

A Project Report on

# Home Automation using AI

Submitted in fulfillment of the requirements  
of the degree of

**Bachelor of Engineering**

in

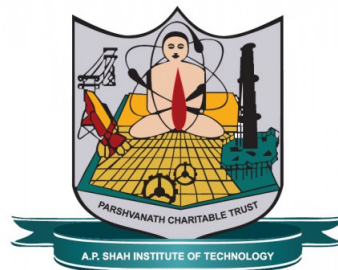
**Information Technology**

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## Approval Sheet

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## CERTIFICATE

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## Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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## **Abstract**

Home automation system is becoming popular day by day all-over the world because of making life smoother and minimizing the work load. Considering the system's contribution toward making daily life easier and strengthening home safety and security, the necessity of development and modernization of the system is apparent. Home automation refers to the automatic and electronic control of household appliances, features and activities. So, this project is done in such a way we can have the control of our home through a single device. The system is composed of hardware, communication and electronic interfaces that work to integrate electrical devices with one another. The project will come in handy for the disabled and elderly people. Moreover, it provides security by automatic door controlled by fingerprint sensor. Performing all these tasks with a single Android device makes everything faster because the Android makes SMS communication. It allows a person to control appliances from a remote location over the internet. The user can easily verify and close machines left on in one's absence which will help to save energy. In this project we have combined home assistance and security system with the help of a microcontroller. So this project serves as a basic structure of the AI (Artificial Intelligence) system.

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# List of Abbreviations

AI - Artificial Intelligence

AI - Artificial Intelligence

GPRS – General Pack Radio Service

LCD - Liquid Crystal Display

LDR - Light Dependent Resistor

LDR - Light Dependent Resistor

PIR - Passive Infrared Sensor

RFID - Radio Frequency Identification

IP - Internet Protocol

ARM – Advanced RISC Machines

RISC – Reduced Instruction Set Computer

PAN – Personal Area Network

UART – Universal Asynchronous Receiver-Transmitter

# Introduction

The 21st century is the era of smart technology. It was said that modern life is unimaginable without electricity but it this saying has changed. Now we say daily life is unimaginable without internet. Modern technology has advanced to another level of automatic and smart systems.

There is no need to introduce the advancement of technology in modern times. As we know, the advancement has gone a long way and almost has reached to its peak of modernization. Today innovation has turned into a coordinated piece of individuals' lives. It has and keeps on affecting numerous parts of day by day life and has permitted better social association, simplicity of transportation, the capacity to enjoy excitement and media and has helped in the advancement in pharmaceutical. One of the most important devices of modern times is Smartphone. Another important element of modern age is the internet. The key to step into the world of automatic control system is the combination of Smartphone and the internet. Therefore, with the help of these two and microcontrollers home automation was possible. If we look few years back, people have been using washing machine, water heaters, hair dryer etc. for household chores. Not in every house in India but in western countries these machines are used daily for household chores. We can consider these machines as the starting of home automation. Now we are able to control TV, light, fan refrigerator etc. with Android phones. This project is about easy and cheap home automation system and security system.

The quantity of Smartphone clients in India has expanded by 3.1 million to 8.2 million in 2015, as indicated by a current report distributed by Counterpoint Technology Market Research. Study shows that seventy five percent of the market share is Android and a total of one hundred and six million android Smartphone were shipped in the second half of 2012. Android Smartphone became the top operating system in the market in the present time worldwide and it became the most popular operating system known to man. This is making android phone the most needed element of today's life. Home automation was possible with the help of this small device. The fast development of remote correspondence inspired us to utilize cell phones to remotely control a household appliance. Apart from houses, we have restaurants where food is served with the help of robot in India.

Android controlled home system is not common in India but is available in some offices to some extent. The fast development of remote correspondence inspired us to utilize cell phones to remotely control a household appliance. There is no actual definition of embedded system. Computer controlled devices can be termed as embedded systems.

With the presentation of better equipment and better programming, cell phones have turned

out to be capable gadgets and have turned into an imperative piece of individuals' day by day lives. As per Li et al. (2016) there are three ages of home computerization.

Firstly, wireless technology with proxy server. Example: Next Zigbee automation. Artificial intelligence controls electrical devices. Example: Amazon Echo. The latest technology is robot interacting with human. Example: Robot Rovio, Roomba.

We have good and cheap facilities to wireless networks and still developing in India. The 2nd and 3rd generation from above, aren't available in India. It doesn't mean that we don't want it. The government and some organizations are trying to develop our country in high technology. Now high technology is not bound within few features. The thing that takes high technology to next level is automatic system. That is why the demand of automatic electronic device is increasing. To accomplish that, home automation is necessary.

## Objective

The objective of this project is to develop an inexpensive smart home automation system consisting of a fingerprint scanner, an Android App and a web-based control integrated into a mobile application available on the user's smart phone. This project aims to maximize security and enhance access convenience in a cost efficient manner.

## Motivation

In 2016, the CEO of Facebook, Mark Zuckerberg has built an Artificial Intelligence (AI) voice controlled assistant for his home. His inspiration came from the character "Jarvis" from the movie called Iron-Man. He has described that it is like a digital butler who can speak, play music, control lights and toasters. It can also say who is at the door. This project has made a movie character almost come to real. This excellent work of his has inspired us to do the project of home automation. There are many smart home appliances like underground refrigerator, smart closet etc. used in few luxurious houses of western countries. We believe a day will come when almost all houses will be a smart house. This project is a small step to reach this goal.

Almost every house has smart phones, smart television, smart watch, smart refrigerator, smart washing machine, smart garage which ultimately leads to a smart home. From there it is predictable that one day almost every house will be a smart house with automatic control system.

## Proposed System

This wireless Arduino based system includes controlling of home appliances like light, fan, air conditioner, television and finger print sensor security system.

This project proposes remotely controlling of home appliances with security of home both inside and outside. The project is composed of:

1. Controlling of appliances like light, table fan, TV, air conditioner etc will be controlled with Android phone through Bluetooth communication using Bluetooth module. This is used inside the house only.
2. Through GSM module we will control the above appliances from a distance via text messages. This will ensure safety inside the house.
3. The fingerprint recognition module is for automatic door locking and unlocking system.
4. Arduino UNO is the microcontroller in Arduino.
5. Finally all appliances are controlled by Android Application through Android mobile phone.

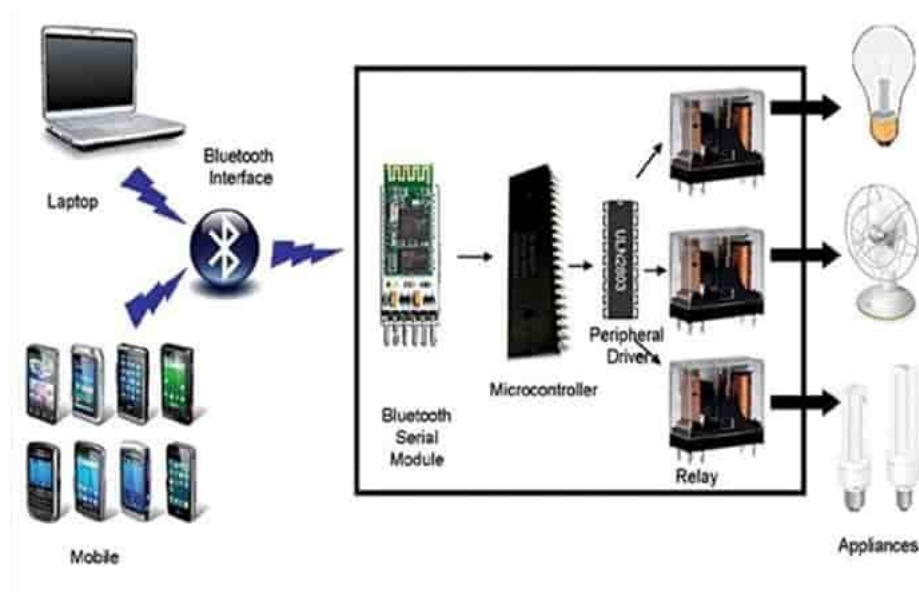


Figure 1: An example of home automation system.

## Advantages

In the present day home automation has becoming essential for the purpose of improving life style.

Home automation offers a futuristic way of life in which an individual gets to control the entire house using a smart phone, from turning on a TV to locking or unlocking doors. It

also offers an efficient use of energy. Automation system also allows us to control the home appliances and keep an eye on the house from a distance.

It is beneficial to the grandparents who usually stay at home alone. It is also very helpful for the handicap to look after the home and easy to inform if there is any trouble in the house.

# Literature Review

Home automation or smart homes can be described as introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants.

There are many other projects done on home automation in different countries. They are all different from each other in designs; features, devices, elements and algorithm. They were designed according to specific needs and availability of components in the respective areas. Some of them are cheap; some of them are very expensive. Availability of both hardware and software is necessary to work. After a long searching, we have found a lot of articles. Searching for security purpose articles, we also found some projects done for garage security. These are mainly done in western countries. Many projects are done only for security purpose with Arduino or Raspberry Pi. Again, the projects are done only for controlling home appliances using Arduino or Raspberry Pi.

There are few projects on Fingerprint recognition module for strong home security issues. One of the projects used biometric method for next generation E-passport. The e-passport, as it is sometimes called, represents a bold initiative in the deployment of two new technologies: Radio-Frequency Identification (RFID) and biometrics.

Furthermore, there are projects done on fingerprint recognition module describing the methods how to identify the fingerprints. A wide variety of systems requires reliable personal recognition schemes to either confirm or determine the identity of an individual requesting their services. The purpose of such schemes is to ensure that the rendered services are accessed only by a legitimate user and no one else. Those papers didn't mention about how to use it for home security using any kind of microcontrollers.

Face recognition is another excellent and smart way that serves security purpose. We have found projects for door security using face recognition using Raspberry Pi. We avoided this part for the security purpose because error occurs more in face recognition than fingerprint recognition. Fingerprint has high accuracy. They didn't explicitly mention about the security purpose or Raspberry Pi. They have only mentioned about the techniques of recognition. Different people have described the procedure of recognition in different ways. Basically all of them have tried to minimize errors for computer to recognize face.

Three researchers of Malaysia proposed a web-based indoor air quality system with GSM and Arduino. The system consists of gas sensor, temperature and humidity sensor, particle dust sensor and wireless sensor network (WSN) node as a wireless transmitter. A desktop computer acts as the base station.

According to Chen Shih-Chung, the systems proposed by him is designed that can be easily be adapted for various applications such as control of machines in machining industries, automotive industry, navigating mobile wireless nodes, automating offices etc.

There are few home automation systems that use ZigBee or Bluetooth for the wireless connection. With the help of Wi-Fi and due to the introduction of IPv6 the connection of almost unlimited number of embedded devices is possible.

Isa Elina and Sklavos Nicolas proposed cameras and sensors inputs based system operates on different levels of user's access control, based on passwords policies. The system works through SMS communication via the available GSM network.

Al-Ali and Al-Rousan presented a design and implemented Java-based automation system through World Wide Web. It has got a standalone embedded system board integrated into a PC-based server at home.

Andrew, the writer of the book "Raspberry Pi Home Automation with Arduino", introduced Raspberry Pi and hoe to use it for home automation. He described the use of Raspberry Pi with Arduino for Linux operating system. The book describes some home appliances automatic control. First he described how to install all the necessary equipment and all required conditions. Firstly, he gave the history of Arduino and Raspberry Pi with all sockets, required shield specifications and all necessary ports with power supply. We were able to find necessary data of Arduino since were used it. Good examples of thermometer, opening and closing of curtain based on light and temperature data are given. On the other hand, he didn't show any example related to security of home.

Annan Zhu, Peijie Lin and Shuying Cheng of Fuzhou University of China described the remote control system of home appliances using android phone through GSM network (2012 International Conference on Control Engineering and Communication Technology). They focused on the design of Android terminal, the communication between ARM and GSM module. Minimizing the difficulty in supplying the appropriate low-voltage DC for MCU and wireless module by a single live wire was also one of the tasks. Here we have found only the controlling of appliances using android, nothing more than that.

An article of Singapore by the authors Thomas Gonnot, Won-Jae Yi, Ehsan Monsef and Jafar Saniie showed a protocol standard for home automation system called Home Automation Device Protocol (HADP). Wi-Fi, Bluetooth 4.2, ZigBee IP, 6LoWPAN, IEEE 802.15.4 standards, and Ethernet network layer supporting IPv6 protocol were their components. Mainly they proposed a protocol if-this-then-that. So it connected many devices together using WIFI connection.

K. M. Abubeker, Jose J Edathala, Shinto Sebastian from India introduced PIR sensors and an intelligent power saving mode in ATM counter. This uses pyro-electric infrared sensors to detect pedestrians and the ATM users. The system is controlled by the real time clock RTC DS 1307 to differentiate the day and night time with a surveillance video. This gives an excellent security to the ATM counter.



According to an article by Suresh, J. Bhavya, S. Sakshi, using PIR sensor with Arduino Mega is a cheap and effective security system that can inform about an intruder through text message. In India, people largely rely on personal security guard for home security. Same goes for India. They made this easier and cheaper than costly surveillance video cameras.

Again, there is another article to prevent theft in home by P. Satya Ravi Teja, V. Kushal, A. SaiSrikar titled “Photosensitive security system for theft detection and control using GSM technology”. They did it using LDR (Light Dependent Resistor) based sensor which acts as an electronic eye for detecting the theft or attempt, and a signaling procedure based on SMS using GSM (Global Systems for Mobile communications) technology. It is also quite cheap.

These are the few previous researches done on similar topic. It is mentioned earlier that most of them lack either the security system or the controlling system. We avoided the face recognition system for home security because people are trying to minimize a lot of error in recognition of face. The face has to be at a particular angle so that the computer is able to recognize. Therefore fingerprint recognition module is more reliable for door security. Some of these projects are done with Arduino, some of them are done with Raspberry Pi. The components, like sensors and shields are also of different models. Our aim is to combine those systems together i.e. controlling home appliances and security system with Arduino keeping it as cheap as possible.

# Brief introduction of all the components

## Introduction

To begin with the project, let's get the idea of all the components that we used for the project. It is very important to know all the information about both hardware and software specifications. The components we are using are as follows:

- Arduino Uno R3
- Raspberry Pi 3B+
- Bluetooth Module HC-05
- Relay Module
- Fingerprint Recognition Module R307

## Arduino UNO -

Arduino Uno is a microcontroller board based on ATmega328. The Arduino Uno MCU will handle the matching process of the fingerprint data, data transfer from the camera to the server and send signals to change the state of the door lock (locked or unlocked).



Figure 2: Arduino UNO

Operating Voltage	5V
Input Voltage	7-12V
DC Current I/O Pin	40 mA
DC Current 3.3V Pin	50 mA
Analog Input Pins	6
Power	USB Connection or External
Digital I/O Pins	14
Memory	32KB of flash memory, 2KB of SRAM, 1KB of EEPROM
Clock Speed	16 MHz

Table 1: Specifications of Arduino UNO

## Specifications

### Raspberry Pi -

Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools and in developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring, because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of HDMI and USB devices.

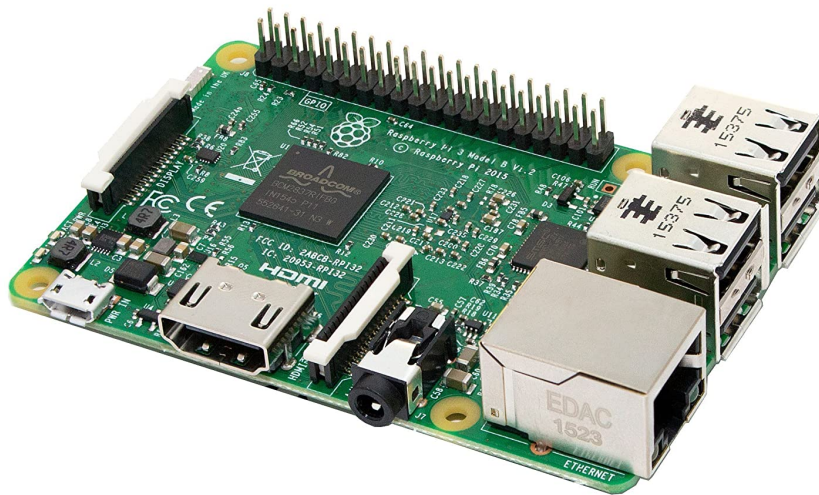


Figure 3: Raspberry Pi

## Specifications

Architecture	ARMv8-A
CPU	1.4 GHz ARM Cortex-A53
Cores	4
SoC	Broadcom BCM2837B0
GPU	Broadcom VideoCore IV HD 1080p
Memory RAM	1 GB
Operating System	Linux based

Table 2: Specifications of Raspberry Pi 3B+

## Optical Fingerprint Scanner -

This finger-print sensor have two basic functions:

1. Capture the image of fingers.
2. Determine whether the pattern of ridges and valleys in the image matches the pattern of ridges and valley in the pre-scanned images or save the new pattern if it is detected as a new finger (only if the user knows the password to save his fingerprint). When the user place

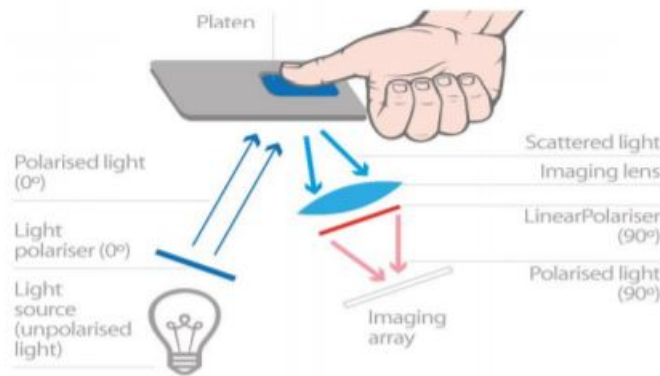


Figure 4: Optical Fingerprint Scanner

fingers on a glass plate, the CCD camera takes the picture. CCD (Charge Couple Device) is an array of light – sensitive diodes (photosites) which generates the inverted image of the finger (darker areas represent ridges of the finger – more reflected light and lighter areas represent valleys between the ridges – less reflected light). Each photosite records a pixel and collectively, the pixels form an image of the user's fingerprints. Then, the A/D (Analog to Digital) converter converts the images from analog to digital signal and with this, they compare the results with the one being saved before. Users can store the fingerprint data in the fingerprint sensor database and configure it in 1:1 or 1:N mode to identify the users.

## Specifications

Dimension	55x32x21.5mm
FS type	Optical
Sensor life	100 Million times
Interface	USB1.1/UART(TTL Logic Level)
Storage Capacity	250
Voltage	3.6-6 VDC
Working Current	Working Current
Verification Speed	0.3 sec
Scanning Speed	0.5 sec
Resolution	500 DPI (dots per inch)
Matching Method	1:N

Table 3: Specifications of R307

## Mechanical Lock -

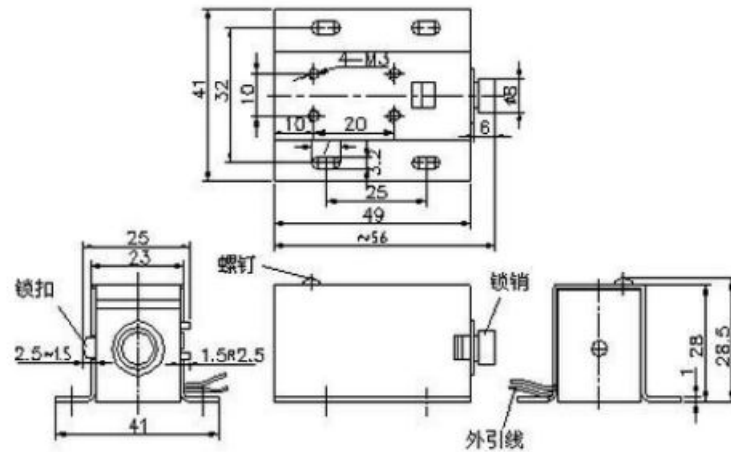


Figure 5: Schematic of the solenoid lock

Procedures in building the PCB:

1. Understand the legs of TIP120 transistor. When the transistors labelled side is facing up the legs, from left to right is B, C, E : Base, Collector, Emitter.
2. Connect the output pin of Arduino to the base leg of transistor through 1k $\Omega$  resistor.
3. Connect the collector leg of transistor to the ground leg of the solenoid.
4. Connect the emitter leg of transistor to the ground channel of circuit.
5. Diode is polarized and therefore, should be oriented white/silver stripe on the power channel side of the connection. It will connect with the power channel to the solenoid-ground-leg/transistor-collector-leg to prevent the voltage from damaging the circuit.

## Bluetooth module (HC-05) -

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 serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue-core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).



Figure 6: Bluetooth Module(HC-05)

## Specifications

Sensitivity	80dBm (typical)
Transmit power	upto +4dBm
I/O operations	1.8V to 3.6V
Default Baud rate	38400 Data bits

Table 4: Specifications of Bluetooth Module HC-05

Pin connections are given below

<b>Arduino Pins</b>	<b>Bluetooth Pins</b>
RX (PIN 0)	TX
TX (PIN 1)	RX
RX	V <sub>cc</sub>
GND	GND

Table 5: Pin Configuration of Bluetooth Module

# Methodology

## Introduction

According to the proposed system, we have designed the system structure shown in the block diagram. We have designed the model in such a way that it can be kept at a safe place inside the house. All programming and components installation are done and tested inside the laboratory and in home. There are a lot of components and wires that we have used for the system. This is done in the easiest and lowest cost possible. However, the system is flexible and can be customized by the user. Changing one of the components setup has to be compatible with the right software available. Every components used in this system was programmed and tested separately for safety measures and matching with the right driver. Each component was programmed separately with both Arduino Mega and Arduino UNO using different Arduino IDE. Also they were run in different computers. Later on all were combined in a single Arduino IDE. It is not possible to run the system without the Wi-Fi and computer.

## Hardware Architecture and Implementation

Components can be divided into two categories: sensors and modules. All of them are described below:

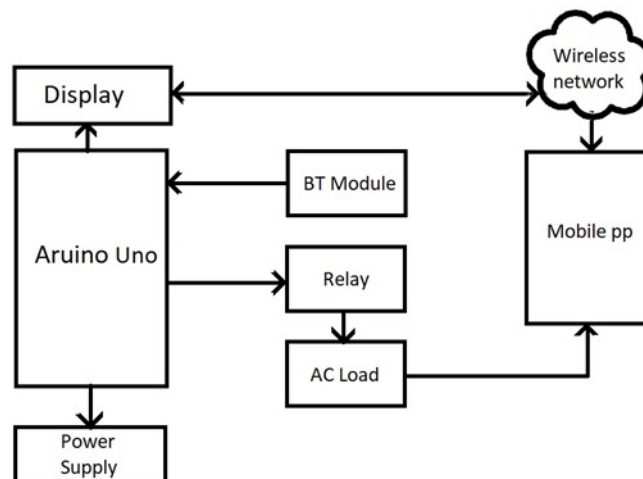


Figure 7: System Block Diagram



## Modules

### Bluetooth Module HC-05

Bluetooth module plays a very important role in interfacing the home appliances with the Android phone but it has only four pins for connection.

### 4-channel Relay Module

All the components are with the relay. The relay is on after all the sensors and modules are high. In case of door unlocking, when the fingerprint matches the relay is on and the door opens by Solenoid Lock.

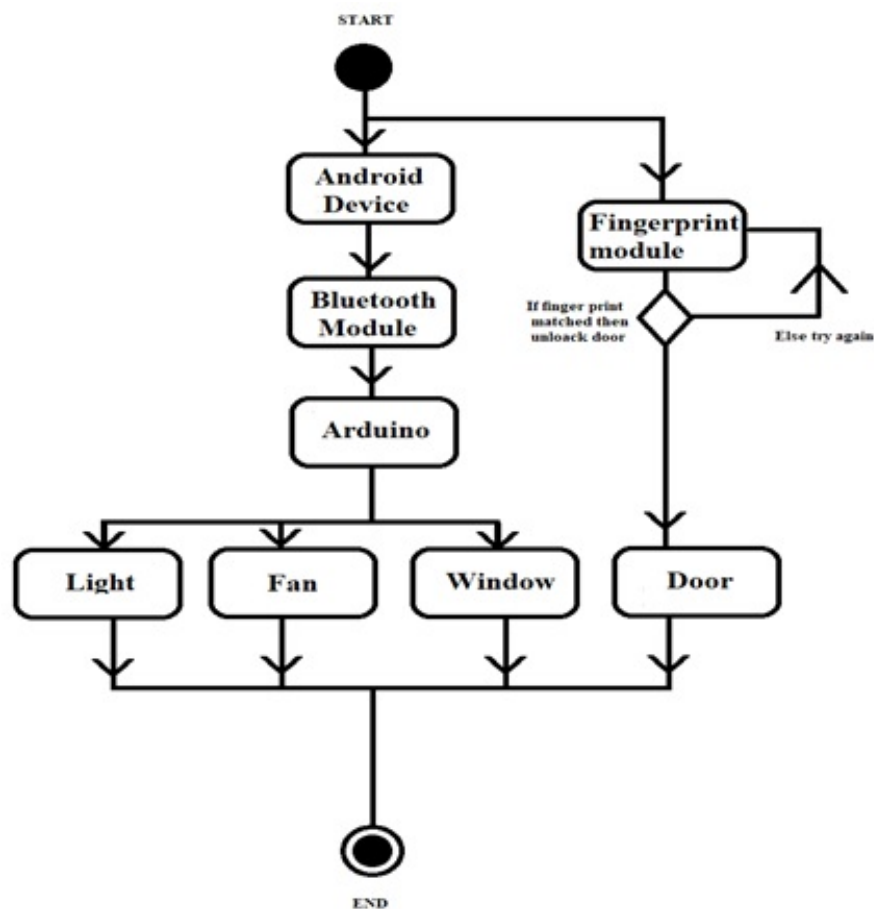


Figure 8: Activity Diagram

## Software Implementation

The software we used is Arduino IDE 1.8.5. All code is written in a single IDE called sketch. All the components are Arduino compatible so we have included respective Arduino Adafruit Library.

## **Bluetooth Module HC-05**

The default baud rate for AT mode is 38400. First we have to manually enter the AT mode. It keeps reading data after entering. The Bluetooth module relays the command and displays it when the command is given in the serial monitor. Determining communication speed we used the function `setup()` in place of `begin()` and `findBaud()`. To send a command to the module the function `cmd()` is used. The key (`cmdPin`) pin is activated to put the module in command mode where 'AT' commands are recognized. The default functions of mode start and end are used for the speed 38400. In our system, we control the home appliances through Android Application via Bluetooth. The Android App interfaces with microcontroller via Bluetooth. Switching of home appliances is its main function. In this system we only give command from the Android to the system. Both the Voice Control Application and Android Application are used to control home appliances. No command is returned through the Bluetooth.

## **4 Channel Relay**

There is no programming for the relay. It is a part of hardware connection only.

## **Fingerprint Recognition Module (R307)**

One of the most important parts of this system is fingerprint recognition module. While designing the home automation system we prioritized the matter of home security and tried to figure out a way to come up with a solution. As we know every human being has unique finger print of his own that deviates from all other and we put that uniqueness to the task. Finger print sensor is already used widely for biometric identification and in our case we used that very same technology to provide security to our home automation project. From other biometrics we have chosen this because it has the highest accuracy level. The sensor that we used is quite easy to get and we mounted the sensor with an Arduino Uno as it is quite flexible to work with. As mentioned earlier, we followed the algorithm that has two steps: enrollment and print matching. The scanner we are using is designed for Arduino and data can be transferred to Android phone. In this scanner the algorithm looks for ridges and lines end of a finger where a ridge splits in two. These distinctive features are called minutiae. Rather than matching the whole fingerprint, matching those minutiae reduces processing time. The first and foremost thing that has to be done is enrollment of finger prints that you want to create a database with. In order to allow the people to enter the home their finger prints must be taken and saved to system memory through enrollment process. For that particular purpose we used an Arduino codes under the same name that is available in the library of the sensor. The sensor itself has internal memory to save up to 256 types of different finger prints that is without having external memory which can even increase the numbers. The user data is kept in the computer hard drive as database.

We have given persons fingerprints for the door to open. The door opens only when the fingerprints of those persons match. 4-5 seconds delay is needed to close the door again. There is a solenoid lock to open and close the door. The following figure portrays the step:

## Android Application

In this system we have the Android application to control all the home appliances. From Android phone we select any home appliance from the options that appear in the App then we select ON or OFF. This can be done only when the user is inside the house. There should be Bluetooth connection for the App. It is related with the Bluetooth module. It allows establishing point-to-point connection with Bluetooth support devices. This technology is known by Android's support for the Bluetooth network stack which permits to exchange data wirelessly.

The Android Software Development Kit (SDK) provides all necessary tools to develop Android Application (API). This application is a Java based program. The Android uses .apk file to install the application. The code is written in Android Studio IDE. All appliances buttons list will appear first. Then the user has to choose an option. Later the action button ON and OFF appears. There are 2 layouts of the code structure, two Class code and user permission code. These are written in Android Studio IDE. The code is written according to the appearance of the options in the phone.

## AI Chat Bot

The AI chat bot is a sort of proof of concept that will demonstrate the possibility to remote control sensors and actuators (for example a couple of relays) via Telegram.

Telegram is an instant messaging application, similar to the famous Whatsapp. Last June, the Telegram developers announced that a new set of APIs were available to develop bots. My idea was to develop a bot, running on my Raspberry Pi, that receives commands via Telegram chats. I connected to the Raspberry a solenoid lock and a module with two relays.

The user, through the Telegram app installed on his smartphone, starts a chat with the "bot" account; the messages are delivered to the Telegram servers.

The first step in developing your own bot, is to create it in Telegram. You create new bots or configure existing ones sending the right commands to a "built-in" bot, the BotFather: Start the process to create a new bot sending to the BotFather the command /newbot. You'll be prompted for the name (display name) of your new bot and for its username. If the process is successful, you'll receive an authorization token, that is the "password" you must specify in your program to "impersonate" the bot.

# Result

After connecting and programming all the components with the, we conducted the experiment. We have run all the components according to the proposed system. All modules and microcontroller are kept together with a lot of wires. This part is the main centre of the home automation system. All commands are given from Android App and Telegram App.

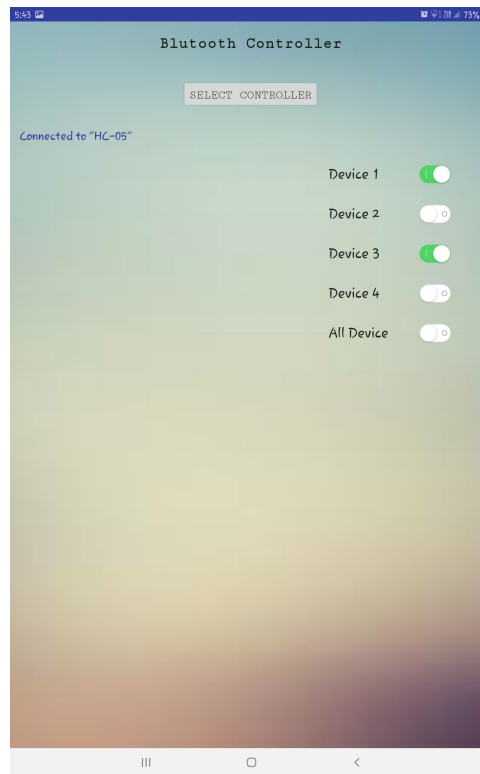


Figure 9: Android Application Screen 1

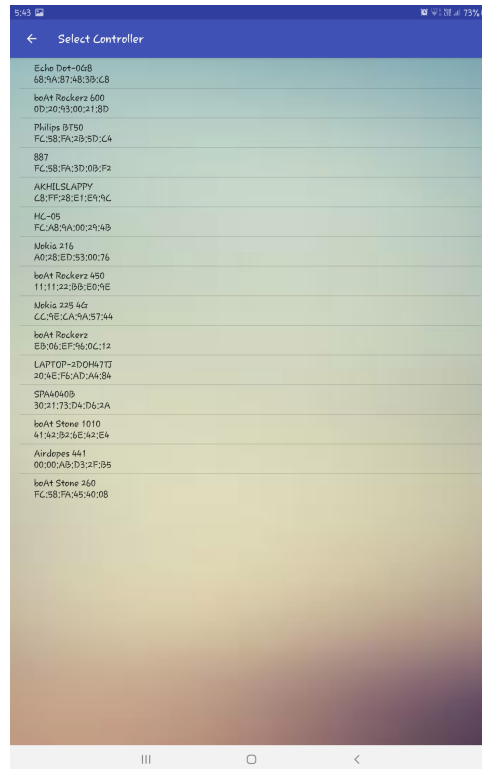


Figure 10: Android Application Screen 2

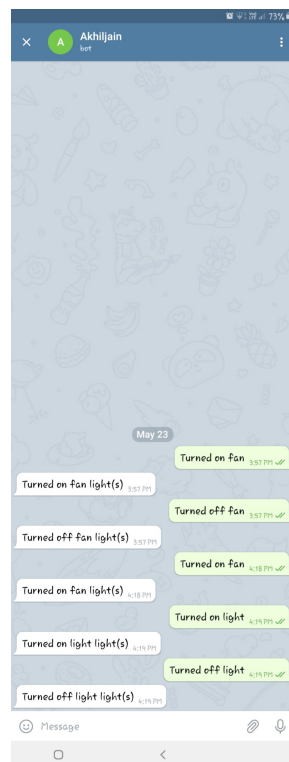


Figure 11: Telegram Chat Bot Screen

# Conclusions and Future Scope

## Discussion

From the project carried out, we find the system effectively low cost and user friendly. The whole house remains under the user's control all the time. In future we may find some devices that are more reliable, faster and cheaper. We have tried to make a good controlling and security system. The components that we have used can be changed with the latest device but it should have the right software and the right driver.

All the tasks of this project are done successfully. We were able to fulfill our goals as proposed in this system. We had our limitations in time and expenses but we hope that it will serve as basis of other latest AI systems as that of western countries.

Almost all scientific and latest technologies have both good and bad sides. That doesn't mean we should avoid technology. This type of work inspires us to do better for our country. Smart Technology is a blessing for our country. We should try to avoid the bad consequences and use it for our betterment.

## Limitations

There are some limitations observed throughout our project. Since our project is internet based, our home appliances are totally controlled through internet access. As we control the whole system through internet, we need to confirm high speed of internet. Otherwise, the system delay will occur as Ethernet shield will not be working as a network provider to the circuit.

The project relies on power supply. So if the power supply fails, the internet connection will be halted. Then database access will be stopped. For this, without security system the whole system will not be worked. In our project, security system is powered by another power source for security safety.

Though it needs less circuitry but its cost is not in minimal range. To get facility, users need to expense for this. The cost of installing a home automation system can be to a certain extent expensive. But it depends on the apparatus. The more sophisticated the system is the more expensive it will be.

This real time server base system is limited to only one person which means only one person can operate the system at a time.

If there is any break due to rupturing of cables or the fibers then the total system will be crashed. So, this will not be the case of radio signals or the other signals. There will be a difficulty of receiving signal.

If the individual does not handle the equipment safely or make use of the exact key to carry out the operations, human error can occur. Human faults also direct to the destructions of the device. Then there will be system collides.

Home automation has numerous drawbacks. For having home automated system, people will be lazier. That ultimately might end up with making great harm in human social and professional life.

In exceptionally uncommon cases, the unwavering quality of the home computerized gadgets fluctuates (decreases). It depends generally on the innovation utilized and the progressions being finished.

## **Future Scope**

As we have mentioned earlier this thesis is not a complete project. This is just a basic structure of another complete system. We have done all the basic necessities of a typical house. The tasks that we have done are not the only tasks the components are able to do. There are a lot of other scopes for this project.

More appliances can be added in this system with a powerful relay module. Garage automatic door system can be added for extra security. All available smart devices can interface with this system including a car.

DS1307 Real Time Clock module is a very important device. This project could have a cloud database to save all the data. Readings from all the sensors with date and time can be saved.

Room air purifier can be added to this system to make it more efficient. We can add a surveillance camera outside the house for extra security.

Solar power system can make this system extra cheap and durable. Then the system can run with the solar power.

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# Appendices

## Keywords

Home automation, fingerprint recognition, Bluetooth, GSM, Google Voice App, sensors, microcontrollers, power consumption, home appliances, security system.

## Abbreviation

AI - Artificial Intelligence

AI - Artificial Intelligence

GPRS – General Pack Radio Service

LCD - Liquid Crystal Display

LDR - Light Dependent Resistor

LDR - Light Dependent Resistor

PIR - Passive Infrared Sensor

RFID - Radio Frequency Identification

IP - Internet Protocol

ARM – Advanced RISC Machines

RISC – Reduced Instruction Set Computer

PAN – Personal Area Network

UART – Universal Asynchronous Receiver-Transmitter

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