



# Smart Home Project

Embedded systems project

(AVR ATMEGA32)

# By:


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**GitHub Repository Link: https://github.com/odc-pcb-2/Grad_project**

# Acknowledge

We would like to thank Orange Digital Center and AMIT for providing the opportunity to take the Integrated software and hardware diploma, and we appreciate their efforts to implement the diploma in a proper and orderly form. We also would like to thank Instructors for their proper guidance to us throughout the diploma.

# Abstract

This Smart home system is a system implemented with C Language for ATMEGA32 microcontroller. The system is implemented at microchip studio and simulated at proteus.

System can control several devices remoted or with interfacing their LCD and Keyboard. The devices that are controlled in the system are the door (open or close it), Air condition is Automatically Turned on if the room temperature greater than 28 C and turned off if room temperature less than 21 C and room lighting.

System consists of two modes:

1. Admin mode can add users, control all the home devices that included in the system and only remoted log in.
2. User mode can control home except the door and can log in remoted or with interfacing the Keypad and LCD.

The system is secure for the entering repeated wrong password or user, the maximum number of trials is three then the system fire alarm until reset.

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# Introduction

A Smart home system focuses on controlling home electronic devices whether you are inside or outside your home. Smart Home gives an individual the ability to remotely or automatically control things around the home. A Smart home is a device or instrument. designed to perform a specific function, especially an electrical device, such as an Air-conditioned, for household use. The task can be performed on the bases of sensor data this will take decisions and actions to perform.

The main problem of this project is to design and create a system that would help people to reduce the amount of power they consume and help them save money on their utility bills. This will be done by a system that can be easily installed in any building no matter how old it is.

# 1.System Components & Tools Requirements

## 1.1.System Components

- **ATMEGA32 Microcontroller**
  A microcontroller is used to act as a brain to the home automation system. A microcontroller is a highly integrated chip where all the peripherals like CPU, timers, counters, RAM, ROM, registers, I/O pins, clock circuit, etc. are built in.
- **LCD**
  Used for user log in and display the running devices.
- **Keypad**
  Used for taking inputs from user to log in the system and control the devices.
- **Bluetooth module HC-05**
  HC Bluetooth serial interface module HC-06 is used as to provide Bluetooth connectivity to provide wireless. communication between a mobile phone device and home automation system. Default communication baud rate: 9600.
- **LEDS**
  For room Lighting
- **LM53 Temperature sensor**
  The IC LM35 is used as a precision temperature sensor. It has an output voltage linearly proportional to the ambient temperature in Celsius and low output impedance.

The LM35 is rated to operate over a −55°C to +150°C temperature range.

- **DC motor**
  To act as Air condition
- **Servo Motor**
  The actuator used is a servo motor to control the opening door only in admin mode.
- **Internal EEPROM**
  To store the usernames and passwords.
- **Buzzer**
  Used for indication that the user enters the password or username three times wrong.

## 1.2.Tools used for implementation of the project

- **Microchip studio**
  Microchip Studio provides a project management tool, source file editor, simulator, assembler, and front-end for C, programming, and on-chip debugging. Microchip Studio supports the complete range of Microchip AVR tools. Used for editing and compile the code and export the hex file to burn it on the microcontroller.

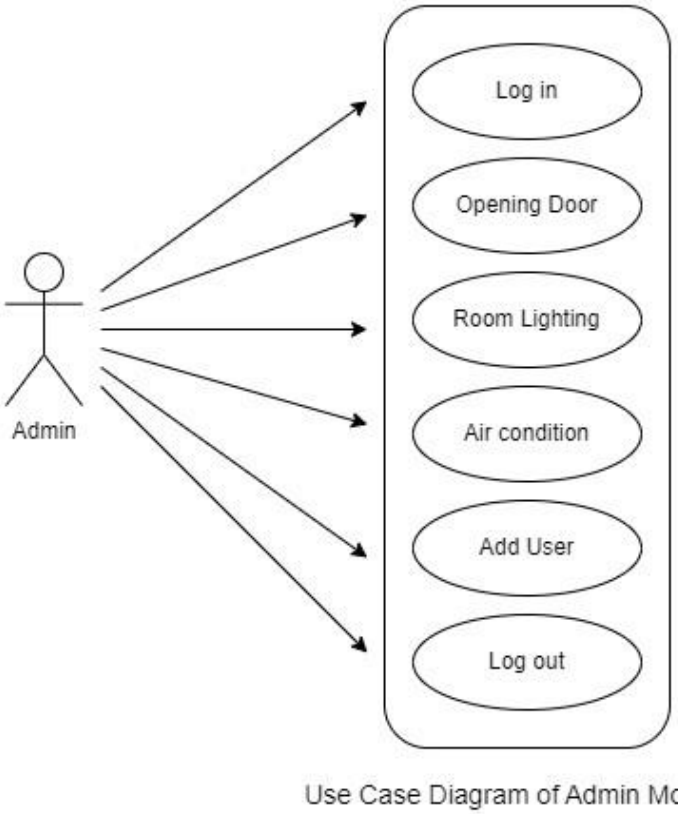
- **Proteus 8**
  Used to design the electronic circuit of the system and simulate the project.

# 2.System Analysis

System is divided into many sub systems sub systems, such as Log in sub-system, Bluetooth control sub-system, Door opening, Air condition and Room Lighting.

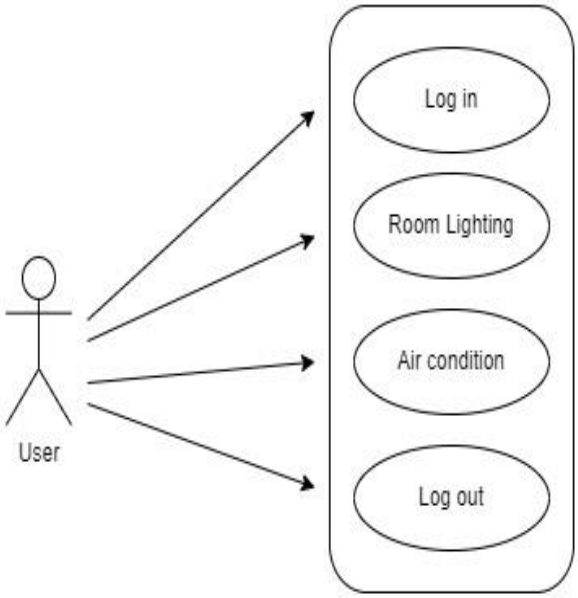
## 2.1.System Actuators

System has two actuators Admin and User, that they can control the home with different processes for each one. Admin can log in to system, control room lighting, control air condition, open door and add users, User can only control the room lighting and air condition.




Use Case Diagram of Admin Mode

**Figure 2.1**




Use Case Diagra of User mode

**Figure 2.2**

## 2.2.Login Sub-system

Log in sub-system provides security to the system. The smart home automation system employs home security system to restrict the entry of any intruder into the house. A keypad is connected to the microcontroller as an input to PORT C (from PIN 0 to PIN 7). The user must enter a username and password into the keypad or send them via Bluetooth to log in.

System receive the username and password from the user throughout the keypad or Bluetooth and compare them between the stored values at EEPROM. If the username password entered is correct, the user successfully logged in to the system and begin to control the devices according to his mode. If the username or password entered is incorrect, the user have chance to log in again until the number of attempts is over, when the number of attempts is over the system will fire alarm and became blocked until reset.

For the first time to use the system the admin username and password must be set at first and then he only can add users to control the home.

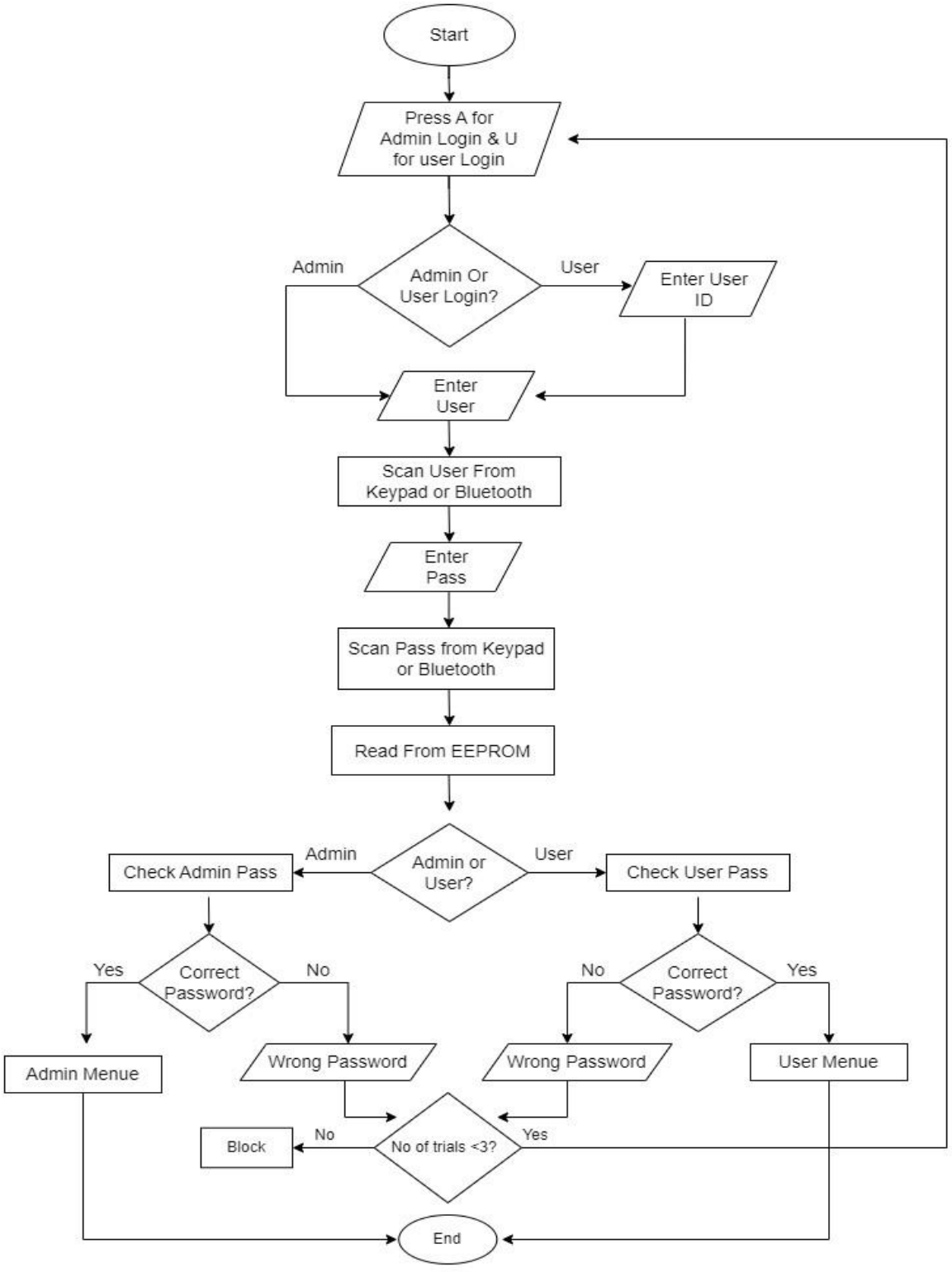
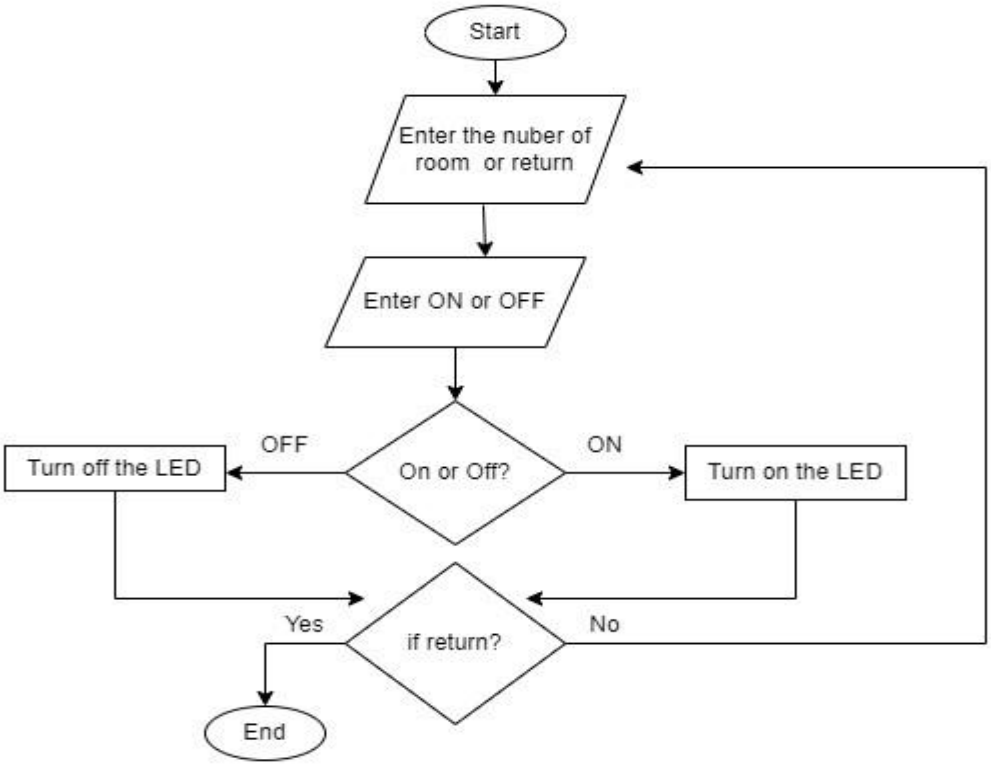

Start
Press A for Admin Login & U for user Login
Admin
Admin Or User Login?
User
Enter User ID
Enter User
Scan User From Keypad or Bluetooth
Enter Pass
Scan Pass from Keypad or Bluetooth
Read From EEPROM
Check Admin Pass
Admin
Admin or User?
User
Check User Pass
Yes
Correct Password?
No
No
Correct Password?
Yes
Admin Menue
Wrong Password
Wrong Password
User Menue
Block
No
No of trials <3?
Yes
End
Remoted Log in Sub-system Flow Chart

**Figure 2.3**

## 2.3.Room Lighting sub-system

consists of 6 LEDS and Relay, user can turn on and turn off each of them by keypad and LCD  or by Bluetooth. LEDS connect at PORTC (from PIN0 to PIN5) in the slave microcnontroller, they recive their commands from master microcontrollers in the two ways of controlling the system. In Keypad and LCD controll way the user can controll them by press the number that represent the LED (each one has specific number to access). In bluetooth controll way user can controll them by send the the letter that represent each LED (each LED has specific letter to access).




Room Lighiting Flow Chart

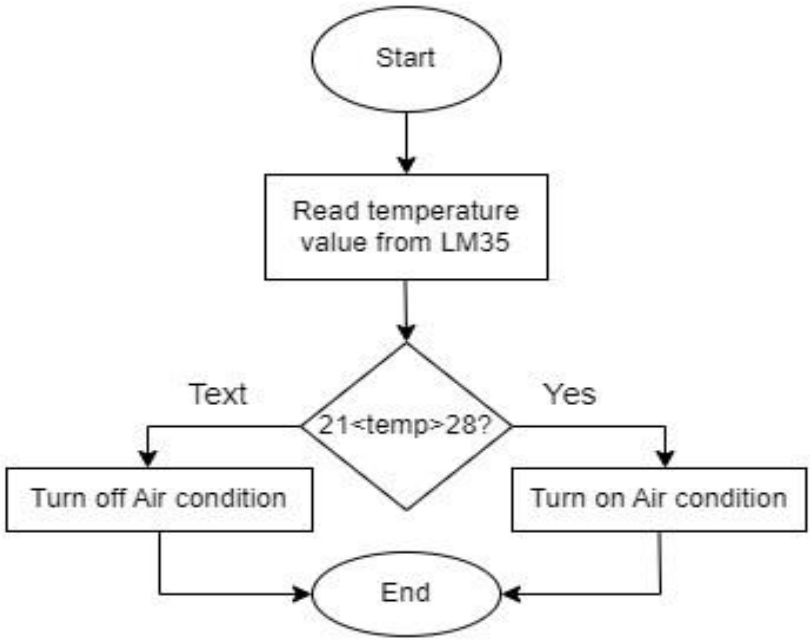
Figure 2.4

## 2.4.Air Condition sub-system

DC Motor and LM35 temperature sensor are used to control air condition, air condition automatically turned on and turned off according to the room temperature. LM35 senser read the temperature continuously and send it to the DC Motor if the temperature greater than 28 degrees DC Motor will turn on, if the temperature is less than 21 degrees DC Motor will turn off.

L293D driver is used to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V that satisfied to operate the DC Motor.

DC Motor connected at PORTB in master microcontroller (PIN6 & PIN7), LM35 sensor connected at PORTA (PIN0).



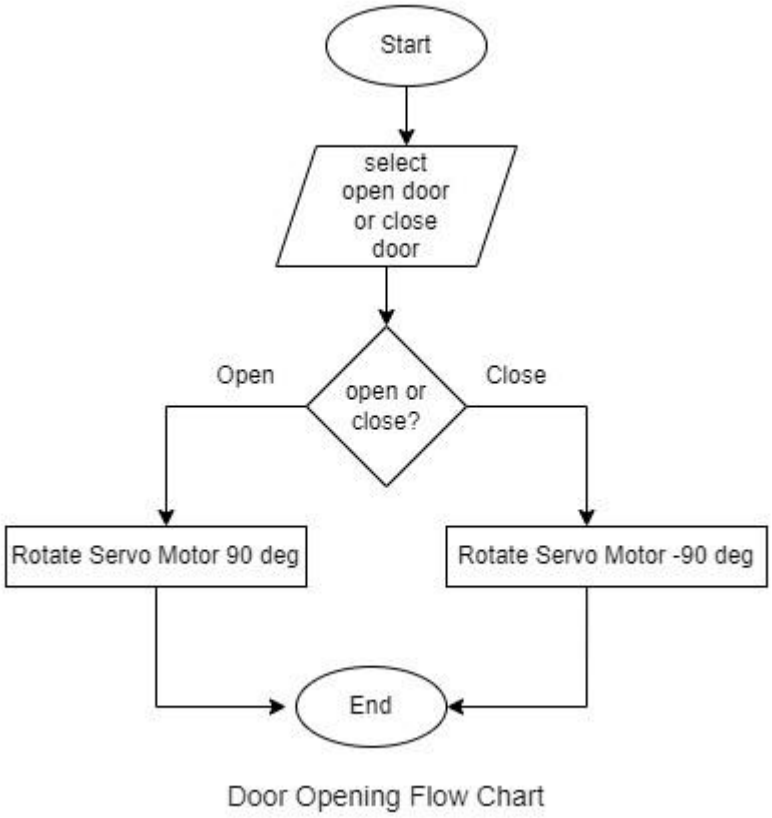

Air Condition Flow Chart

**Figure 2.5**

## 2.4.Door opening sub-system

Servo motor is used to control the door opening, it rotates by 90 degrees when opening the door and rotate by -90 degrees when closing the door. Only admin who can control the door.

Servo motor connected at PORTD (PIN5).




Door Opening Flow Chart

**Figure 2.6**

# 3.System Interfacing

System was implemented by C Language and simulated at proteus 8. System designed in two ways of interfacing, Keypad & LCD interface way and Bluetooth interface way, two actuators can interface with the system user and admin.

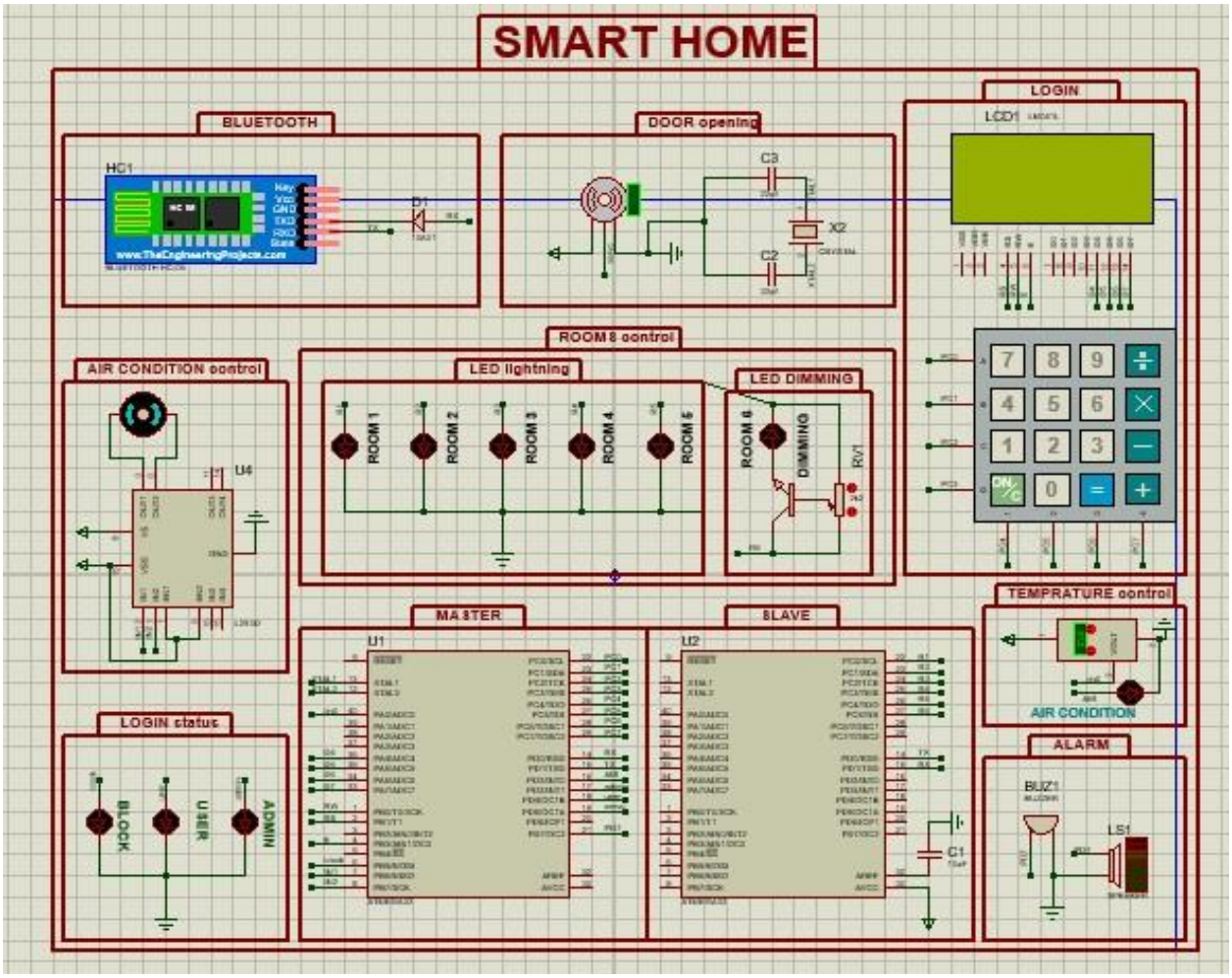



**Figure 3.1**

At first the user must select the way of interface that he wants to use and then according to the choice of user the selected way of interfacing will begin to use it.

## 3.1.Keypad & LCD control way

At Keypad & LCD interfacing way the user can use Keypad to Enter Username, password and any other input required to interface with the system. When the user selected this way directly the LCD would print messages to ask user for log in, if he logged in successfully the control option with be available to choose from it.

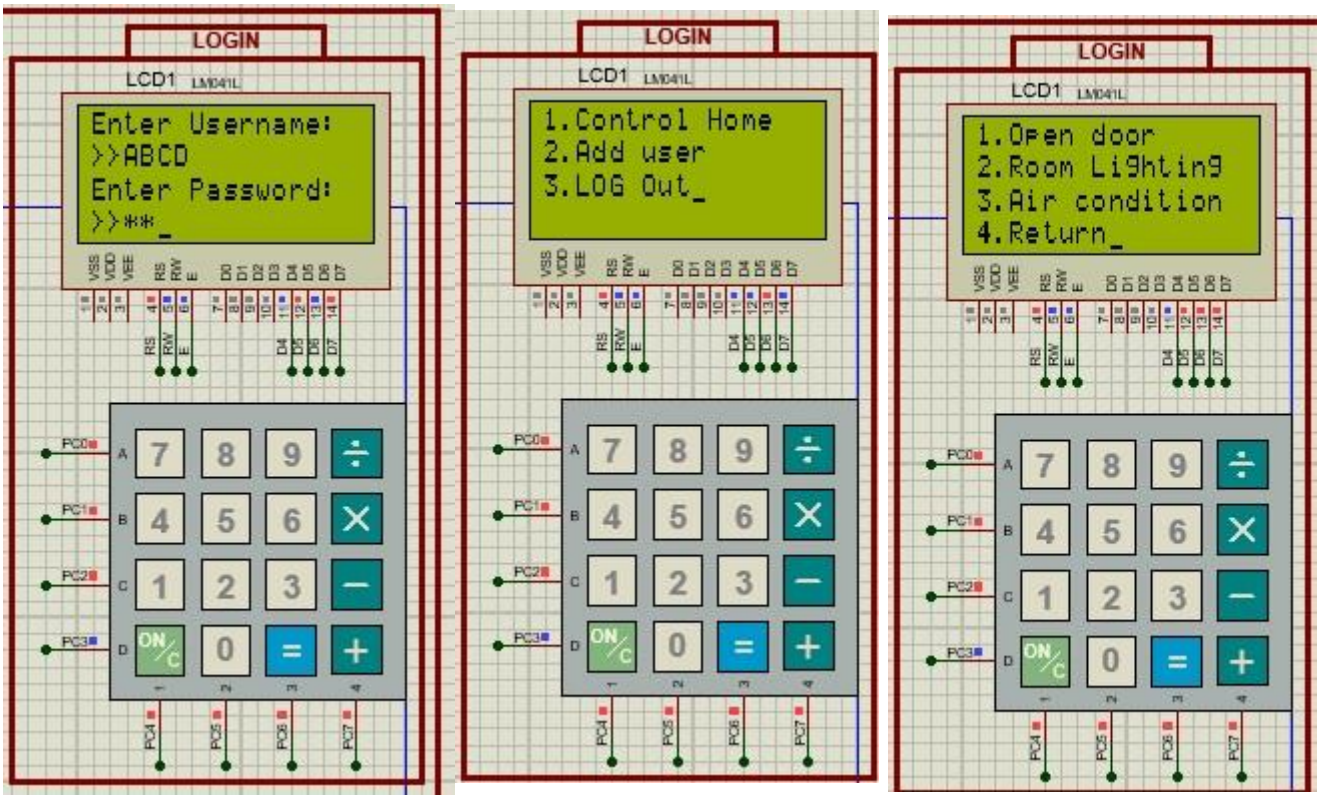



**Figure 3.2**

Admin log in, if username and password are correct, the admin menu will display, and user can choose from menu by keypad and control devices.

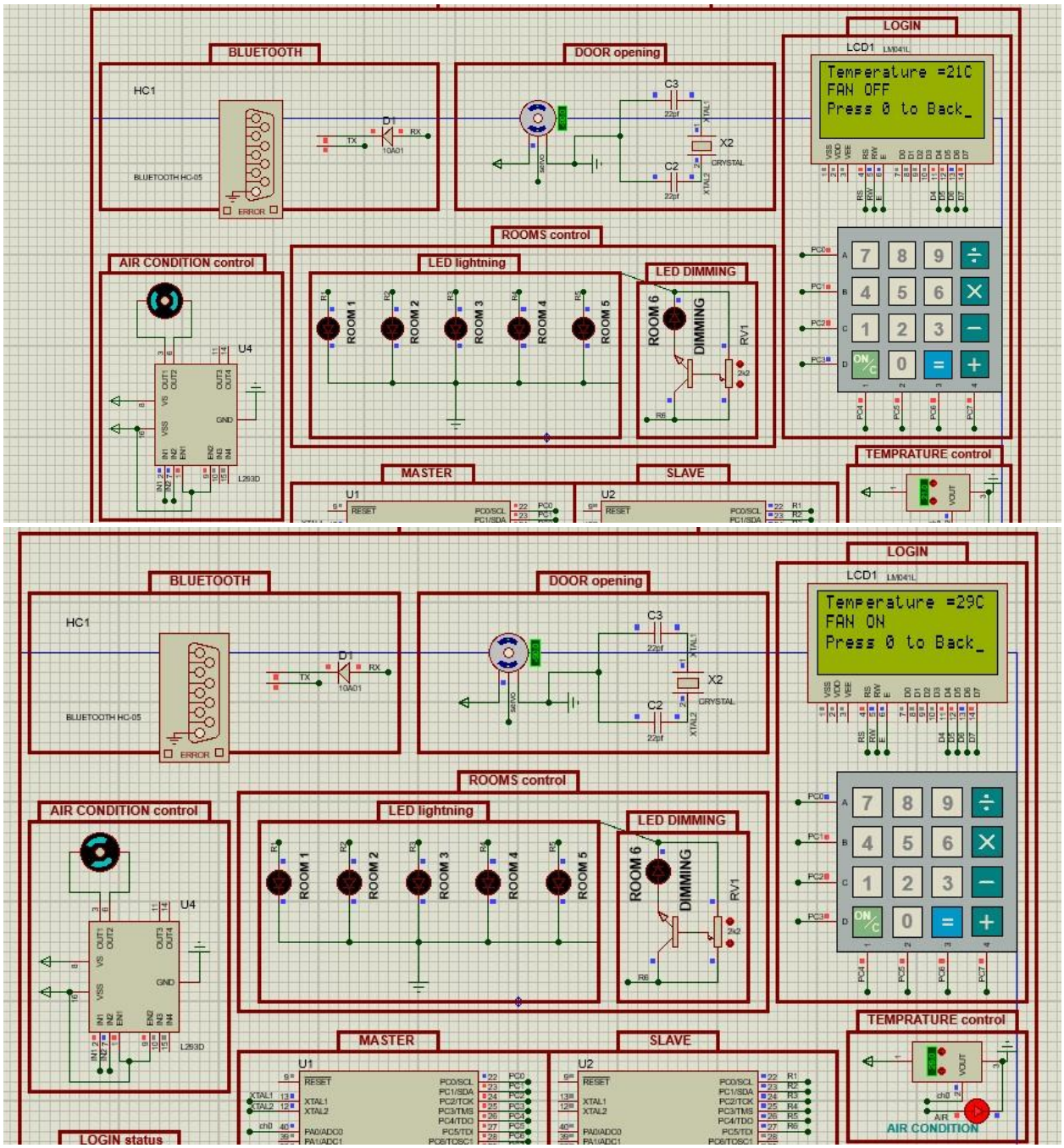



**Figure 3.3**

Air condition will turn on if the temperature is greater than 28 degrees and will turn off if the temperature is less than 21 degrees, user can see the status of the air condition by choosing it from the menu.

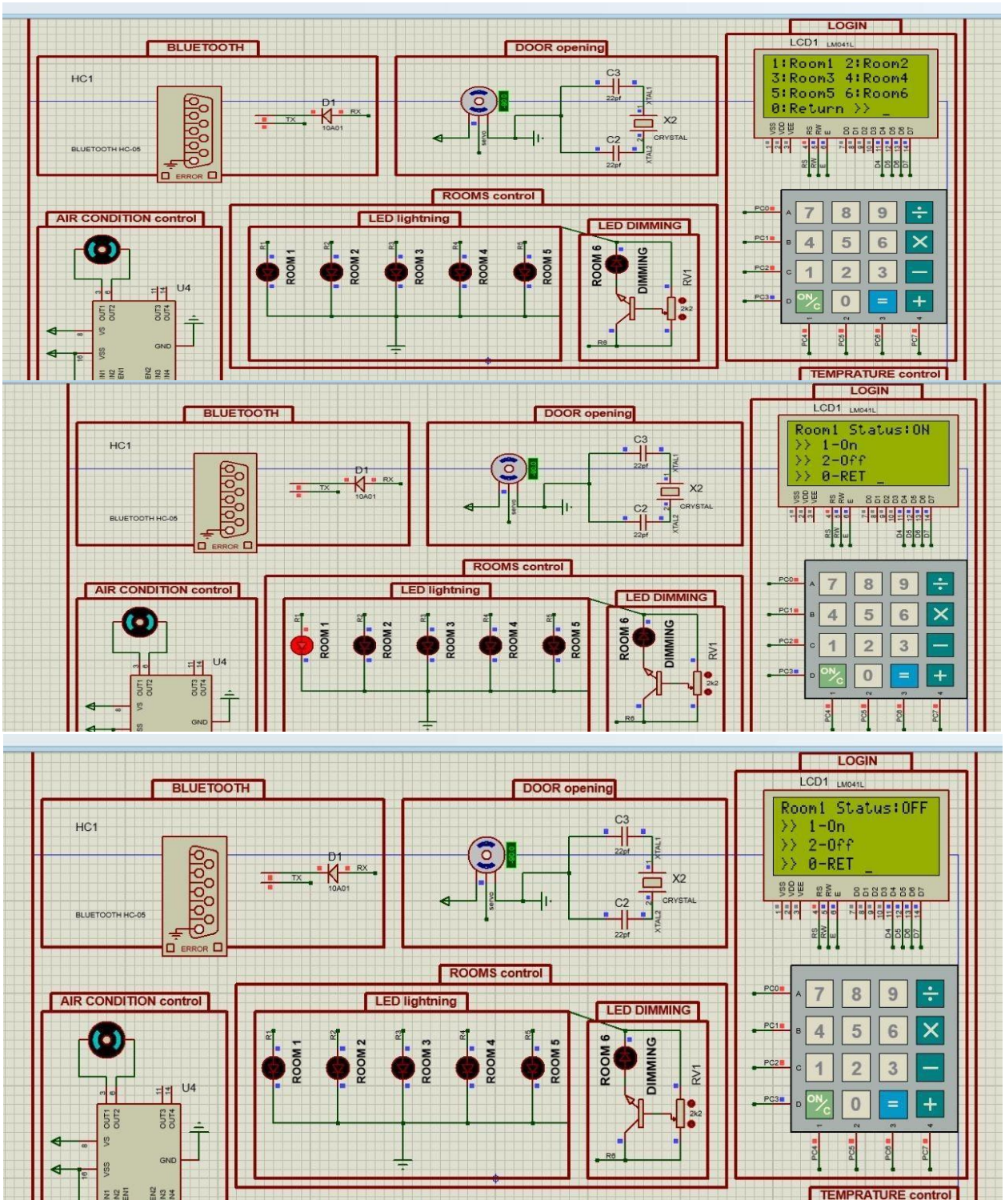

BLUETOOTH
HC1
BLUETOOTH HC-05
ERROR
D1
10A01
TX
RX
DOOR opening
C3
22pf
X2
CRYSTAL
C2
22pf
LOGIN
LCD1 LM041L
1:Room1 2:Room2
3:Room3 4:Room4
5:Room5 6:Room6
0:Return >> _
AIR CONDITION control
U4
GND
ROOMS control
LED lightning
ROOM 1
ROOM 2
ROOM 3
ROOM 4
ROOM 5
LED DIMMING
ROOM 6
DIMMING
RV1
2k2
TEMPRATURE control
Room1 Status:ON
>> 1-On
>> 2-Off
>> 0-RET _
Room1 Status:OFF
>> 1-On
>> 2-Off
>> 0-RET _

**Figure 3.4**

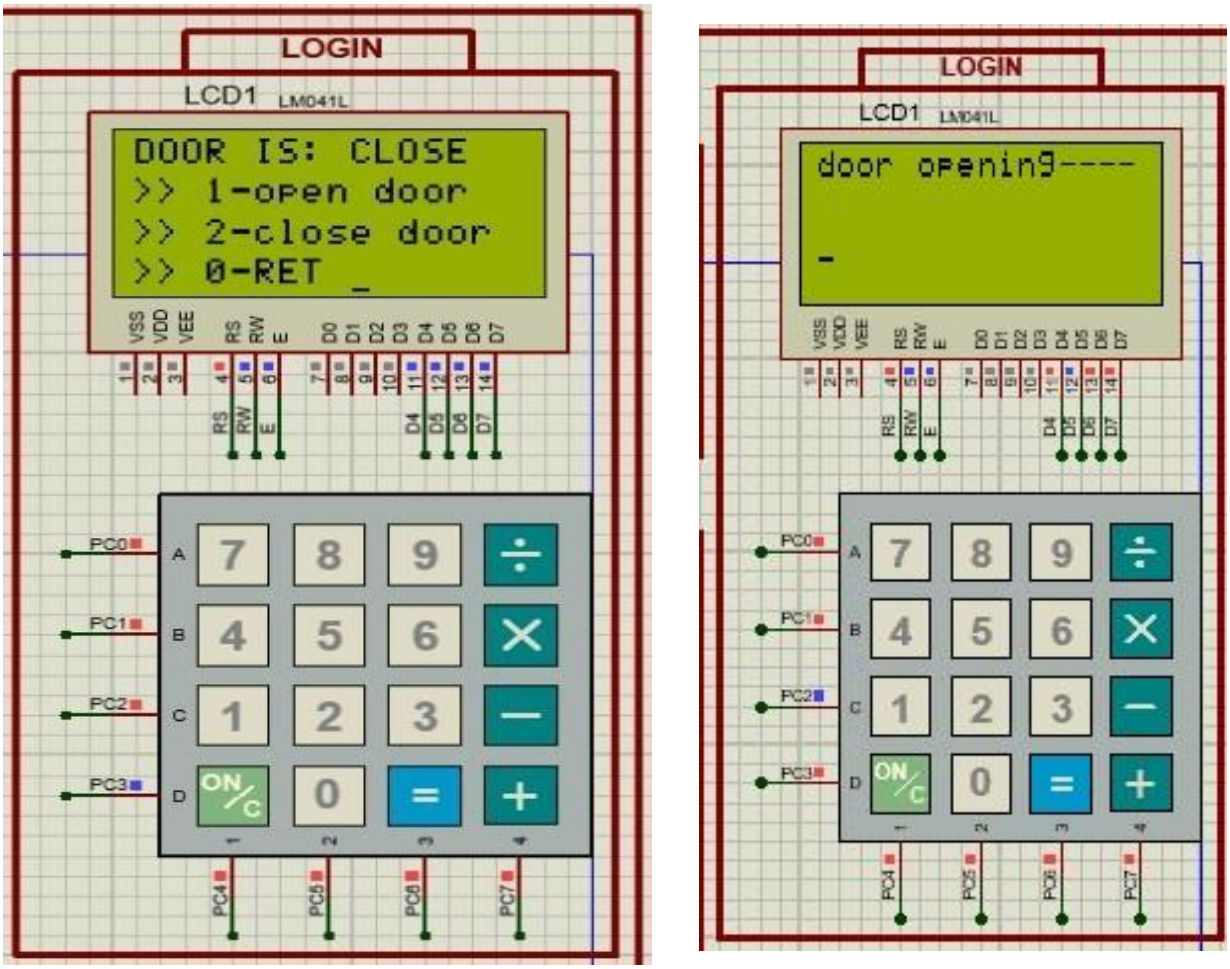



**Figure 3.5**

## 3.2.Bluetooth interface way

If user selected Bluetooth interfacing way, the Bluetooth control way will begin, the system transmits to the user terminal interface and receive his choices and can control the devices such as Keypad interface.

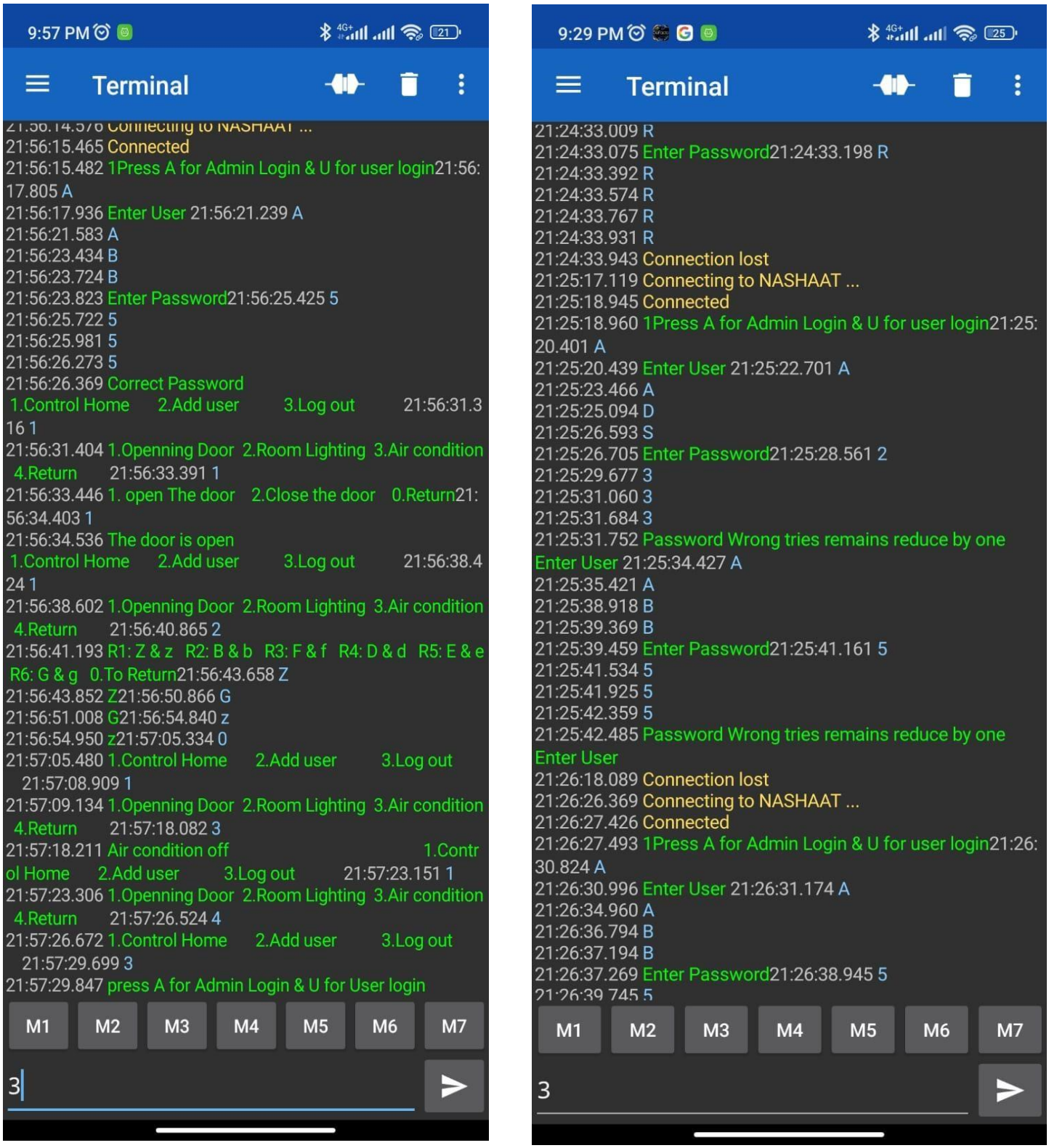

9:57 PM
Terminal
21:56:15.465 Connected
21:56:15.482 1Press A for Admin Login & U for user login21:56:17.805 A
21:56:17.936 Enter User 21:56:21.239 A
21:56:21.583 A
21:56:23.434 B
21:56:23.724 B
21:56:23.823 Enter Password21:56:25.425 5
21:56:25.722 5
21:56:25.981 5
21:56:26.273 5
21:56:26.369 Correct Password
1.Control Home 2.Add user 3.Log out 21:56:31.316 1
21:56:31.404 1.Openning Door 2.Room Lighting 3.Air condition 4.Return 21:56:33.391 1
21:56:33.446 1. open The door 2.Close the door 0.Return21:56:34.403 1
21:56:34.536 The door is open
1.Control Home 2.Add user 3.Log out 21:56:38.424 1
21:56:38.602 1.Openning Door 2.Room Lighting 3.Air condition 4.Return 21:56:40.865 2
21:56:41.193 R1: Z & z R2: B & b R3: F & f R4: D & d R5: E & e R6: G & g 0.To Return21:56:43.658 Z
21:56:43.852 Z21:56:50.866 G
21:56:51.008 G21:56:54.840 z
21:56:54.950 z21:57:05.334 0
21:57:05.480 1.Control Home 2.Add user 3.Log out 21:57:08.909 1
21:57:09.134 1.Openning Door 2.Room Lighting 3.Air condition 4.Return 21:57:18.082 3
21:57:18.211 Air condition off 1.Control Home 2.Add user 3.Log out 21:57:23.151 1
21:57:23.306 1.Openning Door 2.Room Lighting 3.Air condition 4.Return 21:57:26.524 4
21:57:26.672 1.Control Home 2.Add user 3.Log out 21:57:29.699 3
21:57:29.847 press A for Admin Login & U for User login
M1 M2 M3 M4 M5 M6 M7
3
9:29 PM
Terminal
21:24:33.009 R
21:24:33.075 Enter Password21:24:33.198 R
21:24:33.392 R
21:24:33.574 R
21:24:33.767 R
21:24:33.931 R
21:24:33.943 Connection lost
21:25:17.119 Connecting to NASHAAT ...
21:25:18.945 Connected
21:25:18.960 1Press A for Admin Login & U for user login21:25:20.401 A
21:25:20.439 Enter User 21:25:22.701 A
21:25:23.466 A
21:25:25.094 D
21:25:26.593 S
21:25:26.705 Enter Password21:25:28.561 2
21:25:29.677 3
21:25:31.060 3
21:25:31.684 3
21:25:31.752 Password Wrong tries remains reduce by one
Enter User 21:25:34.427 A
21:25:35.421 A
21:25:38.918 B
21:25:39.369 B
21:25:39.459 Enter Password21:25:41.161 5
21:25:41.534 5
21:25:41.925 5
21:25:42.359 5
21:25:42.485 Password Wrong tries remains reduce by one
Enter User
21:26:18.089 Connection lost
21:26:26.369 Connecting to NASHAAT ...
21:26:27.426 Connected
21:26:27.493 1Press A for Admin Login & U for user login21:26:30.824 A
21:26:30.996 Enter User 21:26:31.174 A
21:26:34.960 A
21:26:36.794 B
21:26:37.194 B
21:26:37.269 Enter Password21:26:38.945 5
M1 M2 M3 M4 M5 M6 M7
3

**Figure 3.6**

# 4.Communicatin protocol

The communication protocol that used in the project is UART, stands for Universal Asynchronous Receiver/Transmitter.

In UART communication, two UARTs communicate directly with each other. The transmitting UART converts parallel data from a controlling device like a CPU into serial form, transmits it in serial to the receiving UART, which then converts the serial data back into parallel data for the receiving device. Only two wires are needed to transmit data between two UARTs. Data flows from the Tx pin of the transmitting UART to the Rx pin of the receiving UART:

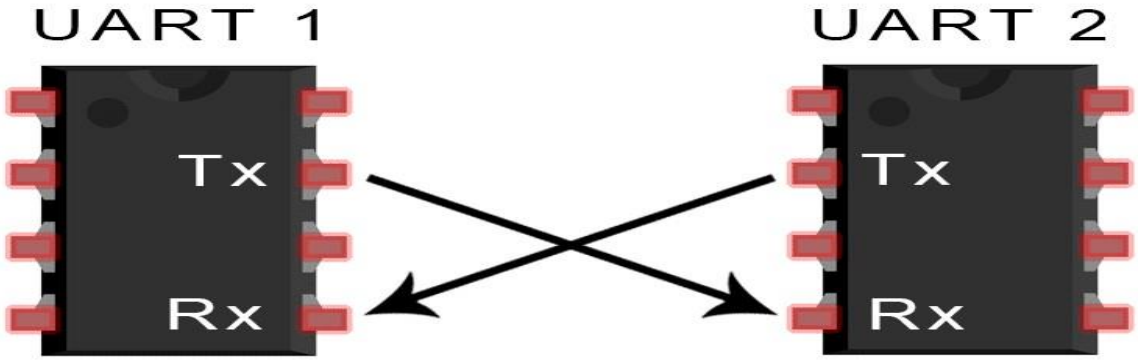



**Figure 4.1**

Bluetooth module HC-05 use UART communication protocol to transmit or receive data to microcontroller; system consists of one master and two slaves, Master connected to Bluetooth module to receive and transmit interfacing commands, if it receive command that responsible of control device at the slave microcontroller the master will transmit command to slave to achieve the result.