

Bluetooth Based Automation System Using Android App

Jolan Baccay Sy¹, Shaik Irfan²

^{1,2} School of Electrical and Computer Engineering, Wollo University, Ethiopia.

^{1,2} E-mail: jolansy_ece2@yahoo.com, smdirfan19@gmail.com

¹ORCID: 0000-0002-4099-6987

Abstract

Automation is a technology of controlling multiple devices at home, office or industry by any technique. Interfacing all devices at home or office and controlling using mobile phones offers enormous convenience especially now mobile phones are very common to everyone. In this paper, Shows one best approach to home automation. The system is designed and implemented through Bluetooth based home automation system using android app and microcontroller Arduino Uno. This study describe about home automation system which would use to ON/OFF home lighting, garage door motor, water pumping motor or any load in home or office by using a smart phone application with Bluetooth wireless technology. The system used different components: an Arduino Uno as processor and for connecting the appliances using relay module as output and Bluetooth module for receiving signal from android smartphone with the Android application to control home appliances. Bluetooth communication technology had operating range atleast ten (10) meters from the receiver and it can controlled from anywhere inside of home. By using smart phone application we can control any household appliances to avoid the dangerous of electric shock and convenience especially to elderly 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, home automation works smartly by providing increased quality of life, and comforts to users.

Photos of the tested prototype, a schematic diagram and pictorial circuit diagram of the control system, and the flowchart on which the Arduino script is developed are shown. The operation and user-interaction of the actual system are also described. Data are also tabulated with the given results. The control system program is written such that the Arduino process the input from Bluetooth to control the entire system.

Keywords: Android Phone, Arduino Uno, Bluetooth Module, Home Automation System

1. INTRODUCTION

We are living in 21st century where automation of any form i.e. home or industrial plays an important role in human life. When it comes to industrial automation, the concept is applied to large machines or robots which helps in increasing the efficiency in terms of production, energy and time.

Home automation on the other hand involves automating the household environment. This is possible because of the smartphones and internet that we are widely using. Home automation can be again divided in to just controlling the appliances using a smartphone from a remote location and another type filled with sensors and actuators which controls the lighting, temperature, door locks, electronic gadgets, electrical appliances etc. using a “Smart” system.[1]

The mobile phones are very common and using mobile device as the key for controlling the home appliances will enhance the affordability and simplicity. Mobile phones with android based operating system are regarded as smart phone this group study on controlling devices using android app and presented a possible application of GSM Bluetooth based home computerization framework which is minimal effort, secure, pervasively available and remotely controlled [2][3][4][5].

They successfully designed, implemented and simulated an IoT based Home Automation System(HMS) enabling full control of all the loads in the system from anywhere in the world, via a public web application, with an internet connection. Home Automation gives us access to control devices in our homes from a mobile device anywhere on Planet Earth. [6], [7].

Everything is automated , from study of Jolan Baccay Sy and group they demonstrated that it is possible to control several independent hand washing stations using a single micro-controller and an appropriately programmed control system.[8], Another study they developed a non-contact automated hand wash with a hand dryer[9], even in irrigation from another study they developed automated Arduino-based smart irrigation system needed less water and less time compared to conventional irrigation system[10] ,A group of researchers developed and automated Non-Contact Temperature and Sanitizer Dispenser Devices to avoid the used of traditional contact thermometer and Handheld device for preventing the spread of SARS-Cov-2 infections[11]

ZigBee Based Home Automation Wireless Sensor Network is another useful project for adults and physically handicapped persons efficiently when they are at home and need one assistant to perform those tasks[12].Another home automation integrating relays to Raspberry pi board for controlling home appliances from a remote location in a real scenario[13]. From a study in IoT for Home Automation System that is accessible from any web browser and that the system could be usable from anywhere on the Internet and therefore from anywhere on the planet[14].Study using micro web server and Bluetooth communication as an interoperable application

layer for communicating between the remote user and the home devices[15].

Home automation are required for energy saving and remote monitoring and control. Raspberry Pi is an intelligent platform using which multiple appliance can be connected to each other and can be controlled from a longer range of distance[16]. Study developed a low cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution using WiFi technology to connects system parts and system is highly reliable and efficient for the aged people and paralyzed person on a wheel chair.[17] [18].

Automation system can be cheaply made from low-cost easily available components and can be used to control various home[19]and focused on home automation using internet of things (IoT) technology to aid flexibility and to improve user experiences[20].

II. METHODOLOGY

The development of the Bluetooth based home automation system using android app used different methodology, Design of Android App using MIT app inventor , Designing for the hardware ,Modeling, Simulation , Hardware Manufacturing(Prototype) , testing and data collection.

2.1 System requirements

The system depicts the highest level design of android app, software script for Arduino ide to hardware. The user can automatically control such as light, appliances, water motor, air-conditioned or any load that is interfaced in the system using the mobile device which the android app is installed.

2.2 Control System Design

Control System Design is illustrated in figure 1.

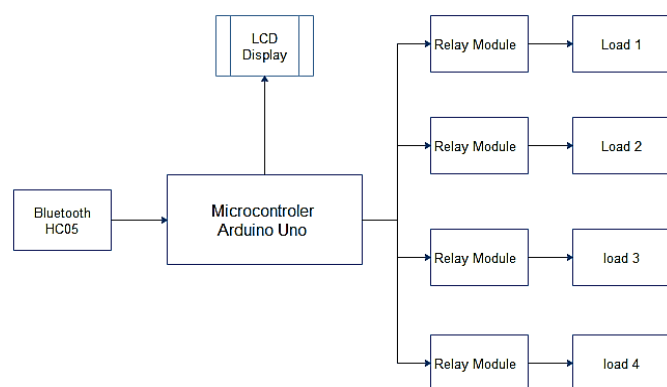


Figure 1: Bluetooth Based Home Automation System Using Android App Schematic Diagram

The Bluetooth module is connected to Arduino UNO. The Bluetooth module(HC05) works on 5V that's is available in microcontroller Arduino uno. Liquid Crystal Display(LCD) is

used to display which device is being on. The single relay module are used to interface different loads.

Flowchart

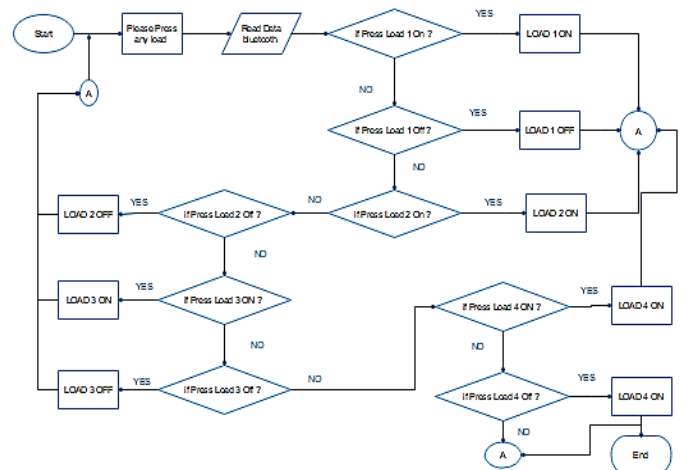


Figure 2: Bluetooth Based Home Automation System Using Android App Flow Char

The loop flow chart shows the steps/procedure for the user, First the user will open the android app that is installed on the mobile and connect to the Bluetooth(HC05) used in the system . When the Bluetooth are connected from android phone to the system , the user can choose which load to switch . There are four(4) load attached in the system and also there are eight choices in the android app for switching ON/OFF.

2.3 Bluetooth Based Home Automation System Using Android App Hardware Prototype Development

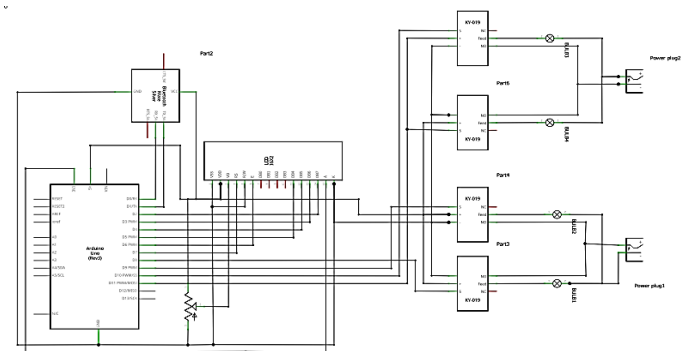


Figure 3: Bluetooth Based Home Automation System Using Android App Schematic Diagram

The schematic diagram shows clearly that the Bluetooth module has 4 – pins: VCC, TX, RX and GND. VCC and GND are connected to 5V and ground from Arduino UNO respectively. The TX and RX pins of the Bluetooth module must be connected to RX and TX pins of the Arduino. LCD is used to display which load are being currently ON and OFF

and each load are drive by the single relay module which is capable of 10A capacity.

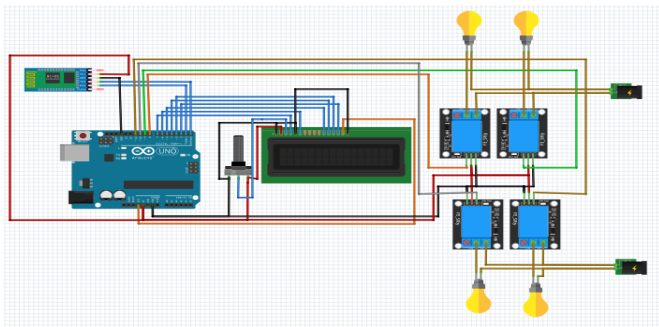


Figure 4: Bluetooth Based Home Automation System Using Android App Pictorial Circuit Diagram

When the power is turned on, LED on the Bluetooth module starts blinking with green indicator light once the Bluetooth Jolan_Home Automation app in our smartphone and get connected to the Bluetooth module, the LED indicator light is red. The Rx/Tx of Arduino will blink once any keys is pressed in the app. Different keys for different loads and their corresponding value are set in Arduino script .

Model Parts List:

- 1 – Arduino Uno
- 1 – Bluetooth Module(HC05)
- 1 – LCD
- 1 –Potentiometer
- 4-Single channel relay module
- 4-Incandecent Lamp (10w)

Hardware Parts

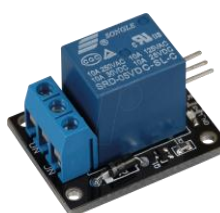
1. Arduino Uno-The microcontroller board based on the Microchip ATmega328P microcontroller that controls the Inputs/output of the smart irrigation system.



2. Bluetooth Module(HC05)- HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. This module used as receiving data from the android app Bluetooth transmitter.



3. Relay Module - The relay module drives (switches ON/OFF) the appliance according to the keypad pressed in the remote control. The relay module is controlled by the microcontroller. It allows a low power 5V circuit to switch a relatively high current on or off for example a bulb connected to the 220V mains supply.



4. Liquid Crystal Display (LCD)- electronic display module used to display either the load is ON or OFF



2.4 System Development , Tests and Data Collection from android app to hardware(Prototype)

The development of Bluetooth based automation model through its final hardware prototype, a series of similar tests are conducted from designing the Android app to interfacing with the hardware.

In figure 5A, the android is design using MIT app inventor , it shows the blocks how to interface Bluetooth and different buttons .

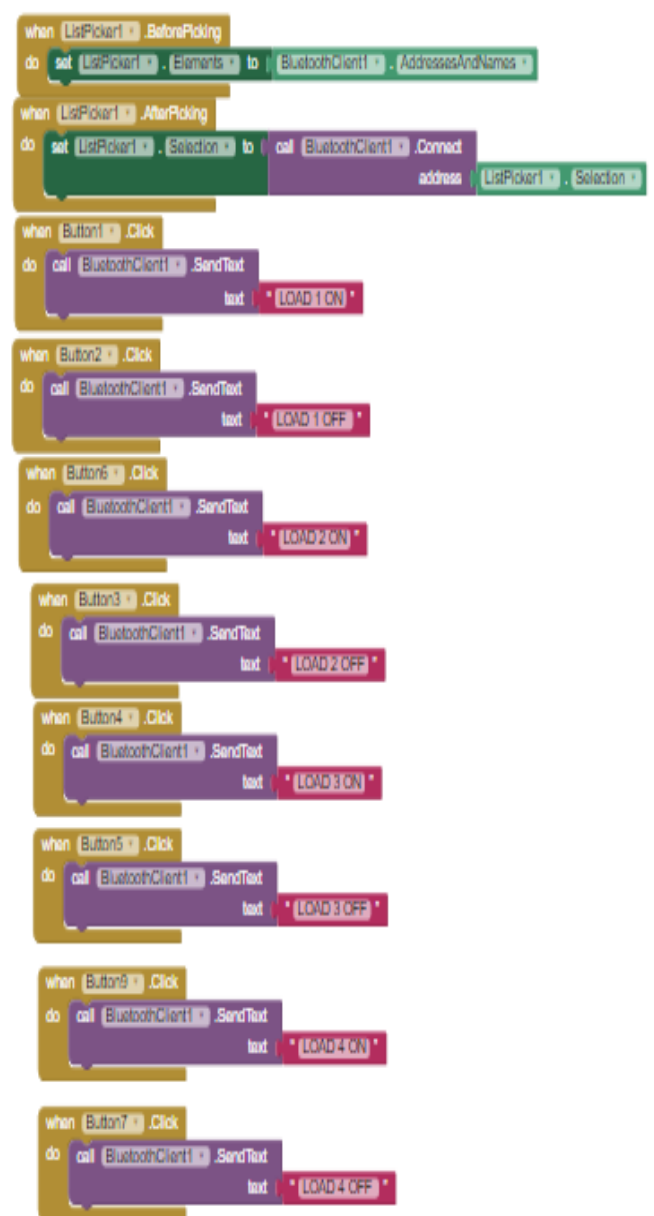


Figure 5A: Android App using MIT app Inventor Blocks equivalent

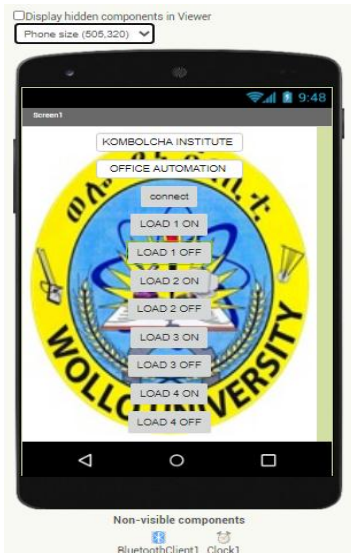


Figure 5B: Android App using MIT app Inventor Created app for home automation system

In figure 6B , The Android App for home automation system . There are 4 loads with 8 buttons for ON/OFF

2. TESTING THE PROTOTYPE

Testing prototype as illustrated in figure 6C and 6D for interfacing the android mobile phone with installed android app and switching the loads.

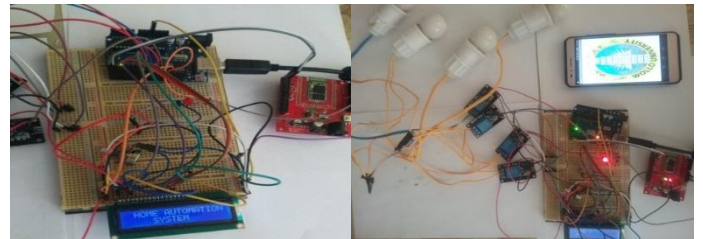


Figure 6C: Prototype upon switching on the system and paired with the android phone.

III. RESULTS AND DISCUSSION

1. Testing the Android App.

Figure 6A shows the list of Bluetooth available that can be interface , the system used HC-05, Select HC -05 to pair .When its Pair the Bluetooth LED Blink RED.

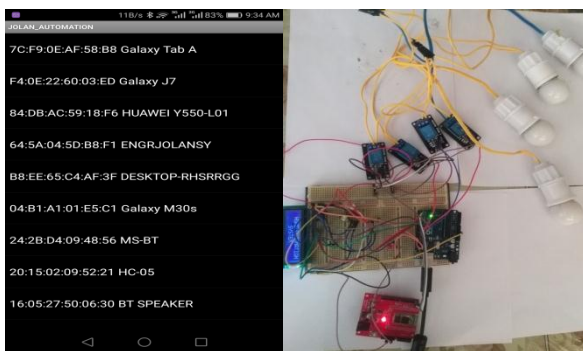


Figure 6A: Connecting Android Phone Bluetooth to Bluetooth based home automation system

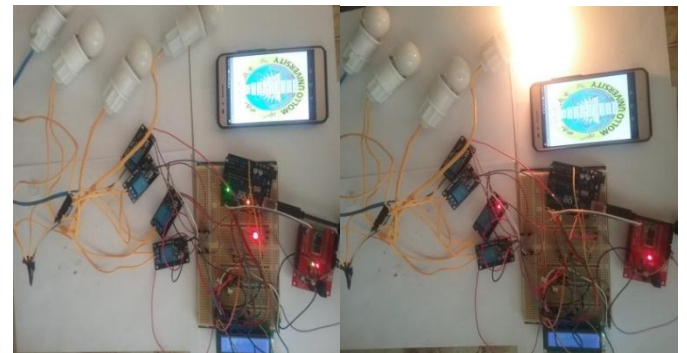


Figure 6D: Load 1 OFF /ON

Table 1: Summary of System Responses under the Different Test Cases in Android APP

Button Number	Prototype LOAD	Prototype LCD Display
LOAD 1 OFF	Working	Working
LOAD 1 ON	Working	Working
LOAD 2 OFF	Working	Working
LOAD 2 ON	Working	Working
LOAD 3 OFF	Working	Working
LOAD 3 ON	Working	Working
LOAD 4 OFF	Working	Working
LOAD 4 ON	Working	Working

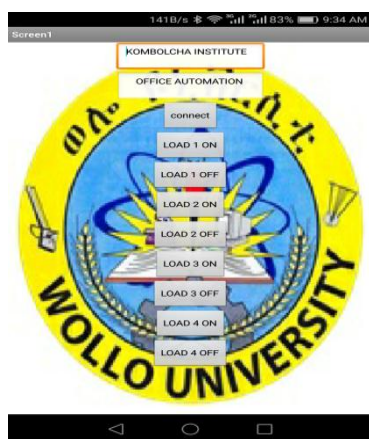


Figure 6B: App Running in mobile android phone

Bluetooth module that has been set to slave mode is used to communicate the controller with the smart phone application. The researcher developed the android app using MIT App Inventor. There are two components main type in an app Inventor which visible and non-visible. Visible components in the design are the buttons, text boxes, and labels and Non-visible components are the Bluetooth client interface and clock.

The application installed in Smart phone, and the Bluetooth receiver is interface in Arduino using RX/TX pin and the output are connected in digital pin number 8,9,10,11. LCD is connected in Arduino Uno Pin no. 2.3.4.5.6.7

IV. CONCLUSION AND RECOMMENDATION

This project is simple and easy to use. These are very essential for anyone and most especially for disabled person and those who are living in risk area. This system gives the best solution to completely eliminate manual switching. By using this method, home appliances can be controlled to avoid the dangerous of electric shock and convenience for users. The Bluetooth client was tested on different android phones from different manufacturers, and its working based on its desired functions.

Tests shows that all the requirements are met and the system can be implemented to any home or offices.

For further studies home automation can be controlled using web based automated system, Wireless sensor network using 433MHz transceiver.

REFERENCES

- [1] "How To Make Arduino Based Home Automation Project via Bluetooth?" <https://www.electronicshub.org/arduino-based-home-automation/> (accessed Oct. 05, 2020).
- [2] P. V. G. Y. R. Kalshetty, "Bluetooth Based Smart Automation System Using Android," *Int. J. Sci. Res.*, vol. 6, no. 5, pp. 1003–1006, 2017, [Online]. Available: <https://www.ijsr.net/archive/v6i5/3051709.pdf>.
- [3] N. Sriskanthan, F. Tan, and A. Karande, "Bluetooth based home automation system," *Microprocess. Microsyst.*, vol. 26, no. 6, pp. 281–289, 2002, doi: 10.1016/S0141-9331(02)00039-X.
- [4] D. H. Dev, A. Gupta, H. Jain, A. Agarwal, R. Gupta, and K. Kaur, "Android Based Home-Automation using Microcontroller," *Int. J. Adv. Netw. Appl.*, vol. 10, no. 01, pp. 3724–3727, 2018, doi: 10.35444/ijana.2018.10018.
- [5] S. N. Mallikraj, N. T. Rao, C. Sekhar, D. Bhattacharyya, and T. Kim, "Studies on Utilization of Low Cost GSM-Bluetooth Based Home Automation System," *Int. J. Control Autom.*, vol. 10, no. 12, pp. 67–76, 2017, doi: 10.14257/ijca.2017.10.12.06.
- [6] S. Paul, V. Indragandhi, N. K. Kumar, R. Raja Singh, and V. Subramaniaswamy, "An IoT Based Home Automation System," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 623, no. 1, 2019, doi: 10.1088/1757-899X/623/1/012014.
- [7] A. Pawar, R. Sharan, R. Patil, and S. Chavan, "International Journal of Innovative Research in Computer and Communication Engineering Home Automation using Bluetooth and IOT," pp. 896–902, 2018, doi: 10.15680/IJIRCCE.2018.0602036.
- [8] J. B. Sy, M. G. Rojo, E. R. Calibara, A. V. Comendador, and W. Degife, "Multi-Station Automated Hand Washing System (MSAHWS)," no. 3, pp. 36–43, 2020, doi: 10.35940/ijrte.C4243.099320.
- [9] J. B. Sy, W. Degife, W. Teka, and E. B. Panganiban, "Automated Hand Washing System With Hand Dryer," *Int. J. Emerg. Trends Eng. Res. Available*, vol. 8, no. 9, 2020.
- [10] J. B. Sy, "A Low-Cost Arduino-based Smart Irrigation System (LCABSIS)," *Int. J. Emerg. Trends Eng. Res.*, vol. 8, no. 9, 2020.
- [11] D. Netrsd, W. Degife, and A. Sisay, "Non - Contact Temperature Reader with Sanitizer," vol. 10, no. 9, pp. 583–592, 2020, doi: 10.29322/IJSRP.10.09.2020.p10567.
- [12] J. R. Rana and S. N. Pawar, "Zigbee Based Home Automation," *SSRN Electron. J.*, no. April 2010, 2012, doi: 10.2139/ssrn.1587245.
- [13] K. Venkatesh, P. Rajkumar, S. Hemaswathi, and B. Rajalingam, "IoT based home automation using raspberry Pi," *J. Adv. Res. Dyn. Control Syst.*, vol. 10, no. 7 Special Issue, pp. 1721–1728, 2018.
- [14] P. M. B. R, V. K. R, and D. N. Gowda, "IoT Based Home Automation System over Cloud," *Int. J. Trend Sci. Res. Dev.*, vol. Volume-3, no. Issue-4, pp. 966–968, 2019, doi: 10.31142/ijtsrd24005.
- [15] R. K. Kodali and A. Anjum, "IoT Based HOME AUTOMATION Using Node-RED," *Proc. 2nd Int. Conf. Green Comput. Internet Things, ICGCIoT 2018*, no. March, pp. 386–390, 2018, doi: 10.1109/ICGCIoT.2018.8753085.
- [16] S. H. Nalawade, N. K. Verma, and R. N. Rathod, "Web Based Home Automation using IoT Web Based Home Automation using IoT," *Researchgate*, no. March, 2017.
- [17] M. Das, "Home Automation Using ESP8266," *Trans. Mach. Des.*, vol. 6, no. 2, p. 47, 2018, doi: 10.6025/tmd/2018/6/2/43-46.
- [18] S. Bhowmik, S. Biswas, K. Vishwakarma, S. Chattoraj, and P. Roy, "Canteenautomation System using Android Application," *Int. J. Recent Technol. Eng.*, vol. 8, no. 4, pp. 4173–4176, 2019, doi: 10.35940/ijrte.d7582.118419.

- [19] M. T. Riaz, E. M. Ahmed, F. Durrani, and M. A. Mond, "Wireless android based home automation system," *Adv. Sci. Technol. Eng. Syst.*, vol. 2, no. 1, pp. 234–239, 2017, doi: 10.25046/aj020128.
- [20] M. M. Islam, M. N. Farook, S. M. G. Mostafa, and Y. Arafat, "Design and Implementation of an IoT Based Home Automation," *1st Int. Conf. Adv. Sci. Eng. Robot. Technol. 2019, ICASERT 2019*, no. 11, pp. 46–51, 2019, doi: 10.1109/ICASERT.2019.8934606.