Control of Home Appliances using Arduino

A Project report submitted in partial fulfillment
of the requirements for the degree of B. Tech in Electrical Engineering

by

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CERTIFICATE

To whom it may concern

This is to certify that the project work entitled **Control of Home Appliances using Arduino** is the bonafide work carried out by **Subrata Ghosh (11701618016), Hrittik Kumar Rajak (11701618043), Sourav Chatterjee (11701618021), Anish Kandar (11701618061)**, the students of B.Tech in the Department of Electrical Engineering, RCC Institute of Information Technology (RCCIIT), Canal South Road, Beliaghata, Kolkata-700015, affiliated to Maulana Abul Kalam Azad University of Technology (MAKAUT), West Bengal, India, during the academic year 2021-22, in partial fulfillment of the requirements for the degree of Bachelor of Technology in Electrical Engineering and that this project has not submitted previously for the award of any other degree, diploma and fellowship.

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To

The Head of the Department
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Respected Sir,

In accordance with the requirements of the degree of Bachelor of Technology in the Department of Electrical Engineering, RCC Institute of Information Technology, We present the following thesis entitled "**Control of Home Appliances using Arduino**". This work was performed under the valuable guidance of Mr. Dipankar Santra, Associate Professor in the Dept. of Electrical Engineering.

We declare that the thesis submitted is our own, expected as acknowledge in the test and reference and has not been previously submitted for a degree in any other Institution.

Yours Sincerely,

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ABSTRACT

The main objective of this project is to develop a home automation system using an Arduino board with Bluetooth being remotely controlled by any Android OS smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a most modern solution with smart phones. In order to achieve this, a Bluetooth module is interfaced to the Arduino board at the receiver end while on the transmitter end, a GUI application on the cell phone sends ON/OFF commands to the receiver where loads are connected. By touching the specified location on the GUI, the loads can be turned ON/OFF remotely through this technology. The loads are operated by Arduino board through optoisolators and thyristors using triacs.

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LIST OF ABBREVIATIONS

AC	Alternating Current
ARM	Advanced RISC machines
CPU	Central Processing Unit
DC	Direct Current
EEPROM	Electrically Erasable Programmable Read Only Memory
GSM	Global System for Mobile Communications
HVAC	Heat, Ventilation and Air Conditioning
IC	Integrated Circuits
LAN	Local Area Network
PC	Personal Computer
PDA	Personal Device Assistant
RFID	Radio Frequency Identification
RISC	Reduced Instruction Set Computing
TCP/IP	Transmission Control Protocol/ Internet Protocol
WPAN	Wireless Personal Area Network

CHAPTER 1

INTRODUCTION

Home automation systems have gained popularity in recent years, paralleling the advances in the concept of the Internet of Things. Although automation for commercial buildings is a mature technology, automation applications for residences are a relatively new development, which is gradually being adopted by consumers. Home automation involves the monitoring and control of activities such as lighting, heating, ventilation, air conditioning (HVAC), electrical appliances, sound systems, security cameras, door locks, and alarms. Home automation has various advantages, such as comfort, increased security, and energy efficiency. Figure 1 shows the general home automation system. The figure shows the various home appliances such as security sensors, thermostat etc. which is controlled through the central control panel via the Internet.

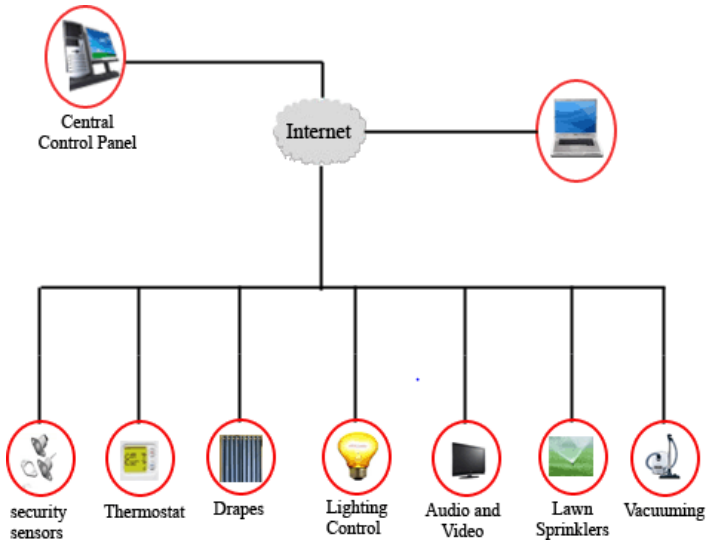


FIGURE 1. A general home automation system.

The widespread use of home automation can be seen in cold cities such as Milwaukee, where people set the heating of the house to go off when they leave and switch on the heater 15 minutes before they return. The system is known as HVAC and is the best option for home automation.

In an era with wireless technology such as Bluetooth, WiFi, Zigbee, and GSM, users want home appliances to be connected wirelessly. Each of these wireless technologies has its own significance and specifications. This project successfully uses Bluetooth with an available frequency of 2400 Hz, a range of 100 meters, and a speed of approximately 3 Mbps.

There are a few concerns to be addressed when designing a home automation system. The system should be designed in a manner that integrates new devices, so that these devices should not be a problem at a later stage. On the host side, the system should be user-friendly, so that the devices can be monitored and controlled easily. In case of any problems in the future, the interface of the system should provide diagnostic services. Finally, the system should be cost- effective so that it can be widely used by anyone in the market.

CHAPTER 2

LITERATURE REVIEW

Home automation was first introduced into the world market in the 1970s, but it failed to meet the expectations of people and was unsuccessful. There were various reasons associated with the failure of the home automation system. The system was neither user friendly nor cost efficient. Currently, the foremost point to be kept in mind when designing a home automation system is that it should be cost-efficient and easy to install.

K. Y. Lee and J. W. Choi [1], in their research on the Housing Learning and Improvement Network in 2003, defined a Smart Home as a "unit where all the appliances of the house are connected together and controlled and monitored remotely." The following paragraphswill give a summary of the previous research works in the field of Smart Homes.

T. Tamura et. al. [2], in their research, constructed the welfare techno houses in Japan in 2003. The motive behind the project was to monitor the health of the disabled and older people living in the home, thereby improving their quality of life. D. J. Cook et. al. [3] successfully conducted the MavHome project at the University of Texas, Arlington. The project used sensors to detect the state of the environment, and with the help of controllers, took the necessary action to maintain equilibrium. These sensors form an ad-hoc network to make the decisions.

H. Kanma et. al. [4] conducted a medical research to monitor people who require medical help and present a wireless solution at the University of McGill in Canada. The project made use of cell phones and inexpensive sensors. It worked by making use of wireless protocols such as Bluetooth, ZIGBEE, as well as GSM and analyzing data through an adaptive architecture.

The research had an architecture that consisted of three, aim parts. First, sensors collected the medical data and transmitted it via sensors to mobile device. Second, an application called J2ME on mobile devices processed the collected data. Finally, all the data thatwas collected was combined to address the needs of the elderly. The major benefit of this projectis that it could be implemented at an inexpensive price in a short span of time.

In the past few years, significant research has been conducted in the field of Smart Homes to make the technology better for handicapped and elderly people. N. Liang et. al. [5] have described challenges related to Smart Homes and conducted research at the University of Erlangen, Germany, for the betterment of these populations and identified the benefits in-order tohelp them lead more independent lives.

For the implementation of these projects, there are various sub-networks used such as the Bluetooth module, Wireless LAN, RFIDs, and TCP/IP. A Bluetooth network transports the sensor data and interconnects the network. As per the location of the occupancy recorded, the RFID system transmits data from the RFID tags. The messages are transmitted via Bluetooth using Bluetooth modules. This reduces the cost, as no further hardware is required for the implementation.

The idea presented in this project is the one similar to the project presented by the students at the University of Nigeria regarding the design of a home automation system using Arduino. The project focuses on the design of a home automation system using the Atmega 328 microcontroller.

The project does, however, emphasize the advantages of using a wireless standard. To connect to a wide range of devices, Bluetooth is a global standard and is easily available in almost

all devices, for it is easy to set up and use. It also encrypts data using a 128 bit long shared key, making it a secured connection as well.With the advancements in RF Technology, such as Zigbee and Bluetooth, these systems have also become popular in the market. The previous infrared systems had numerous security issues and there were interferences between signals, making it unsecuredand less popular in the market. Research is still occurring in this field; various systems have been proposed, but very few of them have been implemented in the market.

AUDRINO

Arduino is an open source physical processing hardware, which is based on a microcontroller board and an incorporated development environment for the board to be programmed. Arduino is simple and can be easily learned by beginners. Arduino can run on any platform that includes Windows, Linux Operating System, and Macintosh, unlike other microcontrollers, which run only in the Windows operating system.

The Arduino can be used to develop an interactive interface, get inputs from a diverse collection of switches as well as sensors, and simultaneously control the output from various physical devices including lights and other appliances. Arduino is focused on an environment, which needs to be programmed with a language that is executed via wiring: a physical computing platform. Figure 2 shows the symbol of the Arduino Uno, which is considered for this project.

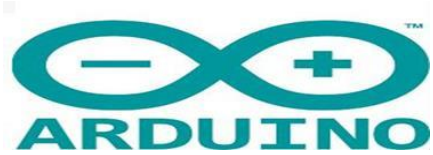


FIGURE 2. Arduino logo[7].

Reasons for choosing Audrino Uno:

There are various successful microcontrollers including MIT‟s Handyboard, Phidgets, and Netmedia‟s BX-24 but the Arduino offers numerous advantages for individuals, including students and instructors, that give it an upper hand compared to the other microcontrollers. The advantages of the Arduino are listed as follows.

1. Less expensive: Arduino boards are inexpensive compared to other microcontrollers that are available in the market. A preassembled Arduino board is available for as low as $50.
2. Compatible: Arduino is compatible with all the operating systems including Linux, Macintosh, and Windows, whereas other microcontrollers are restricted to Windows.
3. Easy to program: The environment used to program Arduino and the ways to perform the coding are user friendly even for beginners.
4. Expandable programming and open source: The programming language of an Arduino is an open source and can incorporate the Arduino code into the AVR-C code if needed.
5. Allows easy and fast prototyping: There are a number of pre-wiring and free code libraries, which help to test an idea instead of spending time in building and creating an excessive amount of low level codes.

Bluetooth

Bluetooth Technology

Bluetooth is the most common and popular technology available in almost all electronic gadgets around the world, which includes PDAs, cell phones, laptops, iPads, and other devices. Bluetooth is a wireless connection and is a good substitution for connections that use wires.

Bluetooth connection can be used in any location, including homes, hospitals, and schools. The modulation that occurs in Bluetooth is Gaussian phase shift keying.

According to the official Bluetooth website [6], the communication via Bluetooth can be a point to point or a multipoint connection. Security is an important aspect while performing a wireless transmission, and Bluetooth guarantees that security. This is an important feature of the

Bluetooth connection. Other advantages of using a Bluetooth include cost-efficiency, ease of use, less complexity, and less consumption of energy. Bluetooth has an encrypted 128 bit long shared key that keeps the data secure when it is being transmitted and eliminates any questions about the security of data.

Working of Bluetooth

Bluetooth is a wireless connection, so the transmission as well as reception of signals between the devices is performed at a frequency of 2.4GHz, which is common throughout the world. Apart from data, Bluetooth also gives the voice recording transmission accessibility on three channels available. The transfer of data takes place at a speed of up to one megabit per second. Bluetooth innovation provides the opportunity to transmit voice recordings, pictures, music and text messages between devices.

Importance of Bluetooth in Home Appliances

Home Automation, or Smart Home, has benefited from the critical innovations of Bluetooth technology can be used to connect devices such as mobile phones and laptops. Wired devices require a point to point connection but communication can be established between multiple devices with Bluetooth. A group of Bluetooth devices is called a piconet and this technology is apt for building a Smart Home. Figure 3 shows the different appliances of the house (light, fan, etc.) which are controlled via Bluetooth. Bluetooth provides a good platform asit is readily available in almost all the smart phones which are present in the market today and is easy to understand and use. This provides the flexibility to people of all ages to use Bluetooth in a handy manner.

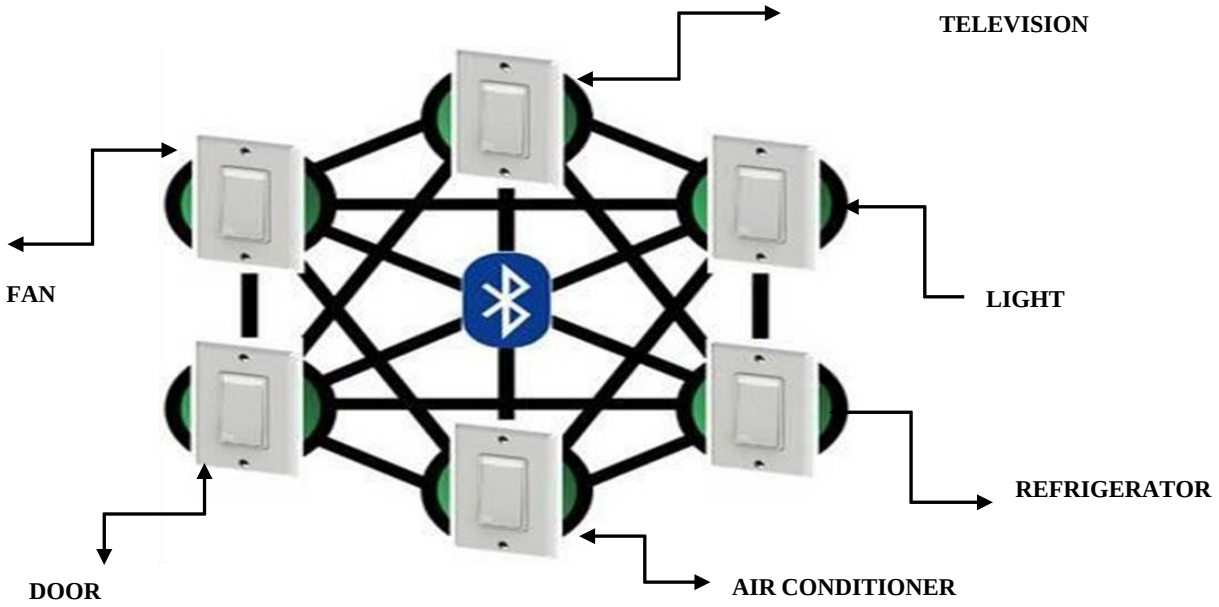


FIGURE 3: Bluetooth for home automation.

Bluetooth Module

The Arduino Uno board does not have any features that make it communicate with a Bluetooth on its own. The Arduino Uno cannot communicate with the Android device on its own. Hence, a Bluetooth module HC-06 is implemented in this project. AT commands are used to program a Bluetooth module HC-06 which is a user friendly module. It only features one fixedmodule, either a master or a slave. In this project, the slave module is used.

The Android Operating System

The Android operating system uses Linux Kernel with the programming interface of Javaand is an open source.

The essential equipment platform for Android is the ARM architecture.

Android applications are typically uploaded/purchased via the Google Play store.

Figure 4 shows the Android architecture.

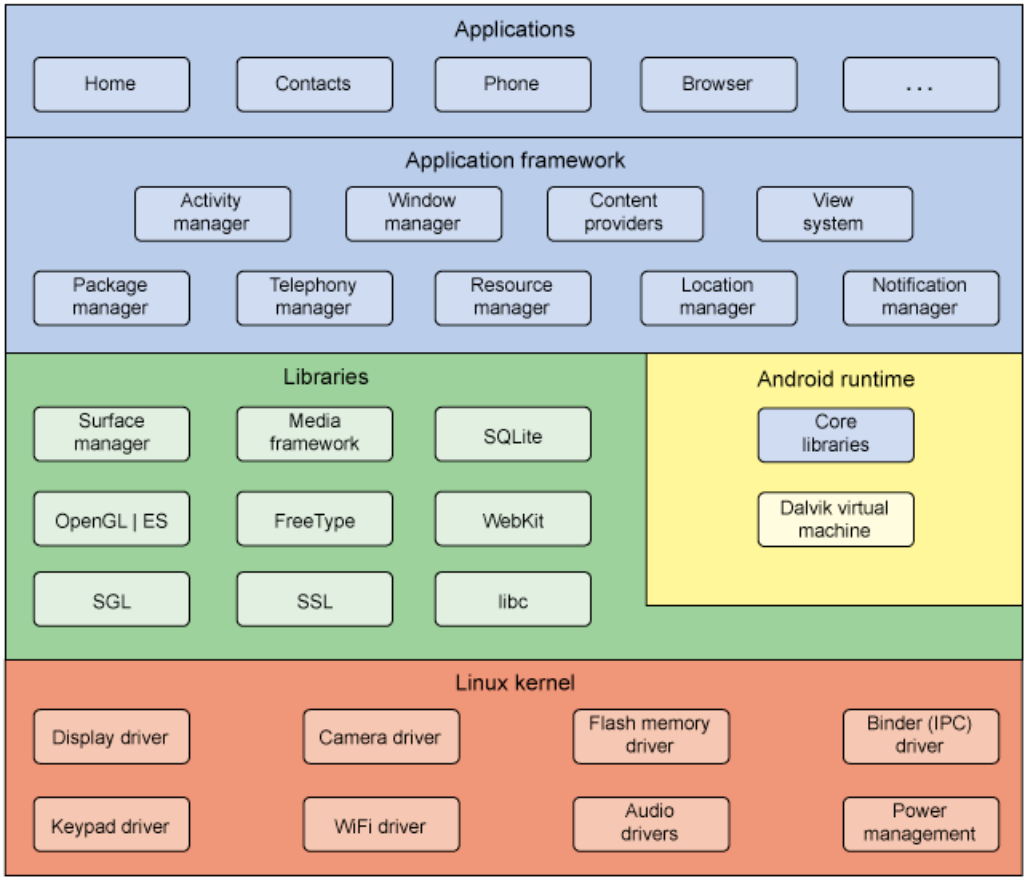


Figure 4 : Android Operating System Architecture

CHAPTER 3

SMART DEVICES ENABLED THROUGH BLUETOOTH

Problem Statement

The primary motive of this project is to build up a system that helps elderly and handicapped people live a more independent life. The objective of this project is to take into consideration all the domestic systems that are difficult to control by elderly people and the handicapped. The project will allow any person who has a Bluetooth enabled Android mobile phone to download an application from the Google Play Store. With the help of this application, auser can control all the appliances in the house via Bluetooth receivers. The proposed system allows the clients to have access to all the appliances in the house including air conditioners, andlights, with a single click on a mobile phone to turn it either ON or OFF.

The most important consideration in the application is that it has to be user friendly and simple to operate. By opening the application, the user can also check the status of the appliancesto see whether they are ON or OFF. To develop a user friendly application and fulfill all the objectives of this project, the GUI of the application has to be the foremost priority. The interfaceof the application will prove how easy the application is to use as well as give flexibility to the user.

Objectives

The following list of objectives must be fulfilled to successfully help elderly and disabled individuals.

1. Develop Bluetooth appliance controller: The Bluetooth will interface with the microcontroller to perform the desired automation. The microcontroller will get the signals from the Bluetooth enabled mobile phone and it will be processed.
2. Develop an application for a mobile phone: An application needs to be developed for themobile phone, which needs to communicate with the Bluetooth receiver HC 06.
3. Integrate the device to the controller: The foremost priority that has to be kept in mind when developing a Smart Home is that it has to be cost-efficient. The appliance controller has to beinexpensively integrated with the appliances in the house with an easy installation.
4. Test the set up and analyze the data: After the system is set-up, with the help of a mobiledevice and a controller, tests are conducted while data is recorded and analyzed.

CHAPTER 4

METHODOLOGIES AND RESULTS

Introduction

The steps needed to achieve the desired goal of the project and successfully run itwill be explained in Chapter 4.

PROJECT FLOW

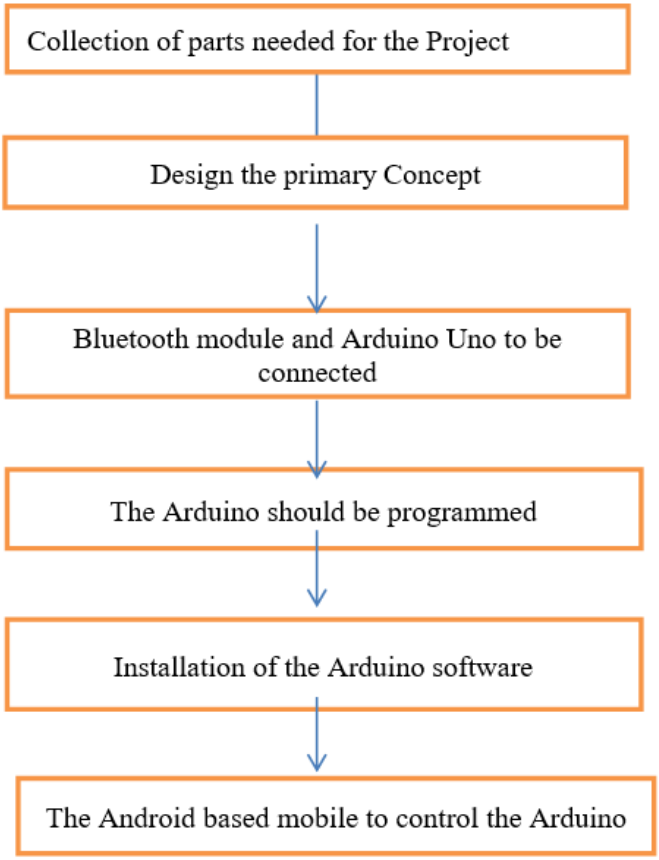


FIGURE 5: PROJECT FLOW

Figure 5 shows the steps needed to accomplish the goals of this project in a sequentialmanner. First, all the parts needed to design the project are collected and a primary concept is designed based on it. Next is the connection between the Arduino Uno and the Bluetooth via the Bluetooth module which is the most important part of the project. After all the connection is being done, the Arduino board needs to be

programmed and the Arduino software has to beinstalled. At the end, the Android based mobile phone is used to control the Arduino Uno via Bluetooth.

Accumulating Tools needed to complete the Project

1. Arduino-Uno
2. Android based mobile phone
3. Bluetooth module(HC-05)
4. An Android application (through which the Arduino is controlled via Bluetooth)
5. Resistors
6. Bulbs
7. Step down transformer
8. Optocouplers
9. Diodes

System Design

Figure 6 explains the system for this project. There are two types of communication involved in this project: wired and wireless communication. The communication between theBluetooth module, or HC-06, and the Android based mobile phone will help connect to the controller wirelessly. In contrast, wired communication is the communication between the controller and the appliances.

Due to space constraints, only a small amount of appliances in the house could be shownin the figure. The system design in Figure 6 will give the user a clear understanding of the connection involved in building up a smart home.

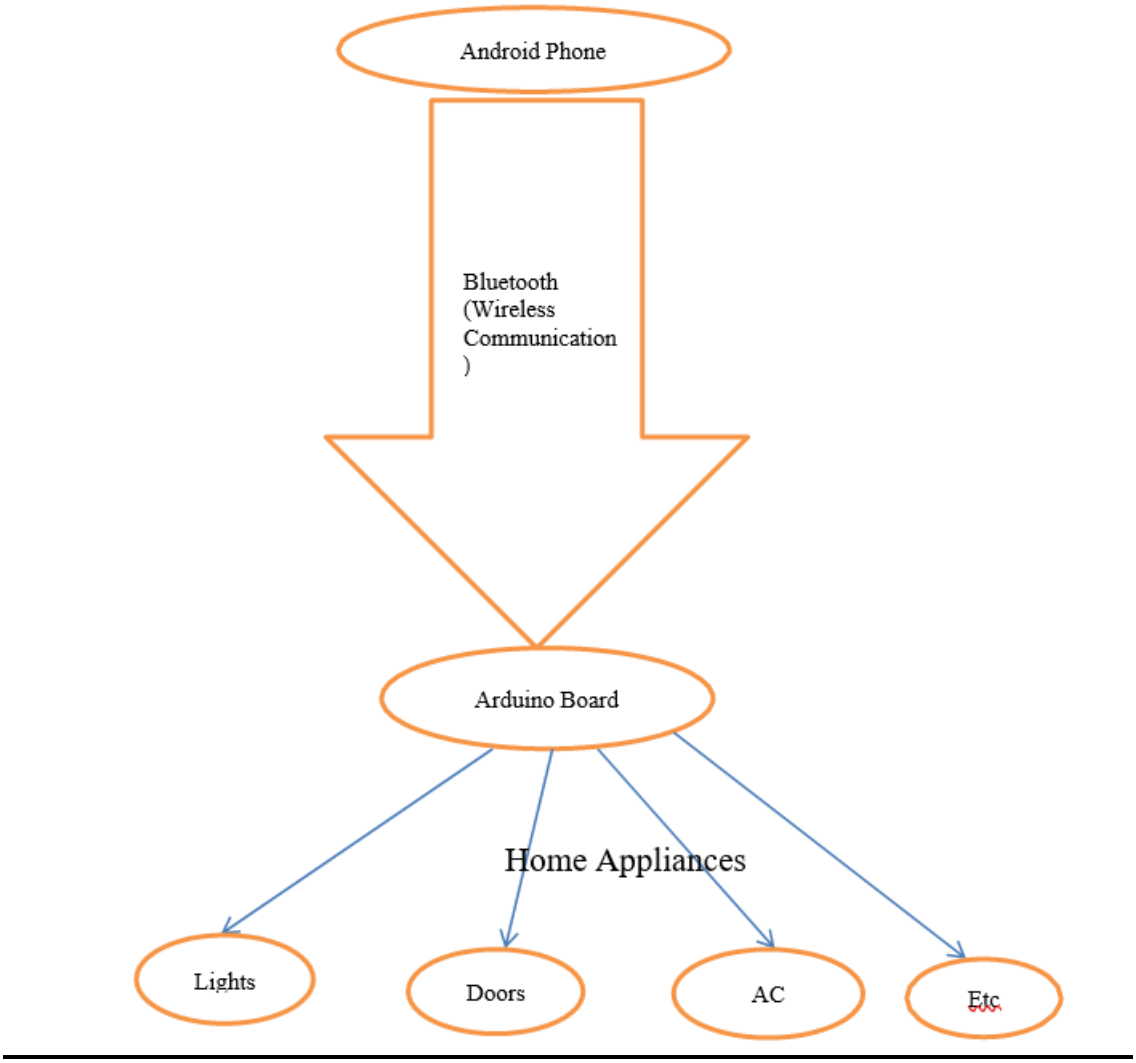


Figure 6: System Design

Implementation of the Hardware

This section describes the overall hardware needed to design this project. The system is designed using the Arduino Uno Board, the Bluetooth module(HC-06), optocouplers, an Android mobile phone, and an Android

application to control the Arduino board as shown infigure 7. It also uses various electronic components involved.

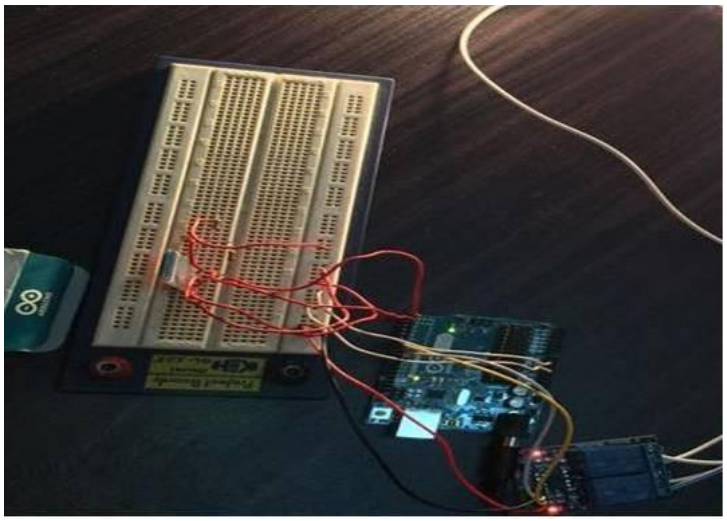


FIGURE 7: HARDWARE IMPLEMENTATION

Arduino UNO

Arduino Uno is a microcontroller board based on the Atmega 328. It has a ceramic resonator that is 16MHz, fourteen digital input/output pins (six of which can be used as PWM outputs), a reset button, a USB connection, a power jack and six analog inputs. It is an 8-bit microcontroller based on RISC architecture. The Arduino Uno board is shown in figure 8 withthe parts labeled.

Table 1 shows the specifications of the Arduino Uno.

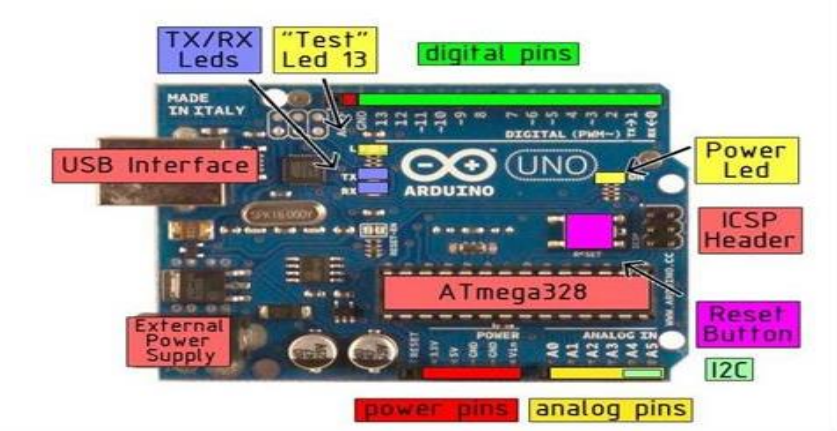


FIGURE 8: ARDUINO UNO

TABLE 1. Specifications of Arduino Uno

Microcontroller	Atmega 328
Operating Voltage	5V
Input Voltage(Recommended)	7-12V
Input Voltage Limitation	6-12V
Digital Input/Output Pins	14
Analog Input Pins	6
Clock Speed	16MHz
EEPROM	1KB

The recommended voltage is between 7-12V because if the voltage dips below 7V, the 5V pin on the Arduino board will become unstable and if the voltage rises above 12V, the boardmay overheat and become damaged.

The Arduino does not use a RC oscillator, but rather a crystal oscillator because of the quality factor (Q). The quality factor for a crystal oscillator is of the order 100,000 whereas thequality factor for an RC oscillator is of the order 100. A quality factor (Q) is defined as:

Q = f / BW

Where f is the resonant frequency and BW is the bandwidth.

BLUETOOTH MODULE (HC-05 BLUETOOTH MODULE)

HC-05 Specifications:

- Bluetooth protocol: Bluetooth Specification v2.0+EDR
- Frequency: 2.4GHz ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Emission power: ≤4dBm, Class 2
- Sensitivity: ≤-84dBm at 0.1% BER
- Speed: Asynchronous: 2.1Mbps (Max) / 160 kbps, Synchronous: 1Mbps/1Mbps
- Security: Authentication and encryption
- Profiles: Bluetooth serial port
- Power supply: +3.3VDC 50mA
- Working temperature: -20 ~ +75℃
- Dimension: 26.9mm x 13mm x 2.2 mm

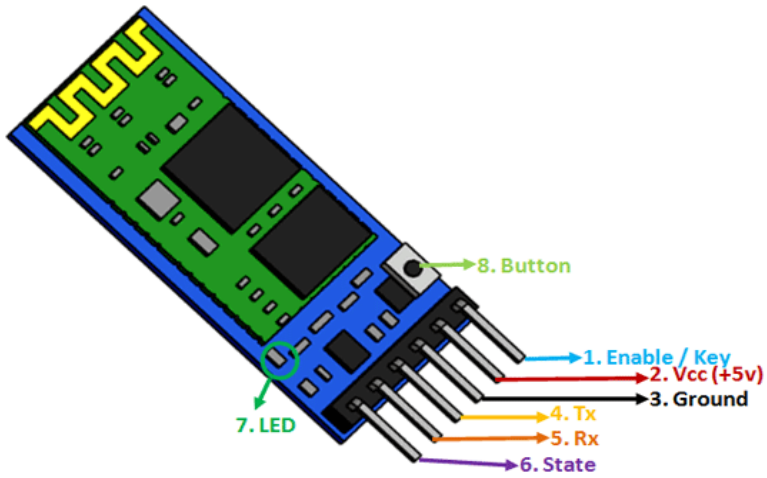
Overview:

HC-05 module is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serialport 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).

Bluetooth Module HC-05:

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default, the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC toyour embedded project, etc.

BLUETOOTH MODULE HC-05



PIN DESCRIPTION OF HC-05

PIN DESCRIPTION OF HC-05:

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate. When enable is left open or connected to 3.3V, the module is enabled i.e., the module remains on and communication also takes place.

V_{cc}:

Supply Voltage 3.3V to 5V

GND:

Ground pin

TXD & RXD:

These two pins acts as an UART interface for communication

STATE:

It acts as a status indicator. When the module is not connected to paired with any other bluetooth device, signal goes Low. At this low state, the led flashes continuously which denotes that the module is not paired with other device. When this module is connected to/paired with any other bluetooth device, the signal goes High. At this high state, the led blinks with a constantdelay say for example 2s delay which indicates that the module is paired.

BUTTON SWITCH:

This is used to switch the module into AT command mode. To enable AT command mode, press the button switch for a second. With the help of AT commands, the user can change the parameters of this module but only when the module is not paired with any other BT device. If the module is connected to any other bluetooth device, it starts to communicate with that deviceand fails to work in AT command mode.

HC-05 Default Settings: -

Default Bluetooth Name: HC-05

Default Password: 1234 or 0000

Default Communication: Slave

Default Mode: Data Mode

Data Mode Baud Rate: 9600, 8, N, 1

Command Mode Baud Rate: 38400, 8, N,1

Default firmware: LINVOR

Android Application and Mobile Phone:

The Android mobile phone used for this Project is Google Nexus 5 with an installed application called LMBT.

The LMBT application is a simple application on Android and is used to control the pinsof the Arduino-Uno from an Android phone in a wireless manner. A simple Android user interface is employed by LMBT to control digital pins of Arduino Uno and PWM pins, to send commands to Arduino Uno in the form of text and reception of data over a Bluetooth serial module from Arduino.

Programming The Arduino UNO:

The Arduino-Uno board needs to be programmed with a code so that it is able to interactwith the application. Arduino provides a flexible platform, which helps to write a code for any function to be performed by the Arduino Uno and upload to the board.

APPENDIX A shows the full source code of the Arduino Uno. Interfacing the Atmega 328 with Electrically Erasable Programmable Read Only Memory (EEPROM) is done using the Universal Synchronous Asynchronous Receiver Transmitter (USART) protocol. The code is written in Embedded C using Atmel studio 6.0. The code is then compiled and converted to HEXcode. Afterwards, the HEX code is then burned to the Atmega 328 microcontroller.

Integrating the Bluetooth Module to Arduino Uno:

For the Arduino Uno to be controlled, a connection is required between the Bluetoothmodule and the Arduino Uno.

The VCC port on the Arduino Uno board is connected to the VCC pin on the Bluetooth module (HC-06). The GND port on the Arduino Uno is connected to the GND pin on the Bluetooth module (HC-06). Finally the transmitter of the Bluetooth module is connected to the receiver of the Arduino Uno as well as the transmitter of the Arduino Uno to the receiver of the Bluetooth module need to be connected. Table 3 shows the connection between the Arduino Unoand the Bluetooth module.

TABLE 3: Connection between Arduino UNO and Bluetooth Module

Arduino Uno Board	Bluetooth Module
GND port	GND pin
VCC port	VCC pin
Transmitter Pin	Receiver Port
Receiver Pin	Transmitter Port

The connection between the Arduino Uno and the Bluetooth module is the fundamentalconnection in the circuit.

Connection between Arduino UNO and Bluetooth Module

The block diagram in Figure 10 shows the connection between the Bluetooth module andthe Arduino Uno.

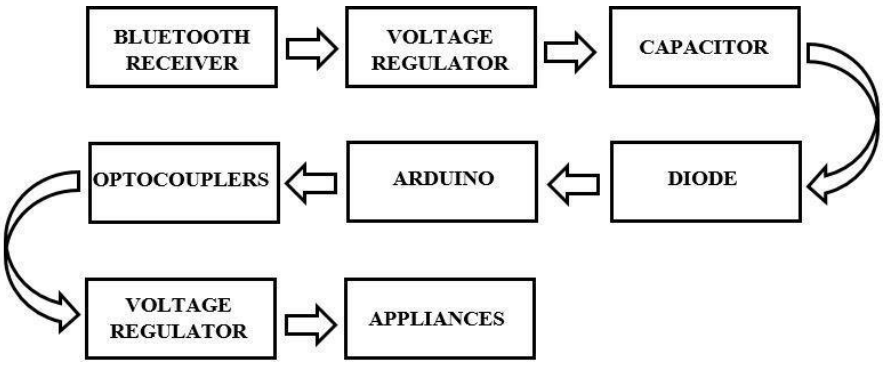


FIGURE 10. Connection between the Bluetooth module and the Arduino Uno.

The Bluetooth receiver transfers the signal to the voltage regulator, which then regulates the voltage and forwards it to the capacitor. Two capacitors are used in this circuit. One capacitoris of 1000 microfarad for appliances, that requires high power to operate and the other is of 10 microfarad, which requires low power to operate. The signal from the capacitor goes to the diodethat restricts the flow of current to one side and allows the current to flow only in a single direction. The Arduino board then receives the signal from the diode, which goes to the optocouplers. Afterwards, the optocoupler is connected to the voltage regulator before being connected to the appliances. This connection is due to the optocoupler having a maximum powerof 9000 watts, which if directly connected to the appliances may cause damage. The optocoupleris connected to a voltage regulator that regulates the voltage and drives the appliances.

Communication Between Android Phone and the Appliances

The application on a mobile phone is coded with an integer value of 49, 50, 51, 52, 53,54, 55, and 56. After opening the application, 1 and 49 are pressed and converted to the binary value as well as sent to the receiver of the Bluetooth module (HC-06) via the Bluetooth on a cellphone. The binary value from the Bluetooth module goes to the Arduino. Arduino checks in its database the equivalent of the binary code. If it is HIGH, the light should be turned ON and if it is LOW, the light should be turned OFF.

The block diagram in Figure 11 explains the steps needed to establish the connection.

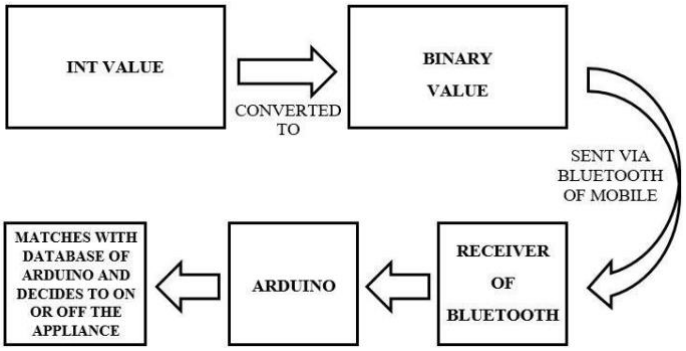


FIGURE 11. Communication between Android Phone and the Appliances

How to Test the Connection

After the application is installed on the mobile phone and the Bluetooth moduleis connected to the Arduino Uno, the connection is to be tested to make sure that the phone is interacting with the Arduino Uno via the Bluetooth module (HC-06).

The steps to test the connection are as follows:

1. Open the application installed on the mobile phone.
2. With the help of the application, search for the Bluetooth devices.
3. Connect to the Bluetooth module (HC-05).
4. If the blinking of the light stops in the Bluetooth module, then it is working correctly, and the connection is established. If the light continues to blink, theconnection needs to be checked.

Connecting the Appliance to the Arduino Board

After all the connections are done, the home appliances should be connected to the Arduino. The positive end of the home appliance has to be connected to the anode port of the optocoupler and negative end of the appliance has to be connected to the powersource using wires.

Using different optocouplers and Arduino ports, the connections is made for other appliances. Finally, with the help of a Bluetooth connected Android phone, all of theappliances in the house are controlled wirelessly.

BLOCK DIAGRAM

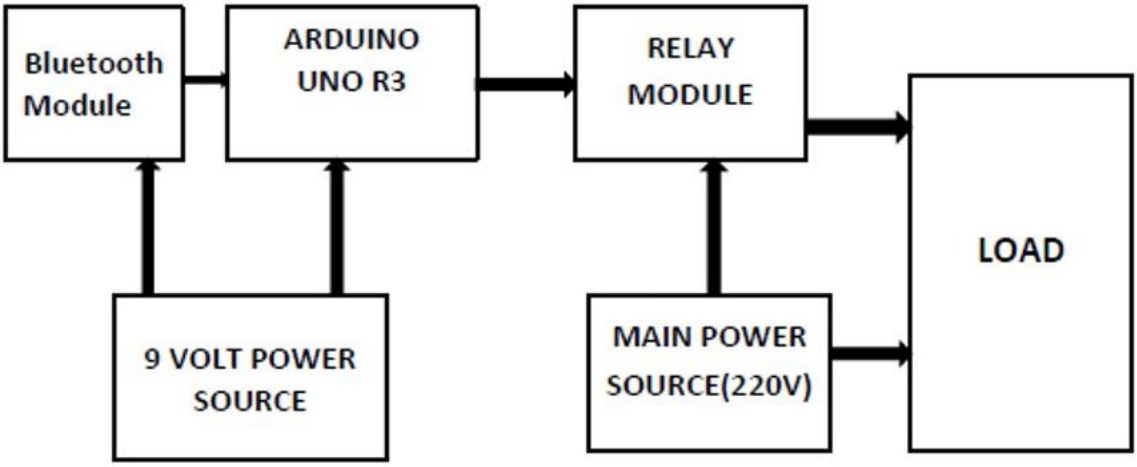


Fig 12: **BLOCK DIAGRAM OF HOME AUTOMATION SYSTEM USING ARDUINO AND BLUETOOTH MODULE**

CIRCUIT DIAGRAM

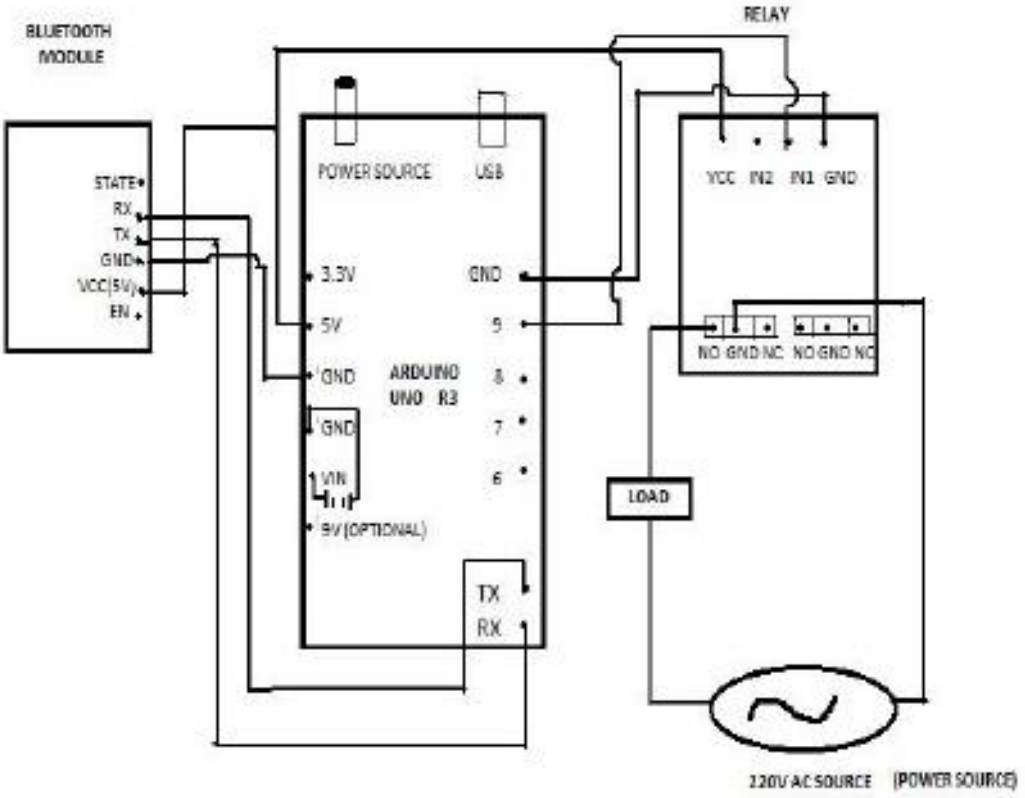
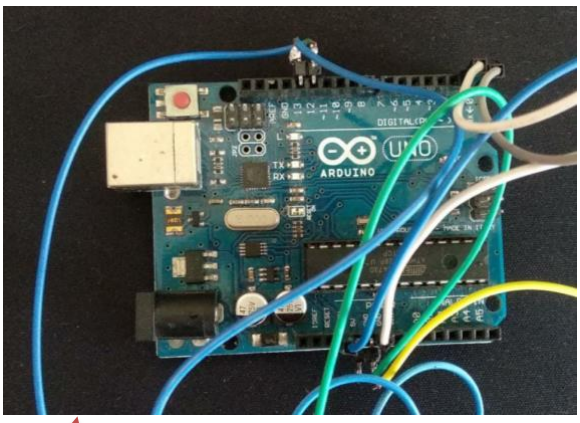
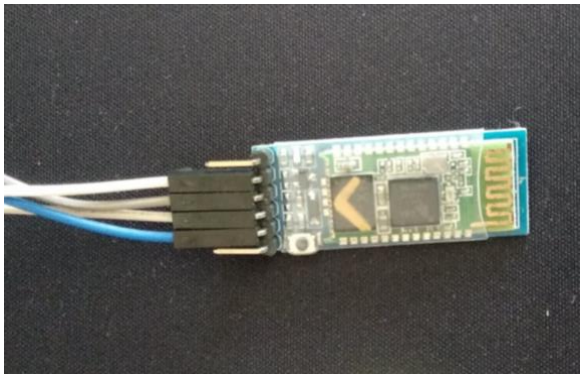


Fig 13: Circuit diagram of Home automation system using Arduino and Bluetooth module

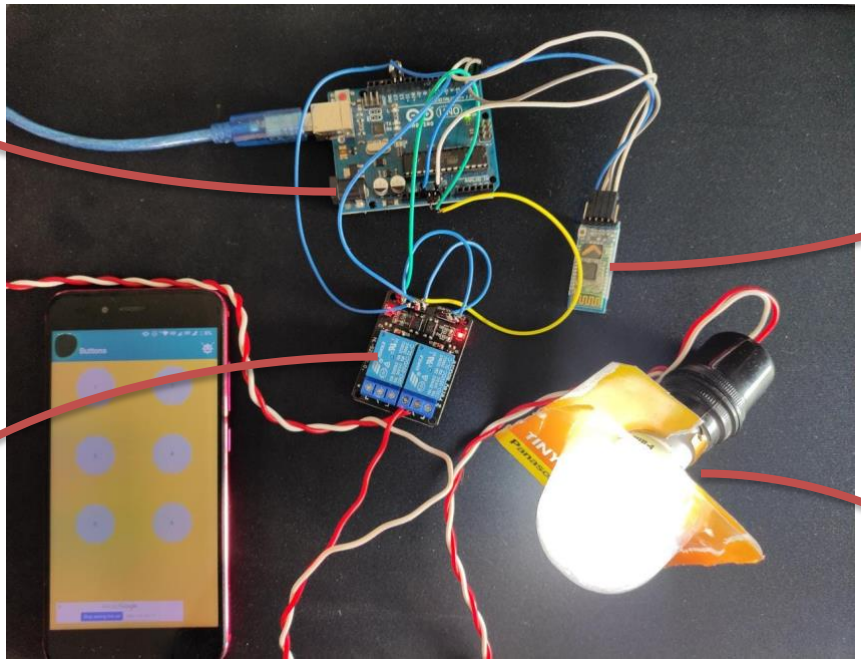
Prototype/Model images



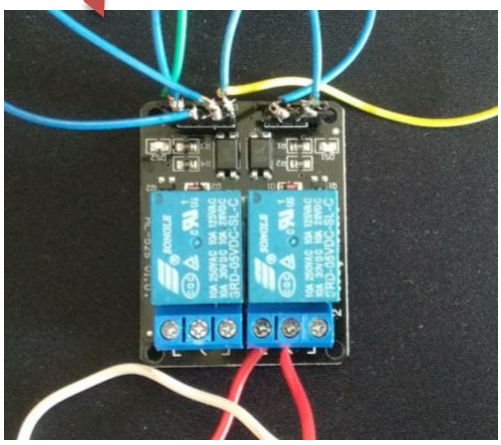
Arduino UNO



Bluetooth module hc-05



Prototype Final assembly



Dual channel Relay (5V)

Light Bulb (Home appliances)

APPLICATIONS

Home is where the Smart is

Evmachine-to-machine communication, and you understand you're not the most tech-savvy consumer, it's impossible that you've missed the abundance of home automation products filling the shelves and ads of every home improvement store. Suddenly an ordinary errand forlight bulbs will leave you wondering if your lamp could send you a message alerting you that the light bulb needs to be replaced. Furthermore, if your lamp is talking to you, could your refrigerator and sprinkler system be too? Experts say: Yes, the possibilities are endless. If that'sthe case, where do you begin?

Any day-to-day, repeatable process is automatable with smart home applications. The greater the control and flexibility of these processes, the more energy and cost savings the resident experiences, which are factors anyone who pays utilities strives to moderate. The smart home revolution is likely to be more of an evolution, with the incorporation of one or two home systems at a time, gradually automating our households through smart mobile devices.

However, with these elements of efficiency comes the question of ease of use. Will it bring you enjoyment or exasperation? With so many brands and models already available in an ever- growing market, how do you know which is best for you?

Lighting Control: Leaving the Dark Ages and Stepping Into the Light

Smart lighting allows you to control wall switches, blinds, and lamps, but how intuitive is a lighting control system? It turns out, quite; its capabilities are extensive. You're able to schedulethe times lights should turn on and off, decide which specific rooms should be illuminated at certain times, select the level of light which should be emitted, and choose how particular lightsreact through motion sensitivity, as seen with Belkin's WeMo Switch + Motion, which is both affordable and easy to use with its plug-and-play simplicity.

HVAC Regulation: No Longer Burned by Your Heating Bill

As fuel costs rise and the availability and sustainability of our resources becomes a greater concern, heating/cooling our homes efficiently is less a budgetary bonus and more of a necessity. Over the past year, smart thermostats and automated home heating systems have become more readily available and easily incorporate into any home. Heating and cooling our homes consume an average of 50% of energy costs yearly, making daily HVAC regulation progressively rewarding. Maintaining a substantial lead among the nearly non-existent competition, the Nest Learning Thermostat, learns your heating and cooling preferences over time, eliminating the need for programming and is accessible from your smartphone app. Withautomated HVAC you are able to reduce the heat when a room is unoccupied, and increase or decrease it at specific times based on your schedule and occupancy.

Lawn Irrigation Systems: The Grass is Always Greener

A lush and healthy lawn is a source of pride for most homeowners, but the weather doesn't always cooperate and provide the adequate elements for a flourishing landscape. For decades we've relied on sprinkler systems to keep our yards at peak presentation, but at what cost? The average American home spends approximately 30% of their daily water usage on lawn and garden maintenance. Nearly half of that amount is wasted due to inefficiency. If you apply that statistic to the national average, up to 4.5 billion gallons of water is wasted per day through ineffective watering methods. If we reflect upon the monetary impact of this, it results in Americans spending over a thousand dollars a year in water, with a portion of that being waste.The global effects are even greater when you consider the growing concern over climate changeand the dramatic decrease in agricultural natural resources. However, sprinkler control systems, like Skydrop, are providing water regulation through real-time communication with local weather data. If a rainstorm develops and deposits two inches of rainwater on your lawn, the automated sprinkler detects the saturation and disables its scheduled watering. Conversely, the system will be alerted to dry conditions and supply the necessary amount of nourishment, without over-watering.

Smart Appliances: What's for Dinner?

Will smart kitchen appliances actually make you a better cook? Maybe. Smart refrigerators, such as LG's Smart ThinQ, allow you to scan grocery store receipts and keep an inventory of your items, and alerts you if an item is about to expire. More impressively, it suggests recipes based on your refrigerator's contents and lets you know when you need to replace items. Smartovens synch with your smartphone and automatically preheat to the correct temperature basedon a recipe selected from your database. While these appliance options seem a bit superficial and convenience based, there is a conservation factor as well. By automating your kitchen appliance and making them accessible from your smart device, you're able to sever the electricity supplied to unused appliances and reduce your energy consumption and costs.

Considering the number of appliances, the average household owns; this could save a substantial amount of money over time.

Result

With the procedures mentioned, the implementation of the project “Home Automation via Bluetooth using the Arduino Uno Microcontroller” is successfully completed and implemented. The project is cost efficient and user friendly because it can beused by anyone with a simple click on an Android based mobile device. All the appliances of the house are controlled successfully via Bluetooth using an Android mobile phone

Limitations and Problems Encountered

This project encountered certain difficulties that are described below.

- Initially, when all the connections were done, the major problem was the connection between the Bluetooth module and the Arduino Uno. It was repeatedly unsuccessful because the Xbee module was used in the project. When the Xbee module was replaced with the HC-05, the connection was only established after reading about the specifications of the XBEE module and the HC-05 online.
- A second problem was also encountered with the use of the fixing of the optocouplers on the board.

CHAPTER 5

CONCLUSION AND FUTURE WORK

The current project presented the implementation of an inexpensive home automation system, within the framework of assistive technology. The system implementation is based on the Arduino microcontroller, which has been programmed to control a range of home automationdevices based on sensor signals and on direct commands by the user. The system has been programmed to have Bluetooth communication capability. Demonstrations of the system show that it facilitates the control of home-based devices such as electrical appliances, lights, heating, cooling systems and security devices by the intended users, i.e., the elderly and the disabled

Conclusion

The system as the name indicates, 'Home automation' makes the system more flexible and provides attractive user interface compared to other home automation systems. In this system we integrate mobile devices into home automation systems. A novel architecture for a home automation system is proposed using the relatively new communication technologies. The system consists of mainly three components is a BLUETOOTH module, Arduino microcontroller and relay circuits. WIFI is used as the communication channel between androidphone and the Arduino microcontroller. We hide the complexity of the notions involved in the home automation system by including them into a simple, but comprehensive set of related concepts. This simplification is needed to fit as much of the functionality on the limited space offered by a mobile device's display. This paper proposes a low cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution. The approach discussed in the paperis novel and has achieved the target to control home appliances remotely using the WiFi technology to connects system parts, satisfying user needs and requirements. WiFi technology capable solution has proved to be controlled remotely, provide home security and is cost- effective as compared to the previously existing systems. Hence we can conclude that the required goals and objectives of home automation system have been achieved. The system design and architecture were discussed, and prototype presents the basic level of home appliance control and remote monitoring has been implemented. Finally, the proposed system is better from the scalability and flexibility point of view than the commercially available home automation systems.

Further Work

Though overall the project is completed successfully, further study could be conducted to consider increasing the range of the signal to discover a method to amplify its range from the Bluetooth module. Furthermore, rather than using optocouplers and connecting them to the breadboard, further study could consider the use of a relay module to connect the modules.

APPENDICES

APPENDIX - A

CODE FOR ARDUINO UNO

```
char t;
void setup()
{
        pinMode(13,OUTPUT);
        pinMode(12,OUTPUT);
        Serial.begin(9600);
}
void loop()
{
        if(Serial.available())
        {
                t= Serial.read();
                Serial.println(t);
        }
        if(t=='1')
        {
                digitalWrite(13,HIGH);
        }
        if(t=='2')
        {
                digitalWrite(13,LOW);
        }
        if(t=='3')
        {
                digitalWrite(12,HIGH);
        }
        if(t=='4')
        {
                digitalWrite(12,LOW);
```

```
        }
}
```

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