

## **AN INNOVATIVE HOME AUTOMATION SYSTEM USING ARDUINO AND BLUETOOTH MODULE**

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### **Abstract**

Home Automation System plays an important role in our daily life. Nowadays people are looking forward to control the home appliances through remote control. The main objective of this research paper is to create and design a home automation system (HAS) using Android with Bluetooth module. In general, Home Automation System provides a simple as well as reliable technology with Android application. On the other hand, it can be controlled the appliances using a smartphone from a remote location. A simple Home Automation System can be designed and constructed using simple components such as an Arduino Uno, Bluetooth module, 8 channel relay module and smartphone. Bluetooth module and Arduino Uno application are remotely and mutually applied for controlling the system. Home appliances like fan, bulb, AC, automatic door lock is controlled by home automation system using Arduino Uno with Bluetooth module. The program for this system is written in C language and upload into the memory of the microcontroller on Arduino board by Arduino Uno window software. The operations of the whole circuit are controlled by the program. The circuit presented in this research is designed and created to control the three electrical devices to turn on or turn off appliances remotely i.e using a smartphone.

**Keywords:** Home Automation Systems; Arduino; Bluetooth; Smartphone; Relay module

### **Introduction**

At the present time, people who are using a smartphone with Arduino Uno and need to control everything from smart phone based on home automation system (Figure 1). Likewise, everyone understands how to control mobile phone thus it is easy to comprehend and use. Currently, the designing of home automation is going to develop simpler and more popular because most of people use smart phone. There has been a significant development in the area of an individual's routine tasks and those can be automated. In the present times, we can find most of the people clinging to their mobile phones and smart devices throughout the day.



**Figure 1** Home Automation System

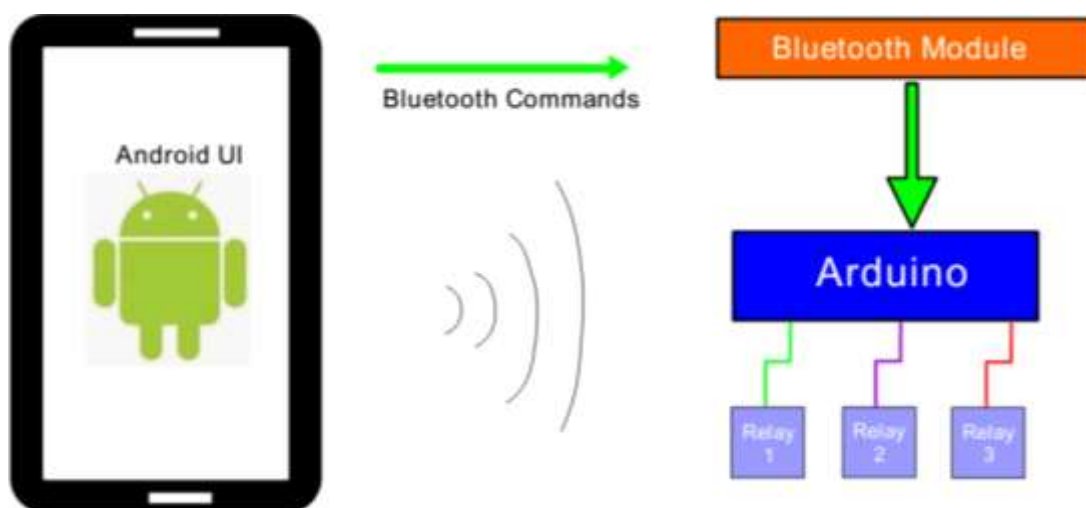
In this device we are using Arduino which is most commonly applied device for automation. Accordingly, Arduino is a hardware which is used to connect computer and the project model thus we can control it by using Arduino code. Arduino Uno is an open-source electronics

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platform based on easy-to-use hardware and software. It is used for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Generally, Arduino is a tiny computer system that can be programmed with the instructions to interact with various forms of input and output. Arduino is connected with the Bluetooth module which receives the information from user. Arduino also connected relay, which receives information from Arduino and perform the operation as switch. Bluetooth technology is Wireless radio transmissions in a short distance providing a necessary technology to create intelligence and controllability (Bharanialankar and Manikanda Babu., 2014). This generates personal area network in home environment, where all these appliances can be interconnected and monitored applying a microcontroller with Arduino using smart phone.

The main process of this system is intended to study the method of application of the wireless communication between Arduino as well as Bluetooth module HC-06 and Android mobile phone (Figure 2). Arduino Uno is used in this system to control Bluetooth module and relay module. Home Automation System contains a degree of computerized or automatic control to certain electrical and electronic systems in a building. In this regard, home automation provides a better solution. The device incorporated not only consumes less power but also saves energy in home automation system. Therefore, home automation technology is so far environmentally suitable. The comfort and security of houses and offices have been developed in home automation system.



**Figure 2** Home Automation System using android mobile phone

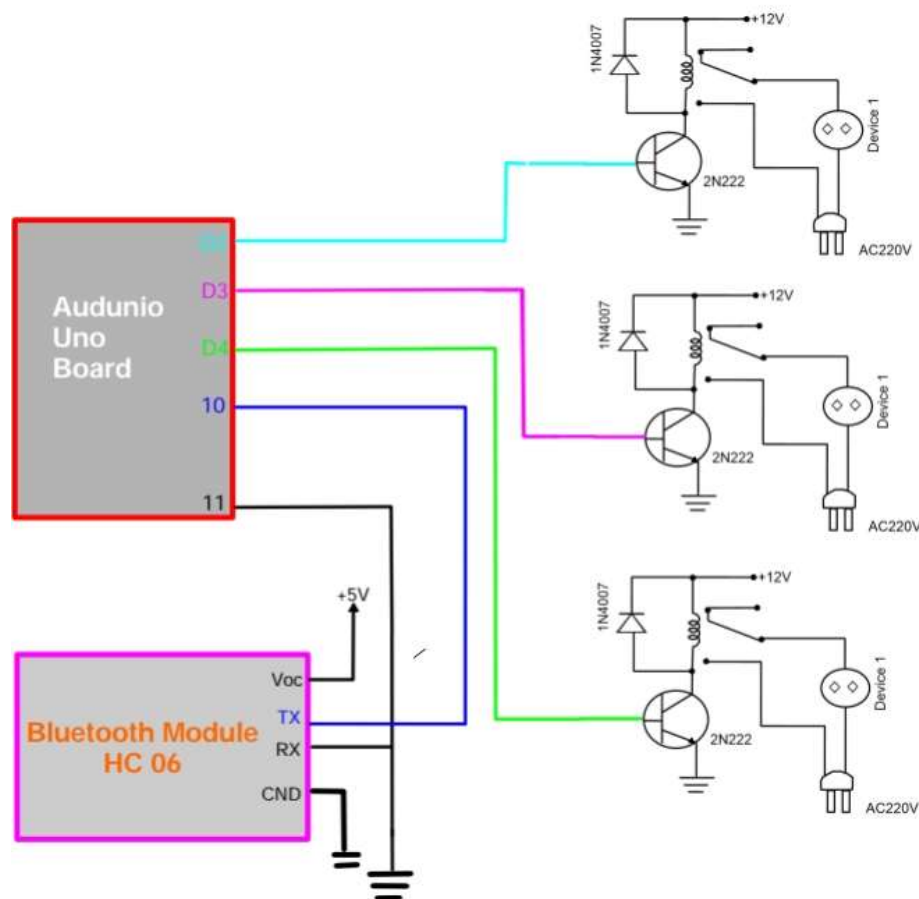
### Objectives of Research

The principal objectives of the current research are:

- To create and design a Home Automation System (HAS) using Android with Bluetooth Module
- To control different home appliances using a smartphone
- To design and implement a low cost, reliable and scalable home automation system that can be used to remotely switch on or off any commercial/household appliance
- To update and consideration in latest technology and make cost effective, power efficient, safely operating system

## Methodology

Home automation represents a system of networked, controllable device that work all together to make your home more comfortable, customized, efficient and secure. In this device, there are four principal parts including Arduino Uno, Bluetooth module, Relay drivers, and android smart phone application respectively. The aim of this system is to control different home appliances using a smartphone. This system needs to download and install the Bluetooth serial controller application into Android Phone from the Play Store and then pair it with Bluetooth Module. The android application software for this system can be downloaded from the Google. After the application is installed on android mobile phone, it is ready to use Bluetooth control system. TX and RX pins of the Bluetooth module can be connected to RX and TX pins of the Arduino (Figure 3). When connecting RX of Bluetooth to TX of Arduino (or any microcontroller as a matter of fact), it needs to be careful as the pin can tolerate only 3.3V. The voltage from TX or Arduino will be 5V. When the power is turned on, the connection LED on the Bluetooth module starts blinking. If the pairing is successful, the LED becomes stable. Now, in the application, the different keys are set for different loads and their corresponding value that must be transmitted when that key is pressed. Using this type of connection, it can control i.e. turn on or off different home electrical appliances using the smartphones. It can be used to control home electrical appliance remotely by Bluetooth communication. An electrical home automation system has been developed demonstrating the use of Arduino Uno board and wireless Bluetooth communication (ElShafee and Hamed., 2012).

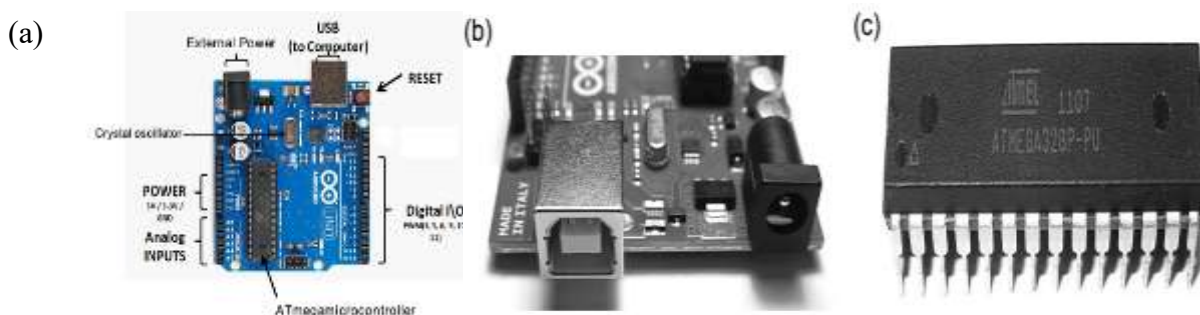


**Figure 3** Complete circuit diagram of the whole system

## Tools and Technology

### Arduino Uno Microcontroller

Arduino Uno is a microcontroller board based on the Atmega328(datasheet). It possesses 14 digital input/output pins in which 6 analog inputs, a 16 MHz quartz crystal, a USB connection, an ICSP (In- Circuit Serial Programmer) header, a power jack and a reset button respectively (Figure 4a). In general, it is required to assist and support the microcontroller that connect to a computer with a USB cable or power it with an AC-to-DC adapter or battery to obtain started (Bharanialankar and Manikanda Babu., 2014). The Arduino Uno can also be powered as well as the USB connection or with an external power supply is also displayed in (Figure 4b). It can be operated on an external supply of 6 to 20 volts. If it is supplied with less than 7V or 5V, it will be unstable. If it is used more than 12V, the voltage regulator will overheat and damage the board. The recommended range is 7 to 12 volts. On the other hand, the chip near the power connector is the heart of the board. It is a tiny computer that contains a processor to execute instructions which includes various types of memory to control data and instructions from our sketches. The ATmega328 has 32 KB as well as 2 kB of RAM and 1 kB of EEPROM (Figure 4c).



**Figure 4** (a) Components of Arduino, (b) USB and power connectors, (c) ATMEGA328P-PU microcontroller

### Features of the Arduino Uno

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 kB used by bootloader
- SRAM: 2 kB (ATmega328)
- EEPROM: 1 kB (ATmega328)
- Clock Speed: 16 MHz

### Bluetooth Module HC 06

Bluetooth receives the information from user and lead to the microcontroller (Arduino Uno). It is a wireless technology standard that is applied for exchange data over short distances using short-wavelength radio transmission. It was designed primarily as a cable replacement

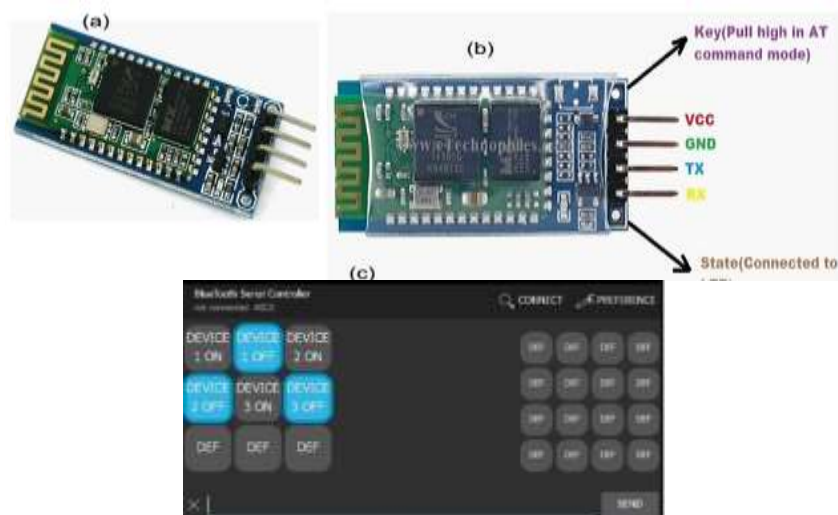
technology for consumer electronic devices and data communication that applies short-range radio links (Ericsson, 2000). The module works on Bluetooth 2.0 communication protocol and it can only act as a slave device. This is the cheapest method for wireless data transmission and more flexible compared to other methods and it even can transmit files at speed up to 2.1Mb/s. HC-06 uses frequency hopping spread spectrum technique (FHSS) to avoid interference with other devices and to have full duplex transmission (Rajeev Piyare and Tazil M., 2011). The device works on the frequency range from 2.402 GHz to 2.480GHz. In this module have six (or four) leads but it will genuinely care about only four of them. Where, the two are V<sub>CC</sub> and GND. V<sub>CC</sub>= Power Supply (in other words 5V or 3.3V) GND= Ground (in other words 0 volt) (Figure 5). And the next two leads are for RX (Receiving End) and TX (Transmitting End). On the basic of idea, the RX of the module will go to the TX of the Arduino Uno. In the same way, the TX of the module can be connected with the RX of the Arduino Uno.

### Features

HC-06 is good option when short distance wireless communication is needed. The module is used for wireless communications of less than 100 meters. The module is very easy to interface and to communicate. The module is one of the cheapest solutions for wireless communication of all types present in the market. The module consumes very less power to function and can be used on battery operated mobile systems. The module can be interfaced with almost all controllers or processors as it uses UART interface.

### Specifications

- Bluetooth protocol: Bluetooth V2.0 protocol standard
- Power Level: Class2(+6dBm)
- Band: 2.40GHz—2.48GHz, ISM Band
- Receiver sensitivity: -85dBm
- USB protocol: USB v1.1/2.0
- Modulation mode: Gauss frequency Shift Keying
- Safety feature: Authentication and encryption
- Operating voltage range: +3.3V to +6V
- Operating temperature range: -20°C to +55°C
- Operating Current: 40mA



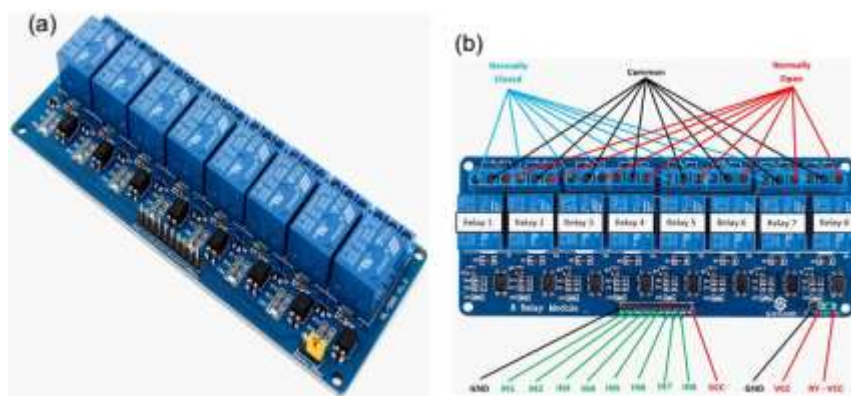
**Figure 5** Bluetooth module HC 06



### Eight (8) Channel Relay Module

In this research paper, 8 Channel Relay Module is applied for controlling the load like on/off operation (Chandra et al., 2016). The 8 Channel Relay Module is a convenient board and contains eight 5V relays. It can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load (Figure 6). The module is associated with switching and isolating components, which makes interfacing with a microcontroller or sensor easy with minimum components and connections. This is useful in creating a central hub from where multiple remote loads can be powered, which is useful for tasks like home automation where the module can be placed in the main switchboard and can be connected to loads in other parts of the house and can be controlled from a central location using a microcontroller (Pooja et al., 2016). The 8 Channel Relay Module can be used to switch multiple loads at the same time since there are eight relays on the same module (Figure 6). Each relay on the board has the same circuit and the input ground is common to all eight channels.

The eight relays on the module are rated for 5V, which means the relay is activated when there is approximately 5V across the coil. The contacts on each relay are specified for 250 VAC and 30 VDC and 10A in each case, as marked on the body of the relays. The switching transistors act as a buffer between the relay coils that require high currents, and the inputs which do not draw much current. They amplify the input signal so that they can drive the coils to activate the relays. The freewheeling diodes prevent voltage spikes across the transistors when the relay is turned off since the coils are an inductive load. The indicator LEDs glow when the coil of the respective relay is energized, indicating that the relay is active. Eight separate loads (represented by light bulbs) have been connected to the NO terminals of the relay. The live wire has been connected to the common terminal of each relay. When the relays are activated, the load is connected to the live wire and is powered. This setup can be reversed by connecting the load to the NC terminal, which will keep it powered on till the relay is activated.



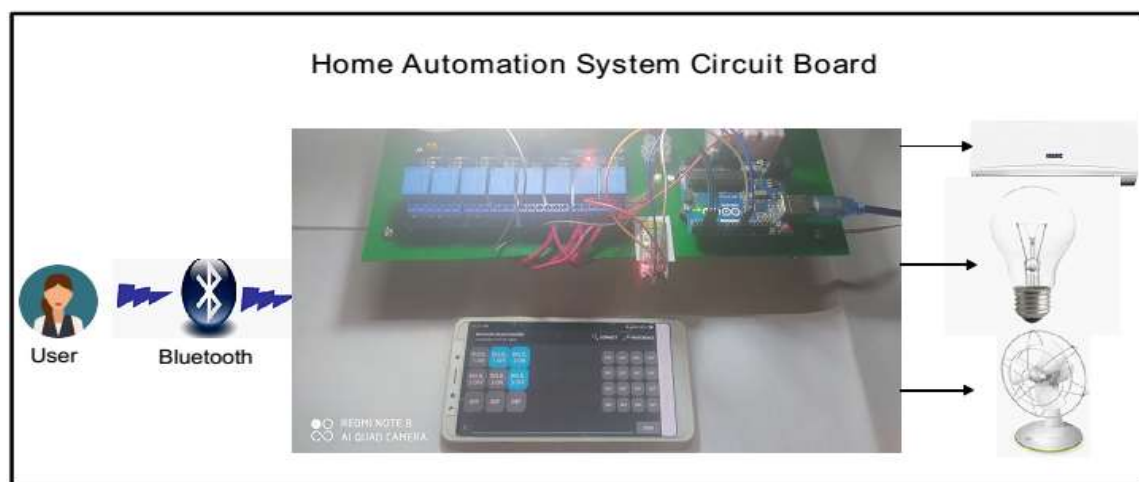
**Figure 6** (a) Eight channel Relay Module, (b) Eight (8) Channel Relay Module Pinout

### Eight (8) Channel Relay Module Specifications

- Supply voltage – 3.75V to 6V
- Trigger current – 5mA
- Current when relay is active - ~70mA (single), ~600mA (all eight)
- Relay maximum contact voltage – 250VAC, 30VDC
- Relay maximum current – 10A

## Results and Discussion

Home Automation System Circuit Board (HASCB) consists mainly of an Arduino-Uno board, a Bluetooth module, an Android phone, eight (8) channel relay module, home appliances and an android Application. It is user friendly and it is cost effective. Through this research project, home automation system circuit board has been created to be easily controlled home appliances like as fan, tube light, air conditioner, bulb, etc. Bluetooth and Android application are recognized to develop and create a smart home in this article. In general, modern houses are expected to have centralized control system, instead of conventional switches which are fitted on walls. Managed to be successfully this research using mobile technology for controlling various electrical home appliances ON and OFF. On the other hand, we have provided information about Arduino Uno, Bluetooth controller and relay module. Final outcome of the research project is given below in Figure 7.



**Figure 7** Home Automation System Circuit Board

## Advantages of Research

Home Automation System is greatly sensitive system. This system works with any mobile phone from anywhere. This system is of low cost and having reliable arrangement. Home Automation System is durable and efficient. It works on arduino based system so we can easily understand how it works. It saves our time. Every home appliance can control by using android application based on the home automation system. Home automation system is widely used for the control of home appliances, hotel lights or fans, shops and showrooms appliances and industrial appliances.

## Conclusion

The proposed work has developed a Home Automation System using Bluetooth, Android and Arduino. This is a cost-effective, low maintenance and user-friendly automation system to assist and support for the elderly and differently skilled people. Main motive of this paper is to have a centralized control system to operate the appliances through an Android phone. It also saves the time for operating appliances to the consumers. The appliances in the home can be controlled and its status (ON or OFF condition) can be monitored from a remote location. The idea proposed in this research paper can also be extended for the automation of industries, malls and hospitals. Moreover, the requirement of this research paper is to create a device which saves the electricity and improve human life style.

## Acknowledgements

The author would like to acknowledge Rector Dr Khin Thidar, Rector of West Yangon University for giving me the opportunity to submit this manuscript to the Arts and Science Research Journal (MAAS) 2022 Conference. I am also indebted to my supervisor, Dr Win Win Thein (Retired), Professor and Head of Physics Department, Hinthada University, for her valuable guidance, suggestions, and insight from the initial to reach the final goal of this research. Finally, I would like to express sincere thanks to Dr Maung Maung Shwe, Professor and Head of Physics Department, West Yangon University for his permission to carry out this research and to submit this manuscript to the conference.

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