two are close, the efficiency can exceed 90%.
- The switching Regulator exhibits excellent efficiency over the full range of input and the output load. But it's a much more complex design with many more components and requires careful attention to maintain stability and minimize losses.

- Switching topologies are overwhelmingly preferred for their higher efficiencies. They are also the only option if the system requires more than a simple step down conversion.

In summary, the following key points give an elaborate view of regulators:-

- Voltage regulators keep a constant dc output despite input voltage or load changes.
- The two basic categories of voltage regulators are linear and switching.
- The two types of linear voltage regulators are series and shunt.
- The three types of switching are step-up, step-down, and inverting.
- Switching regulators are more efficient than linear making them ideal for low voltage high current applications.
- IC regulators are available with fixed positive or negative output voltages or variable negative or positive output voltages.
- Both linear and switching type regulators are available in IC form.
- Current capacity of a voltage regulator can be increased with an external pass transistor [2].

2.2.7. Relay unit.

A relay is an electrically operated switch, typically incorporating an electromagnet that is activated by a current or a signal in one circuit to open or close another circuit. Relay switches open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. In either case, applying electrical current to the contacts will change their state.

This means that a relay can be used as a switch to control high-power loads such as AC/DC lighting and electronic appliances, with input from the Arduino which outputs about 40 mA [2]. Hence, for this project, relays are most suitable to be used as switches to electronic appliances.

Relay Configurations

There are various configurations for a relay's contacts depending on its use. Four common types of relays will are discussed here [2]:

- ❖ Single Pole, Single Throw (SPST): This type of relay uses one coil to control one switch with two contacts (Figure 8).
- ❖ Single Pole, Double Throw (SPDT): This type of relay uses one coil to operate one switch with three contacts (Figure 8).
- ❖ Double Pole, Single Throw (DPST): One coil is used to operate independent SPST switches at the same time. Useful for switching two loads at the same time (Figure 9).
- ❖ Double Pole, Double Throw (DPDT): This type of relay uses one coil to operate two independent DPDT switches at the same time. This relay can be configured as an H-bridge circuit (Figure 9).

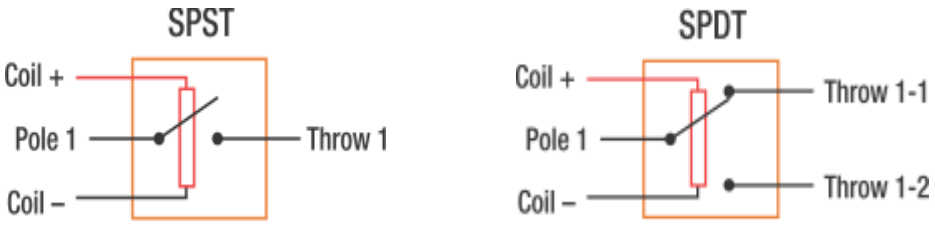

Fig 8: SPST and SPDT Relay Configurations

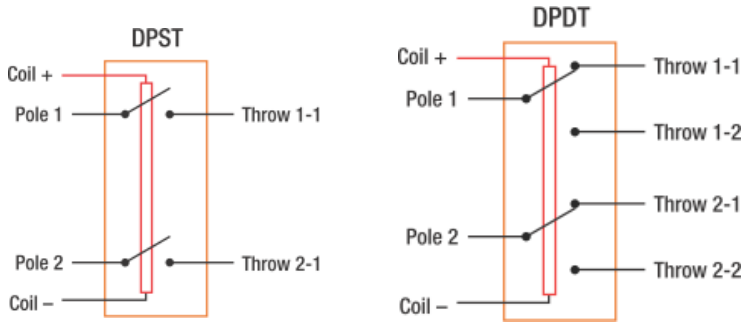

Figure 9: DPST and DPDT Relay Configurations

(Source: M.H.Rashid)

2.2.8. Arduino Board.

Arduino / Genuine 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 quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Arduino I/O Board is the physical, tangible part of the Arduino system. The board is based on the Atmel AVR ATmega8 microprocessor as mentioned above and latter derivatives containing a serial port, power supply circuitry, expansion connectors, and various support components [5].

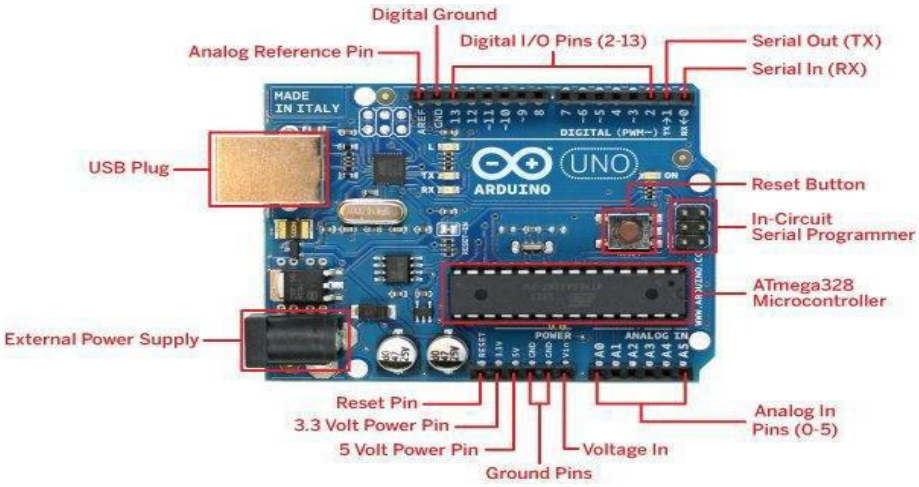

Fig 10: Diagram of the Arduino.

(Source: http://arduino.cc/en/Main/arduinoBoardUno)

2.2.8.1 Inside the Arduino Uno

Processor – Atmel ATmega328

The Atmel ATmega328 is the microcontroller which functions as the brains of the Arduino Uno, containing a central processing unit (CPU), memory arrays, clocks, and peripherals; basically a computer on a chip.

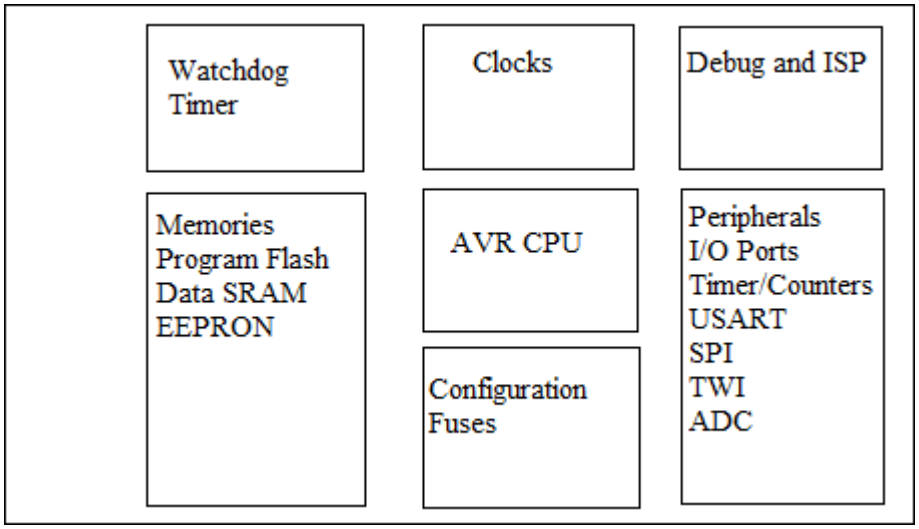

Fig 11: A simplified block diagram of the ATmega328

ATmega328 can operate from 1.8 to 5.5 V, making it suitable for battery-powered applications. Lower voltages however, have a lower maximum clock rate.

To run at the maximum rated clock rate of 20 MHz, at least 4.5 V supply is required. As the Arduino I/O board supplies 5.0 V to the ATmega328, the processor can run at any speed up to the maximum of 20 MHz [5].

The ATmega328 comes with a wide variety of features such as:

- Memory system,
- Port system,
- Timer system,

  Analog-digital-converter (ADC) and,
- Serial communications.

A simple chart of the systems available in Arduino can be seen in Figure 12.

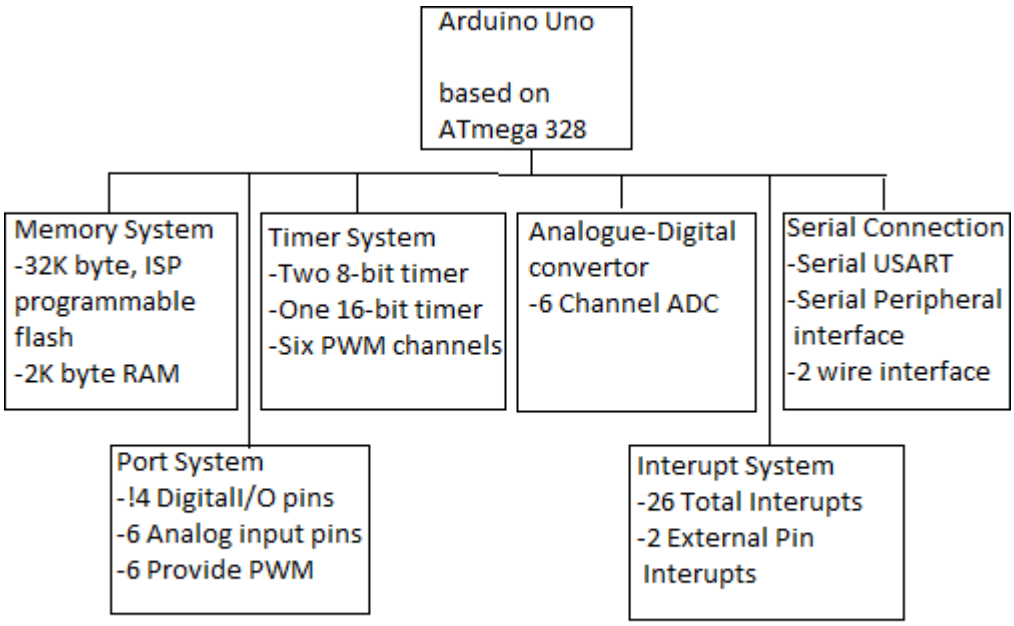

Fig 12: Systems Available in the Arduino

(Source: http://arduino.cc/en/Main/arduinoBoardUno)

2.2.9. Bluetooth module (HC-05)

Bluetooth wireless technology is becoming a popular standard in the communication. It is one of the fastest growing fields in the wireless technologies. It is convenient, easy to use and has the bandwidth to meet most of today's demands for mobile and personal communications.

Bluetooth technology handles the wireless part of the communication channel; it transmits and receives data wirelessly between these devices. It delivers the received data and receives the data to be transmitted to and from a host system through a host controller interface (HCI) [3].

The most popular host controller interface today is either a UART or a USB. Here, the focus is put on the UART interface, it can easily show how a Bluetooth module can be integrated on to a host system through a UART connection and provide the designer an optimal solution for Bluetooth [3].

Table 2: showing Bluetooth pin Configurations.

Pin Number	Pin Name	Description
1	Enable Key	Used to toggle between data mode (set low) and AT command mode (set high). By default, it is in Data mode
2	Vcc	Powers the module. Connect to +5 V supply voltage
3	Ground	Ground pin of the module; connect to the system ground
4	TX Transmitter	Transmits serial data. Everything received via Bluetooth will be given out by this pin as serial data
5	RX Transmitter	Receives serial data. Every serial data given through this pin will be broadcasted via Bluetooth.
6	State	The state pin is connected to o board LED, It can be used as a feedback to check if Bluetooth is working properly
7	LED	Indicates the status of the module. ❖ Blink once in 2 sec: module has entered command mode. ❖ Repeated Blinking: waiting for connection in data mode ❖ Blink twice in 1 sec: connection successful in data mode
8	Button	Used to control the Key/Enable pin to toggle between data and command mode

2.2.10 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. The Android platform has been used because of its huge market globally and it's easy to use user interface. 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 in Figure 13.

Fig 13: Voice Recognizer Android Application

(Source: Google app store)

2.3 REVIEW OF THE EXISTING METHODS.

Different types of approaches have been made towards the control of appliances and loads.

2.3.1 Manual method.

The common method of controlling appliances and loads is manual switching. In this the user has to switch on and off the appliances for example Lights, fans, TV, etc. manually by placing the appliance control switch. The disadvantages of this is that it is time consuming since the user has to first move at the control position of every appliance to switch it off or on. Again, it can't be used by the disabled, physically handicapped or those with some physical impairments like he blind, or those without arms.

2.3.2 An SMS based method

An Sms based method uses GSM technology available in phones to communicate with a microcontroller which acts as the main control for access to home appliances. A GSM module is also required to be attached to the microcontroller through a port to enable SMS capability. Also, two mobile phones can be used in a way that they can communicate through the GSM and connecting to the computer via Bluetooth, electrical appliances are controlled [11].

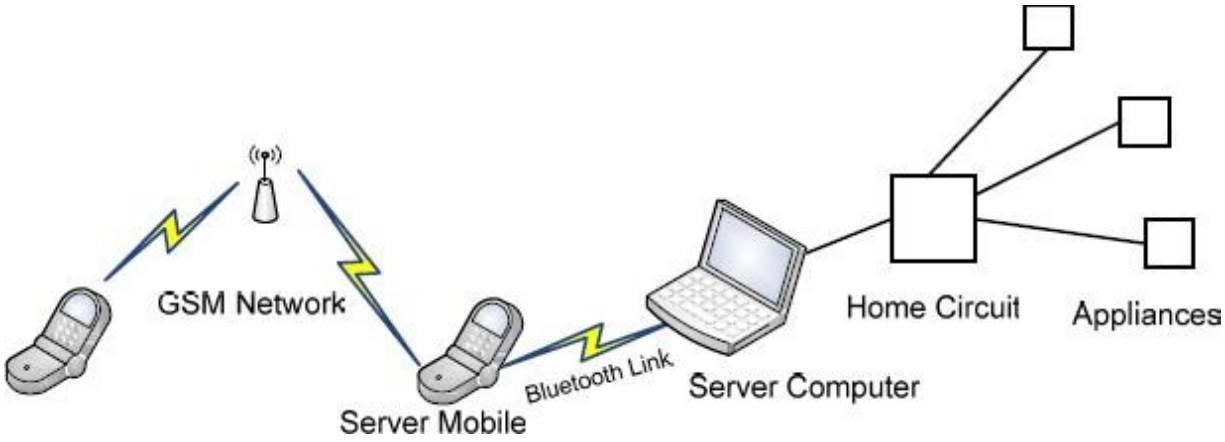

Fig 14. Flow Diagram for Sms based method of Controlling Appliances

(Source: Malik Sikandar Hayat Khiyal, Aihab Khan, and Erum Shehzadi.)

A client mobile phone can communicate with the server mobile phone via any existing GSM network. Short Message Services, mainly known as SMS, is a globally accepted wireless service that enables the transmission of alphanumeric messages between mobile subscribers. Reducing the cost and increasing the usability of the system SMS is chosen for the communication between mobile phones. The server computer is the core of the system. It is connected to the network via the server mobile phone. Bluetooth technology is used to communicate between the server computer and the server mobile phone.

Electronic circuit that controls the home appliances is connected with the server computer via parallel port as shown in figure 14.

The disadvantage of such a system is that it is not user friendly, as there is no graphical user interface, access codes and command codes must be remembered to operate the system; and it is very expensive.

2.3.3. Remote Control System of Appliances Based on Wireless Sensor Network.

Remote control mode adopts SMS and Internet. As the interface with outside information, GSM module and Internet interface module are the gateway from household to outside and they assume a protocol conversion task between household and outside. GSM module mainly adopts Siemens TC35i. It communicates with information processing center through USART, and uses AT commands to send messages and read the information in SIM card. Internet Interface adopts ENC28J60. It communicates with the host computer through TCP/IP protocol and with information processing center through SPI [9].

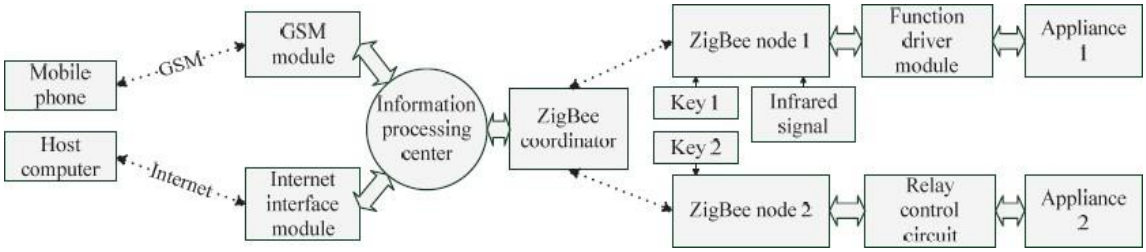

Fig 15: Remote control of Appliances using a Wireless sensor network

(Source: R. Shahriyar, E. Hoque, S. M. Sohan, I. Naim and M. M. Akbar)

To operate it, you send a message such as "open light" to the designated number, and then the remote light in household will be on. Or send a message such as "inquire about air conditioner" to obtain operating parameters such as on/off and temperature of air conditioner. When operating parameters of smart appliances are changed through other method, the mobile phone receives an attention message, which can be close or open through send a message such as "close / open". When operating smart appliances through any other method, if SMS attention is open, mobile terminal will be informed.

This method is also complicated to operate by an illiterate person, is expensive and may not work efficiently for the disabled people [9].

2.3.4 Another approach focuses on voice recognition to send commands through a wireless RF network.

The voice command is captured using a microphone, digitalized, and sent to a computer to be processed by a program based on Visual Basic which employs Microsoft speech API. Upon recognition of the voice command, control signals are sent to the specified appliance addresses for action [10].

This system is also very expensive.

2.3.5 Controlling of Appliances Using Hand gestures

Hand gestures were also proposed as control for home automation systems by [7]. A small camera is worn as a necklace to observe the various gestures made by a user's hand in order to interpret and send command signals.

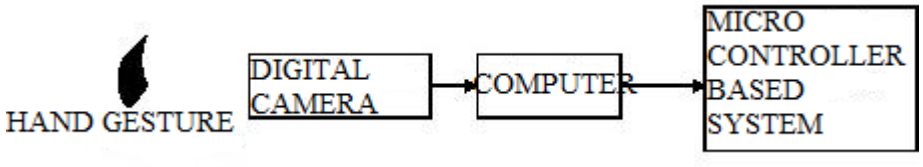

Fig 16: Block diagram of controlling appliances by hand gestures
(Source: "PhD thesis, IDIAP_RR, 6(73), 94, 2006)

Recognition stage captures the image. Then it processes on the captured image and compare with the database images. Each database image is set to the command interface mode. If a particular image is identified then a command is sent to the microcontroller. In its second stage the microcontroller identifies the command and sends signal to the reference port for operation. The use of such technology, however, requires the use of a high end PC for data processing, resulting in a higher setup cost. Another disadvantage of this system is that it's not efficient in comparing of the captured images and data base images [7].

24. THE PROPOSED SYSTEM VERSUS OTHER METHODS OF APPLIANCE CONTROL

- The proposed system is user friendly and very cheap. 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 help people with varied disabilities access the same technology. An Android Application has been deployed as user front end primarily because of the ease at which the platform provides 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 and at least almost every home now days is having a smart phone.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION.

Figure 17 is the circuit diagram of the voice control system; following are the design arrangements, calculations, assumptions the specifications of the components used, reasons for choosing those components; and the details of how all the objectives are achieved.

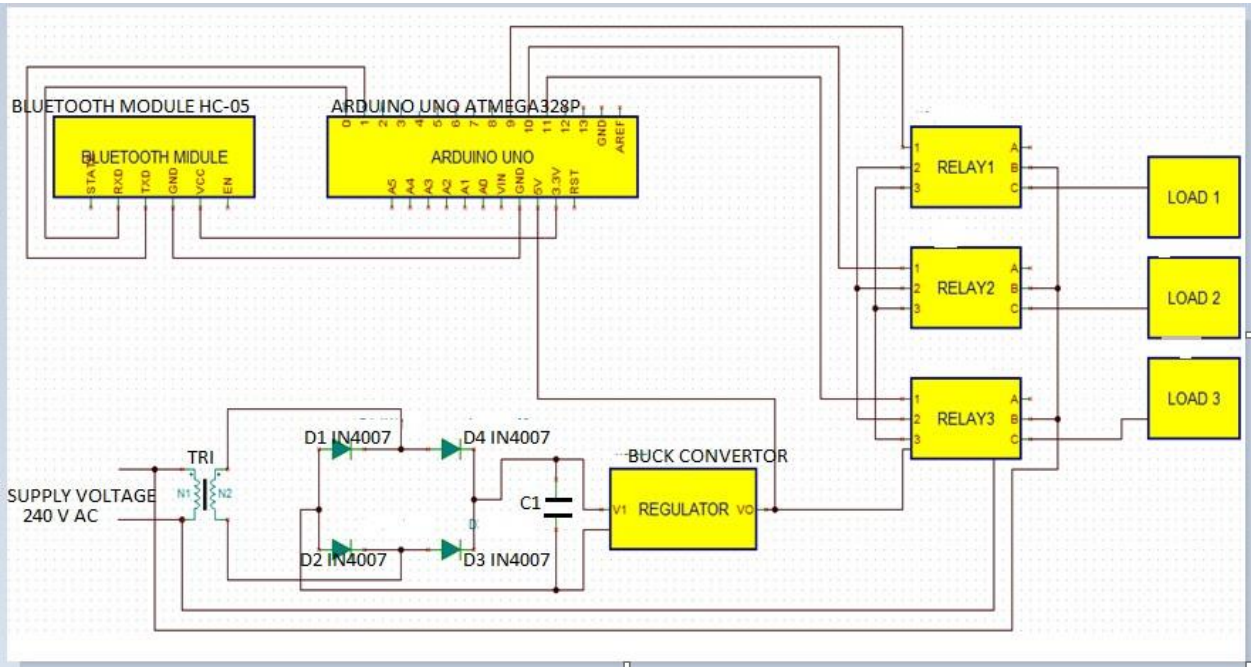

Fig 17: A circuit diagram of voice control of appliances using android via Bluetooth

3.2. POWER SUPPLY

The considered power supply is 240 volts and this system needs less voltage than this hence the need for designing the appropriate power supply.

3.2.1. The design of 5 V dc power supply.

In this design, the sections of the circuit are designed individually and then at the end they are put together to have a complete circuit ready for use. So to achieve this, the guiding block diagram as in figure 18 is first drawn.

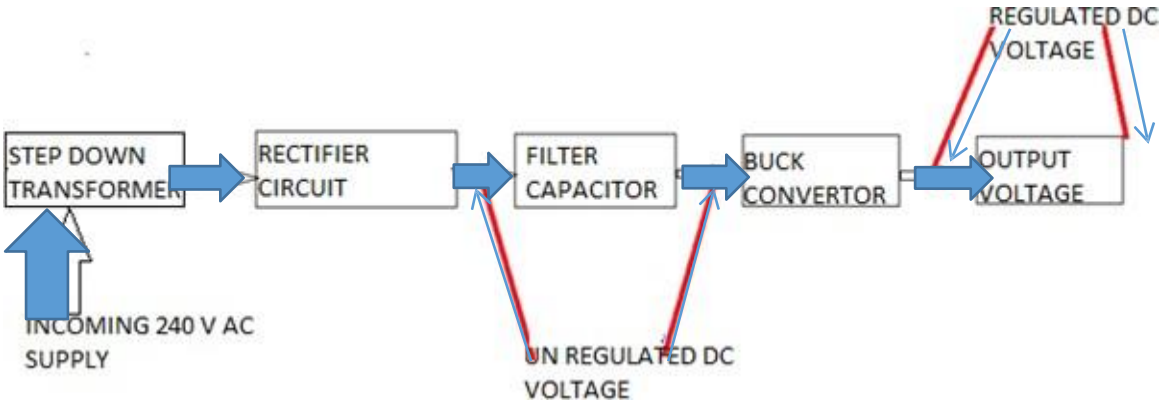

Fig 18: A Block diagram of the power supply.

It has the following Four main Blocks:-

I. The Transformer
II. The Rectifier Circuit
III. The Filter
IV. The Buck Convertor

In brief, the transformer is used for stepping down the voltage from the supply; the rectifier circuit is for changing the rectified Ac voltage to Dc; the filter is for filtering out the ripples since the rectified output is Pulsating Dc and the regulator is to give us the constant 5 V DC.

3.2.2. Steps to Design

i. Selection of the Regulator
ii. The Selection of the transformer
iii. Selection of the Diodes for the Bridge

iv. Selection of the smoothing Capacitor

3.2.2.1 Selection of the regulator

The selection of the Regulator depends on the output voltage. In this case, the output voltage being designed for is 5 V, therefore a selected regulator should be able to output 5 V. The linear Regulator that would be selected is LM7805 linear regulator IC. On a Linear regulator, the first digit shows the minimum input voltage to the regulator while the last digit shows the output voltage. So on LM7805, the minimum voltage is 7 V AC and the output voltage is 5 V DC. But because the linear regulators have heating problems and limited to one output, a buck convertor is chosen instead for this circuit.

Why a Buck Convertor not other Regulators?

- ✓ Buck convertor can provide variable output by varying the potentiometer; whereas linear voltage regulator is stuck at only one output.
- ✓ Again, linear voltage regulators heat up a lot and switch off after heating up, and switches on again; and this is solved once you use buck convertor.

Selected Buck Convertor Specifications

- ❖ Conversion efficiency: 92%(highest)
- ❖ Switching frequency: 150 kHz
- ❖ Output ripple: 30 mA maximum)
- ❖ Load Regulation: ± 0.5%
- ❖ Voltage Regulation: ± 0.5%
- ❖ Input voltage: 220 – 35 V
- ❖ Output voltage:1.25 - 26 V(Adjustable)
- ❖ Output current: Rated current is 2 A, maximum 3 A
- ❖ Module Properties: Non-isolated step-down module (buck)
- ❖ Operating Temperature: Industrial grade (-40 to +85) (output power 10 W or less

3.2.2.2 Selection of the Transformer.

The voltage from the supply in Uganda is generally 240 V AC and the AC voltage needed for rectification to get 5 V DC is in the range of 7-12 V AC. So to get this a step down transformer is used. If the minimum input voltage to the regulator is 7 V, the transformer needed should be able to step 240 V to atleast this value. But between the regulator and the secondary side of the transformer, there is a diode bridge rectifier too. The rectifier has a voltage drop across it of 1.4 V. So this has to be compensated as well.

V secondary = 7+1.4 = 8.4 V peak value. This means the transformer to be selected has to be having an output of atleast 9 V or Close to 9. So a 230/10 V is selected. The transformer selected is of the current rating of 2 A. Why 2 A current? Because the regulator has a current rating of 2 A, so it's not advisable to pass more current than this value as it would cost extra.

Voltage Transformer Specifications

- Type of the transformer: Step Down
- In put voltage/Primary Voltage: 230 AC
- Output voltage/ Secondary Voltage:10 V AC
- Current rating: 2 A
- Frequency: 50 Hz

3.2.2.3 Selection of the diodes for the bridge rectifier.

Basically, there are two types of Rectifier circuits; half wave and full wave. However, the one that is selected is the full wave rectifier because it is more power efficient than the first one. When selecting the diodes for the circuit, the output load current is kept in mind, and the maximum peak secondary voltage of the transformer i.e. 10 V in this case. The selected diode must be having the current rating more than the load current (i.e. in this case 500 mA).

The IN4001 diodes qualify to be used but we choose IN4007 diodes because of the following.

- ✓ IN4007 diodes can withstand high voltages up to 1000 V unlike other diode; For instance IN4001 with a peak repetitive voltage of 50 V, IN4148 with a Repetitive

voltage of 100 V. So IN4007 is widely used as a general purpose diode even for high frequency circuits.

- ✓ 1N4007 diodes are used as rectifiers for low frequency having big capacitance at the junction, other diodes have less capacitance value therefore they have quick ON –OFF time.

IN4007 Diode Specifications

- ❖ Average forward current is 1 A.
- ❖ Non repetitive Peak current is 30 A.
- ❖ Peak repetitive Reverse voltage is 1000 V.
- ❖ Power Dissipation 3 W

3.2.2.4 Selection of a smoothing Capacitor

The output of the rectifier is pulsating DC. This pulsating DC is converted into pure DC using filter. The filter being used is a Capacitor Filter.

The value of the capacitor is given by,

$$Q = C \times V \text{.....(1)}$$

$$Q = C \times IR$$

$$Q = I \times RC$$

$$Q = I \times T \text{ .....(2)}$$

Where Q is the charge, C is the Capacitance

Substituting equation (2) into (1) gives

$$I \times T = C \times V$$

$$C = (I \times T) / V$$

Here output voltage is V = 5 DC; Output current is I = 1.5 amps

Input voltage is AC 230V, 50 Hz.

So f = 50 Hz,

$$T = 1/2\ f$$

$$= 1 / 2 \times 3.14 \times 50\ Hz$$

$$= 3.184713376 \times 10$$

Output current is I = 1.5 amps

$$C = (1.5 \times 3.184713376 \times 10) / 5$$

$$C = 955 \text{ uF}$$

The value of capacitor is 955 uF. This value of capacitor is not available in market so the capacitor with a value nearer to it is selected which is 1000 uF.

- ✓ According to the design calculations, a 1000 µF, 25 V Electrolytic capacitor is the one suitable for the system.

Fig 19 shows the connection of the components in Proteus and simulation results. It is observed that the output Voltage is 4.998 V which is approximately 5V DC which is required for supplying this system. After Simulation, it is simpler to draw the circuit diagram and it is shown in Figure 20.

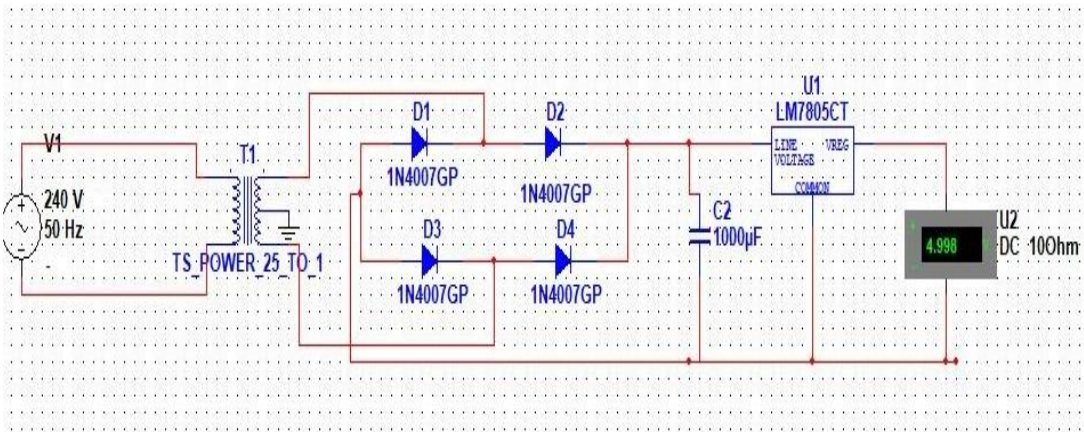

Fig 19: Power Supply Simulation circuit.

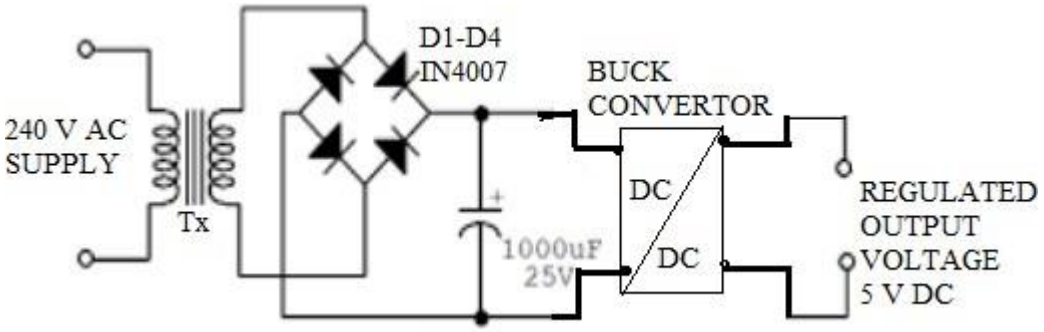

Fig 20: Circuit Diagram of 5 V DC Supply.

The 240 V AC from the supply is stepped down by the low voltage transformer. The stepped down value which is AC is rectified by the bridge circuit. The rectified voltage is Pulsating DC so it is filtered by a Capacitor and it is regulated by a regulator to get 5 V DC.

3.3 CONTROL CIRCUIT.

The major thing in the control circuit is programming. A Bluetooth is interfaced to the Arduino board using Rx and Tx pins for communication. Arduino programming is done since the main control is achieved by the microcontroller. In this this system C and C plus programming language is used in order to get the right code for running the program and it is so such that the respective devices connected to the circuit are turned on or off depending on the voice command given.

3.3.1. Micro Controller.

There are different categories of micro controllers; the common ones being the Arduino Nano and the Arduino Uno.

In this system, the Arduino Uno is preferred because of the following reasons

- ✓ It offers Simple clear programing environment.
- ✓ The main reason is that we can connect the board to the computer via a USB cable which does dual purpose of supplying power and acting as a serial port unlike other micro controllers.
- ✓ Also is relatively inexpensive.

Specifications.

- ❖ Processor: AT mega 328P
- ❖ Input voltage: 5 V
- ❖ Speed of the CPU: 16 MHz
- ❖ Analogue I/O: 6/0
- ❖ Digital IO/PWM: 14/6
- ❖ EEPROM/SRAM: ½
- ❖ FLASH: 32
- ❖ USB: Regular

- USART: 1

3.3.2. Bluetooth Module (HC-05).

A Bluetooth Module is interfaced with the Arduino through the Transmitter and Receiver pins to communicate. It is paired with the Android phone wirelessly so when a command is given, it communicates with the Arduino about the necessary action according to the command given.

Why HC-05 Bluetooth module?

- ✓ HC-05 is an easy to use SPP (serial port protocol) module which manages the communication channel of the wireless part.
- ✓ It is cheap and easy to use than using Wi-Fi shields.

Technical Specifications

- Operating Voltage: 4-6 V (Typically 5 V)
- Operating Current 30 mA
- Range:<100
- Works with Serial Communication (USART) and TTL compatible
- Follows IEEE 802.15.1 standardized protocol
- Uses Frequency –Hopping Spread Spectrum (FHSS0
- Can Operate in master, Slave or Master/Slave mode

Software Features

- Default baud rate: 38,400
- Data bits: 8
- Stop Bit: 1
- Supported baud rate: 9600, 19200, 38400, 56000, 115200, 230400
- Auto Connect to the last device on power as default
- Permit pairing device to connect as default
- Auto pairing Pin code: '0000'

- ❖ Autos reconnects in 30 minutes when disconnected as a result of beyond the range of Disconnection.

3.4 THE SWITCHING CIRCUIT.

This is achieved by using the relays and connecting them to the Arduino in a way that they will coordinate with it after a voice command is given. The relay gets the supply from the regulator 5 V DC and the appliances are connected on the output side. The relays coordinate with the Arduino to switch on and off the appliances depending on the command given.

3.4.1. Relay Module.

Relays and transistors are some of the Electronic switching devices commonly used in electronic circuits.

However, a relay is used for switching in this system because of the following reasons:-

- ✓ Relays can switch AC and DC unlike other electronic switching devices like transistors which can only switch DC.
- ✓ Relays can switch high voltages, transistor switch cannot.
- ✓ Relays can switch many contacts at once,
- ✓ And are a better choice for switching large currents.

The relay module used is switched on by 5 V DC and 250 V AC can be connected on its output side.

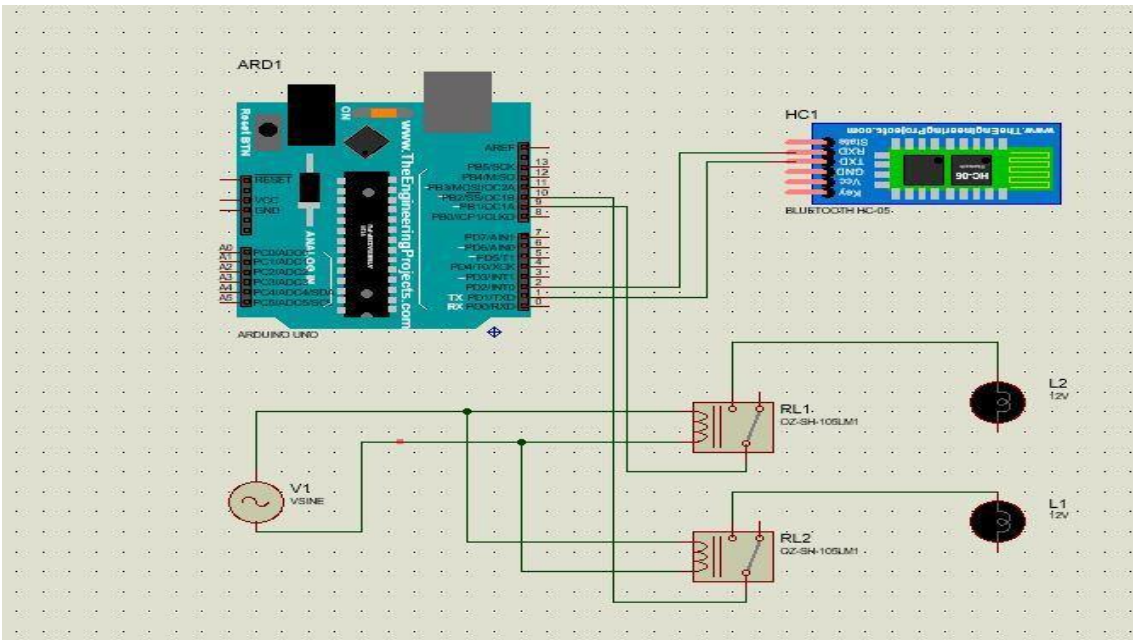

Fig 21: Simulation Circuit Minus the power supply.

Fig 21 shows the arrangement of the components in proteus software. This is done to see the working of the system before the prototype design.

CHAPTER FOUR: RESULTS PRESENTATION

4.1 INTRODUCTION.

After all the components were connected, the circuit is tested on power, and all the commands are observed.

4.1.1 Power Supply.

After designing and constructing of the power supply, the following results are observed after powering the circuit.

- Voltage in put to the transformer = 236 V
- Voltage output = 10.8 V
- After rectification, the voltage after testing is 6.8 V which is further regulated by varying the potentiometer of the voltage regulator to get the 5 V for supplying the Arduino board and to get the relay switching voltage.

The experimental results are according to the commands used. In this system, only two loads are being used hence the four commands but it's possible to put as many loads as one can according to the preference. The commands are:-

i. Lights on
ii. Lights off
iii. TV on
iv. TV Off

4.1.2 Circuit display when Lights are on

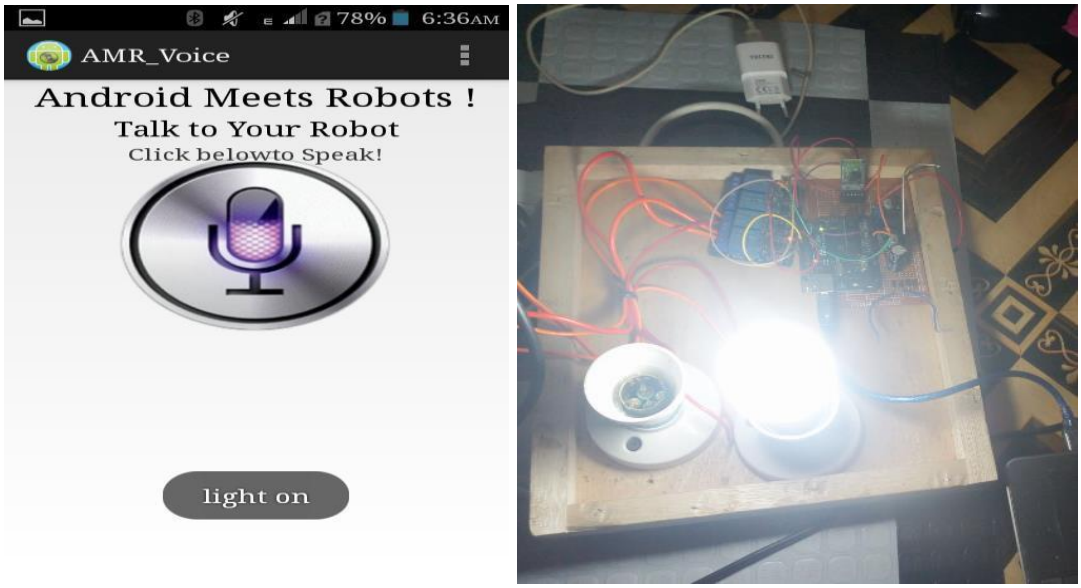

Fig 22: A working prototype.

Fig 22 shows the Prototype being operated. The system is limited to a home model for prototyping purposes. It is observed that when you give a command let's say lights on, it is displayed on the AMR android voice application and lights come on as indicated in the figure.

4.3 DISCUSSION OF THE RESULTS AND CONCLUSION

Basing on the above results, it is clearly observed that when a command is given, the appliances immediately respond to the command given. For instance, when you say lights on or Lights off they will respond to that command and will immediately go either on or off. Similarly, when you say TV on it will automatically go on and when you say TV off, it will automatically go off depending on the command. Basing on the above results, the project objectives were achieved.

CHAPTER FIVE: CONCLUSION AND THE FUTURE WORK

5.1. CONCLUSION:

This project was designed to show an efficient and economic technique of controlling appliances using android application via Bluetooth by using a voice command.

The project has been successful and I have achieved my objectives though it has been through a struggle.

Lastly, the project has been a good learning experience; I personally have learnt that there are always new things on the horizon. If someone's mind is put to work, a lot of new things practically can evolve therefore I can opt for more learning through such projects once given opportunities.

5.2. FUTURE WORK

In the near future automation is likely to be embraced in many spheres of life in homes and industries. Therefore such a system can be improved by using of internet instead of Bluetooth to make it highly efficient. If internet is used, the android phone cannot be used because it is possible to control the appliances directly and automatically by voice commands.

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APPENDICES

PROJECT CODE

```
* Voice control of appliances using android phone via Bluetooth designed by

Twizerimana Daniel*/

String voice;

#define lights 9

#define tv 10

//#define fridge 11

void setup() {

  // put your setup code here, to run once:

  Serial.begin(9600);

  pinMode(lights,OUTPUT);

  digitalWrite(lights,HIGH);

  pinMode(tv,OUTPUT);

  digitalWrite(tv,HIGH);

}

void loop() {                  // put your main code here, to run repeatedly:

    while (Serial.available()){ //Check if there is an available byte to read

    delay(10); //Delay added to make thing stable

    char c = Serial.read();       //Conduct a serial read

    if (c == '#') {break;}     //Exit the loop when the # is detected after the word
```

```
 voice += c; //Shorthand for voice = voice + c}
if (voice.length() > 0) {
     Serial.println(voice);
 //.....
    .....//
    if(voice == "*lights off")
          {digitalWrite(lights,HIGH);}
       if(voice == "*lights on")
   {digitalWrite(lights,LOW);}
   if(voice == "*TV on")
    {digitalWrite(tv,LOW);}
       if(voice == "*TV off")
{digitalWrite(tv,HIGH);}
   if(voice == "*fidge on")
    {digitalWrite(fridge,HIGH);}
      // if(voice == "*fridge off")
//{digitalWrite(fridge,LOW);}
   if(voice == "*all on")
{    digitalWrite(fridge,HIGH);
 digitalWrite(tv,HIGH);
 digitalWrite(lights,HIGH);
     Serial.println( "good design by Daniel");
```

```
  }
  if(voice == "*all off")
  {
   digitalWrite(fridge, LOW);
   digitalWrite(tv,LOW);
   digitalWrite(lights,LOW);
       Serial.println( "GOD IS GOOD"); }
 }
voice=""; //Reset the variable after initiating
}
```