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ASIA PACIFIC UNIVERSITY
OF TECHNOLOGY & INNOVATION

INDIVIDUAL ASSIGNMENT

TECHNOLOGY PARK MALAYSIA

CT047-3-2-SPCC

SYSTEM PROGRAMMING & COMPUTER CONTROL

HAND OUT DATE: Week 3

HAND IN DATE: Week 13

WEIGHTAGE: 40%

STUDENT NAME: NG ZE-KANG

TP NUMBER: TP061488

INSTRUCTIONS TO CANDIDATES:

1. Submit your assignment online in Moodle Folder unless advised otherwise

2. Late submission will be awarded zero (0) unless Extenuating Circumstances (EC) are upheld

3. Cases of plagiarism will be penalized

4. You must obtain at least 50% in each component to pass this module

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1.0 Introduction

A smart home is a practical home design that allows you to remotely control your electronics and appliances over the internet from anywhere using your smartphone or other connected devices. The Internet connects devices in smart homes, allowing users to remotely control functions such as temperature, lighting, security access, and home entertainment systems. This task requires students to develop a smart home control system for their new home. Additionally, the student must use her LabView as a development language.

1.1 Assumption

- This project assumes that the user can register and login by entering username and password to enter the smart home system.
- This project assumes that when the door light is red, the door is closed, while when the door light is green, the door is open.
- This project assumes that when the curtain colour is filled, the curtain is closed, while when the curtain colour is not filled, the curtain is open.
- This project will display the real picture of the room with smart home controls instead of displaying the floorplan of the house.

1.2 Project Functionalities

Some of the functionalities listed below are required in this smart home project.

Basic requirement:

- ➢ Control lights in each room.
- ➢ Control curtain in different room.
- ➢ Open and close different door.
- ➢ remote control for television that includes basic functionalities such as on, off, change channel, mute, fast forward, backward, and pause.
- ➢ Login authentication, the user needs to enter username and password to enter the smart home system.

Additional features:

- ➢ Web browser that includes open browser, combo box with saved website, go back, go forward, and refresh page.
- ➢ 30 second countdown timer; after 30 seconds, the LED light will blink.

- E-clock which is able to show the local date and time.
- air conditioning, which can adjust the temperature.

2.0 LabView

National Instruments produced the software development environment known as LabVIEW. It began with an emphasis on collecting data from various lab devices, but it has significantly grown. LabVIEW is a development environment and not a programming language, strictly speaking. The true name of the language is "G," however most people are referring to LabVIEW as though it were a language, saying things like "that's coded in LabVIEW (Metzler, 2022)."

Due to the fact that LabVIEW is graphically based, users may move different building components around and connect things in such a data flow architecture. Sketching your code is comparable to designing a block diagram, but unlike text-based programming languages like C# and VHDL, you type down what the user wants the program to perform in text.

Moreover, there are several benefits that can be found in LabView, one of the most significant benefits is the graphic user interface is adaptable and straightforward. Most engineers and programmers can rapidly pick it up and use it. Therefore, students don't need to spend a lot of time figuring out how LabView works. Besides that, a ubiquitous platform for multiple applications in various domains is offered by LabVIEW and it can be used with hardware from third parties and can connect with languages like C/C++, VB, Fortran, etc.

2.1 Visual programming language

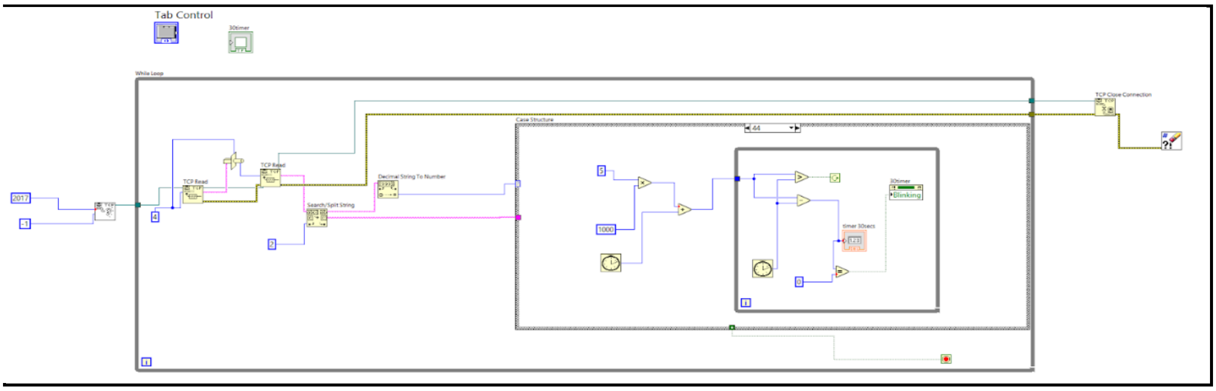


Figure 2.1.1

The figure above shows an example of a visual programming language using LabView in this project.

A type of programming language labelled visual programming allows users to represent processes. Unlike traditional text-based computer languages, which require developers to think like machines, visual programming languages allow developers to describe processes in a human-understandable way. Visual programming tools determine the scale of the leap from graphical programming to traditional programming. Developers use visual programming tools to outline the flow of the application and create a to-do list. Flowcharts include instructions for viewing, user interaction, and processing information at each level. The tool then creates software out of it.

2.2 Client-server Model

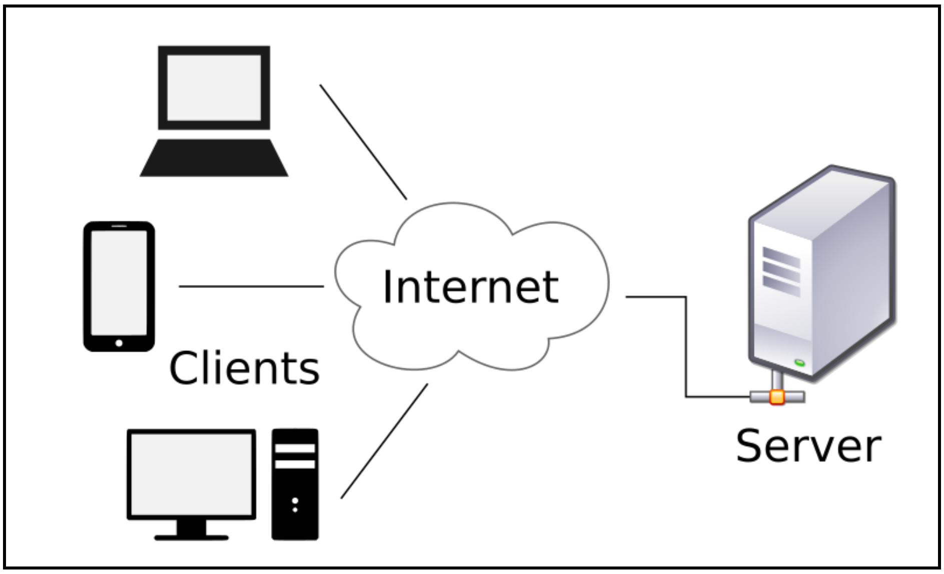


Figure 1.2.1

The client/server paradigm, generally known as client/server architecture, is actually a distributed application framework that assigns tasks to servers and clients that share systems or connect over a computer network or the Internet. In order to utilize the services provided by the server, the client must make requests to other software. One or more applications run on the server, share resources, and distribute work to clients.

Implementation of client-server in this project

A standard communications protocol that clearly defines the rules, vocabulary, and dialogue patterns to be utilised must be followed when communicating in a client-server connection using a request-response message pattern. In this project, the TCP/IP protocol suite is commonly used for client-server communication.

3.0 System Design

3.1 Flow chart for server side

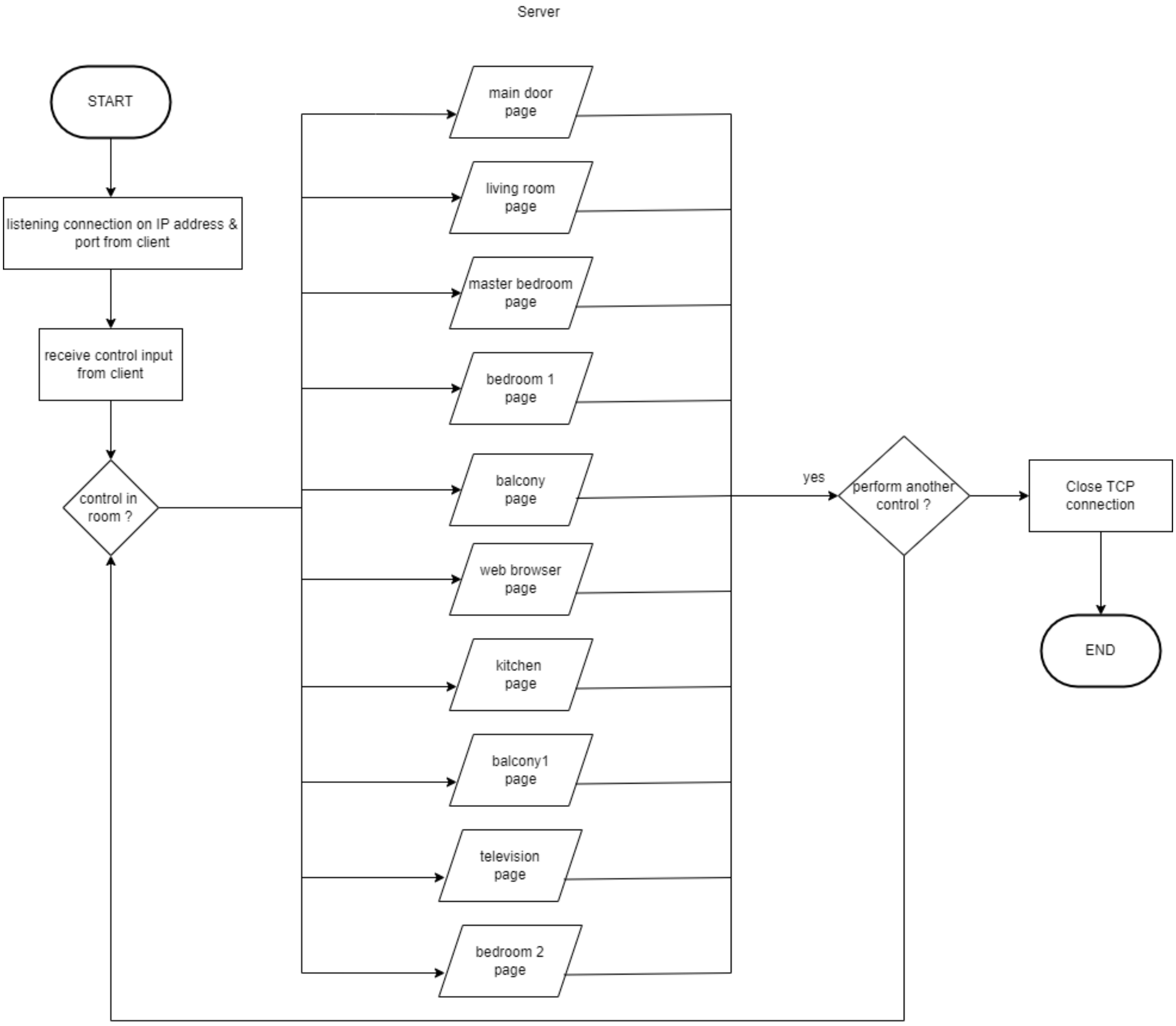


Figure 3.1.1 server side

The figure above shows the flow chart for the server side. First and foremost, the system will listen for a connection from the client on the IP address or port. Once the system is able to connect with the client side, it will start to receive control input from the client side. If the client side does not enter control input, the server-side system will close the TCP connection.

3.2 Flow chart for client side

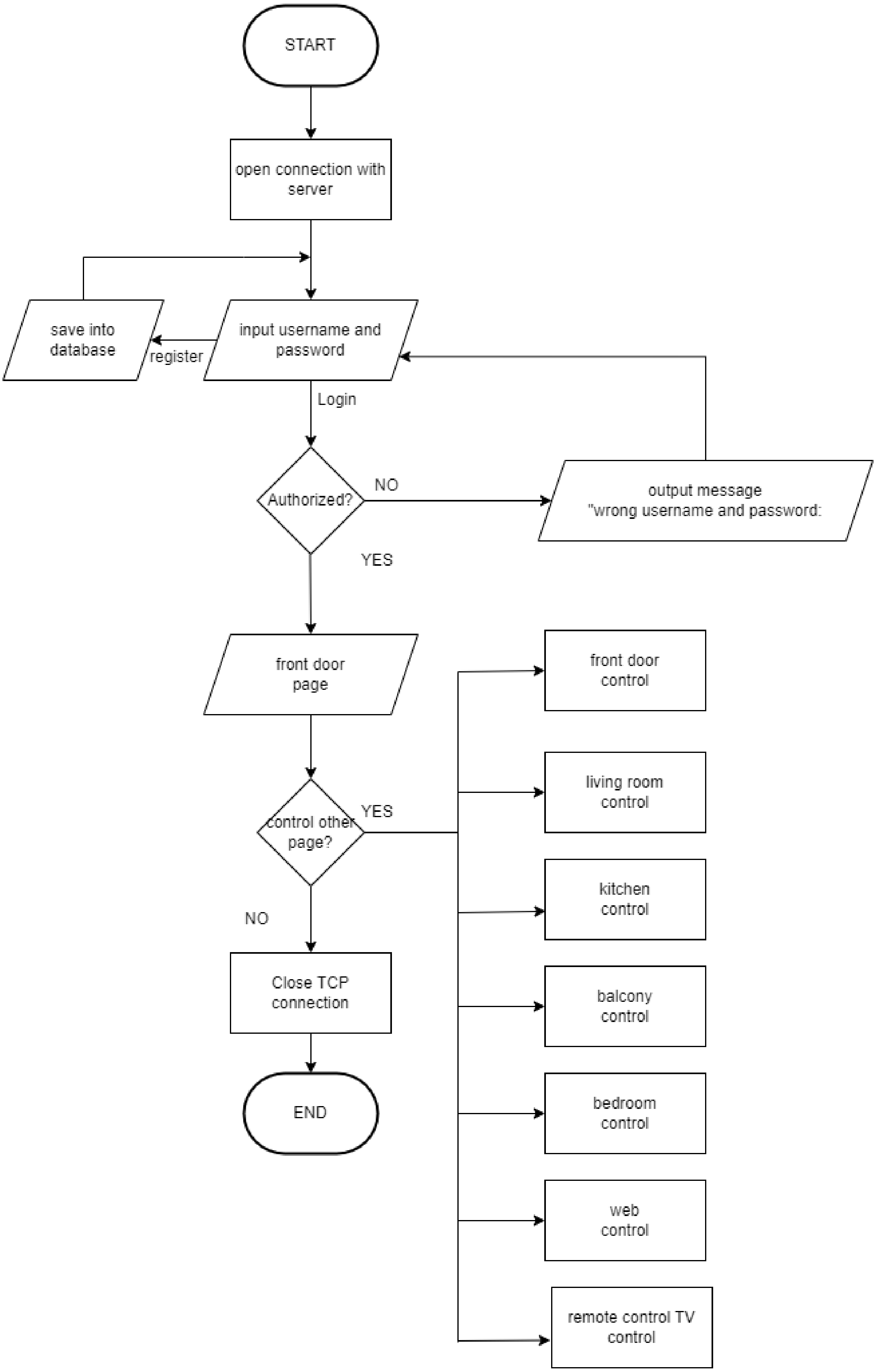


Figure 3.2.1 client side

The figure shows the flow chart for the client side. Firstly, the client system will open the connection with the server. After that, the client needs to input a username and password for the authentication process. After the authentication process is complete, the client can perform a variety of actions by clicking buttons on various pages. Lastly, the client system will close the TCP connection if there is no other control input.

4.0 Protocol Design

4.1 TCP IP and network programming

The basic tools of network communication are Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Internet Protocol (IP). Transmission Control Protocol and Internet Protocol, two of every best-known protocols in the Internet Protocol suite, are the source of the TCP/IP moniker. They can interact over another network or networks that are bridged using TCP/IP (Internet). The simple user interface of TCP/IP communication hides the challenge of ensuring reliable network interaction. For more information on TCP/IP communication, refer to Using LabVIEW with TCP/IP and UDP (ni, 2022) in the LabVIEW Help.

When connect with a drive server, external measurement server, or DAQ card server, in most cases the processor is the client that opens the connection. A computer can act as a client or server in a TCP/IP connection. The following block diagram shows a client application connecting to a remote server using TCP Open Connection. A server or daemon remotely monitors connections and responds as needed.

Server

On the server side, it always read input from the client input. Only when a client initiates a connection does the server need to listen to connections and decide whether to accept or reject them. Therefore, 3 TCP/IP terminals are used on the server side which are the listener terminal, reader terminal, and closing connection terminal.

- Listener terminal

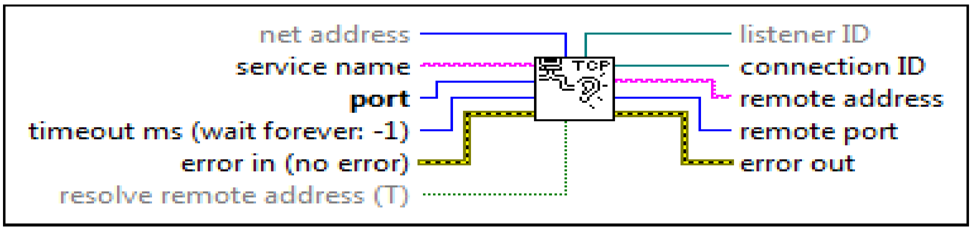


Figure 4.1.1

The figure above shows the symbol of the listener terminal. In this project, net address, and timeout Ms are used to connect with numeric data. Which network address to connect to is specified by the net address. Providing an address is useful if the user has multiple network cards, including two ethernet cards, and wants to limit eavesdropping on the card with the provided address. The number of milliseconds the VI waits for a connection is specified by the Timeout Ms parameter. If the connection cannot be established within the allotted time, the VI terminates and reports an error. The default value of -1 indicates an infinitely long lag.

- TCP read

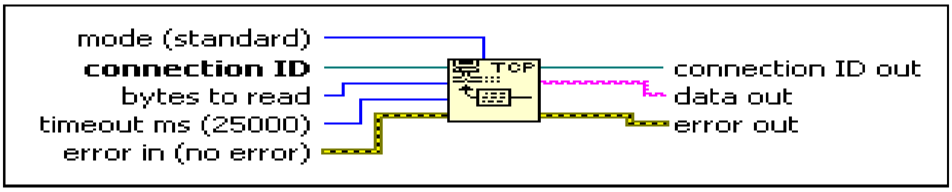


Figure 4.1.2

The main function of TCP read on this server side is it can read the total number of bytes received by the listener terminal from the client side.

- TCP close connection

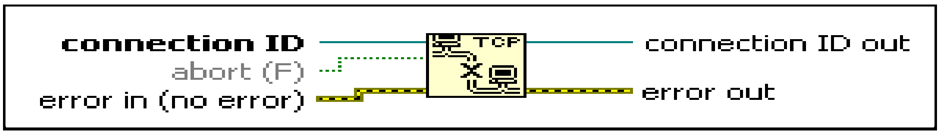


Figure 4.1.3

TCP close connection is used to close the TCP network connection.

Client

The Client must be aware of the IP Address of the Server it wants to connect to as well as the port number through which it desires to send and receive data once the connection has been made. Thus, 3 TCP/IP terminals are used on the server side which are the TCP open connection, writer terminal, and closing connection terminal.

- TCP open connection

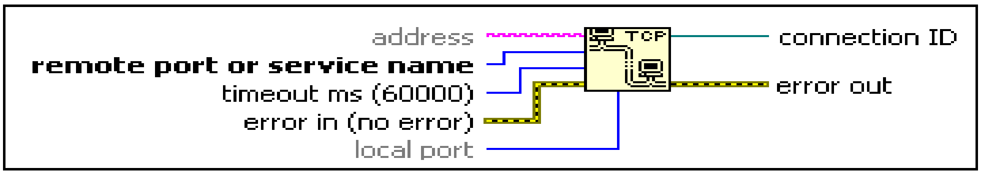


Figure 4.1.4

Open TCP Connection is used to authorize a TCP network connection using the specified address, remote port, or account name. Similar to the server side, in this project the remote port or account name and timeout ms are connected.

- TCP write

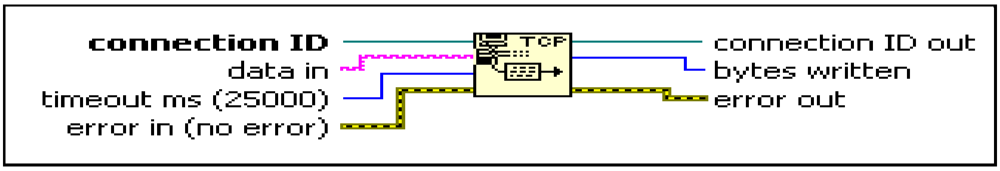


Figure 4.1.5

TCP write is used to write the data in and keep the data to the TCP network connection.

- TCP close connection

TCP close connection is used to close the TCP network connection in client side as well.

4.2 TCP communication

TCP guarantees dependable data delivery over networks, sending data in order without loss, duplication, or errors. TCP keeps sending the datagram till it gets a response.

Server-side network diagram

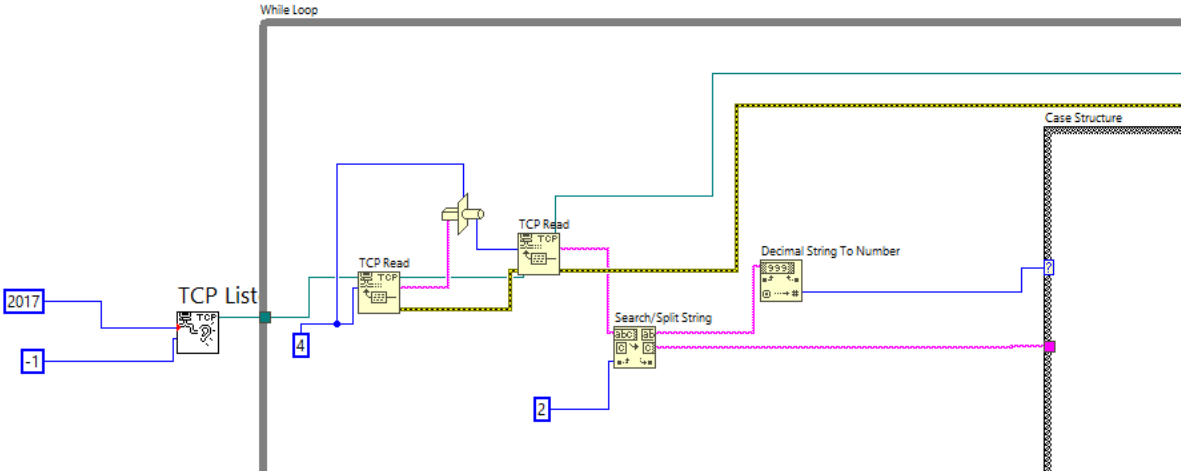


Figure 4.2.1

Figure 4.2.1 shows the server-side network diagram for this project. The while loop is used to receive signals continuously from the client side. After the server system receives the input from the client, a case structure is used to find the appropriate action for the input.

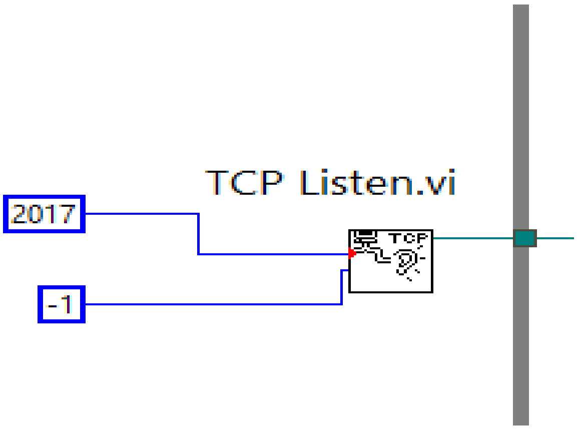


Figure 4.2.2

The figure shows the TCP listen on port “2017” with timeout “-1” is used in server side. This is the initial move for server side which is match the port with the client side.

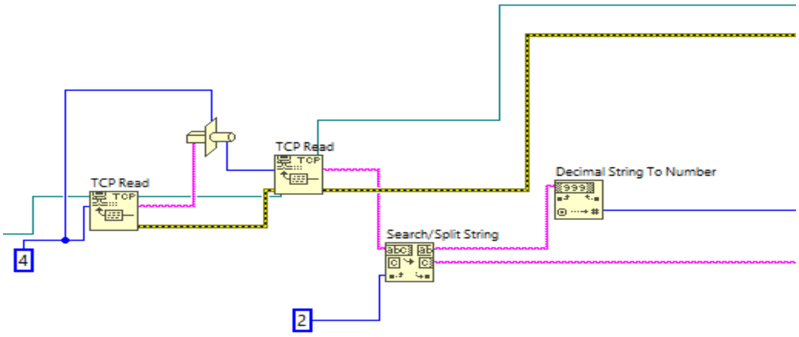


Figure 4.2.3

Moreover, the TCP read with 4 bytes to read is used to listen the data which sent by the client side. After that, the bytes data will send into search/split string to identify the first two number and match with the case structure.

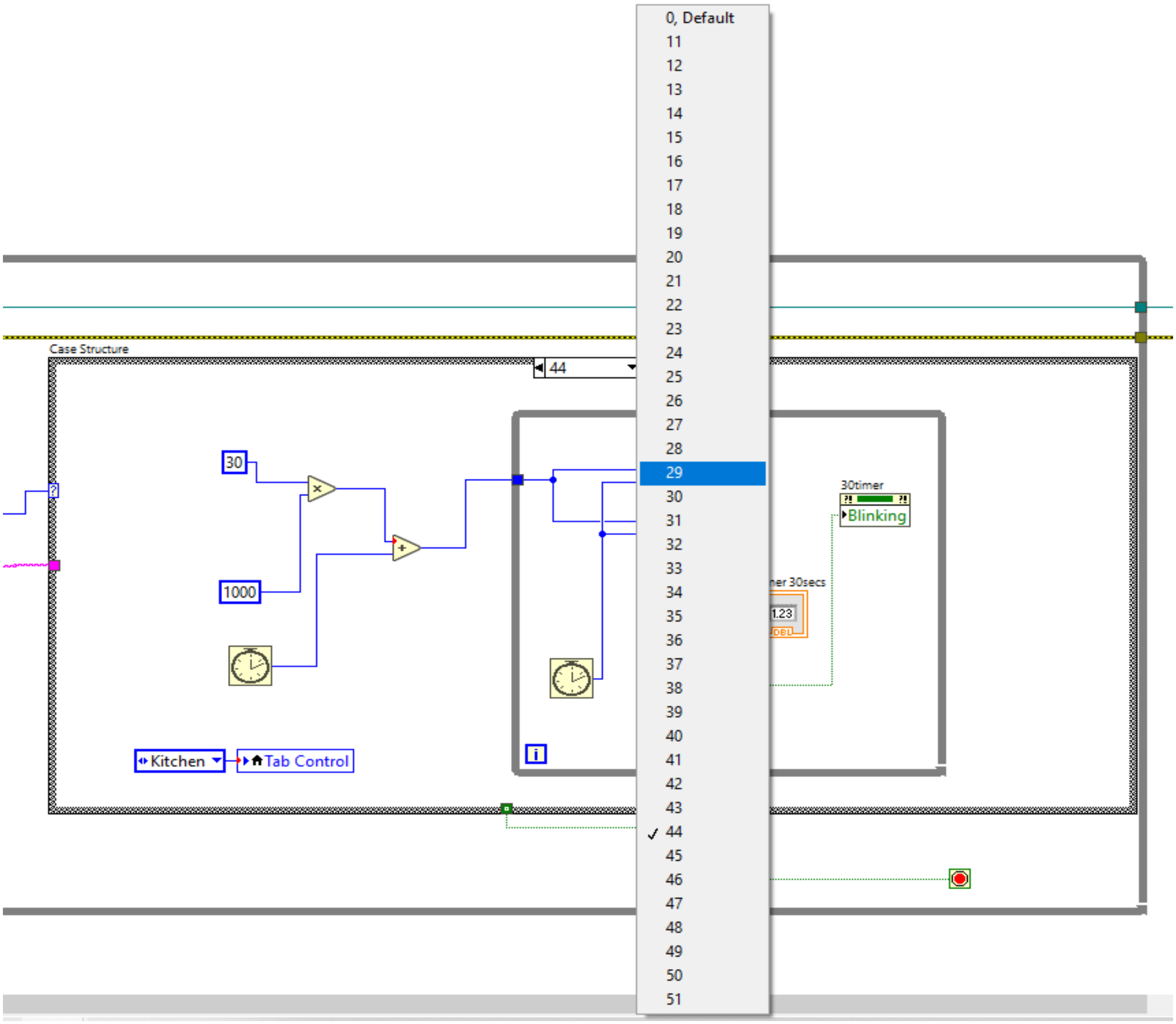


Figure 4.2.4

The figure above is case structure which will receive 2 digits of numbers and match with the selective case. There is total 42 cases in this project.

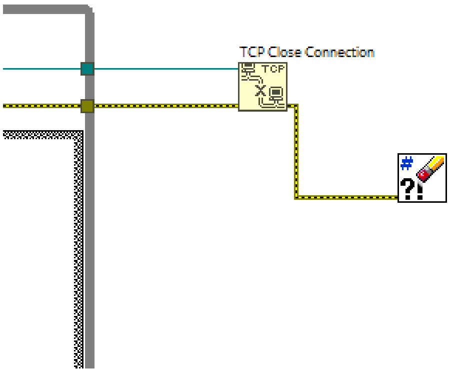


Figure 4.2.5

Figure above shows the TCP close connection is used to close the TCP network connection once the connection between server and client is done and clear error is used to resets the error code to 0, the source to an empty string, as well as the error status to no error. When the user wish to ignore a mistake, use this VI.

Client-side network diagram

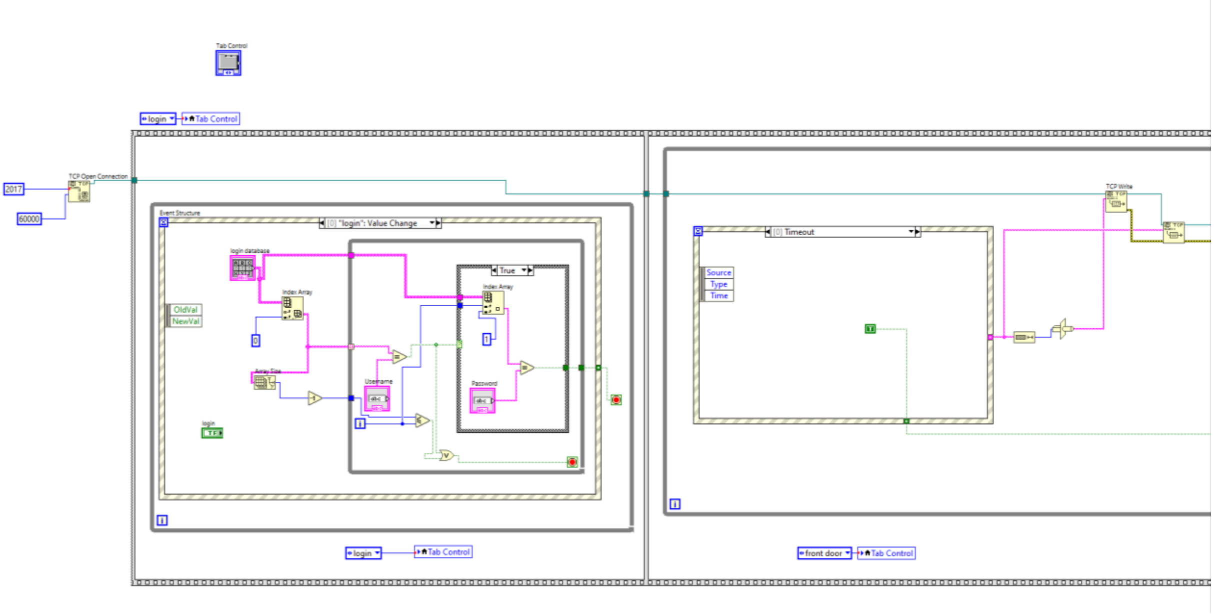


Figure 4.2.6

The figure above shows the client-side network diagram. A flat sequence structure is used to make sure the user will need to pass through the authentication process at first. Once the authentication process is done, the user is allowed to control the smart home system.

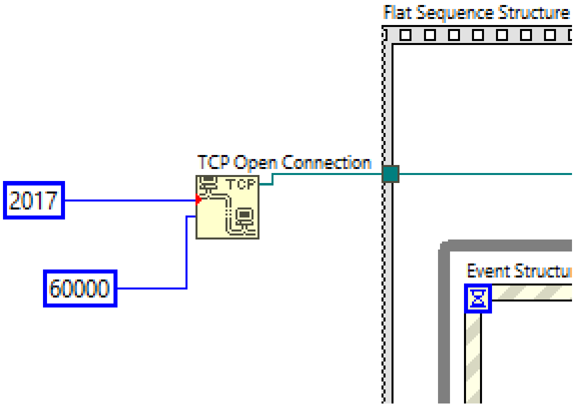


Figure 4.2.7

The Figure 4.2.7 shows the TCP open connection on the client side with the port “2017” which is the same as the server side and 60000 seconds time out.

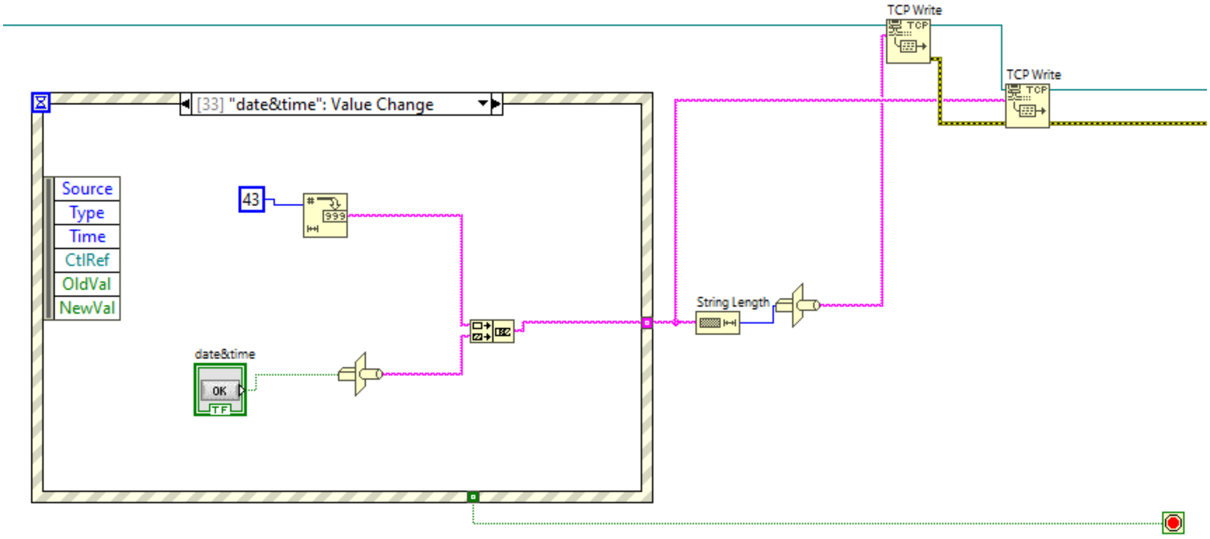


Figure 4.2.8

After that, the system will receive actions from the user, such as turning on or off the button. The bytes of data, which consist of two bytes, are declared variables, which will combine with the action performed by concatenating strings and send it to the TCP write.

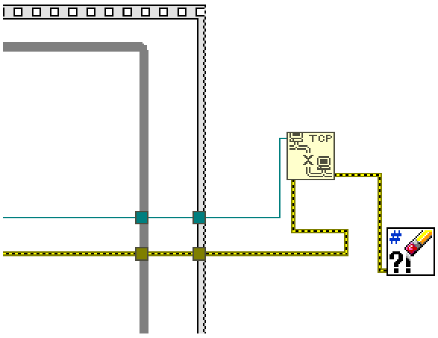


Figure 4.2.9

Once the action performed is done, the TCP close connection is used to close the TCP network connection once the connection between server side and client side is established.

4.3 Network code list

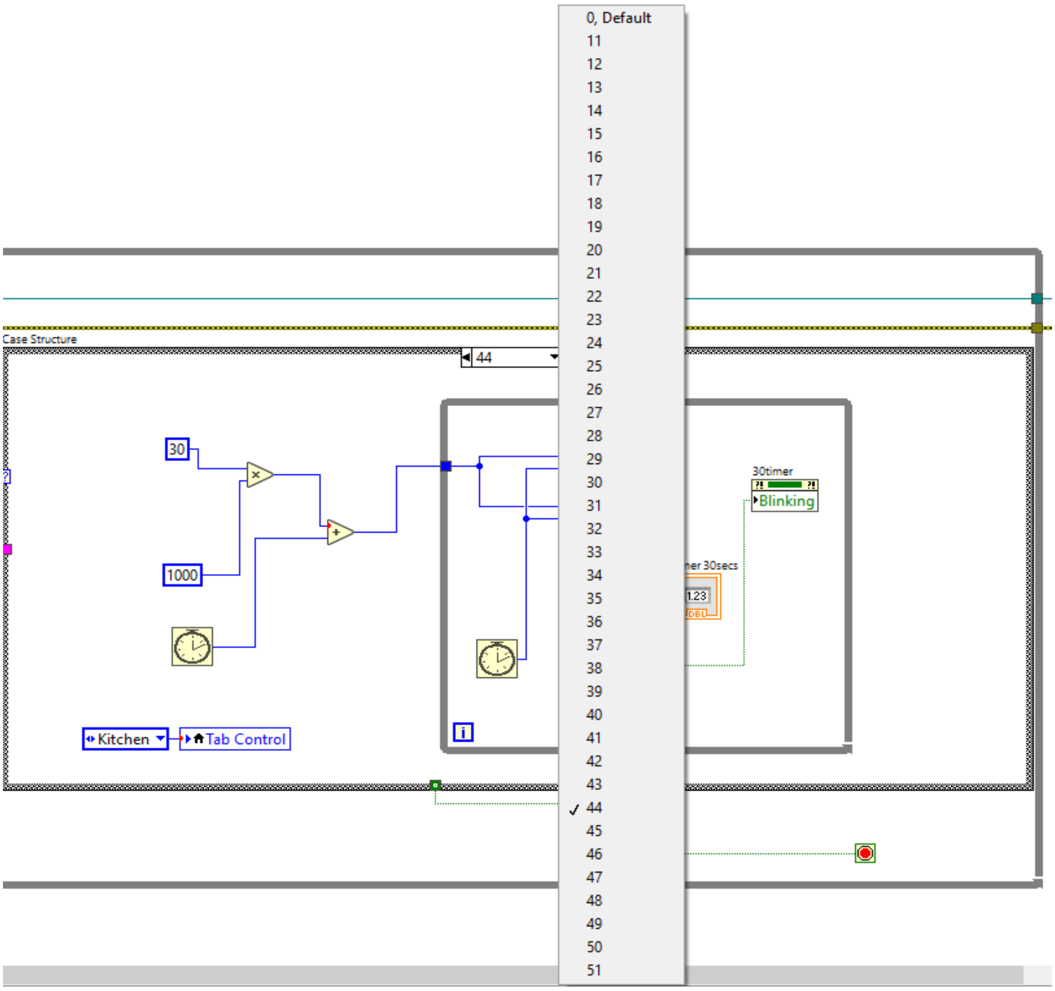


Figure 4.3.1

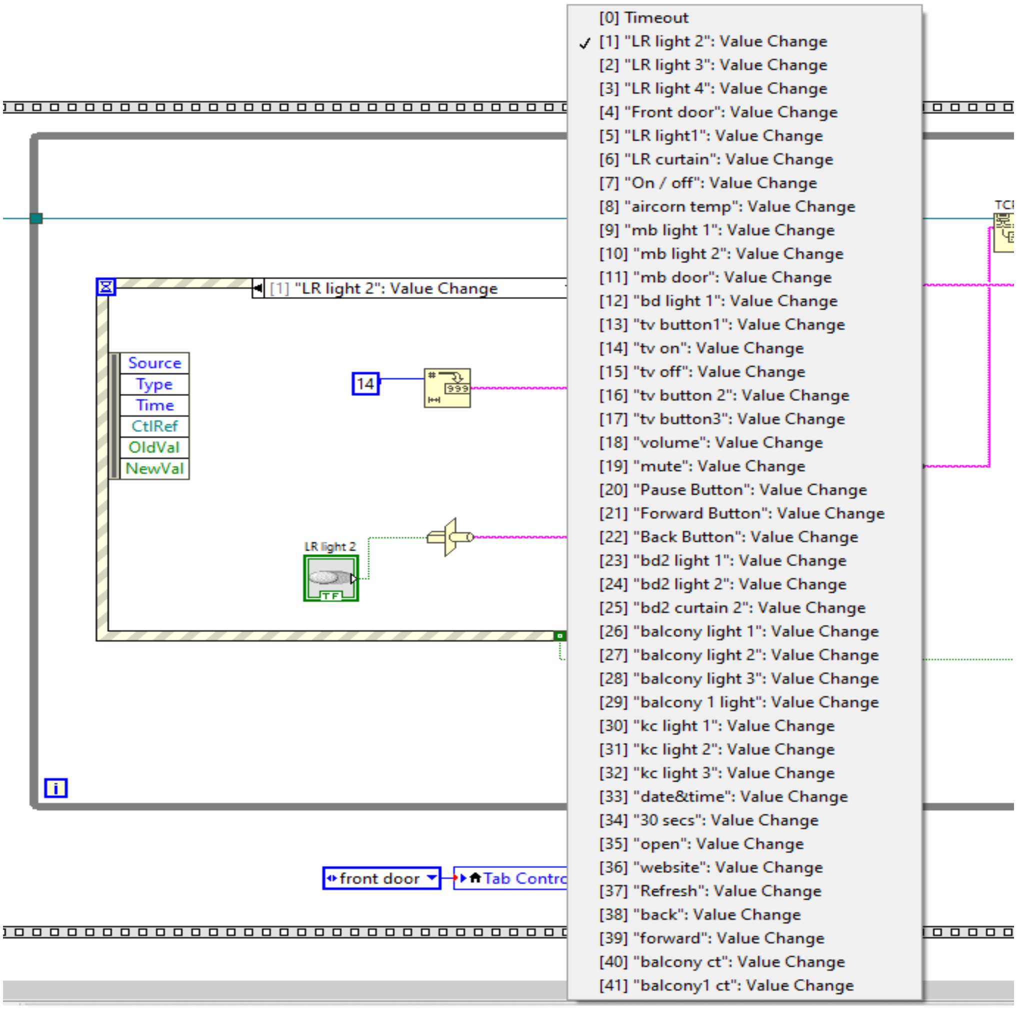

[0] Timeout
✓ [1] "LR light 2": Value Change
[2] "LR light 3": Value Change
[3] "LR light 4": Value Change
[4] "Front door": Value Change
[5] "LR light1": Value Change
[6] "LR curtain": Value Change
[7] "On / off": Value Change
[8] "aircorn temp": Value Change
[9] "mb light 1": Value Change
[10] "mb light 2": Value Change
[11] "mb door": Value Change
[12] "bd light 1": Value Change
[13] "tv button1": Value Change
[14] "tv on": Value Change
[15] "tv off": Value Change
[16] "tv button 2": Value Change
[17] "tv button3": Value Change
[18] "volume": Value Change
[19] "mute": Value Change
[20] "Pause Button": Value Change
[21] "Forward Button": Value Change
[22] "Back Button": Value Change
[23] "bd2 light 1": Value Change
[24] "bd2 light 2": Value Change
[25] "bd2 curtain 2": Value Change
[26] "balcony light 1": Value Change
[27] "balcony light 2": Value Change
[28] "balcony light 3": Value Change
[29] "balcony 1 light": Value Change
[30] "kc light 1": Value Change
[31] "kc light 2": Value Change
[32] "kc light 3": Value Change
[33] "date&time": Value Change
[34] "30 secs": Value Change
[35] "open": Value Change
[36] "website": Value Change
[37] "Refresh": Value Change
[38] "back": Value Change
[39] "forward": Value Change
[40] "balcony ct": Value Change
[41] "balcony1 ct": Value Change
[1] "LR light 2": Value Change
Source
Type
Time
CtlRef
OldVal
NewVal
14
LR light 2
front door
Tab Contro
TCI

Figure 4.3.2

Figure 4.3.1 shows the case structure on the server side, which can receive the two bytes of declared variables from the client side as shown in Figure 4.3.2 and match them with the specific case to perform actions. The table below shows the case number and its actions.

Case number	action
0	Default time out, stop the while loop
11	front door on/off
12	Control living room light 1
13	Control living room curtain
14	Control living room light 2
15	Control living room light 3
16	Control living room light 4
17	Air conditioning on/off

18	Air conditioning temperature
19	Control master bedroom light 1
20	Control master bedroom light 2
21	Master bedroom door open/close
22	Control bedroom 1 light
23	Television channel 1
24	Television on
25	Television stop
26	Television channel 2
27	Television channel 3
28	Control television volume
29	Mute television
30	Pause television
31	Fast forward television
32	Reverse television
33	Control bedroom 2 light 1
34	Control bedroom 2 light 2
35	Control bedroom 2 curtain
36	Control balcony light 1
37	Control balcony light 2
38	Control balcony light 3
39	Control balcony 1 light 1
40	Control kitchen light 1
41	Control kitchen light 2
42	Control kitchen light 3
43	Get local date and time
44	30 second timer
45	Open web browser
46	Search URL in web browser
47	Refresh web browser
48	Go back to the previous page of web browser
49	Go forward page of web browser

50	Control balcony curtain
51	Control balcony 1 curtain

Table 4.3.1

5.0 Features Prototype Design

5.1 Login authentication

The login authentication in the client side is separated into 2 parts, register and login.

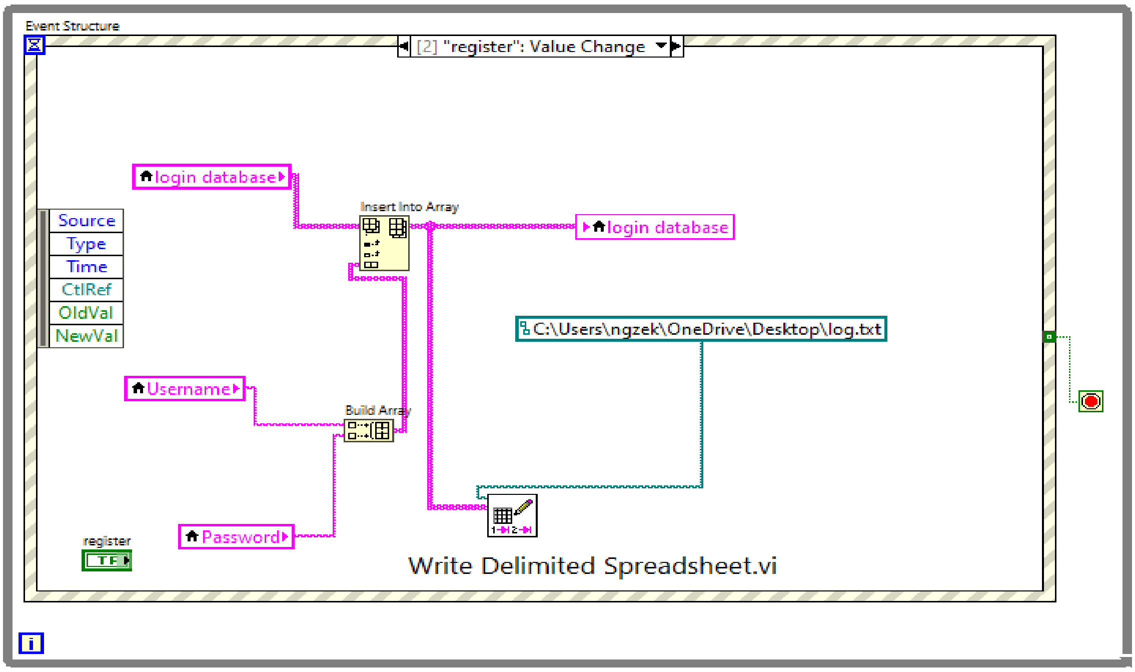


Figure 5.1.1

The figure above shows the programme design for users to register. The username and password for the user input are combined and become an array by using "build array." After that, the array will be added to a table called "login database" and be written into a text file.

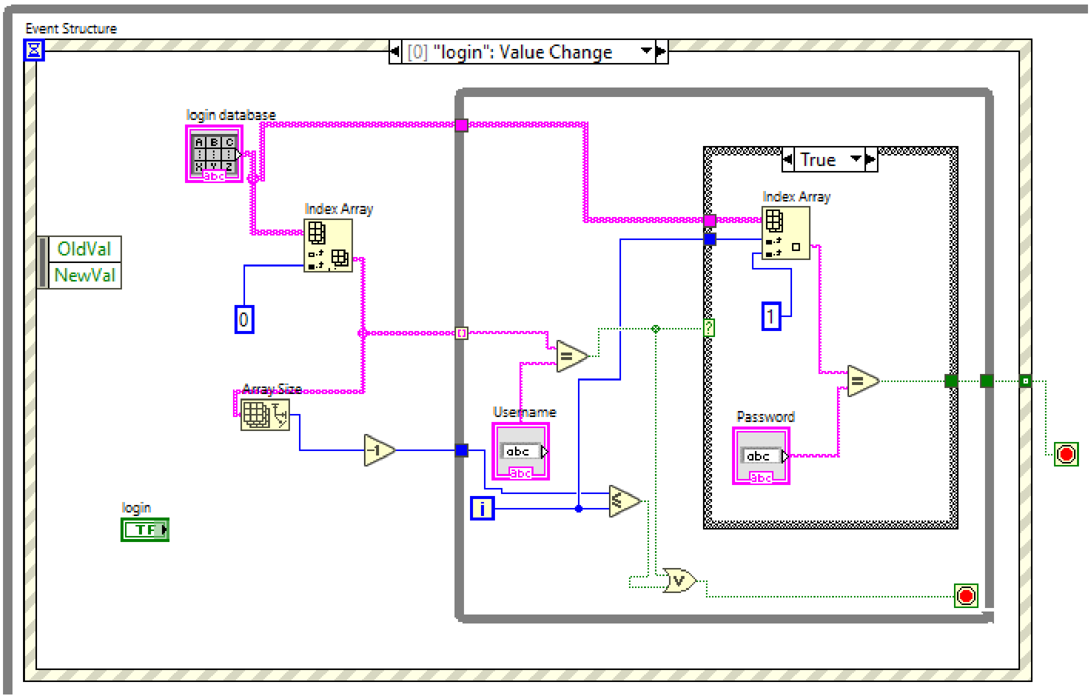


Figure 5.1.2

To begin the user login process, the system will divide the table data into two parts: the username and password. The system will match the username input with the existing username; if it is able to match, the system will then match the password. The user can log into the system if the password input is matched.

5.2 Door and Light

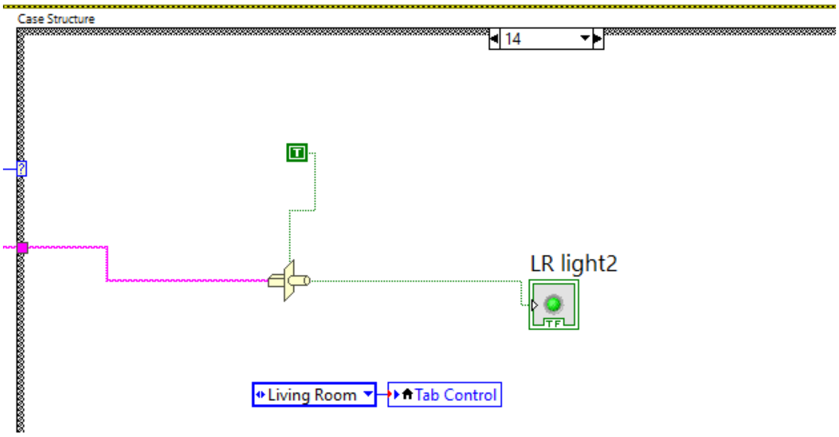


Figure 5.2.1

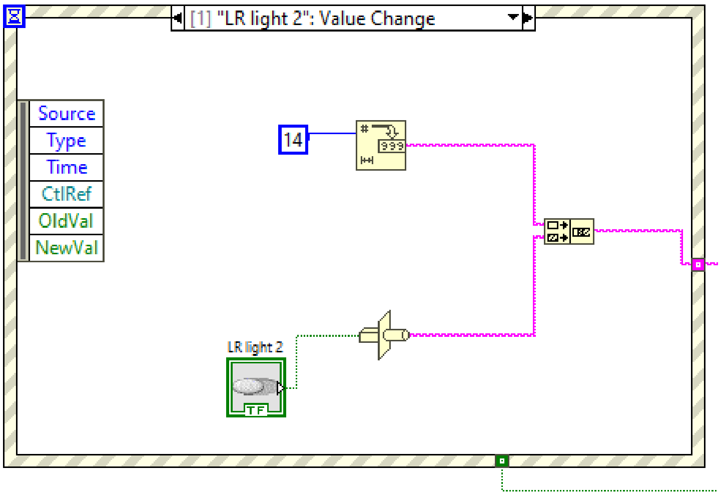


Figure 5.2.2

For the smart home control lighting and door system, the two bytes declared variables and Boolean button will be written into the TCP on the client side, as shown in figure 5.2.2. After that, figure 5.2.1 shows the server side will receive the Boolean value and bytes from the client side to determine whether a light is on or off.

5.3 Curtain

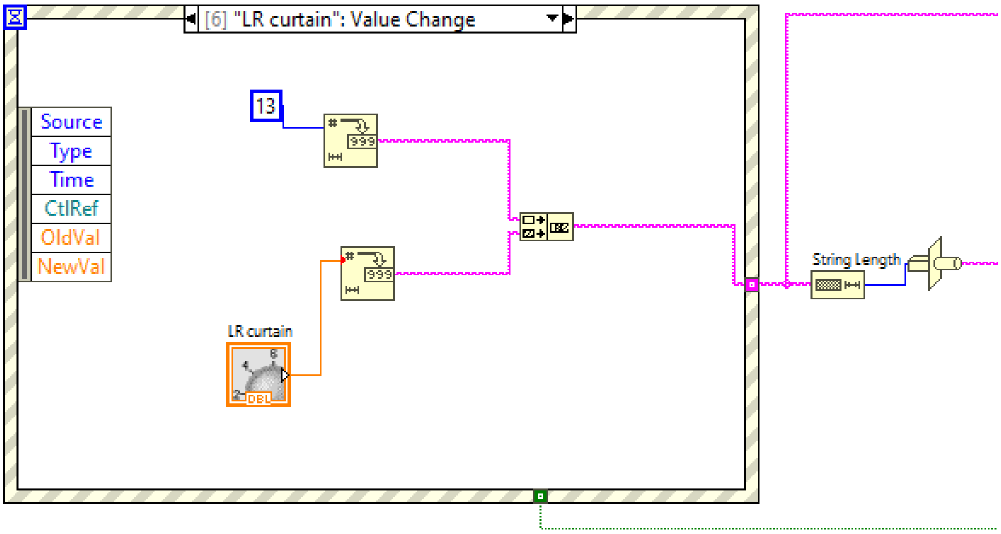


Figure 5.3.1

For the smart home control curtain system, the two bytes declared variables and the numeric control will be converted to string and write in to the TCP as shown in the figure above.

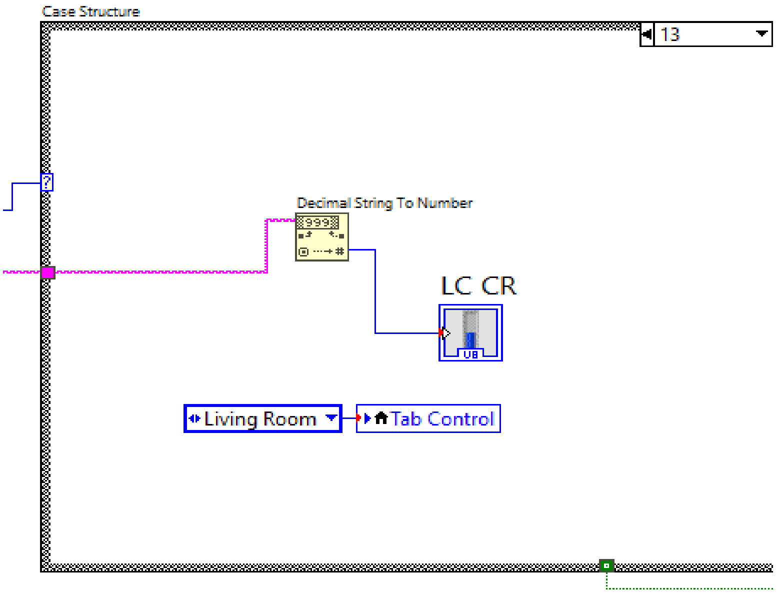


Figure 5.3.1

The figure above shows the received string will be converted into a number, and the value will be used to control the curtain.

5.4 Television

Channel selects

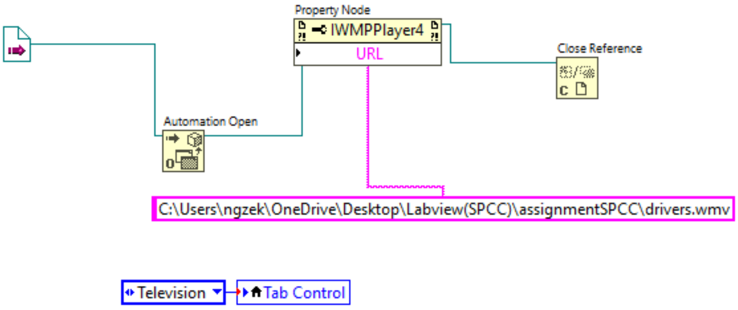


Figure 5.4.1

Figure 5.4.1 shows the program design for channel select in the television. A URL property node from window media player is used to read the video string.

Television on/off

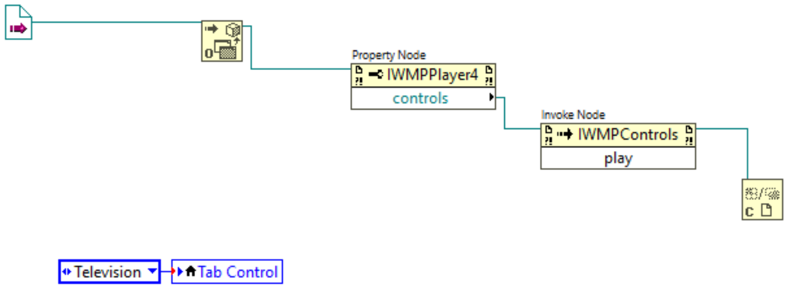


Figure 5.4.2

Figure 5.4.2 shows the program design for open and close the television by using control property code and invoke code from window media player.

Volume control

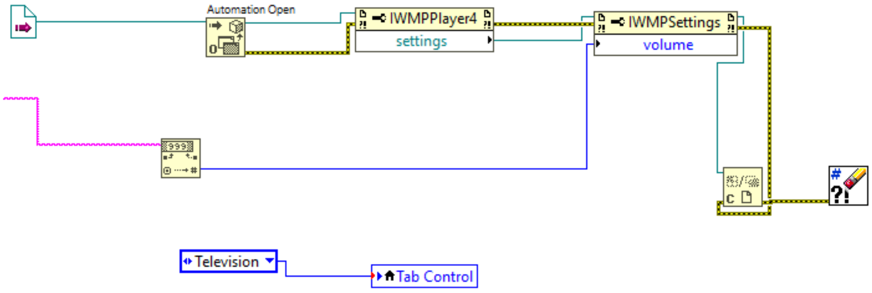


Figure 5.4.3

For the volume control function, the volume property node will receive the numeric value from the client side and make changes to the volume.

Mute

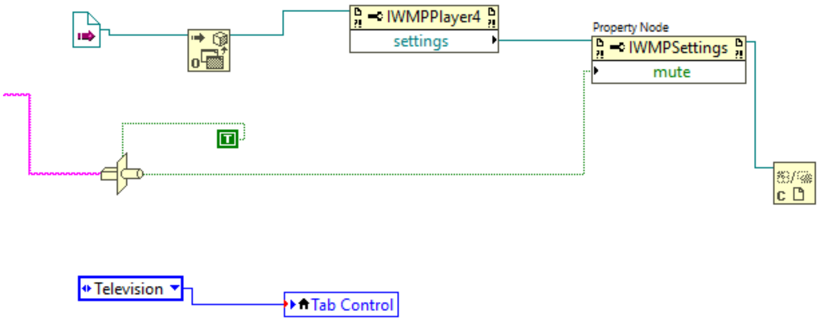


Figure 5.4.4

For the volume mute function, the mute property node will receive the Boolean value from the client side and mute or unmute the television.

Pause

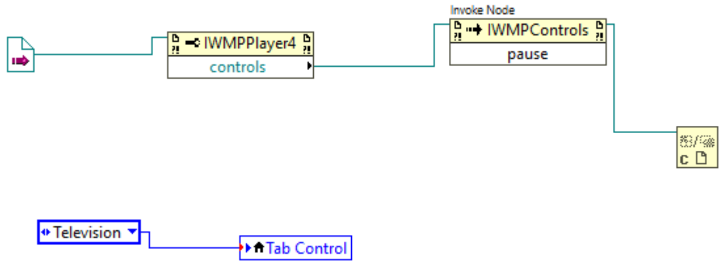


Figure 5.4.5

For the pause function, the pause property node will receive the Boolean value from the client side and pause the television.

Fast forward

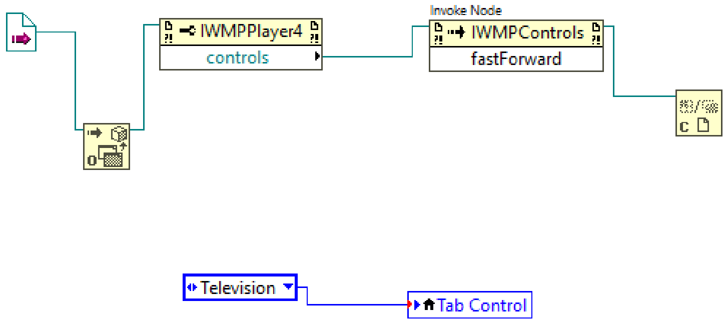


Figure 5.4.6

For the fast forward function, the “fastForward” property node fast forward the television media when the client clicks on fast forward button.

Backward

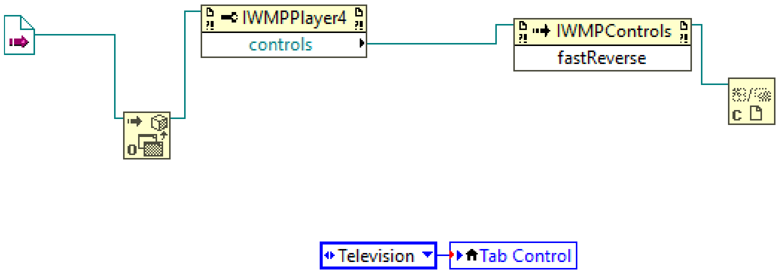


Figure 5.4.7

For the backward function, the “fastReverse” property node fast forward the television media when the client clicks on backward button.

6.0 Additional Features

Web browser

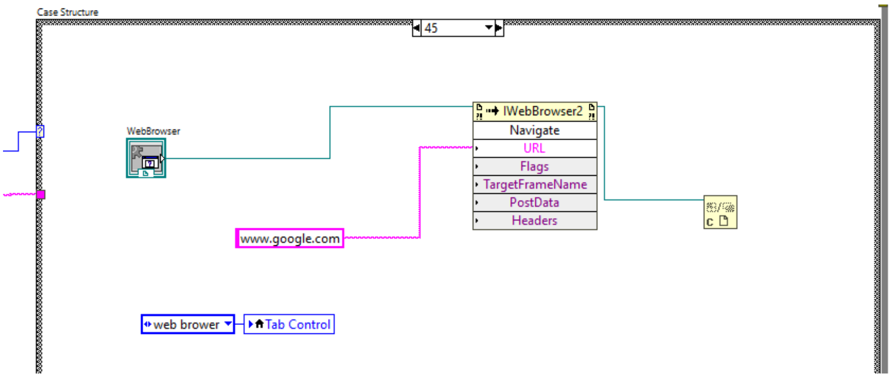


Figure 6.1

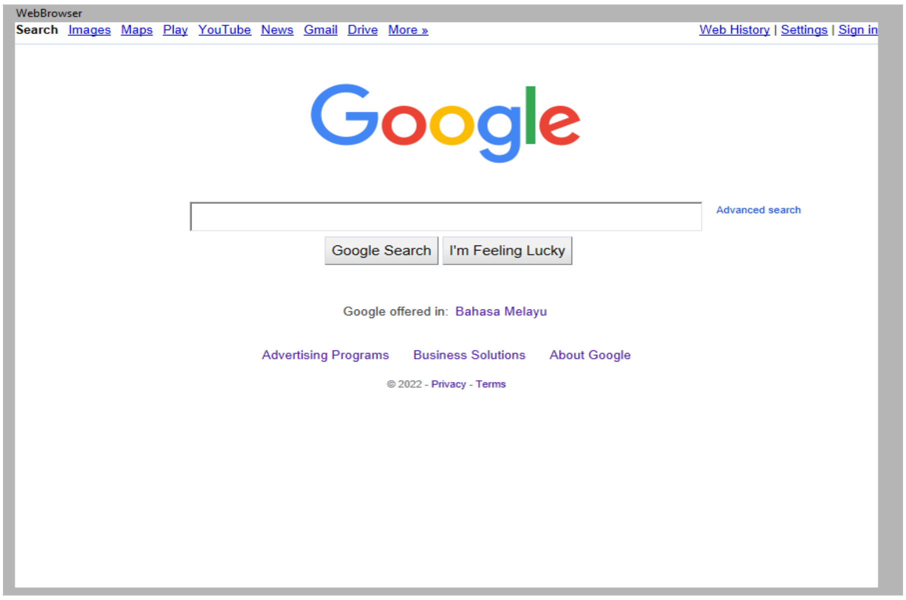


Figure 6.2

The figure above shows the programme design for accessing the web browser. The default web browser under ".NET & Active X" is used as the reference for the navigate invoke node, which can read the URL link and display the result. The default web browser for this project is set as Google.com.

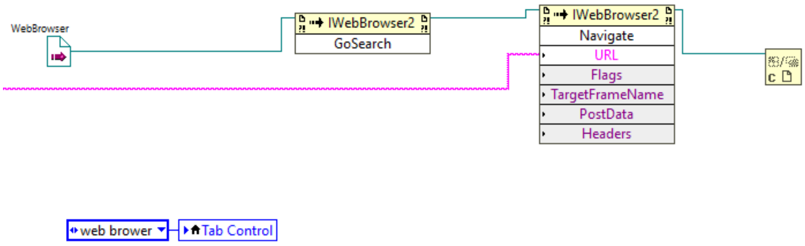


Figure 6.3

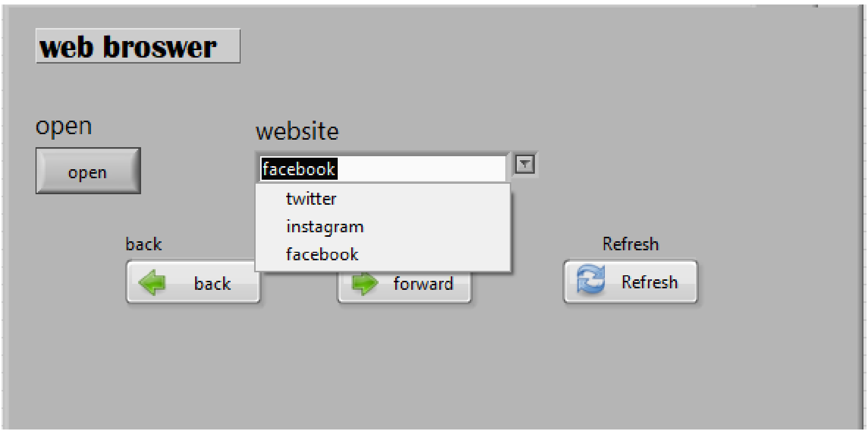


Figure 6.4

Moreover, the web browser in this smart home system allowed the user to save their favourite website as a URL link in a combo box. When the user selects the website in the combo box, the web browser will search the respective URL link and display the result.

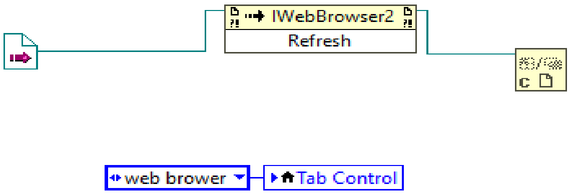


Figure 6.5

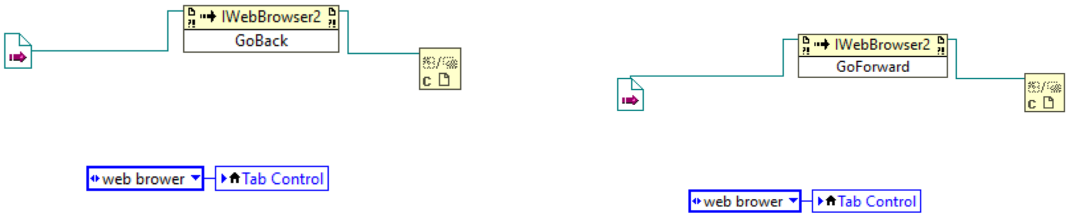


Figure 6.6

In addition, the web browser has extra features such as the ability to refresh the web page, go back to the previous page, and go forward to the next page by using invoke nodes, as shown in the figures above.

30 seconds timer

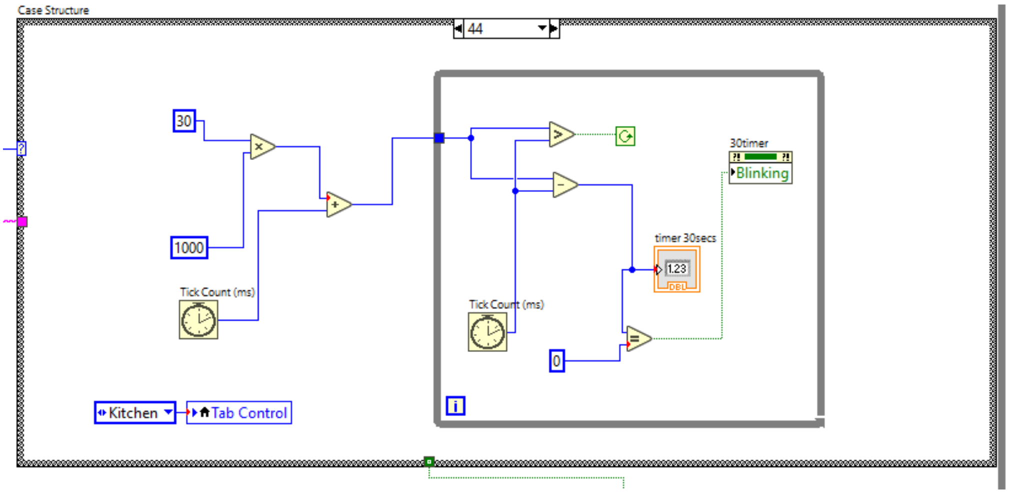


Figure 6.7

The figure above shows the program design for the 30 seconds timer.

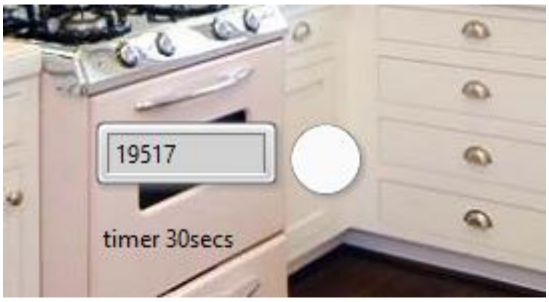


Figure 6.8

When the user clicks on the countdown timer, the remaining time will be displayed on a numeric indicator as shown in figure 6.8.

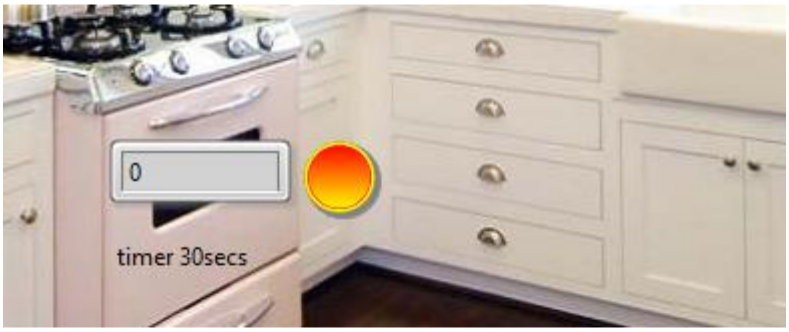


Figure 6.9

Once the timer is stopped, a blinking LED light will be activated and start to blink.

E-clock

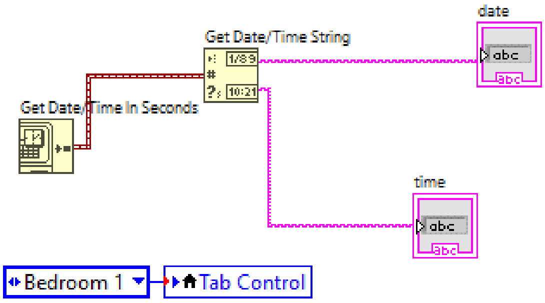


Figure 6.10

Based on the figure above, the default function "get date/time in seconds" in LabView is used to get the local date and time. Once the system receives the local date and time data, it will convert it into string values so that it can be displayed on the server side.

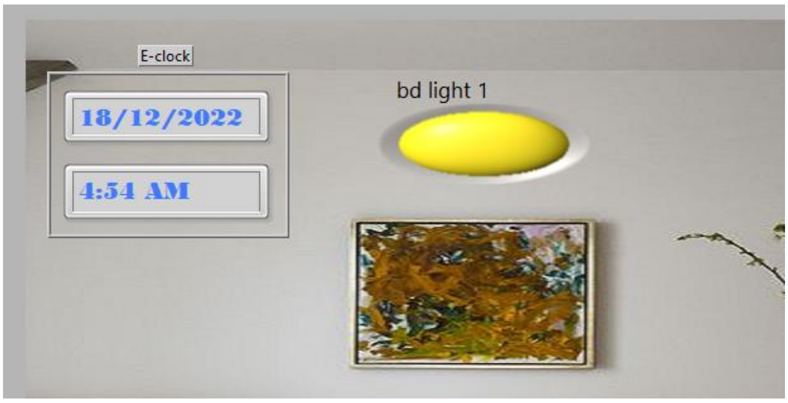


Figure 6.11

The figure above shows the local date and time are displayed on the server side.

Air conditioning

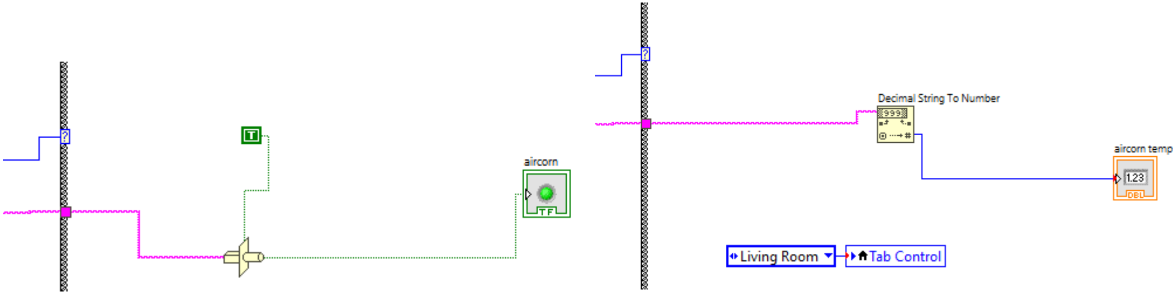


Figure 6.12

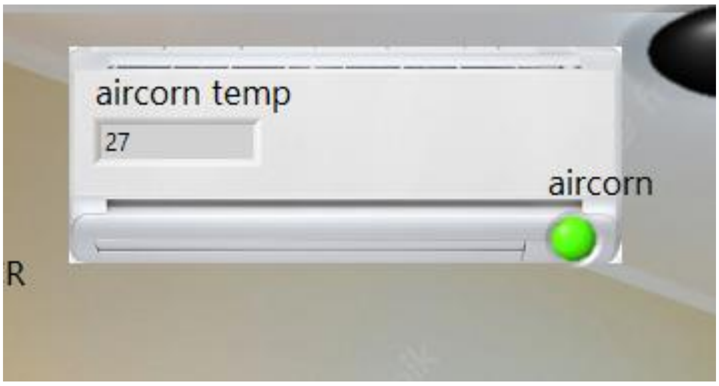


Figure 6.13

Figures above shows the air conditioning which can be on and off and adjust the temperature by the user.

7.0 Hardware Implementation

Data Acquisition

An electrical or physical phenomenon, such as voltage, current, temperature, pressure, or sound, can be measured via a method known as data acquisition (DAQ). Sensors, measuring hardware for DAQ, and programmable software for computers make up a DAQ system (ni, 2022).

DAQ System Option

NI hardware components are connected to the PC or laptop over USB or Ethernet inside a PC-based control and measurement system. There are two basic architectural options for this type of system: either link a multifunction I/O device directly to your PC or link a CompactDAQ Chassis to the PC and fill it with conditioned I/O modules. The most adaptable option with a direct sensor connection is offered by CompactDAQ.

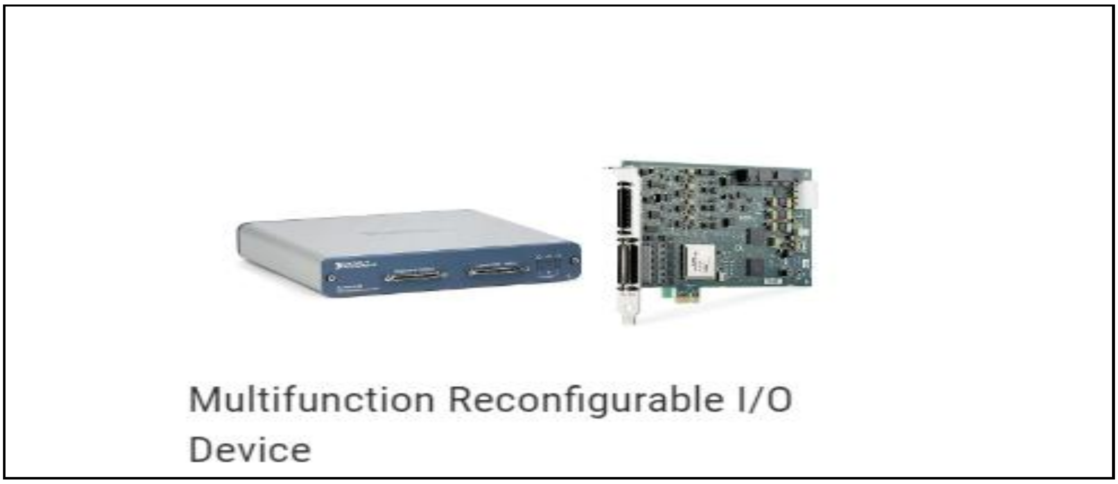


Figure 7.1

This hardware device is used to satisfy numerous typical measurement requirements, the Multifunction I/O Device offers I/O with a variety of channels, sample rates, output rates, and other characteristics.

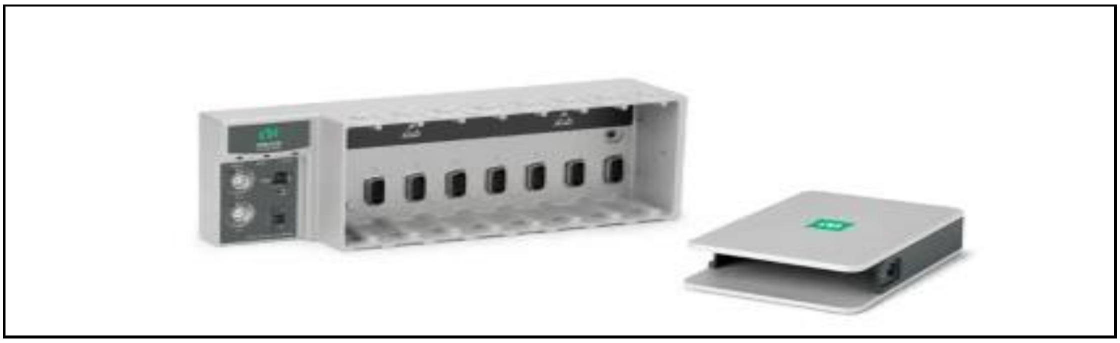


Figure 7.2

The figure shows the NI ComactDAQ Chassis. It is used to control data flow between NI C Series I/O devices and an external host in terms of timing, synchronisation, and timing. CompactDAQ Chassis provide varied slot counts and USB, Ethernet, or Connected to offer the appropriate number of I/O for diverse applications.

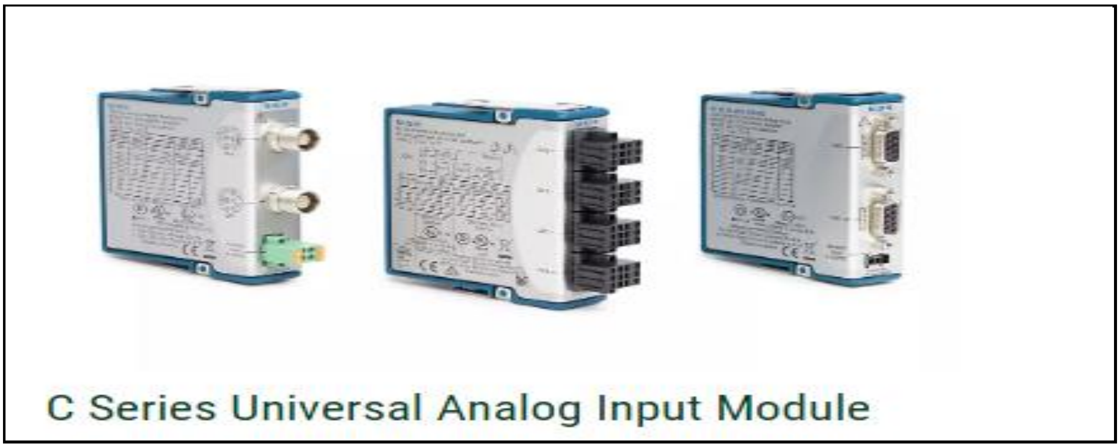


Figure 7.3

Gives CompactDAQ or CompactRIO systems access to analogue input channels for measurements of voltage, current, temperature, and strain. the user may carry out versatile measurements with the help of the C Series Universal Analog Input Module.

<u>Sensor</u>

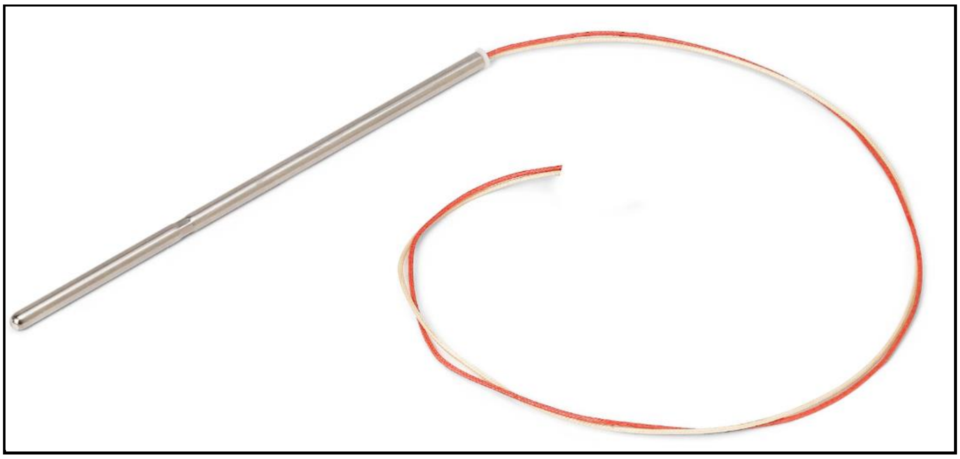


Figure 7.4

The figure above shows the temperature sensor which can be used for measuring temperature in thermocouples and resistor temperature detector (RTD) form factors to be used in data logging and data gathering systems.

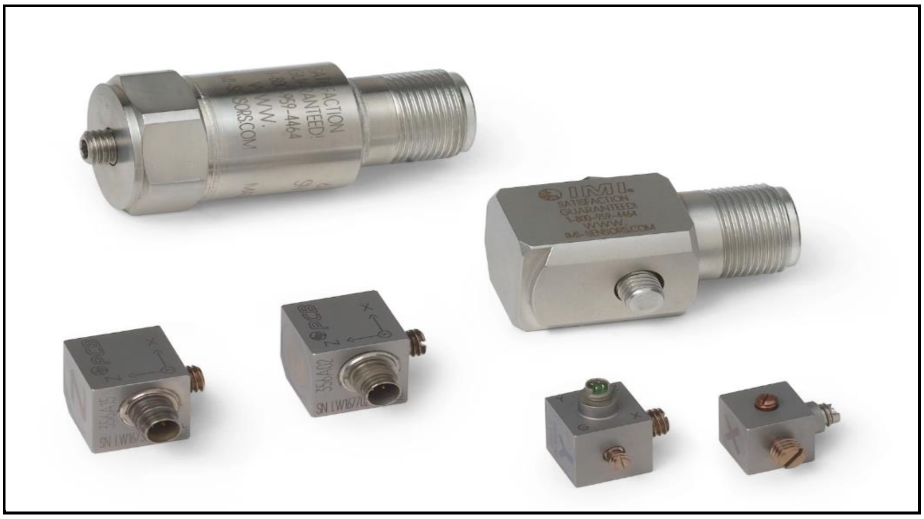


Figure 7.5

The figure above shows the vibrator sensor which can be used to offer acceleration and vibration measurements using integrated electronic piezoelectric (IEPE) in a variety of form factors.

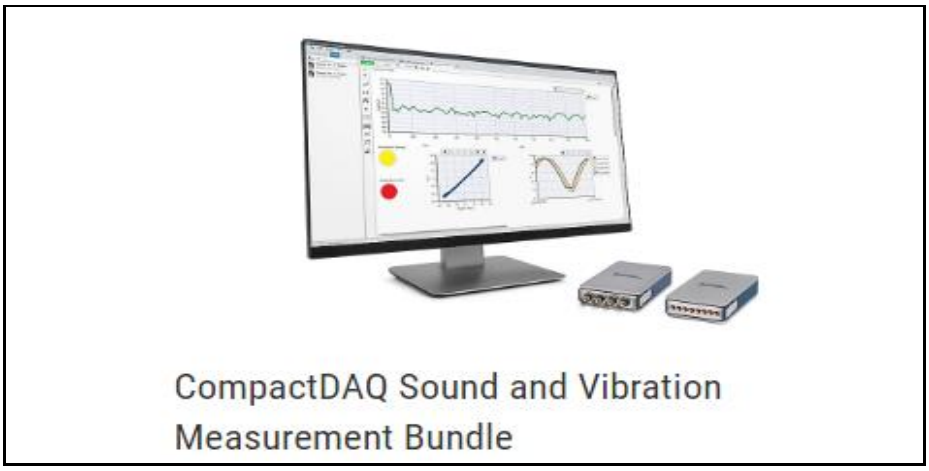


Figure 7.6

The C Series Sound and Vibration Input Module and a CompactDAQ Chassis are both parts of the CompactDAQ Sound and Vibration Measurement Bundle. With the CompactDAQ Sound and Vibration Measuring Bundle, you may measure signals from integrated electronic piezoelectric (IEPE) and non-IEPE sensors like accelerometers, tachometers, and proximity probes using a compact, USB-based sensor measurement device.

8.0 User Manual

Client

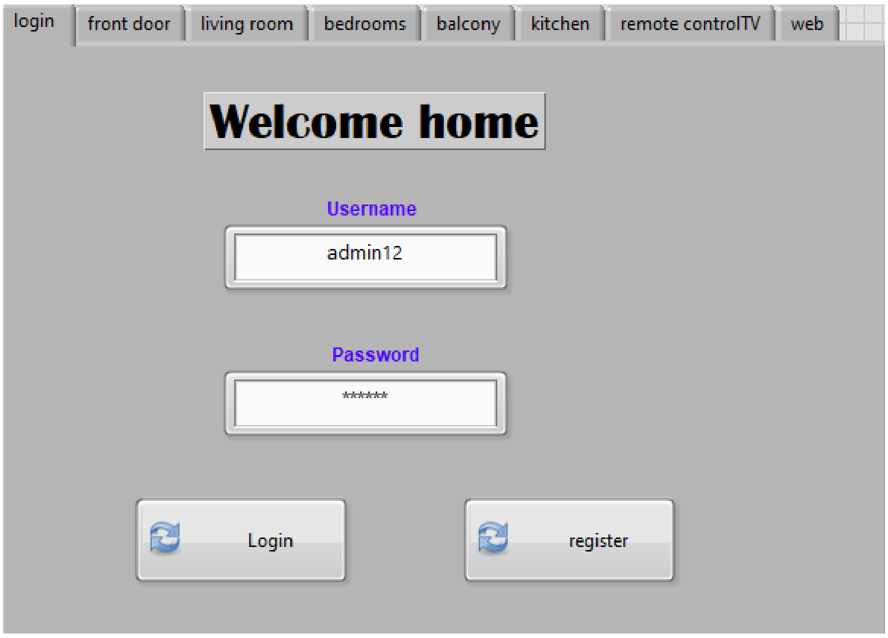
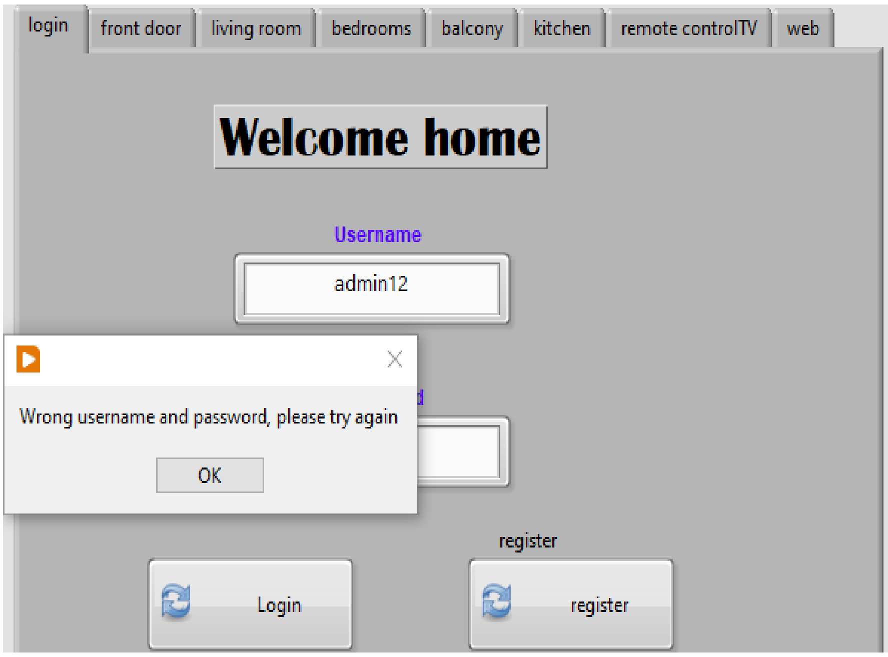


Figure 8.1

Firstly, before entering the system, the user needs to enter the correct username and password in order to login into the smart home system. Besides that, the user can click on the "register" button to save the username and password into the database.



Wrong username and password, please try again

Figure 8.2

If the user enters the wrong username or password, an error message will be popping out and the user is not allowed to enter to the system.

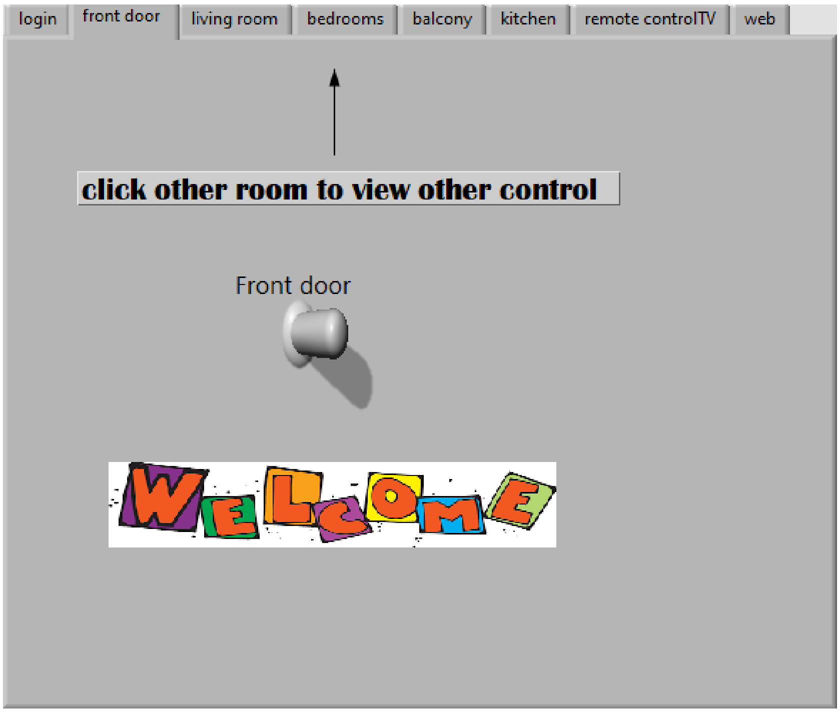


Figure 8.3

if the user login succeeded, figure 8.3 will be displayed and the user can turn on the front door light.

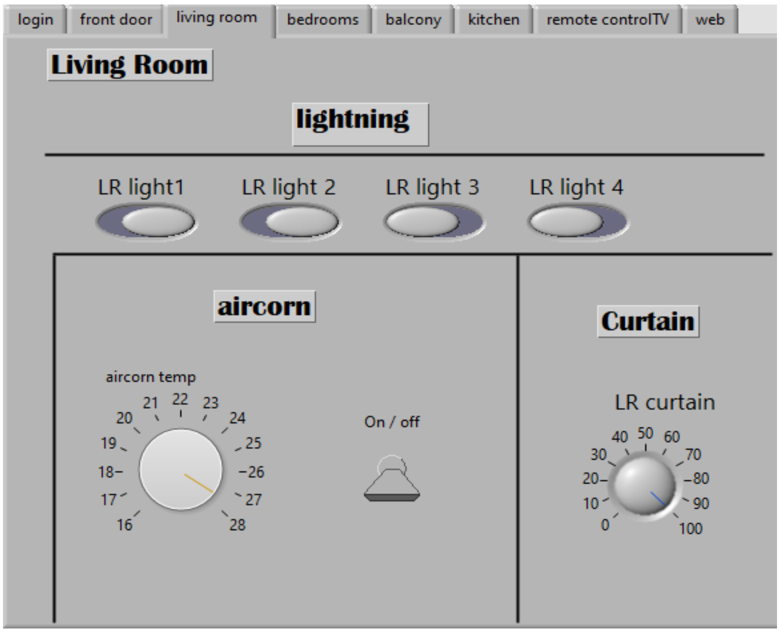


Figure 8.4

On the living room control page, the user can control multiple lights, the curtain, and the air conditioning by clicking on the button and changing the value on the switch.

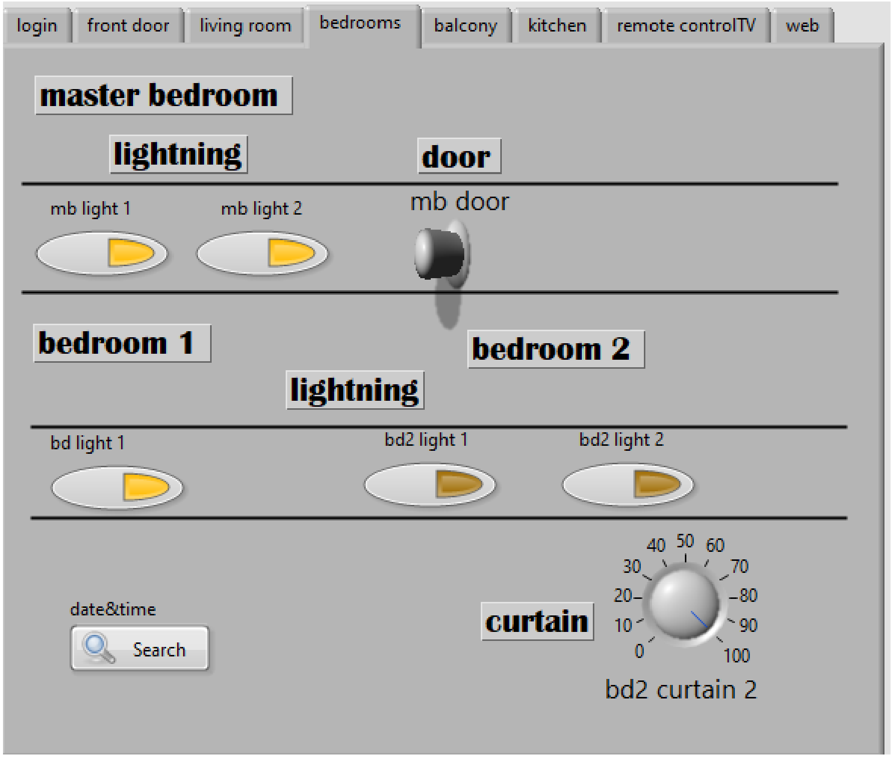


Figure 8.5

There are 2 sections on the bedrooms control page, the master bedroom and bedroom 1& 2. the user can get the local date and time on bedroom 1 by clicking the search button in this page.

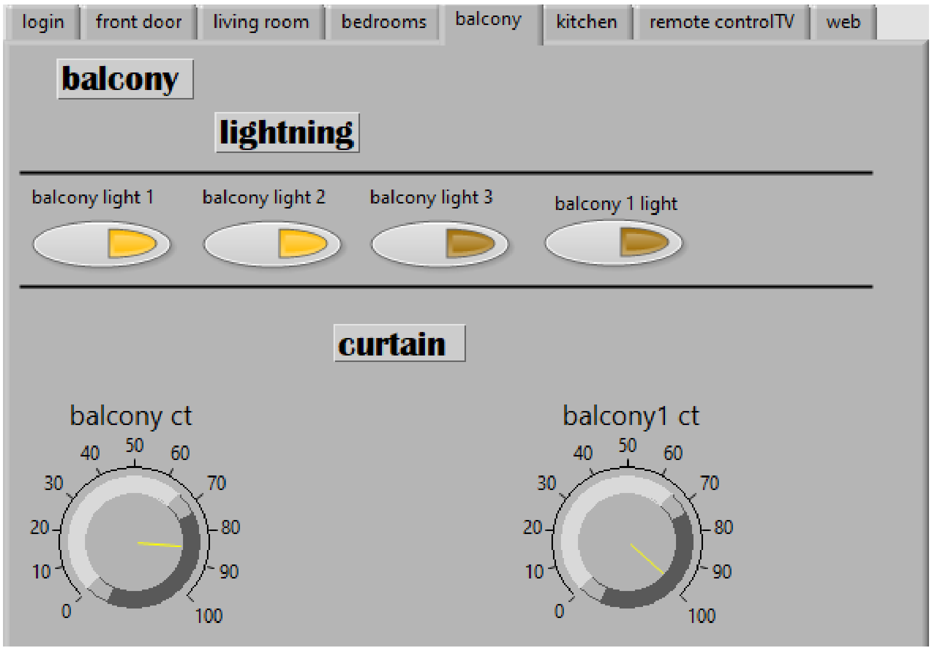


Figure 8.6

The figure above shows the balcony control page in the smart home system.

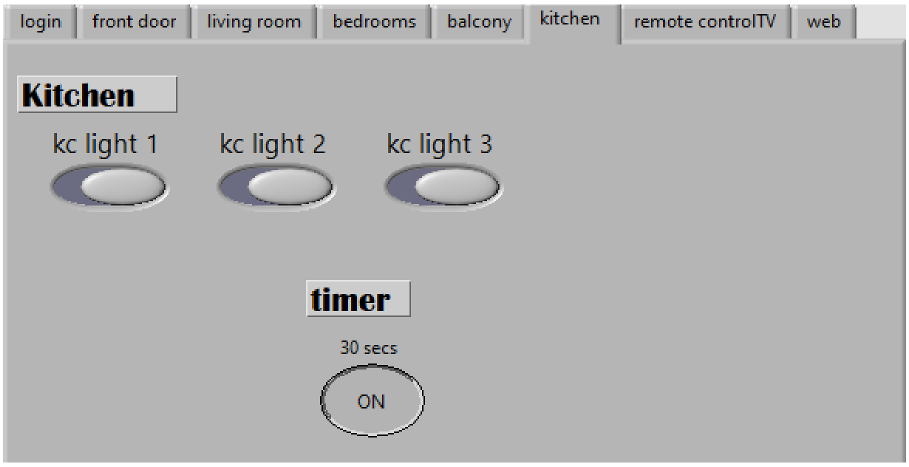


Figure 8.7

On the kitchen control page, the user can control lights and activate a 30 second timer.

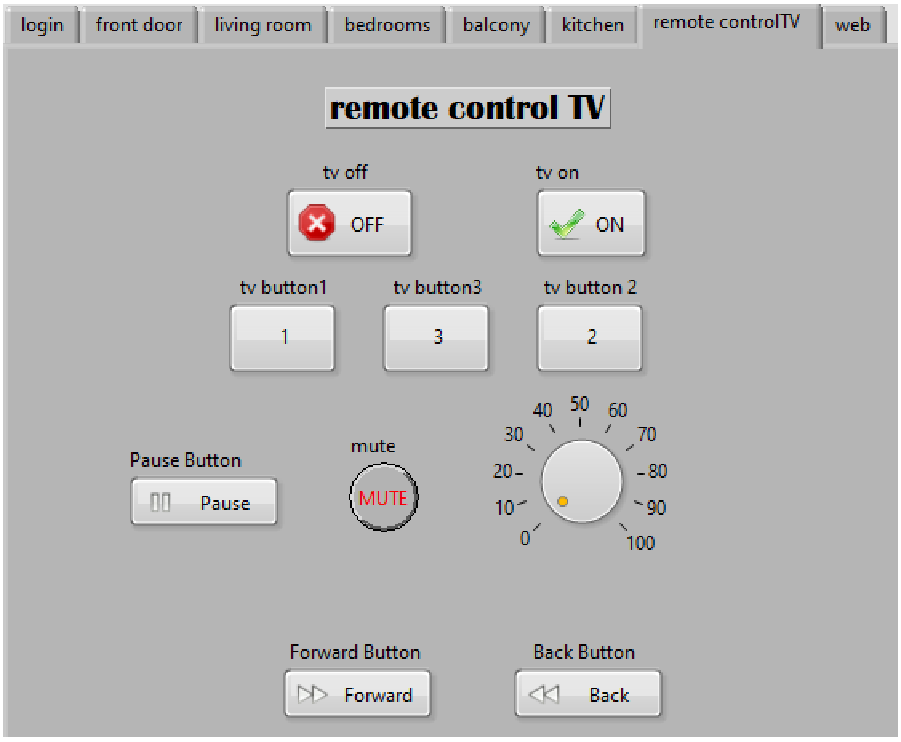


Figure 8.8

The figure 8.8 shows the remove control TV in the smart home system. The user is allowed to turn on, turn off, select channel, pause, mute, control volume, fast forward, and backward the television by clicking buttons in this page.

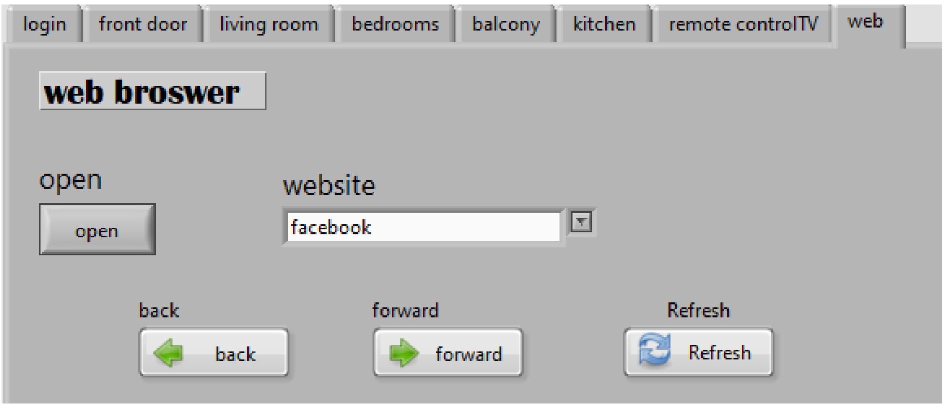


Figure 8.9

For the web browser control page, the user can open the web browser, select website from combo box, go back to the previous page, forward to the next page and refresh web page.

<u>Server</u>

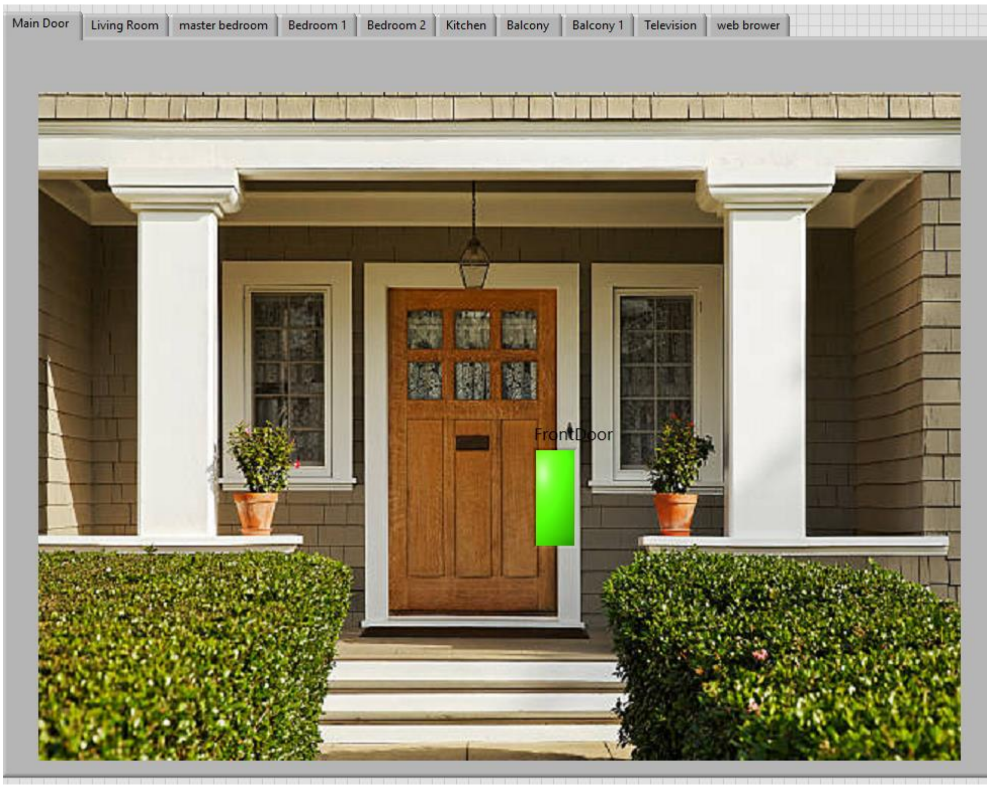


Figure 8.10 front door

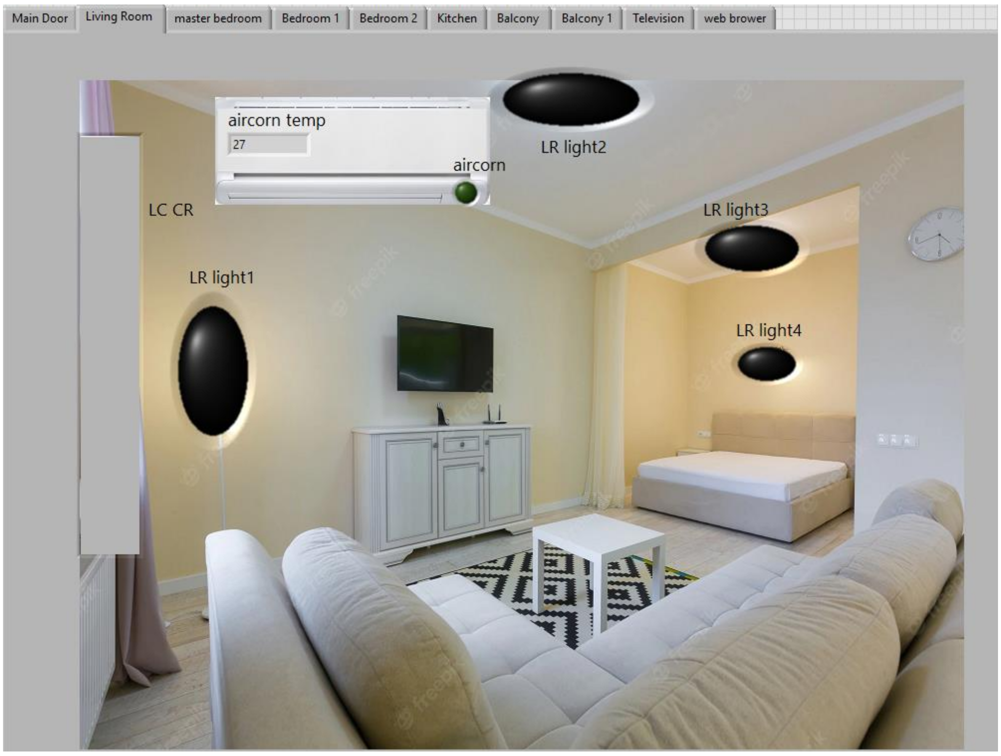


Figure 8.11 living room

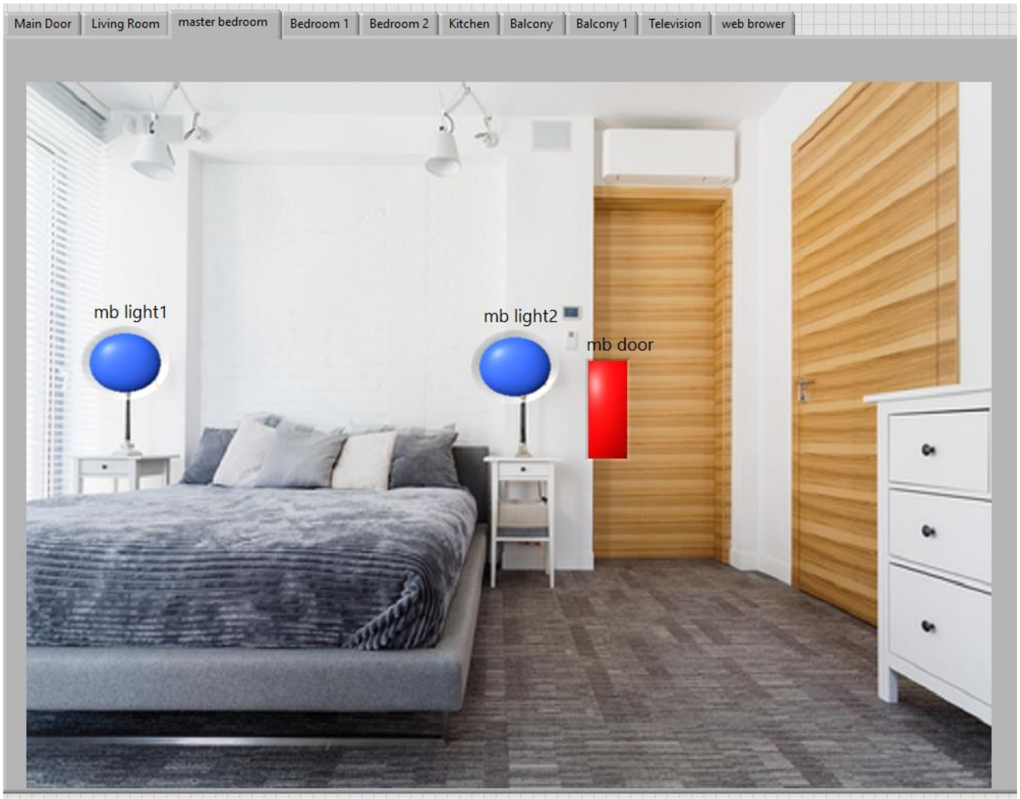


Figure 8.12 master bedroom

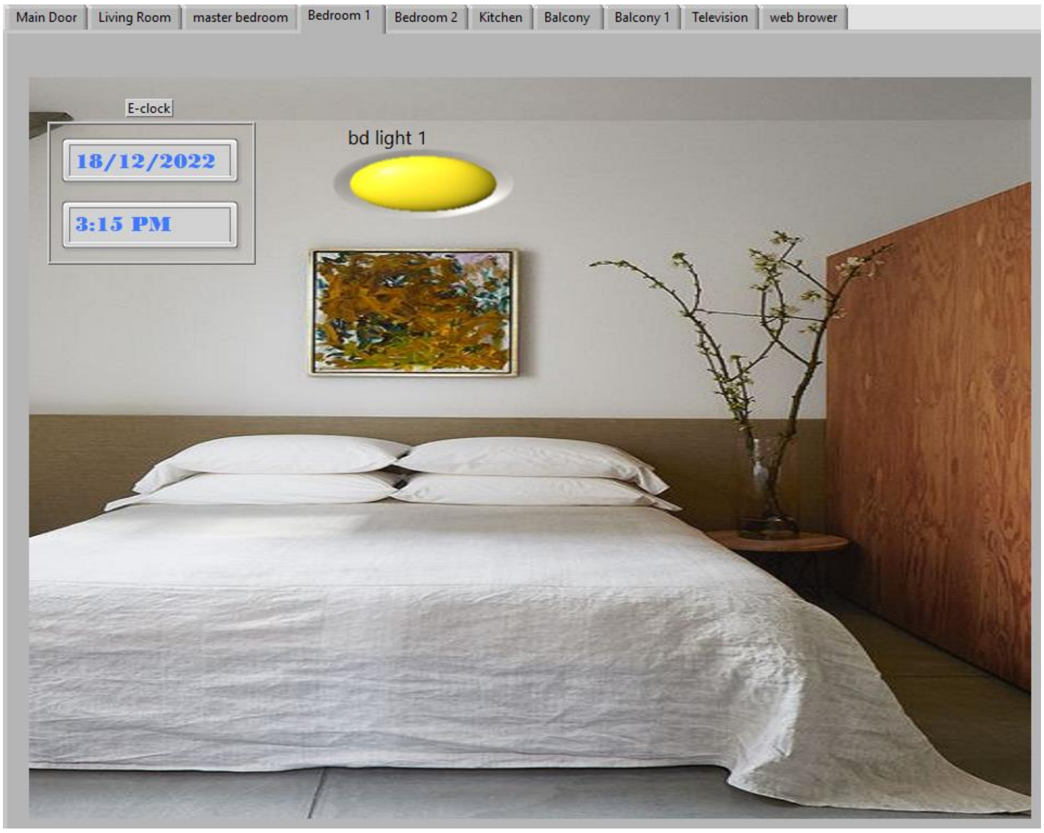


Figure 8.13 bedroom 1

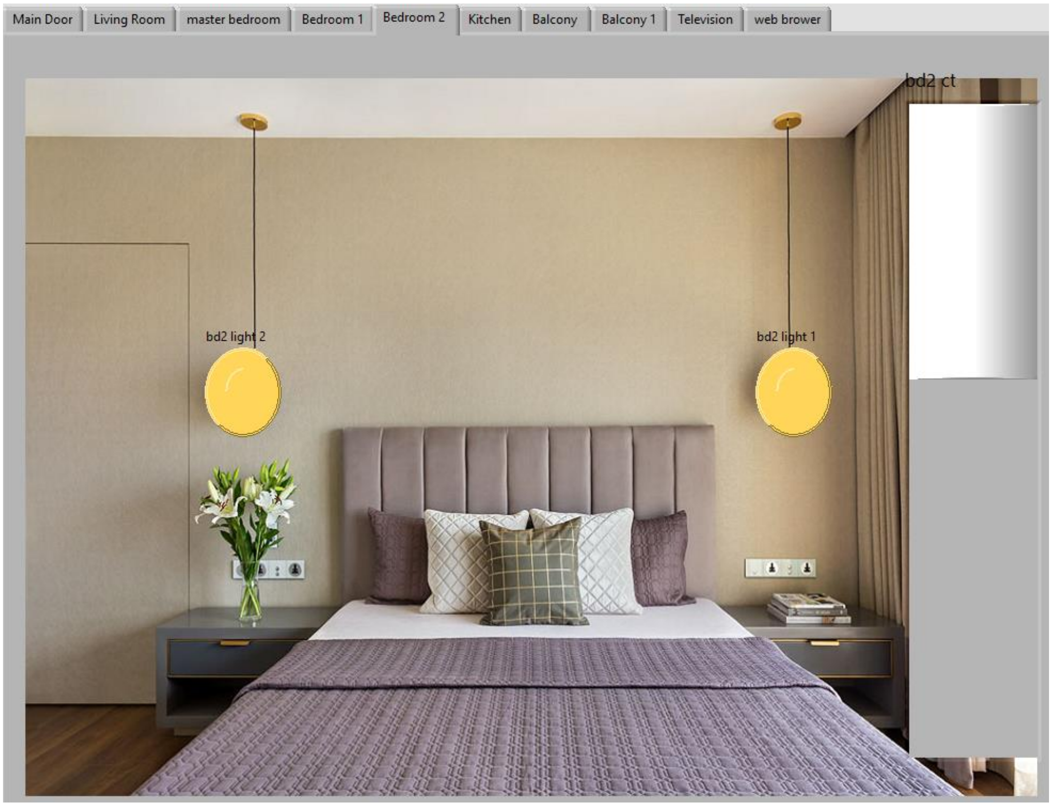


Figure 8.14 bedroom 2

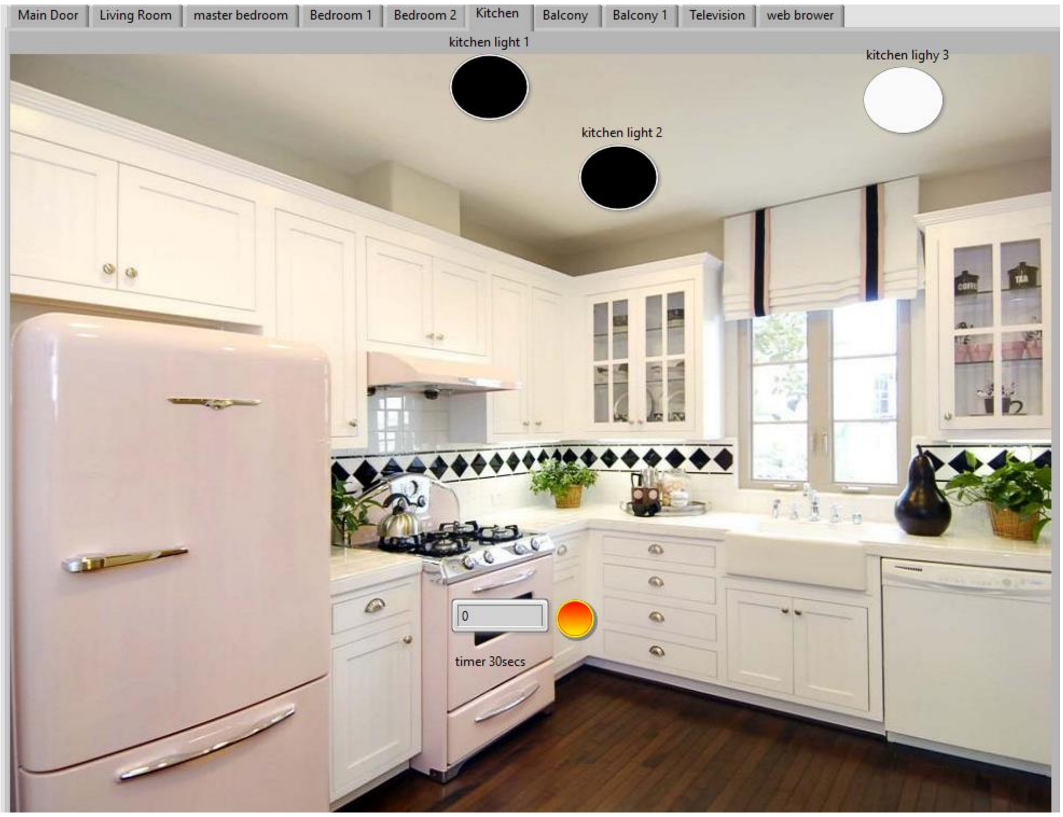


Figure 8.15 kitchen

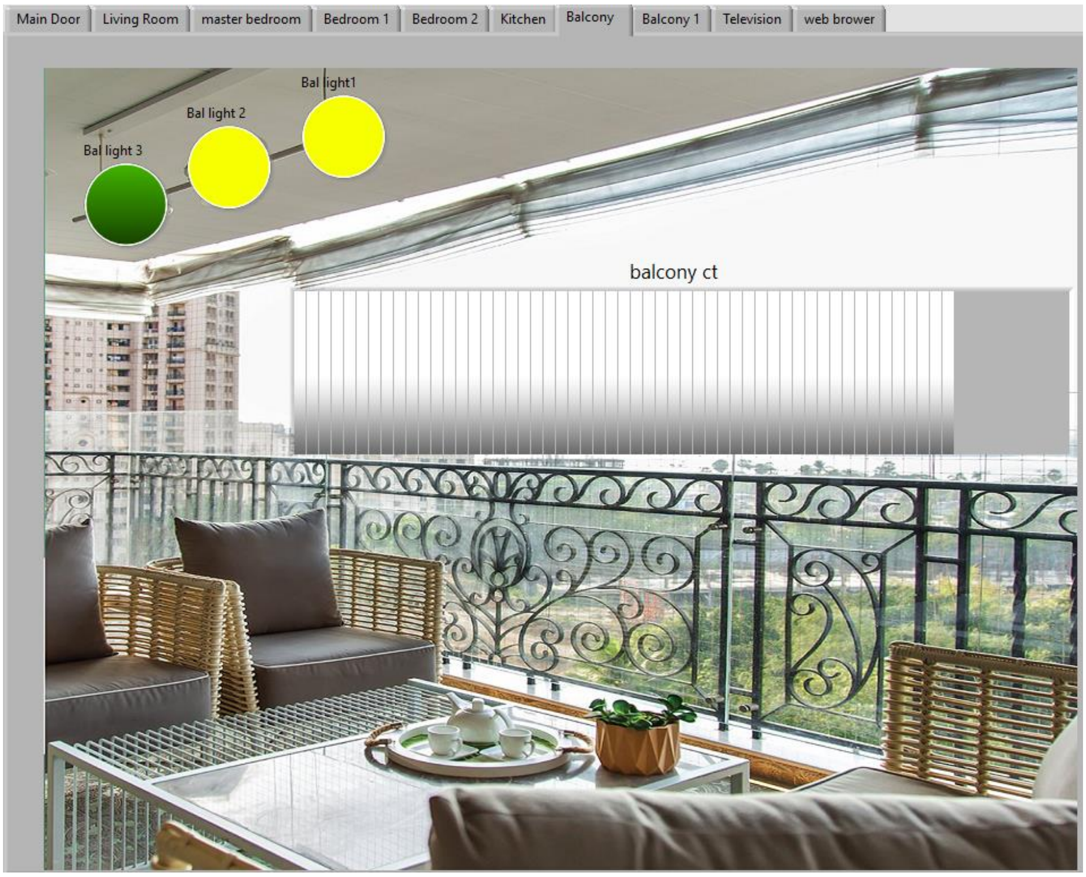


Figure 8.16 balcony

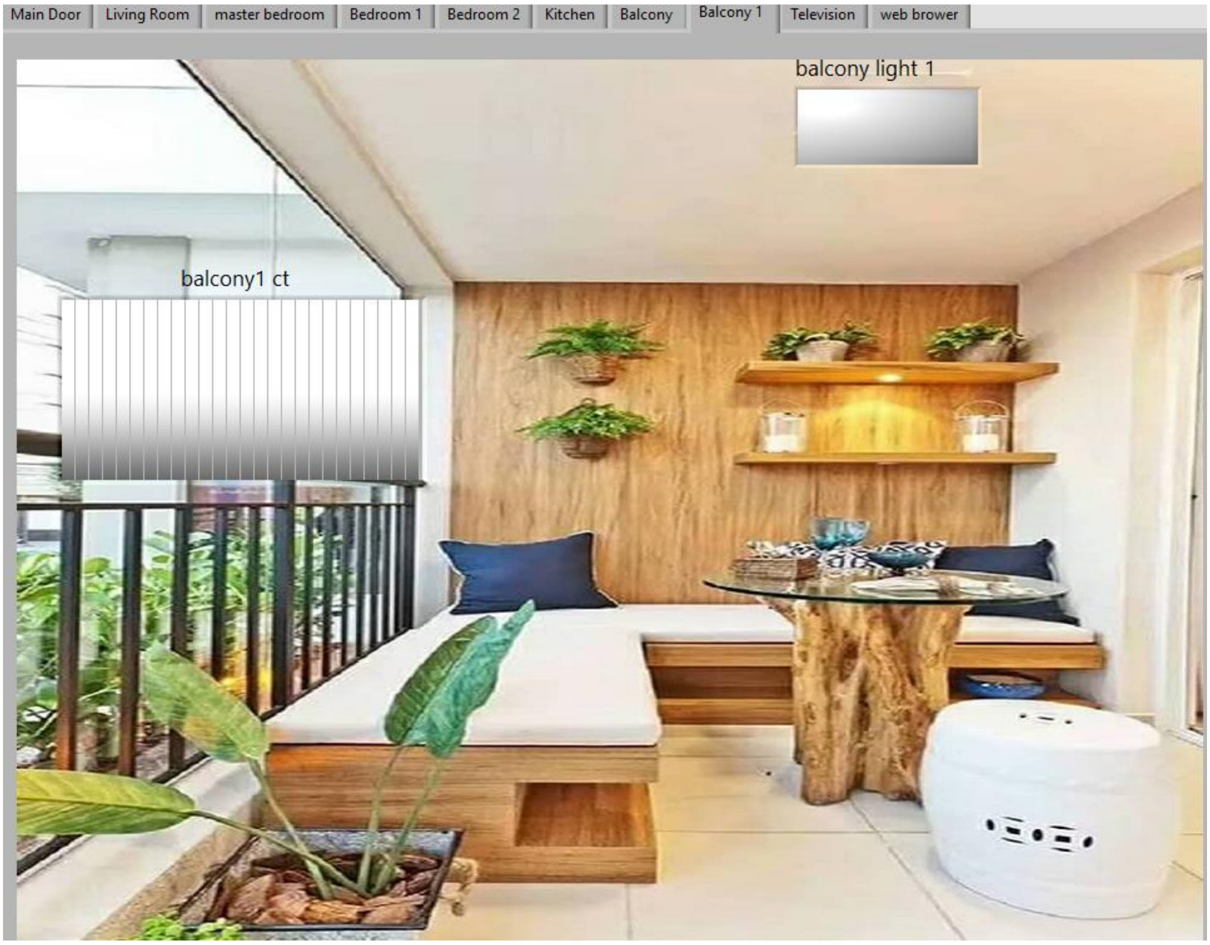


Figure 8.17 balcony 1

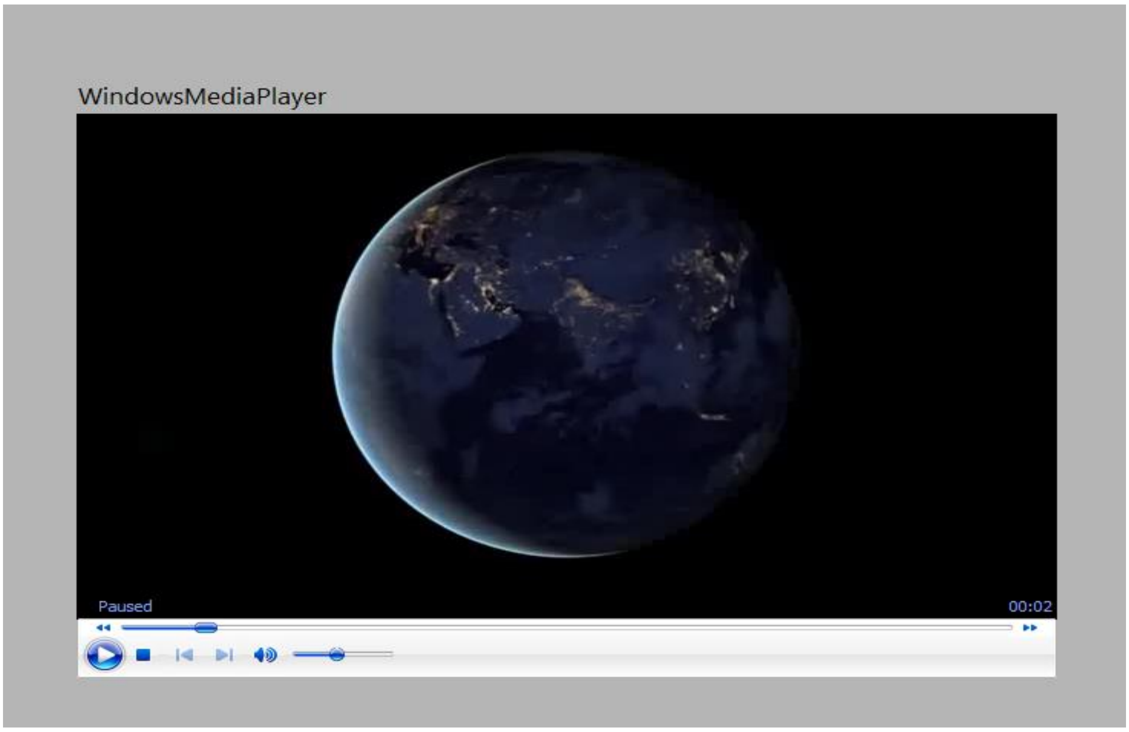


Figure 8.18 television

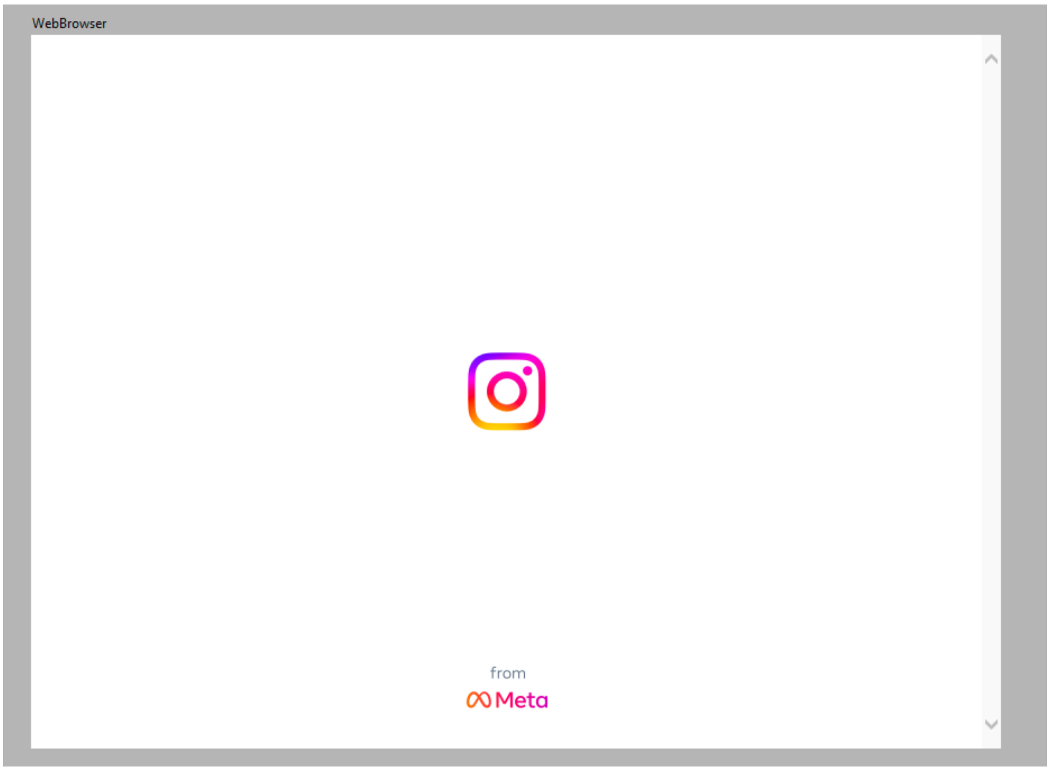


Figure 8.19 web browser

9.0 Reference

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Picture

Front door:

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.istockphoto.com%2Fphotos%2Ffront-door-of-house&psig=AOvVaw0glNVeB8r7udNdVg0E-R9C&ust=1671436348429000&source=images&cd=vfe&ved=0CA8QjRxqFwoTCOiVhOHXgvwCFQAAAAAdAAAAABAE

living room:

https://www.google.com/imgres?imgurl=https%3A%2F%2Fimg.freepik.com%2Fpremium-photo%2Fliving-room-interior-with-large-sofa-tv-with-purple-curtains-modern-style-light-colors_321831-5593.jpg&imgrefurl=https%3A%2F%2Fwww.freepik.com%2Fpremium-photo%2Fliving-room-interior-with-large-sofa-tv-with-purple-curtains-modern-style-light-colors_18674647.htm&tbnid=OSuMFXQfRtSG9M&vet=12ahUKEwjbpJiE2IL8AhWLi9gFHVD0BZcQMygTegUIARDsAQ..i&docid=0-9sAd2YtM_XuM&w=626&h=417&q=living%20room%20with%20tv%20light%20curtains&ved=2ahUKEwjbpJiE2IL8AhWLi9gFHVD0BZcQMygTegUIARDsAQ

balcony:

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.magicbricks.com%2Fblog%2Fbest-balcony-grill-design-ideas%2F118306.html&psig=AOvVaw1lw2tr8nDxY-PrWF2Fs-Qt&ust=1671436454052000&source=images&cd=vfe&ved=0CBAQjRxqFwoTCNj92JLYgvwCFQAAAAAdAAAAABAE

master bedroom:

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.magicbricks.com%2Fblog%2Fbedroom-door-design-ideas%2F120559.html&psig=AOvVaw1WVn0mx0V9UFWe0uIwWQQg&ust=1671436559114000&source=images&cd=vfe&ved=0CBAQjRxqFwoTCMCwhcXYgvwCFQAAAAAdAAAAABAE