

Bluetooth Based Home Automation System

^[1] Vijay Kumar, ^[2] Kaushik Kishor Chakrabarty, ^[3] Tarun Gulati

^[1] ^[2] Student, Department of Electrical Engineering, MMEC, MM(DU), Mullana, Ambala, Haryana, India.

^[3] Professor, Department of Electronics & Communication Engineering, MMEC, MM(DU), Mullana, Ambala, Haryana, India.

Corresponding Author Email: ^[1] vijaymoudgil5@gmail.com, ^[2] shopnilchakroborty@gmail.com,

^[3] gulati_tarun@mmumullana.org

Abstract—The automatic and electronic control of household features, activities, and appliances is referred to as home automation. It means that users may simply control their home's utilities and functions over the Internet, making life more easy and safe while also saving money on household expenses. Home automation is a network of hardware, communication, and electronic interfaces that operate together over the Internet. Each item is equipped with sensors and is connected through WiFi, allowing users to control them from their smartphone or tablet, whether they are at home or thousands of kilometres away. This allows users to turn on the lights, lock the front door, or even turn down the heater from anywhere.

Index Terms - Home Automation, Assistant, IoT, ZigBee.

I. INTRODUCTION

The automatic control of electrical gadgets in houses is known as home automation. Because these gadgets are connected to the Internet, they may be operated from afar. Devices can trigger one another with home automation, eliminating the need for users to operate them manually via an app or voice assistant. Put lights on timers so that they turn off when people go to bed, or adjust the thermostat or A/C up about an hour before you return to work. Home automation makes life easier and can even save money on utility expenses such as heating, cooling, and electricity. With Internet of Things devices like security cameras and systems, home automation can also lead to increased safety. Home automation is accomplished by a network of devices connected to the Internet via various communication protocols such as Wi-Fi, Bluetooth, ZigBee and others. The devices can be controlled remotely via electronic interfaces, such as a voice assistant like Alexa or Google Assistant or an app. Many of these IoT devices include sensors that track changes in motion, temperature, and light to provide information about the device's surroundings to the user. The user activates actuators, which are physical mechanisms such as smart light switches, motorised valves, or motors that allow devices to be controlled remotely, to make physical changes to the device.

Home automation works on three levels:

1. **Monitoring:** Monitoring refers to the ability for consumers to check in on their gadgets remotely via an app. Someone could, for example, check their live feed from a smart security system.
2. **Camera control:** Control refers to the user's ability to operate these devices remotely, such as moving a security camera to see more of a living area.
3. **Automation:** Finally, automation entails programming devices to communicate with one

another, such as having a smart siren sound whenever an armed security camera detects motion.

Home Automation System Components

Certain mobile applications link directly to a router, which connects directly to an IoT device, although some home automation systems require hubs. Of course, it's better if there's no hub, as that's merely an additional fee on top of the IoT device's price.

- **Remote Control:** Remote control, which can be done via a mobile application or a voice assistant, is the trademark of home automation.
- **Mobile Application:** Users can control their gadgets in real time with the smartphone app, whether it's turning off the outdoor lights or opening the smart garage door for a neighbour. Users may also use the app to make schedules, create scenes, groupings of IoT devices, and change device settings, such as changing the colour of living room lighting. The bulk of the IoT devices include Android and iOS apps, making them compatible with the vast majority of smartphones and tablets.
- **Voice Assistants:** Think of voice assistants as the icing on top of the sundae of home automation. Users may use voice to operate devices with voice assistants, whether it's disarming a security system as they enter in the front door, viewing video doorbell footage on an Echo Show device or setting a timer on a smart speaker while their hands are full of kitchen tools. Alexa, Google Assistant, and Siri are the three voice assistants that most IoT devices interact with.

Control Protocols: The control protocol is how IoT devices connect to the Internet and each other; if IoT devices were humans, the protocol would be their common language. Devices can communicate in a variety of languages, or protocols, similar to those used on Earth, including:

- i. **WiFi:** WiFi is by far the most popular control protocol; this means that IoT devices will connect to the user's Internet Service Provider's ordinary Internet. While this does not necessitate the deployment of an additional hub, it should be noted that it may delay web browsing rates, particularly if the user has a large number of different IoT devices connected at the same time.
- ii. **Z-Wave:** Z-Wave is a low-power wireless technology that does not interfere with customers' WiFi. It operates at 908.42 MHz in the United States and Canada.
- iii. **ZigBee:** Similar to Z-Wave, ZigBee is a mesh network and universal language that lets IoT devices communicate.
- iv. **Thread:** Thread is a low-power wireless mesh networking protocol based on the IP address open standard that allows IoT devices to communicate with one another and with the cloud.
- v. **Bluetooth:** Finally, Bluetooth is a mesh technology that allows individuals to control, monitor, and automate IoT objects and systems.

Most people will be fine with WiFi-connected gadgets, but for more advanced smart homes, users may wish to move to a mesh network such as Z-Wave or ZigBee.

II. REVIEW OF LITERATURE

In recent years, mobile phones have made it possible to effortlessly operate household gadgets. Mamun A. A. et al. [1] created an Android-based system to automate a Bluetooth-connected Arduino, which uses an on/off relay and servo motor to operate a variety of home appliances such as lights, fans, bulbs, doors, water pumps, and more. Within the Bluetooth module's range, the user can operate their linked gadgets. It has an LCD monitor that shows the water level and temperature, automates room temperature by changing fan speed, and saves electricity. In addition, a door lock system can be employed to secure a home. Otherwise, as compared to manual water pump on/off, this method is more effective and reliable for water pumping and saves a significant amount of electricity.

Home automation systems are becoming increasingly popular around the world as a means of making life easier and reducing work load. Because it makes daily life easier while also enhancing home safety and security, the system's evolution and modernization are obvious. The automatic and electronic control of household appliances, features, and activities is referred to as home automation. The cell phone is the most crucial device in today's world. Android phones are now a very popular and significant part of our lives. The use of this technology in regulating and surveillance work makes life easier and more comfortable for humans. Islam W. et al. [2] proposed a technology that allows users to control their

entire home from a single device. Hardware, communication, and electronic interfaces make up the system, which allows electrical devices to communicate with one another. The initiative will be beneficial to the disabled and aged. This project aims to modernize and build a voice-controlled home automation system that allows for voice control of all electrical gadgets in an apartment, provides safety by detecting fire, identifies suspicious movement, and gives personal support to the owner. It also offers security through an automatic door operated by a fingerprint sensor. Because Android allows for SMS communication, performing all of these operations with a single Android device speeds things up. It enables users to control appliances from a distance over the internet. The user may easily check and close machines that have been left on while they are away, saving energy. With the help of a microcontroller, the authors have merged home assistance with security in their project. As a result, this research acts as the foundation for an AI (Artificial Intelligence) system. The programming is done on a Windows computer. Sensors and serial communication devices are integrated into the computer and synchronized with it.

The evolution of technology is a never-ending process. To be able to build a product that will improve the lives of people utilising existing technology is a great contribution to the community. The design and implementation of a low-cost, yet flexible and secure mobile phone-based home automation system was presented by Muthukumaran M. et al. [3] The design is built on a standalone Arduino BT board, with home appliances connected through relays to the board's input/output ports. Wireless communication exists between the cell phone and the Arduino BT board. This system is built to be low-cost and scalable, allowing it to control a wide range of devices with minimal changes to its core. Password protection is being used to only allow authorized users from accessing the appliances at home.

The world is becoming increasingly automated. People have limited time to complete tasks, thus automation is a simple way to ensure that any gadget or machine operates in accordance with their wishes. Malav V. et al. [4] created a home automation system utilizing an Arduino and a Bluetooth module. With an Android application, a home automation system provides a simple and reliable technology. The Arduino Uno with Bluetooth module is used to control home appliances such as fans, bulbs, air conditioning, and automated door locks. The authors focused on using an Android phone to monitor and control a smart home and to provide a secure smart home while humans are not there. The writers' major goal is to create user-friendly, low-cost, and simple-to-install appliances in smart home.

Bhowmik A. et al. [5] created a home automation system that uses an Arduino board and Bluetooth to be operated remotely from any Android phone. Houses are becoming smarter as technology progresses. Modern homes are

gradually moving away from traditional switches and toward a centralised control system with remote switches. Currently, traditional wall switches are dispersed throughout the house, making it difficult for the user to get close enough to activate them. It becomes even more difficult for the elderly or physically challenged to do so. A smart phone-controlled home automation system gives a cutting-edge solution. At the reception end, a Bluetooth module is connected to the Arduino board, while at the transmitter end, a Bluetooth module is connected to the Arduino board. A cell phone application delivers ON/OFF orders to the receiver where the loads are linked. This technology allows the loads to be turned on/off remotely by pressing a specific spot on the GUI. The loads are controlled by the Arduino board using optoisolators and thyristors, which are powered by triacs.

Electronic devices and appliances have become very common in this recent year of technology especially with fast development in smartphones. Lai T. et al. [6] the design of Home Automation System compatibly with Local housing and good features for home automation via remote access are presented. Bluetooth Based Home Automation System Using Android and Arduino is design and implemented. In this research work a part of smart home technology which using Bluetooth in a mobile device is used, so it will cheap and efficient to use. This paper describe about home automation system which would use to enable home lighting, garage door motor, water pumping motor and smoke detection using a smart phone application with Bluetooth wireless technology. The system included three main components: an Arduino microcontroller for connecting the appliances, a Bluetooth module for signal transfer, and a smartphone with the Android application to control home appliances. Bluetooth communication technology and controlled system is that the operating range is low but it can controlled from anywhere inside of home, By using smart phone application we can control household appliances and provide security to decrepit peoples. The idea of paper is to control home appliances to avoid the dangerous of electric shock and convenience of decrepit and physically disable people, who can easily access and control the home appliances by staying at particular place and access them remotely without the help of other people. By using this system, our home automation works smartly by providing increased quality of life, and comforts to users.

The control of home equipment is made easier with home automation. Embedded systems in home appliances are now possible thanks to technological breakthroughs. The capabilities and benefits of home automation are increased. Automating numerous instruments or electrical equipment can increase the worth of our life. There is always a catch when it comes to home automation via mobile phones. The major goals of Waqas T. et al. [7] is to design a project to assist the elderly and handicapped, as well as to control home appliances from a far. The control of household appliances from both interior and outdoor locations is a primary focus.

The gadget is interfaced with the mobile application to control home appliances via Bluetooth and GSM for indoor and outdoor control, respectively. The initiative focuses on two primary issues. The first one is to use Bluetooth to control various home products and second step is to create a secure home design that will deter thieves and criminals from attempting to steal the property. The webcams were installed in all home rooms and programmed to travel through the criminal in any location in the room. In the future, they may be connected to any mobile phone or computer via Wi-Fi, GSM, or any other method to relay the image and video to the home owner.

Technology has advanced at a breakneck pace in recent years. Electronic equipment and appliances have also grown much more important in people's lives. As a result, the idea of creating a home automation system was born. Abbas A.J. et al. [8] designed a home automation system that uses a smartphone to allow even the most inexperienced user to control all of the appliances. The system is made up of three parts: an Arduino microcontroller for connecting the appliances, a Bluetooth module for signal transmission, and an Android smartphone. For novice users with command sensing, the system also enables voice command. It decodes and extracts the exact meaning of the user's voice command. The suggested system's features and design are the subject of this article. The concept is based on a standalone Arduino BT board with relays connecting the appliances to it. The Arduino and the smartphone communicate through Bluetooth. The major goal of system development is to make it low-cost and scalable to meet the needs. Authentication is done using password protection.

Herreros A. M. [9] designed a project model that simulates home automation with several operation modes that can be managed via a mobile app. A scale house has been designed to fulfil this goal, which can capture both digital and analogue signals. The variables under investigation and control to approach the house to a true home automation application are interior temperature and lighting, movement around the house, and pool water level. There are three primary types of operation for the dwelling. It performs the measurement and control of the variables in automatic mode, regulating itself according to the situations to which it is exposed. The remote mode, on the other hand, is achieved through the use of a mobile application that allows the user to make changes to the system remotely. Finally, when in alarm mode, it regulates the parameters that ensure the house's security while the owner is gone. The prototype features temperature, illumination, movement, and water level sensors for capturing signals, as well as a fan, some LEDs, an auditory warning device, and a water pump for regulation and control. The application's core is an Arduino Mega board, which allows it to run and receives operating mode directives and, if it's functioning remotely, orders to individually operate the various actuators through an Android mobile application.

Bluetooth connectivity is utilised for data transmission from the phone to the board.

III. METHODOLOGY

Components required for the proposed project are:

Following are the components used for designing a project on home based automation for controlling 4 different loads.

- Arduino UNO
- HC-05 Bluetooth Module
- 10 KΩ Resistor
- 20 KΩ Resistor
- 1 KΩ Resistor (4 pieces)
- 2N2222 NPN Transistor (4 pieces)
- 1N4007 Diode (4 pieces)
- 12 V Relay (4 pieces)
- Prototyping board (Bread board)
- Connecting wires
- 12 V Power supply
- Smartphone or tablet (Bluetooth enabled)

SOFTWARE REQUIREMENT:

- Arduino IDE

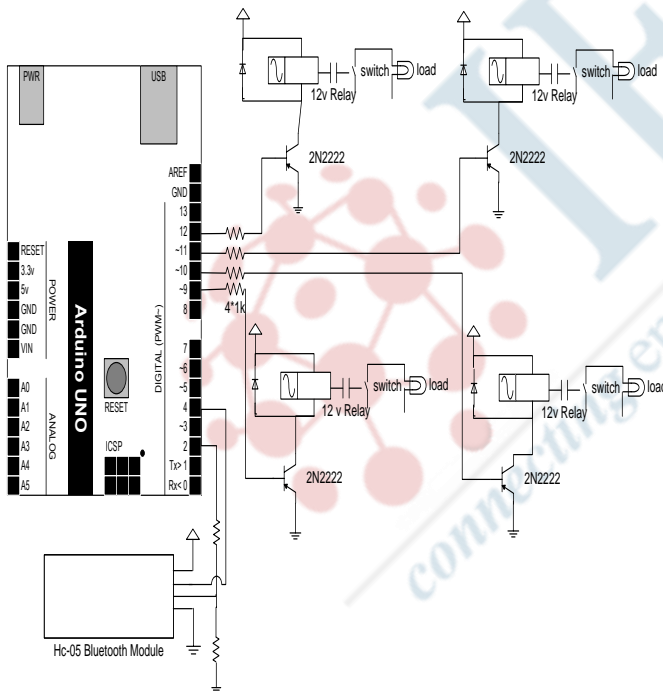


Figure 1: Circuit Diagram of Home Automation System

Circuit Description:

A home automation project including an Arduino UNO, a Bluetooth module, and a smartphone is intended to operate various home appliances via a smartphone. The circuit diagram of home automation system is shown in Figure 1. The concept of the project is as follows:

Step 1: When the power is turned on, the Bluetooth module's connected LED begins to blink. The "Bluetooth Controller" app must be installed on the phone that will be used to connect to the Bluetooth module. The LED becomes stable if the pairing is successful. Different keys are now assigned to different loads in the app. When a key is pressed, the value associated with that key is communicated. Figure 2 depicts a set of keys for controlling four loads, as well as an additional key for turning off all of them.



Figure 2: Description of keys corresponding to connected load

The Bluetooth module gets data from the smartphone when a key is pushed and sends it to Arduino. The data received by the Bluetooth module is "2" if "LOAD 2 ON" is pressed. This data, "2," is sent to Arduino, which compares the incoming data to the data in the sketch and, as a result, switches on the load 2. Other keys and loads can be treated in the same way. With this form of connection, one can use a smartphone to operate, i.e. turn on or off, various home electrical appliances.

Software Description:

The Arduino integrated development environment (IDE) is a cross-platform application For Microsoft Windows, macOS, and Linux) that is written in the Java programming language. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting ,and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for

common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. From version 1.8.12, Arduino IDE windows compiler supports only Windows 7 or newer OS. On Windows Vista or older one gets "Unrecognized Win32 application" error when trying to verify/upload program.

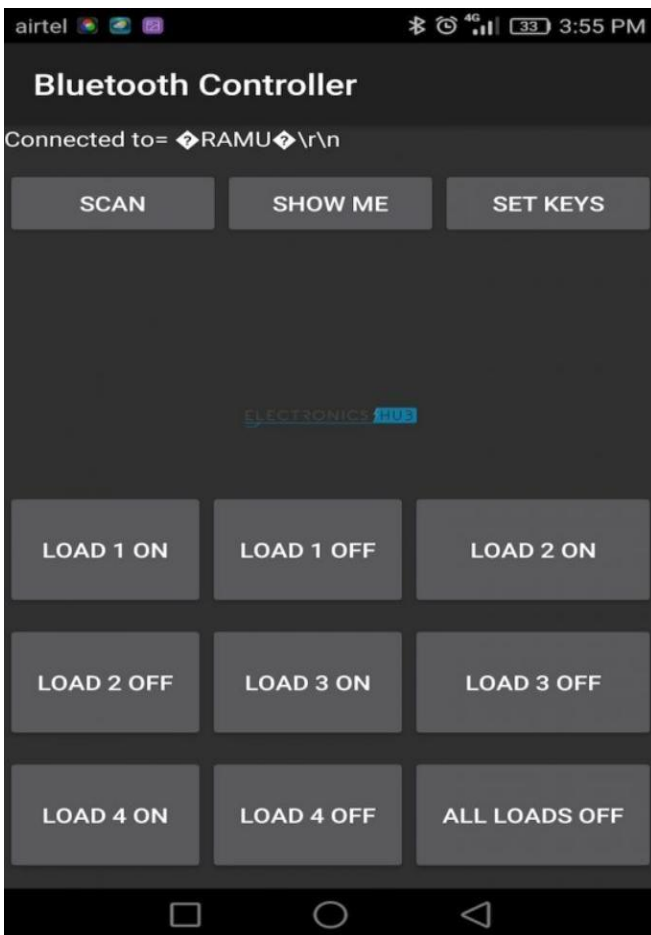


Figure 3: Bluetooth Controller

To run IDE on older machines, users can either use version 1.8.11, or copy "arduino-builder" executable from version 11 to their current install folder as its independent from IDE.

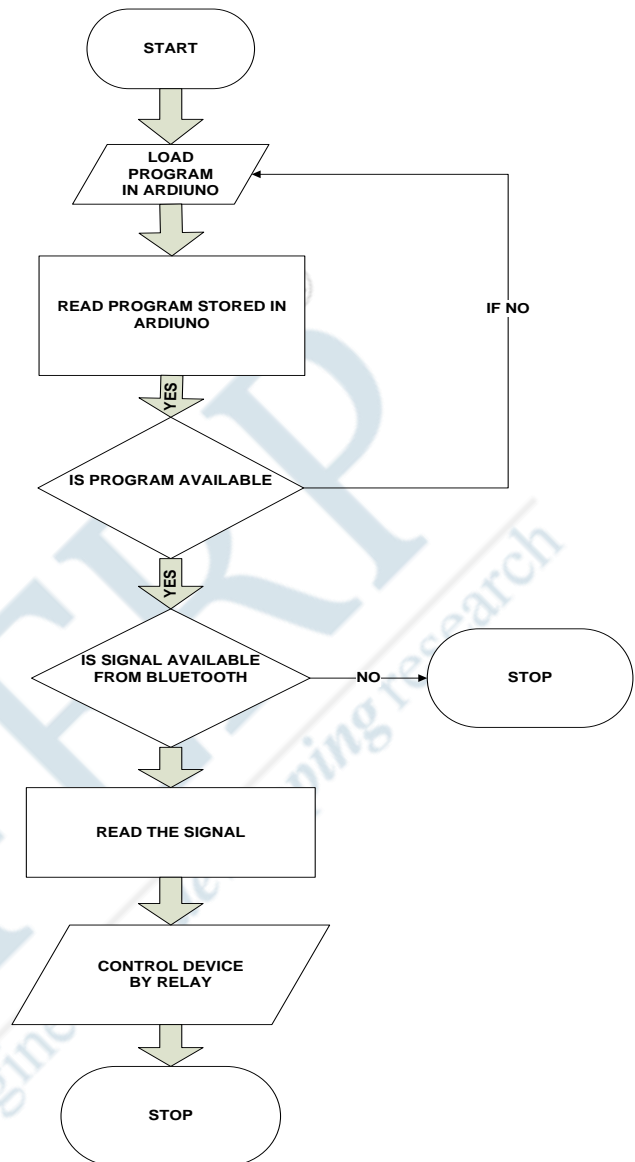


Figure 4: Flow chart of software description

CAUTION: We should be very careful when using a relay with AC mains.

IV. RESULTS

The home automation system was successfully operated from a wireless mobile device after it was experimentally shown to work by attaching sample appliances to it. We learnt numerous skills during this project, including soldering, wiring the circuit, and using other tools, and we were able to work together as a team. The Bluetooth client has been successfully tested on a variety of mobile phones from various manufacturers, demonstrating its mobility and compatibility. As a result, a low-cost home automation system was built, implemented, and tested successfully.

V. CONCLUSION AND FUTURE APPLICATIONS

The home automation system was successfully operated from a wireless mobile device after it was experimentally shown to work by attaching sample appliances to it. We learnt numerous skills during this project, including soldering, wiring the circuit, and using other tools, and we were able to work together as a team. The Bluetooth client has been successfully tested on a variety of mobile phones from various manufacturers, demonstrating its mobility and compatibility. As a result, a low-cost home automation system was built, implemented, and tested successfully. We can turn on or off appliances remotely with this project, utilising a phone or tablet. By adding some sensors such as light sensors, temperature sensors, and safety sensors, the project can be expanded to a smart home automation system that can automatically adjust different parameters such as room lighting, air conditioning (room temperature), door locks, and transmit the information to our phone. Furthermore, we may link to the internet and control the property from a remote location while simultaneously monitoring security. It is primarily designed for handicapped people and can be used in an emergency.

VI. LIMITATIONS

To be practical, the system requires a continuous power source; otherwise, we may be unable to manage the appliances. As a result, the most effective way to build the system is to integrate both automatic and manual control using switches at the same time.

REFERENCES

- [1]. Md. Abdullah Al Mamun, Md. Abdullah Al Mamun, Md. Atiqur Rahman and Md. Ibrahim Abdullah, "Smart Home Automation System using Arduino and Android Application," *Journal of Computer Science Engineering and Software Testing*, Vol 6, No. 2 (2020), pp. 08-12.
- [2]. Md. Wasif Islam, Bishwajit Roy, Nazia Homaira Preety and Farhan Bin Mahtab, "Design Of Arduino Based Home Automation Systems Incorporating Identity Detection," BRAC University, Institutional Repository, 2017
- [3]. M. Muthukumaran, M. Kannusamy, M. Kanagaraj and A. Guruvswaran, "Bluetooth based Home Automation using Arduino," *International Journal of Engineering Research & Technology (IJERT)*, Vol. 7, No. 2 (2019), pp. 01-03.
- [4]. Vaibhav Malav, Raushan Kumar Bhagat, Rahul Saini and Mamodiya, "Research paper on Bluetooth based Home Automation using Arduino," https://www.researchgate.net/profile/Vaibhav-Malav/publication/332835074-Research-Paper-On-Home-Automation-Using-Arduino/links/5ccc2576299bf14d9573a641/Research-Paper-On-Home-Automation-Using-Arduino?origin=publication_detail
- [5]. Anirban Bhowmik, Sandip Kumar Das, Souvik Acharya and Tusharkanti Murmu, "Home Automation Using Arduino," https://rcciit.org/s_tudents_projects/projects/ece/2018/GR30.pdf, May 2018.
- [6]. Anna Merino Herreros, "Home Automation Application Based on Arduino Controllable From Mobile," <https://upcommons.upc.edu/bitstream/handle/2117/108162/Volume%20II.%20Report.pdf>, (May 2017)
- [7]. Tajmalm Waqas, Aqil Javeed, Rabbia Waheed and Sadia Manzoor, "Home Automation," https://d1wqtxts1xzle7.cloudfront.net/64458029/Homeautomation_project_Report-libre.pdf?1600374626=&response-content-disposition=attachment%3Bfilename%3DHome_Automation_Project_Report.pdf&Expires=1647500955&Signature=ecIoAs87IURXhgHDmJvBz02cJILKybDz2fI4oICc-zDQUWx1PEKQeUyRUX7Zwgfirtql5zNj0HU_t042rOiyu-zwOwljoIipapqCDXqqCLK8UKfL4zzUxquT7hW3Kv5oaYU_MZ3JGe-
- [8]. Ahmed Jassim Abbas, Noor Ibraheem Rashad and Omar Talib Mahmoud, "Implementation of Smart Secure and Automated Home System via Bluetooth," https://www.researchgate.net/profile/Mohammed-Therib/publication/320404244-Implementation_of_Smart_Secure_and_Automated_Home_System_via_Bluetooth/links/59e28268aca2724cbfe0168b/Implementation-of-Smart-Secure-and-Automated-Home-System-via-Bluetooth.pdf?origin=publication_detail, (October 2017)
- [9]. Bhavik Pandya, Mihir Mehta and Nilesh Jain, "Android Based Home Automation System Using Bluetooth & Voice Command," *International Research Journal of Engineering and Technology (IRJET)*, Page no: 609-611, (March 2016).