



MINISTRY OF EDUCATION AND TRAINING

FPT UNIVERSITY

Infrared Ray Smart Control

Capstone Project

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Capstone Project Code	IRSC	

HoaLac, 7th August 2015

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DEFINITION AND ACRONYMS

Acronym	Definition	Note
IRSC	Infrared Ray Smart Control	
IRSC-App	IRSC Android application	
IRSC-Box	IRSC Central circuit board	
IR	Infrared ray	
WLAN	Wireless Local Area Network	
cmd	Command	
Arduino	Arduino Mega 2560	
UDP	User Datagram Protocol	
RF	Radio Frequency	
PM	Project Manager	
N/A	Not Available	
B1	Business Rule 1	
SDD	System Design Description	
UI	User Interface	
AC	Alternating Current	
CPU	Center Processing Unit	
ICSP	In-Circuit Serial Program	
USB	Universal Serial Bus	
GPIO	General-Purpose Input /Output	
EEPROM	Electrically Erasable Programmable Read-Only Memory	
UNK	Unknown	

Chapter 1: Introduction

1.1. Project Information

- Project name: Infrared Ray Smart Control
- Project code: IRSC
- Project group name : IRSC-Team
- Product type: Embedded System and Android application
- Timeline: From 11th May 2015 to August 2015

1.2. The people

1.2.1. Supervisors:

	Full name	Phone	E-mail	Title
Supervisor	Hoàng Xuân Sơn	0936232008	Sonhx@fpt.edu.vn	Lecturer

Table 1-1: Supervisor information

1.2.2. Team members:

	Full name	Student code	Phone	E-mail	Role in group
1	Lê Quang Đức	SE02946	01254805797	Duclqse02946@fpt.edu.vn	Leader
2	Trịnh Xuân Trường	SE02811	01652124453	Truongtxse02811@fpt.edu.vn	Member
3	Nguyễn Thị Dự	SE02914	01648472568	Duntse02914@fpt.edu.vn	Member
4	Phạm Văn Anh	SE02918	0963307347	Anhpvse02918@fpt.edu.vn">Anhpvse02918@fpt.edu.vn	Member
5	Nguyễn Thanh Tùng	SE02945	01667015363	Tungntse02945@fpt.edu.vn	Member

Table 1-2: Team member information

1.3. Background

Today, technology are developing day by day, so every house has a lot of equipment that control by Infrared Ray. “Internet of things” trend is starting in Vietnam’s technology steps by step from smallest to bigger that using in real life.

Moreover, the rapid development of mobile handheld devices has a strong impact to the life of human beings. These smart phones not only help people communicate with each other more easily, but they also provide many useful features such as office applications, entertainment, control embedded system... Their power features, plus the fact that they have reasonable price, make these devices more popular and becoming the essential thing of people.

Along the rapid expansion of economic, the improvement of living standard, the demand of people about a comfort, safe and convenience life is essential. Therefore, the idea of an intelligent thing (smart-homes, smart-houses, or home- automation, smart devices control ...) was born, as well as a friendly thing with devices that operated automatically or controlled by people.

1.4. The idea

Typically, each consumer electronic devices in house have individual infrared remote. It is inconvenient. We come up with the idea “All in one”. It means making the equipment that can learn quickly to control by IR. Easy learning signal and control devices – IRSC.

With the recent emergency of smartphone generations, mobile apps become more and more popular because of its convenience and ease in use. We want to develop these apps, which focus on controlling home device by easy way, friendly with user.

1.5. Proposal of system

1.5.1. The scope

The scope of IRSC project is a prototype of control device. It includes both hardware and software. Finally, product must be satisfy some below specification.

Hardware:

- Learning Infrared signal from remote and controlling devices through own IRSC box wireless.
- Saving signal, processing signal exactly and quickly.
- Area of using system in a room, and each type of devices exist only one in this place.
- System support the following types of Infrared protocol: NEC, Sony, RC5, RC6, DISH, Sharp, JVC, Mitsubishi, Samsung and some of undefined Infrared protocol.

Software:

- Using Android Operating system (4.1 or higher).
- Using IRSC box's wireless connects with hardware.
- Supporting most common devices: Fan, TV, Projector, CD-Player, Air Conditioner, Door, Other.
- With Other devices: support only On/Off event
- Best display on 6.0-inches 1440x2560:560dpi

1.5.2. Existing system

Recently, there are various “IR Smart control system” products with good functions, attractive design interface. Below are some of these products:

➤ IRKit:

IRKit is a Wi-Fi enabled Infrared Remote Controller device. Home electronics with an infrared remote, like air conditioners, TVs, lights can be controlled using iPhone, iPad, Android phones via IRKit.

Customer use a smartphone app to control their home electronics. IRKit is a device that helps to bring that future. Example:

- Use location, turns on air conditioner when you arrive near your home.
- Press one button to turn off all your home electronics when you leave home.
- Connect with Facebook, and automatically change your TV's channel to which your friend is watching.



Figure 1-1: IRKit model

IRKit itself runs a HTTP server. It uses POST JSON formatted IR signal to it to send IR signals. When you are not in the same Wi-Fi network, you can POST to our server on internet to send IR signals also.

➤ **Broadlink Pro:**

The Broadlink E-Remote is a universal remote for you to control infrared/ RF appliances through your smart phone. Users can control the appliances anywhere at any time once they can connect mobile internet (Either wireless or GPRS) to preset scheduling, theme so that appliances will turn on/ off automatically under different themes or create a presentation mode for consecutive action.



Figure 1-2: Broadlink Pro

- The Smart Home RM-Pro will control all infrared remote controlled devices/appliances.
- The RM-Pro will control all RF devices/appliances working on the 433MHz & 315 Mhz frequencies throughout your home.
- Use your mobile phone to control your TV, Bluray player, projector or the AC unit, RF sockets, fans, etc...
- Operates over Wi-Fi and mobile internet, at home and away, UK / EU Adapters Supplied
- The RM-Pro lets you schedule your own on/off times using the built in Timer from anywhere over the mobile network

Chapter 2: Project Management Plan

2.1. Definition Problem

The report 1 is clearly specified reason why IRSC project was chose to develop. It is an overview concept about IRSC system and be discussed some main function of existing system. You now have the knowledge of the system's scope. This document will present project planning to get the target. All the tasks and time to implement, the resource of the system, and the risk maybe meet during development.

2.1.1. Name of this Capstone Project

This Capstone project named Infrared Ray Smart Control, abbreviated as IRSC.

2.1.2. Problem Abstract

Nowadays, the embedded system and parts of smart- house is strong developed. With the built-in kit, developer can easy to make a central processing unit for a house. Processing of Infrared Ray is necessary to do first cause in a recent house has a lot of device controlled by Infrared Ray remote. In a big house, you can use the wireless to control device in other room very easy or turn off your equipment without going out your bed.

Therefore, the idea of Infrared Ray Smart Control was born, as well as friendly control devices, was operated automatically or controlled or by smartphone Android. You can save time to find what remote is true for each device, reduce place of holding remotes.

2.1.3. Boundaries of the System

2.1.3.1. Boundaries of the System

The system under development of this Capstone Project will include:

- The app is a gateway installed on the android user phone has the task of sending the request, as well as respond to customer via wireless, saving control information, controlling device.
- Wireless is an information bridge between the app and the central circuit board.
- A central circuit board has responsible for data exchange with the gateway through Arduino Mega to transmit, receive and process information from user.
- User manual, Test Document
- Design circuit broad, Design Document
- Source code Android App and Arduino

2.1.3.2. Development Environment

Below is the list of hardware and software requirements needed for development environment:

❖ *Hardware requirements*

- Develop:
 - Arduino Mega 2560 R3
 - Wi-Fi shield HLK - RM04
 - Breadboard
 - Multi-meter CD800a – Sanwa
 - Infrared emitter LED 5mm, 940nm
 - Infrared receiver
 - Resistors, capacitors, wire...
 - Personal Computers with 4 Gigabytes of RAM or more

- Test:
 - Personal Computers
 - Smartphone LG E975/ Masstel M315
 - Casio Projectors
 - Vinawind Fans
 - Packet Sender

❖ *Software requirements*

- Operating System: Windows 8.1 Pro – 64bit
- Design software: Proteus 7.8, Altium Designer 9
- IDEs: Android Studio v5.0 and SDK tools, JDK 7, Arduino-1.6.4-windows
- Document: Microsoft Office 2013, Microsoft Project 2013
- File Management: Google Drive

2.2. Project organization

2.2.1. System Process Model

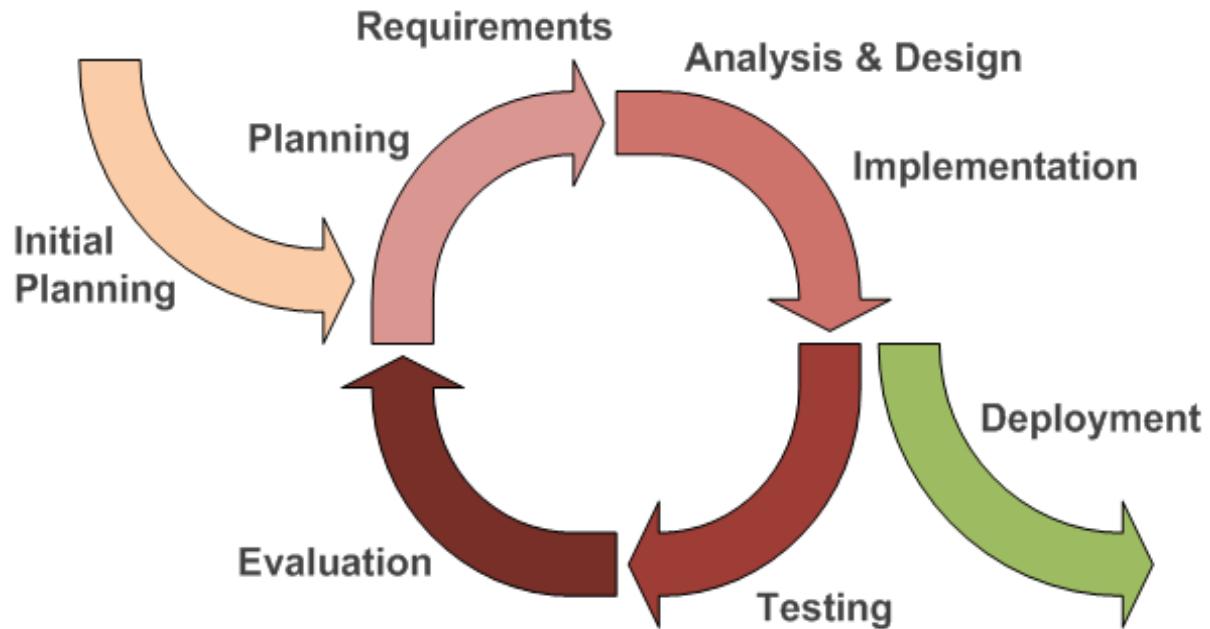


Figure 2-1: Iterative and Incremental Software Process Model

This figure above describes the information and products flow lifecycle process model. IRSC project uses the Iterative and Incremental Software Process Model.

Iterative and Incremental Software Process Model is a method of software development that is model around a gradual increase in feature additions and a cyclical release and upgrade pattern.

The Iterative and Incremental Software Process Model is most use when the scope of the project is big, the major requirements were defined clearly, some more detail will be added in time, and for the newbie group in software development.

By using this software process model, we break down the developing system task into series of smaller tasks are completed separately, evaluated, and subsequently re-worked until the system's performance adequately. In addition, the iterative model is easier than other models when the issues were discover. They are feedback to the team, and solution found while the project is still in development.

2.2.2. Roles and Responsibilities

2.2.2.1. Organization and Structure

Roles	Responsibility
Project Manager	Planning developing schedules, allocating resources, keeping on schedule, coordinating communication, generally responsible for keeping the team's focus on main goal and tries to keep the project team focused on the right goal at a time.
Technical Leader (Hardware and Software)	Responsible for the underlying architecture for the hardware system and software program, assigning tasks, mentoring people, reporting. Technical leaders is a reference book for other team members.
Quality Assurance Manager	Ensuring the products meet the certain standards of quality from requirements.
Test Leader	Responsible for test execution, including test set-up and test run, evaluation of test run and error recovery, defect logging and test results recording.
Developer	Involve to code product
Designer	Involve to design product
Tester	Involve to test product

Table 2-1: Project Structure

2.2.2.2. Project Team Member

Team Member	Roles
DucLQ	Project Manager, Technical Leader, Developer, Tester
TruongTX	Designer, Technical Leader, Developer, Test
DuNT	Technical Leader, Developer, Tester Leader
AnhPV	Designer, Developer, Tester
TungNT	Designer, Developer, Tester

Table 2-2: Project Team Member

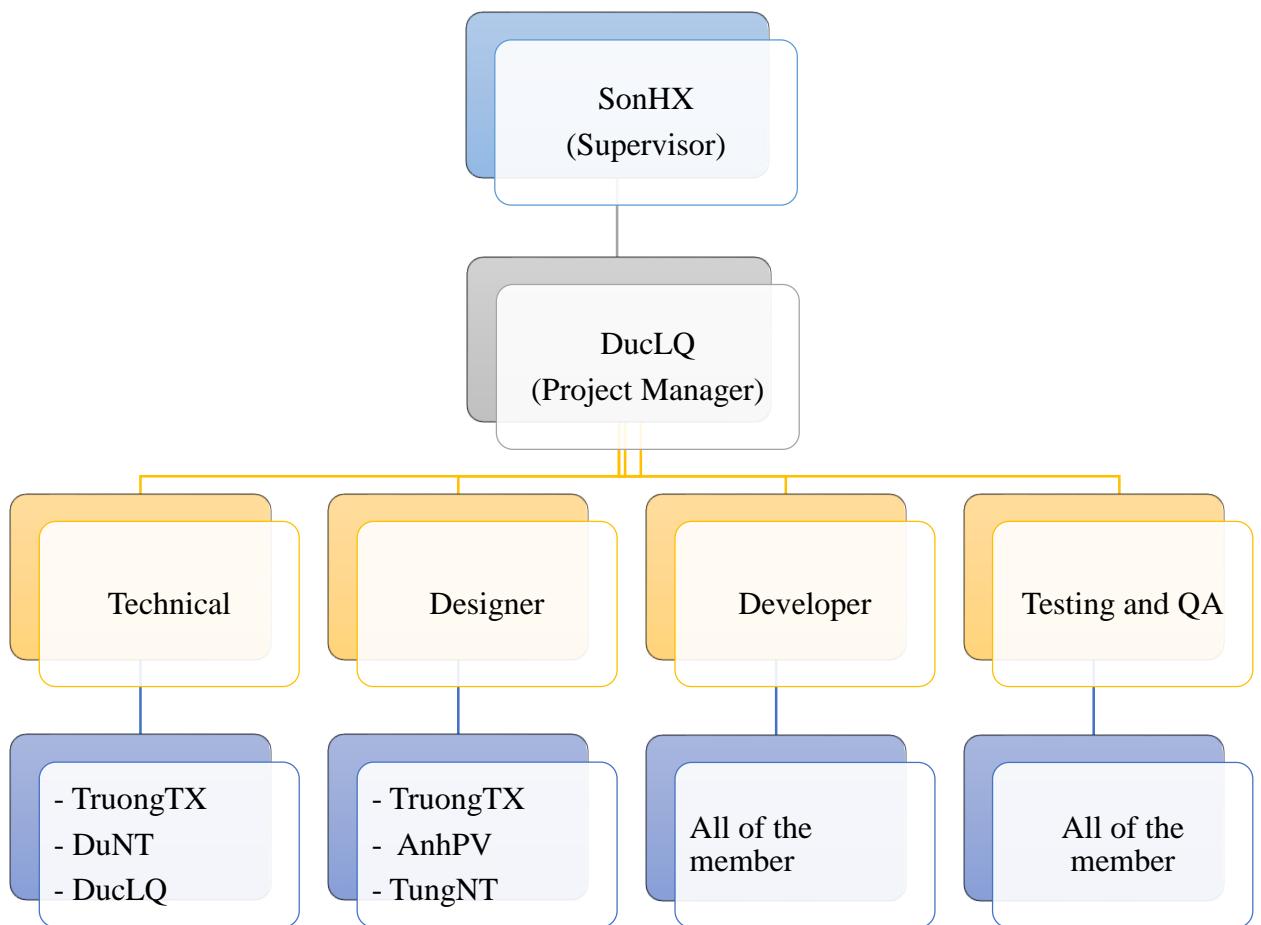


Figure 2-2: Project Team Member

2.2.3. Tools and Techniques

- Programing languages: Java, XML, C, C++.
- Process Model: Iterative and Incremental Software Process Model.
- IDEs: Android Studio, Arduino v1.6.4
- Design tool: Altium Designer 9
- Other:
 - Google driver for desktop
 - Microsoft Word 2013
 - Microsoft Excel 2013
 - Microsoft PowerPoint 2013
 - Microsoft Project 2013

2.3. Project management plan

2.3.1. Tasks

	Task Name	Duration	Start	Finish	Resource Names
1	Capstone Project Plan	76 days	Mon 11/05/15	Sun 23/08/15	
2	Phase 1	68 days	Mon 11/05/15	Wed 12/08/15	
3	1. Initiating	5 days	Mon 11/05/15	Fri 15/05/15	
4	1.1. Generate Project Ideas	3 days	Mon 11/05/15	Wed 13/05/15	IR team
5	1.2. Ideas review	1 day	Thu 14/05/15	Thu 14/05/15	IR team
6	1.3. Meeting for closing final topic and set the group working rules	1 day	Fri 15/05/15	Fri 15/05/15	IR team, Supervisor
7	2. Planning and Preparing	10 days	Mon 18/05/15	Fri 29/05/15	
8	2.1. Requirement analysis and Planning	2 days	Mon 18/05/15	Tue 19/05/15	IR team
9	2.2. Tools and devices analysis and choosing	1 day	Wed 20/05/15	Wed 20/05/15	IR team
10	2.3. Download and Install softwares	2 days	Thu 21/05/15	Fri 22/05/15	IR team
11	2.4. Order the Arduino Kit and Wifi shield from Over sea	7 days	Thu 21/05/15	Fri 29/05/15	TruongTX
12	3. Technical understanding	20 days	Mon 25/05/15	Fri 19/06/15	
13	3.1. Studying Java and Android development	20 days	Mon 25/05/15	Fri 19/06/15	DuNT,AnhPV, TungNT
14	3.2. Study about Infrared-Ray technology	5 days	Mon 25/05/15	Fri 29/05/15	DucLQ
15	3.3. Study about Wifi communication and module wifi shield	5 days	Mon 01/06/15	Fri 05/06/15	TruongTX
16	3.4. Study about Arduino	5 days	Mon 08/06/15	Fri 12/06/15	DucLQ,TruongTX
17	3.5. Study about Circuit of hardware	5 days	Mon 15/06/15	Fri 19/06/15	DucLQ,TungNT, TruongTX
18	4. Design	5 days	Mon 22/06/15	Fri 26/06/15	
19	4.1. Design Circuit for IR Central Controller	3 days	Mon 22/06/15	Wed 24/06/15	DucLQ,TungNT, TruongTX
20	4.2. Design outer shell for IR Central Controller	2 days	Thu 25/06/15	Fri 26/06/15	TungNT,TruongTX
21	4.3. Embedded and Android Software Architecture design	2 days	Mon 22/06/15	Tue 23/06/15	DucLQ,DuNT
22	4.4. Embedded and Android Software Detailed design	3 days	Wed 24/06/15	Fri 26/06/15	AnhPV,DucLQ,DuNT
23	5. Implementation	20 days	Mon 29/06/15	Fri 24/07/15	
24	5.1. Assemble Components	5 days	Mon 29/06/15	Fri 03/07/15	TungNT,TruongTX
25	5.2. Code for wifi communication	8 days	Mon 06/07/15	Wed 15/07/15	TruongTX
26	5.3. Code for InfraRed-Ray embedded software module	15 days	Mon 29/06/15	Fri 17/07/15	DucLQ
27	5.4. Code for Android application	20 days	Mon 29/06/15	Fri 24/07/15	AnhPV,DuNT, TungNT

		6. Testing	16 days	Wed 15/07/15	Wed 05/08/15	
28		6.1. Design test cases	3 days	Wed 15/07/15	Fri 17/07/15	DucLQ,DuNT,TruongNT
29		6.2. Hardware unit test	3 days	Mon 20/07/15	Wed 22/07/15	TruongTX,TungNT
30		6.3. Hardware system test	2 days	Thu 23/07/15	Fri 24/07/15	TungNT,TruongTX
31		6.4. Software unit test	3 days	Mon 27/07/15	Wed 29/07/15	AnhPV,DucLQ,DuNT
32		6.5. Software system test	2 days	Thu 30/07/15	Fri 31/07/15	AnhPV,DucLQ,DuNT
33		6.6. System test	3 days	Mon 03/08/15	Wed 05/08/15	IR team
34		Phase 2	9 days	Thu 06/08/15	Tue 18/08/15	
35		1. Planning	1 day	Thu 06/08/15	Thu 06/08/15	
36		2. Design	1 day	Fri 07/08/15	Fri 07/08/15	
37		2.1. Design for hardware	1 day	Fri 07/08/15	Fri 07/08/15	TungNT,TruongTX
38		2.1. Design for embedded software	1 day	Fri 07/08/15	Fri 07/08/15	DucLQ
39		3. Implementation	4 days	Mon 10/08/15	Thu 13/08/15	
40		3.1. Assemble Components	3 days	Mon 10/08/15	Wed 12/08/15	TungNT,TruongTX
41		3.2. Update Embedded software	3 days	Mon 10/08/15	Wed 12/08/15	DucLQ
42		4. Testing	4 days	Thu 13/08/15	Tue 18/08/15	
43		4.1. Design test cases	2 days	Thu 13/08/15	Fri 14/08/15	DucLQ,TruongTX
44		4.2. Hardware unit test	2 days	Thu 13/08/15	Fri 14/08/15	TungNT,TruongTX
45		4.3. System test	2 days	Mon 17/08/15	Tue 18/08/15	DucLQ,TungNT,TruongTX
46		Prepare for Thesis Defense Ceremony	5 days	Tue 18/08/15	Sun 23/08/15	
47		1. Project review	1 day	Wed 19/08/15	Wed 19/08/15	Supervisor,IR team
48		2. Print Documents	1 day	Thu 20/08/15	Thu 20/08/15	TungNT
49		3. Prepare for Final Presentation	3 days	Thu 20/08/15	Sun 23/08/15	IR team
50		Documents	75 days	Mon 11/05/15	Fri 21/08/15	
51		1. Report 1: Introduction	6 days	Mon 11/05/15	Mon 18/05/15	DuNT
52		2. Report 2: Project Management Plan	6 days	Mon 18/05/15	Mon 25/05/15	DucLQ,DuNT
53		3. Report 3: System Requirements Specifications	20 days	Mon 25/05/15	Fri 19/06/15	DuNT,DucLQ
54		4. Report 4: System Design Description	11 days	Mon 22/06/15	Mon 06/07/15	DuNT,DucLQ
55		5. Report 5: System Implementation & Test	22 days	Tue 07/07/15	Wed 05/08/15	DuNT,TruongTX
56		6. Report 6: System User's Manual	10 days	Thu 06/08/15	Wed 19/08/15	DuNT
57		7. Slide	7 days	Tue 11/08/15	Wed 19/08/15	AnhPV,DucLQ,TungNT
58		8. Final Report	9 days	Tue 11/08/15	Fri 21/08/15	DuNT,DucLQ
59						

Figure 2-3: Project Management Plan

Refer to [IRSC_ProjectPlan.pdf]

2.3.2. Human Resource

- Human resource
 - Team member
 - Supervisor
- Non – human resource
 - Equipment: Personal Computers, Arduino Mega 2560 R3, Wi-Fi shield HLK-RM04...
 - Building: FPT University, Thachhoa, Thachthat, Hanoi
 - Building: FPT University's Library, Thachhoa, Thachthat, Hanoi
 - Building: Room C214, FPT Dormitory C Building

2.3.3. Meeting Minutes

All meeting minutes will be written follow this template:

Meeting/Project	IRSC		
Date of Meeting:	11/5/2015	Time: (Type)	3hours
Meeting Called By:	DucLQ	Location:	FPT University
Note Taker:	AnhPV	Time Keeper:	TruongTX
1. Meeting Objective:			
Brainstorming all functions of systems			
2. Attendance			
Name	Roles	E-mail	Phone
Le Quang Duc	Project	<u>Duclqse02946@fpt.edu.vn</u>	01254805797
Nguyen Thanh Tung	Tester	<u>Tungntse02945@fpt.edu.v</u>	01667015363
Pham Van Anh	Developer	<u>Anhpvse02918@fpt.edu.vn</u>	0963307347
3. Content:			

Table 2-3: Meeting Minutes Template

2.3.4. Risk Management Plan

No	Name	Probability	Prevention	Correction	Impact
1	Miscommunication	Medium	After a meeting, one group member creates an interview report. Every participant or absence person should get a copy of this report. Team members should not hesitate to ask questions if they are unclear.	When it becomes clear that miscommunication is causing problem, the team members are gathered in a meeting to clear thing up.	High
2	Design Error	High	The design should be reviewed very critically. Team leader should be consulted frequency on his opinion about the feasibility and the correctness of certain design decisions.	When error in the design are noticed PM or team leader should be consulted to help correct the design errors as soon as possible. Also all the work, that depends on the faulty design, should be halted until the error is corrected.	Medium
3	Hardware Failure	Low	Check all of hardware before buying. Being sure and testing about current and volt of this hardware before using.	Creating a list of store that is selling this hardware. Checking it exist if having plan goes to buy.	High

4	Illness or absence of team member	Medium	Team members should warn their team leader timely before a planned period of absence.	By ensuring that knowledge is shared between team members, work can be taken over quickly by someone else if a person gets ill.	Medium
5	Requirement change	Medium	Carefully brainstorm system's features among team members. Regularly hold meeting to define and discuss all the features of systems. Design system carefully. Analyze all the possible cases to minimize the change	Team meetings with supervisor to determine whether new feature should be implemented or not. Team leaders create implementation plan for implemented features and sent to team members.	High
6	Time shortage	High	Project manager should create more spare time and calculate plus 20% buffer time.	Lacking time is the fatal problem, can run project to failure. PM should analysis and has change on the next phase.	High

Table 2-4: Risk Management Plan

2.3.5. Communication Plan

2.3.5.1. Communication between team members

➤ *Weekly meeting schedule:* By using Iterative and Incremental Process Model, IRSC Project System will be divided into a series of small tasks, each task will be assigned to team members by Technical Leader and depend on difficulty, and Technical Leader will assign deadlines for each task. We will have a meeting every Thursday, Friday and Monday to report the progress of whole team's tasks. Any member who doesn't finish his/her task (without

reasonable explanation), will be fined. If there is any issue, we will discuss and find solution together. If it is too difficult and can't be solved by ourselves, we will ask our supervisor for advises.

- *Unscheduled meeting:* If someone has an important problem want to be solved immediately, we will have a meeting for discussion.
- *Communication channel:* Our main communication channels are face-to-face meeting, email, Facebook, Skype. However, we sometimes can make a phone call or instant message if someone has problem.

2.3.5.2. Communication with Supervisor

- *Face-to-face meeting:* Weekly on every Thursday afternoons to make sure that supervisor can keep tracking of the team's progress.
- *E-mail:* Gmail is the fastest way to get device and document checking from supervisor.
- *Mobile phone:* is used to get time and place arranged for the meeting every weekly.

2.4. Projection Directory

Main folder	Sub-folder	Purpose
Project's Document	Meeting minutes	Store project meeting minutes
	Report 1	Store final deliverables of report 1
	Report 2	Store final deliverables of report 2
	Report 3	Store final deliverables of report 3
	Report 4	Store final deliverables of report 4
	Report 5	Store final deliverables of report 5
	Report 6	Store final deliverables of report 6
	Final Report	Store final deliverables of final report
Plan		Store project plan, Task list
Resource		Store template needed in project
	Tool	Store tool needed in project
Working space	Each team members has a folder	Team member's working area
Reference		Store reference needed in project

Table 2-5: Projection Directory

Chapter 3: System Requirement Specification

3.1. Introduction

3.1.1. Purpose

System requirement specification outlines functional and non-functional requirements of the project called Infrared Ray Smart Control, which is system that contains hardware and software, helps people control most common infrared device in house by smartphone. It also describes design constraints, and other factors necessary to provide a complete and comprehensive description of the requirements of the system. All members will work (design, code, test) based on information provided in this chapter.

3.1.2. Overview

The rest of the SRS contains three sections:

- **Introduction:** provides an overview of this document. It includes the purpose, scope, definitions, acronyms, abbreviations, references and overview.
- **Overall description:** describes the general factors that affect the product and its requirements Infrared Ray Smart Control.
- **Specification requirement:** contains all hardware and software requirements to a level of detail sufficient to enable designer to design a system to satisfy those requirements, and testers to test that the system satisfies those requirement.

3.2. Overall description

3.2.1. System Description

Infrared Ray Smart Control is a project used to control device by Infrared Ray. The goal of a system is helping customer to control electronic devices easily and remotely. An example of a simple IRSC's function is turning on the TV and turning off the fan. In addition, this system support user controls by smartphone.

Smart Control in this project work via simple system: board, Arduino Mega 2560, Android, Infrared LED. Normal infrared devices such as TV, Air Conditioner, Projector, Light are equipped with receivers.

The IRSC system includes two parts:

❖ Hardware:

- Circuit of IRSC Box contains Module Wi-Fi Shield RM-04 is communicative method between Arduino and App and module receive/emit Infrared Signal, LED block announces status of system.
- Arduino Mega 2560 is central processing unit. It will execute command and transmit information of devices to RM-04.

❖ Software:

- Embedded Software: receives signal from module receive/emit Infrared Signal. It receives infrared frequency from remote to process, save.

Setting up for RM-04 and receive/send data between smartphone and Arduino.

- Android App: display state of each type of devices, learn signal for each button in virtual remote and control devices.

3.2.2. Communication Protocol

Communication Protocol between Arduino Mega 2560 and RM- 04 is serial (UART).

HLK-RM04	Arduino
Pin 1 (+5V)	→ +5V
Pin 2 (GND)	→ GND
Pin 20 (RX)	→ Pin18(TX)
Pin 21 (TX)	→ Pin19(RX)

Figure 3-1: Pin out connection of RM04 and Arduino

UDP uses for communicating between Phone and RM04.

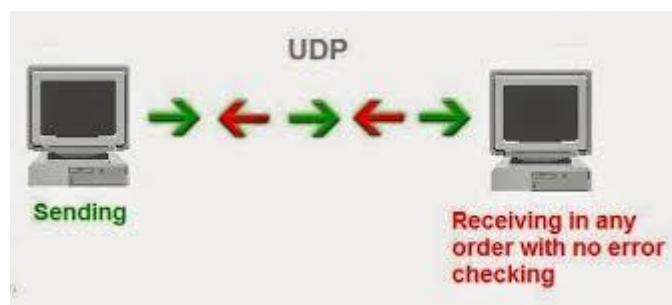


Figure 3-2: UDP

3.2.3. System Function

User Case	Note
UC-1.0 Login	
UC-2.0 Create new device	
UC-3.0 Delete device	
UC-4.0 Learn	Learning Infrared signal from remote
UC-5.0 Try to control	
UC-6.0 Re-learn	
UC-7.0 View List Control	
UC-8.0 View Account	
UC-9.0 View Manual	
UC-10.0 View List Delete	
UC-11.0 Reset system	Using reset button in IRSC Box
UC-12.0 Reboot system	Using reboot button
UC-13.0 Change Account and Password	
UC-14.0 Control Device	
UC-15.0 Synchronous	
UC-16.0 View list devices	
UC-17.0 Change account/password User	

Table 3-1: System User Case

3.3. Specification Requirement

This section describes about functional and non-functional requirement. The functional requirement includes use case diagram and use case description. The non-functional requirement includes usability, reliability and performance, safety... requirement of the system.

3.3.1. Functional requirement

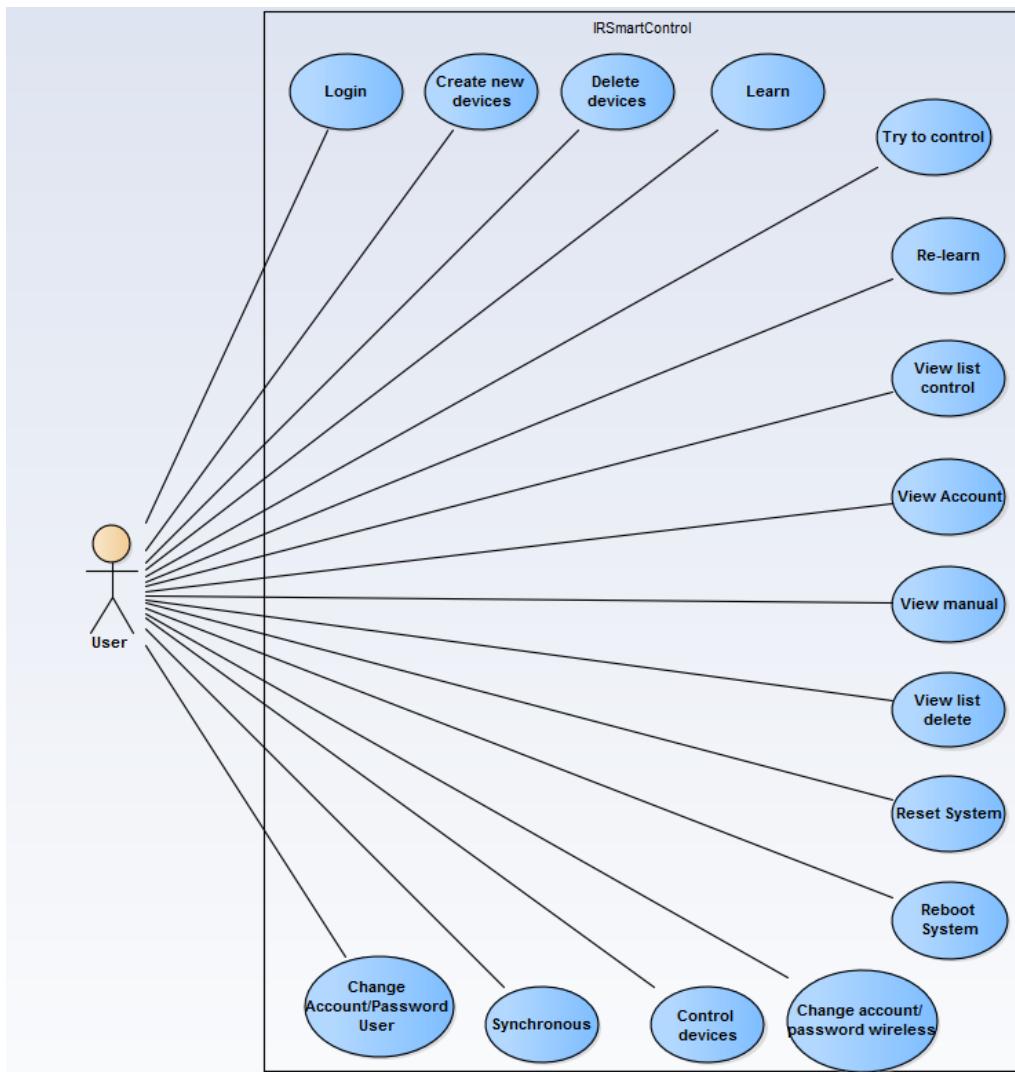


Figure 3-3: All user use case diagram

3.3.2. Business rules

	Function	Item	Validation	Error message
B1	Login	Account/	Not empty, less than 15	Invalid account or
B2	Learn	Button	After learning, color of	Error
B3	Delete	Button	Invisible devices	Delete fail. Try
B4	Add new	Button	Visible new devices from 1	

Table 3-2: Business Rules

3.3.3. User Case

3.3.3.1. Login

UC ID and Name	UC-1: Login		
Created By:	DuNT	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	First User login the Android Application		
Description:	<p>User logins in the first time to application to access function that user can act such as: add new devices, delete devices, learn signal, control...</p> <p>Another Users login with account and password provided by User to control.</p>		
Preconditions:	PRE-1. User is on login app screen		
Post Conditions:	POST -1. Display home screen		
Normal Flow:	<p>Login</p> <ol style="list-style-type: none"> 1. Actor enters username in text view “Enter your account” field. 2. Actor enters password in text view “*****” field. 3. Actor touches “Login” button. 4.1 Login successfully and go to the Home screen 		
Alternative Flows:	<p>Login</p> <ol style="list-style-type: none"> 4.2 System indicates this account is invalid if it is not the first time. 5. User re-enter user name and password. 		
Exceptions:	<p>E1 – Invalid username or password (Step 1, 2)</p> <ol style="list-style-type: none"> 1. System indicates that the username or password entered are not valid 2. A message “Invalid account or password. Please re-enter” 		
Priority:	High		
Frequency of Use:	High		
Business Rules	B1		

3.3.3.2. Create new device

UC ID and Name	UC-2: Create new devices		
Created By:	AnhPV	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User goes to each type of devices to add new		
Preconditions:	PRE -1. User is on “Manage Devices” screen		
Post Conditions:	POST -1. Display screen that user chose, name and number of devices is add.		
Normal Flow:	<p>Add new devices</p> <ol style="list-style-type: none"> 1. User touches on “Manage Devices” button of Home screen. 2. User touches on “Add/Delete Devices” button of Manage Devices screen. 3. User chooses type of devices that they want to add. 4. User touches on “New Devices” to add new devices. And New device button will be visible 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	B4		

3.3.3.3. Delete Devices

UC ID and Name	UC-3 Delete Devices		
Created By:	TungNT	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	Button of deleted devices is invisible.		
Preconditions:	PRE-1. User deletes devices that they don't want to use anymore.		
Post Conditions:	POST -1. User is on Add/ Delete Devices screen		
Normal Flow:	<p>Delete Devices</p> <ol style="list-style-type: none"> 1. User touches on “Manage Devices” button of Home screen. 2. User touches on “Add/Delete Devices” button of Manage Devices screen. 3. User chooses type of devices that they want to delete. 4. User touches on “Delete” to go to delete screen. 5.1 User touches on button of device they want to delete. This button will be invisible. 		
Alternative Flows:	<p>Delete Devices</p> <ol style="list-style-type: none"> 5.2 System indicates this button is error. 6. User re-enter this button. 		
Exceptions:	<p>E1 – Error while learning</p> <ol style="list-style-type: none"> 1. Nothing changes. 2. “Delete fail. Try again!” will be appear. 		
Priority:	High		
Frequency of Use:	High		
Business Rules	B3		

3.3.3.4. Learn Signal

UC ID and Name	UC-4 Learn		
Created By:	DucLQ	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	Each button learns Infrared Signal- respective with this button on remote.		
Preconditions:	PRE-1. User is on Devices screen – that is created new device		
Post Conditions:	POST -1. Button learn Infrared signal and can control device button.		
Normal Flow:	<p>Learn</p> <ol style="list-style-type: none"> 1. In Devices screen, User touches on button they want to learn signal with IRSC box dimension. 2. User waits 5- 7 seconds 3.1 Button change color to blue if success. 		
Alternative Flows:	<p>Learn</p> <ol style="list-style-type: none"> 3.2 System indicates this button is error while learning 4. User re-touches this button 		
Exceptions:	<p>E1 – Error while learning</p> <ol style="list-style-type: none"> 1. Color of button doesn't change. 2. “Error” will appear in the Device screen 		
Priority:	High		
Frequency of Use:	High		
Business Rules	B2		

3.3.3.5. Try to control

UC ID and Name	UC-5 Try to control		
Created By:	TruongTX	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	After learning, user can try to control the button they learned.		
Preconditions:	PRE-1. User is on Devices screen that screen display to learn.		
Post Conditions:	POST -1. User can control device by this button with respectively function.		
Normal Flow:	<p>Try to control</p> <ol style="list-style-type: none"> 1. User touches “Control” button to go to Control of this device 2. User touches to button that they want to control 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.6. Re-learn

UC ID and Name	UC-6 Re-learn		
Created By:	DucLQ	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	If user has something wrong with the button, user re-act to learn.		
Preconditions:	PRE-1. User is on Device screen.		
Post Conditions:	POST -1. The button has own exactly signal.		
Normal Flow:	<p>Re-learn</p> <ol style="list-style-type: none"> 1. In Devices screen, User touches on button they want to re-learn signal with IRSC box dimension. 2. User waits 5- 7 seconds 3.1 Button change color to blue if success. 		
Alternative Flows:	<p>Re-learn</p> <ol style="list-style-type: none"> 4.2 System indicates this button is error while learning 5. User re-touches this button 		
Exceptions:	<p>E1 – Error while learning</p> <ol style="list-style-type: none"> 1. Color of button doesn't change. 2. “Error” will appear in the Device screen 		
Priority:	High		
Frequency of Use:	High		
Business Rules	B2		

3.3.3.7. View list control

UC ID and Name	UC-7 View list control		
Created By:	AnhPV	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User go to Control List screen to view list device to choose what they want to control.		
Preconditions:	PRE-1. User is on Manage Devices screen.		
Post Conditions:	POST -1. User can see the list of existed device.		
Normal Flow:	<p>View list control</p> <ol style="list-style-type: none"> 1. User touches on “Control” button on Manage Devices screen 2. System redirect to <u>View Control</u> screen 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.8. View account

UC ID and Name	UC-8 View account		
Created By:	TungNT	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User view information of account.		
Preconditions:	PRE-1. User is on Home screen.		
Post Conditions:	POST -1. User is on Account screen.		
Normal Flow:	<p>View account</p> <ol style="list-style-type: none"> 1. User touches on “Manage Account” button in Manage Screen 2. System redirect to Account Screen. 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	Medium		
Frequency of Use:	Medium		
Business Rules	N/A		

3.3.3.9. View Manual

UC ID and Name	UC-9 View Manual		
Created By:	DuNT	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User go to Manual screen to see how to use this app.		
Preconditions:	PRE-1. User is on Home screen.		
Post Conditions:	POST-1. User is on Manual screen.		
Normal Flow:	<p>View manual</p> <ol style="list-style-type: none"> 1. User touches on “Manual” button in Manage Screen 2. System redirect to Manual Screen. 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	Medium		
Business Rules	N/A		

3.3.3.10. View List Delete

UC ID and Name	UC-10 View List Delete		
Created By:	TruongTX	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	PRE-1. User sees list of device and then, chooses the device they want to delete.		
Preconditions:	POST -1. User is on Manage Devices screen.		
Post Conditions:	User deletes the device and it will be visible in the each Device screen.		
Normal Flow:	<p>View List Delete</p> <ol style="list-style-type: none"> 1. User touches on “Add/Delete Devices” button Manage Devices screen 2. Choose type of devices that user wants to delete 3. Touches on “Delete” to see the list delete. 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.11. Reset System

UC ID and Name	UC-11 Reset System		
Created By:	TruongTX	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User clear all of data in system by button on IRSC box		
Preconditions:	PRE-1. Led green on hardware is light.		
Post Conditions:	POST -1. Led green and blue is light. Then, Led blue turn off.		
Normal Flow:	<p>Reset System</p> <ol style="list-style-type: none"> 1. User touches on button reset on hardware 2. System redirect each byte of EEPROM become 0xff – initialization value 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.12. Reboot System

UC ID and Name	UC-12 Reboot System		
Created By:	DucLQ	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	Re-start system by the button on the hardware.		
Preconditions:	PRE-1. Led green on hardware is light.		
Post Conditions:	POST-1. Led green and blue is light. Then, Led blue turn off.		
Normal Flow:	<p>Reboot System</p> <ol style="list-style-type: none"> 1. User touches on button reboot on hardware 2. System redirect to start system again without deleting data. 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.13. Change Account and Password wireless

UC ID and Name	UC-12 Change Account and Password wireless		
Created By:	TruongTX	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User change account and Password in Android App.		
Preconditions:	PRE-1. User is on Manage Devices screen.		
Post Conditions:	POST -1. Name and password to access wireless will be change and redirect to Home screen		
Normal Flow:	<p>Change account and password wireless</p> <ol style="list-style-type: none"> 1. User touches on “Change Wi-Fi Information” on Manage Account screen. 2. User touches on “Your Wi-Fi” to type new SSID and “Your Wi-Fi password ” to type new password and “Re-enter your Wi-Fi password” 3. Touch on “Change” button 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	Medium		
Frequency of Use:	Medium		
Business Rules	N/A		

3.3.3.14. Control Devices

UC ID and Name	UC-14 Control Devices		
Created By:	DuNT	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User uses IRS-C app to control devices.		
Preconditions:	PRE-1. User is on Device screen that they want to control		
Post Conditions:	POST -1. Device changes status respectively with action of user.		
Normal Flow:	<p>Control Devices</p> <ol style="list-style-type: none"> 1. User touches on the button they want to control 2. System response to change status of devices 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.15. Synchronous

UC ID and Name	UC-15 Synchronous		
Created By:	AnhPV	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	Synchronous with system when other user uses system in same area.		
Preconditions:	PRE-1. New user is on Synchronous screen.		
Post Conditions:	POST -1. Data of root user device will synchronize in device of new user.		
Normal Flow:	<p>Synchronous</p> <ol style="list-style-type: none"> 1. User touches on “Synchronous” button in Synchronous screen. 2. System will return data of root user device to device of new user. 		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.16. View list devices

UC ID and Name	UC-16 View list devices		
Created By:	TungNT	Date Created:	31/5/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User can view all of exist devices by list.		
Preconditions:	PRE-1. User is on Manage screen.		
Post Conditions:	POST -1. User views list of devices.		
Normal Flow:	<p>View list devices</p> <p>1.1 User touches on “Add/Delete Devices” on Manage screen. 1.2 User touches on “Control” on Manage screen. 2. List of devices will appear on screen.</p>		
Alternative Flows:	N/A		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	High		
Business Rules	N/A		

3.3.3.17. Change Account/Password User

UC ID and Name	UC-17 Change Account/Password User		
Created By:	TruongTX	Date Created:	31/7/2015
Primary Actor	User	Secondary Actors:	N/A
Trigger:	N/A		
Description:	User can change user information of account and password in system		
Preconditions:	PRE-1. User is on Manage Wi-Fi screen.		
Post Conditions:	POST -1. User will changed successfully account/password and redirect to Login screen.		
Normal Flow:	<p>Change Account/Password User</p> <ol style="list-style-type: none"> 1. User touches on “Change User Information” on Manage Account screen. 2. User touches on “Your Account” to type old account and “Your Password” to type old password 3. Touch on Authenticate to verify user 4. User touches on “New Account” to type new account and “New Password” to new old password 5. Touch on “Change” button 		
Alternative Flows:	3.1 If authentication is fail, error message shows “Your account or password incorrect. Please try again!”		
Exceptions:	N/A		
Priority:	High		
Frequency of Use:	Medium		
Business Rules	N/A		

3.3.4. Non- Functional Requirement

3.3.4.1. Reliability

- Learning Infrared signal is correct up to 95- 97%.
- Immediately responses error message if system has error.
- Frequency bands is from 36 – 40 kHz – regular with frequency of Infrared device home.

3.3.4.2. Availability and scalability

- The response time of the system when a request arrives should be prompt and precise.

3.3.4.3. Security

- Using security of Wi-Fi

3.3.4.4. Maintainability

The list below describes maintainability requirement:

- The IRSC system should be easy to modify and add features.
- Although the product is produced under this document is “prototype” version, all modules and components of this prototype version will be designed and implemented in such a manner that they may be easily incorporated in a fully specified commercial version of the IRSC.

3.3.4.5. Performance

- The system should response to user action that the user would expect to be instantaneous.

3.3.4.6. Usability

- The interface of Android app should be elegant and simple.
- Hardware is small and compactable.

3.3.4.7. Safety

- The supply voltage of hardware is 5V- 1A, be safe with user.

3.4. Hardware Infrastructure

The table below is hardware requirement in this project:

<ul style="list-style-type: none"> • Arduino Mega 2560 • 8-bit Atmel Microcontroller 	
<ul style="list-style-type: none"> • Wi-Fi Module HKL-RM04 	
<ul style="list-style-type: none"> • Tsop 1838 	
<ul style="list-style-type: none"> • Emit Infrared LED 	
<ul style="list-style-type: none"> • Resistor 220, 3.3k, 2.2k 	

Table 3-3: Hardware of project

Chapter 4: System Design Description

4.1. Introduction

4.1.1. Purpose

System Design Description (SDD) provides a comprehensive architectural overview system. They are the technical, user interface (UI) and hardware interface design. It includes the architectural design and the detailed design. The architectural design describes the overall architecture of the system, and the architecture of each main component and subsystem. It will describe the patterns is being used, the role of each component and the role of the system in the working environment. The detailed design describes static and dynamic structure for each component and function.

SDD is to give the developer team a guidance of what the system's architecture is, and how they implement.

4.1.2. Design overview

This document consists of:

- ✉ Architecture overview
- ✉ Component diagram
- ✉ Detailed design
- ✉ Detailed description of components

4.2. System Architectural Overview

4.2.1. System Architecture

*** Please see next page for System Architecture ***

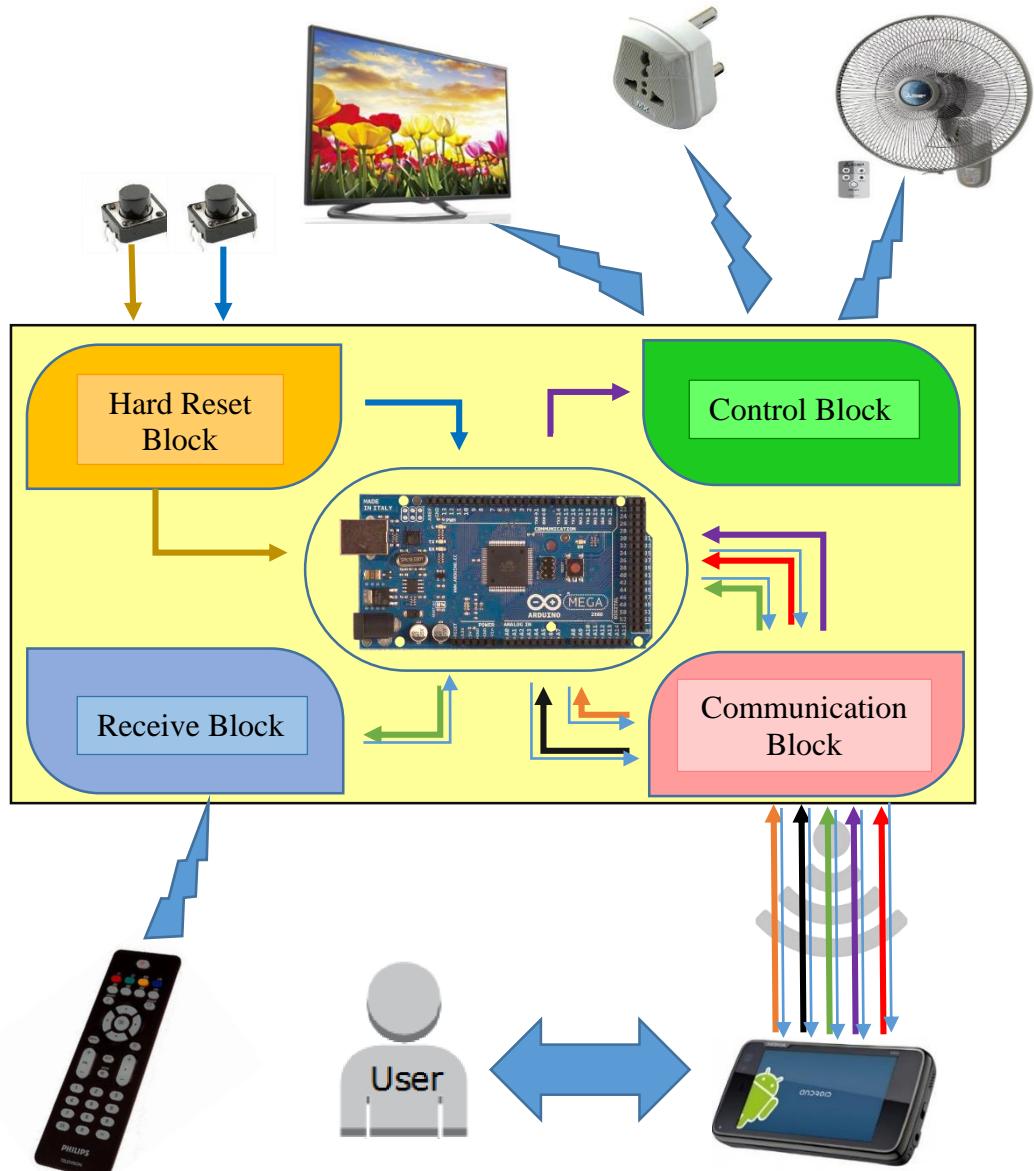
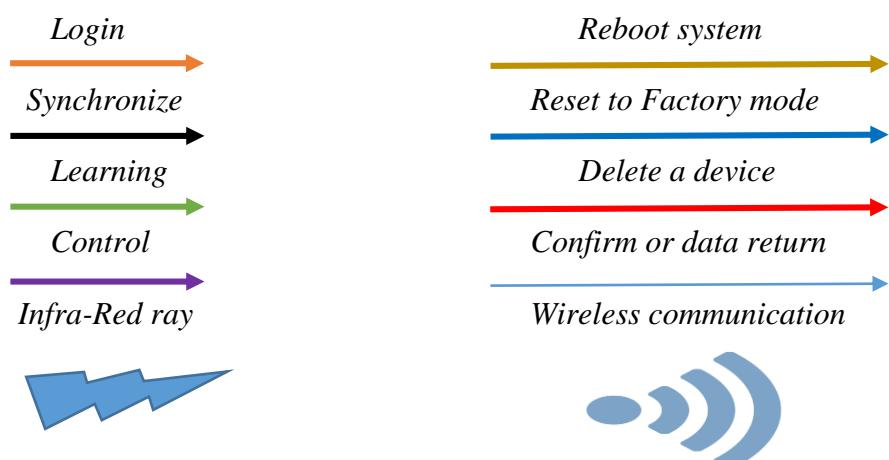


Figure 4-1: System Architecture

Note:



4.2.2. System Architecture Explanation

IRSC project's product has two part. They are **Central circuit board** (we will call him is **IRSC-Box**) and **Android application** that installed on mobile (we will call her is **IRSC-App**).

Via WLAN that was launched by Communication Block of IRSC-Box, **IRSC-App** on Android smartphone can login, change account or password, synchronize, make the IRSC-Box go to Learning mode, emit infrared ray signal that was learnt by Control Block on IRSC-Box to control an equipment. User can also delete a device that exist on system.

Communication Block use Wireless shield HLK - RM04 and antenna to transmit data between IRSC-Box and smart phone that has installed IRSC-App.

When IRSC-App sent command to learn new IR signal, system waited until user press the correlative button on the remote control of an equipment. **Receive Block** receive IR signal. IRSC-Box will learn the signal and save it to EEPROM on a position where is corresponding with this equipment.

When IRSC-App sent command to control an equipment, system is reading EEPROM at corresponding button which user want to press of this remote control's equipment position. The **Control Block** is emitting signal what read on EEPROM in IR format to control expected equipment.

If IRSC-Box encounter an error and user cannot control him by IRSC-App, user can press Reboot button to reboot IRSC-Box.

If this error is serious and it affect data of IR signal that was saved on EEPROM, user can not control an equipment on system by IRSC-App. User can press Reset button to clear all data on EEPROM and reset IRSC-Box to factory default mode.

A relay and other IR receive block form a smart electrical socket. Through IRSC-App, user can control this socket on (to be electrical conduction) or off (to be electrical non-conduction).

4.2.3. IRSC-App Architecture

4.2.3.1. Sequence diagram

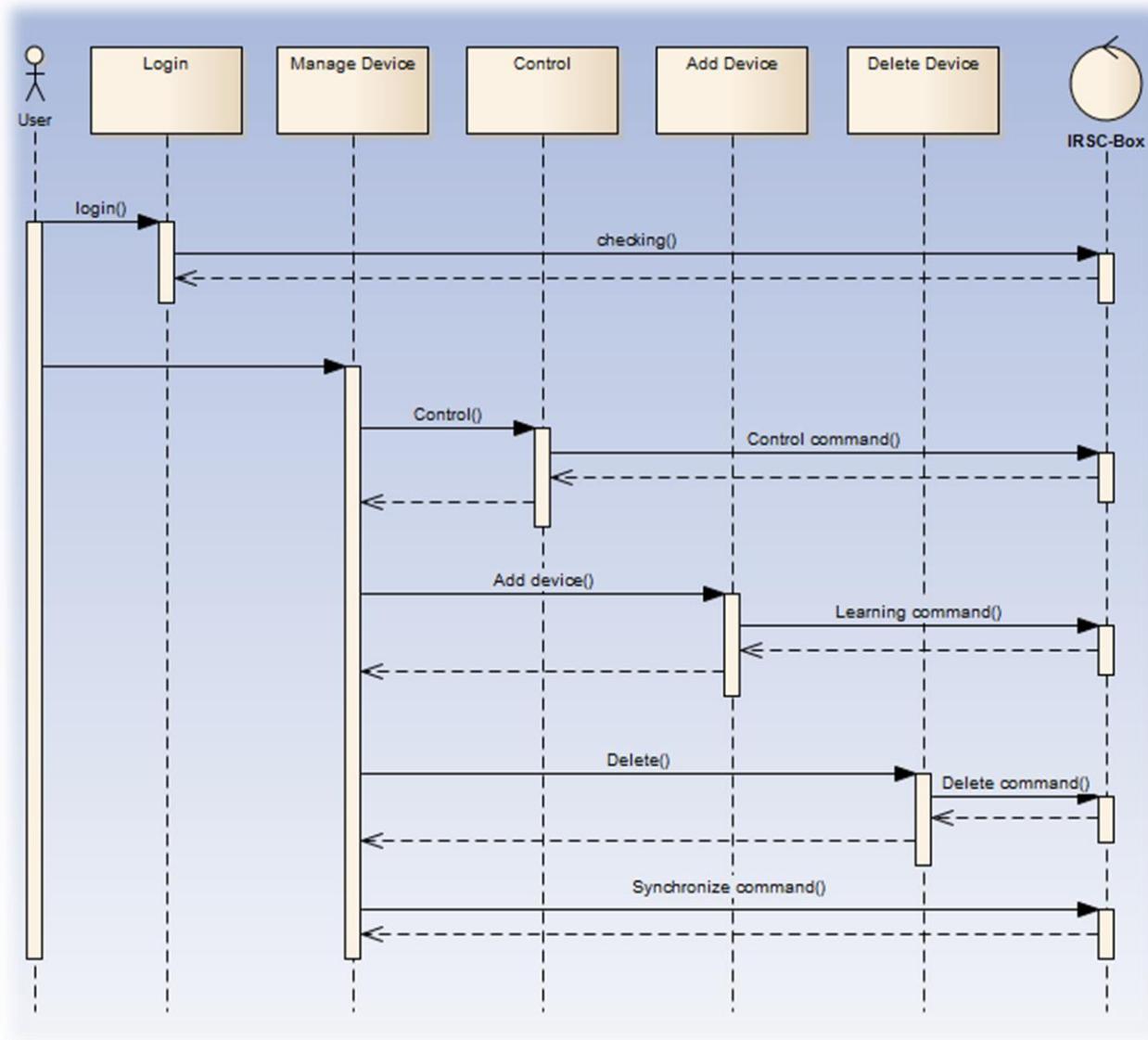


Figure 4-2: Sequence diagram of IRSC-App Architecture

4.2.3.2. Implementation

When user touch on the IRSC-App icon in Menu of Android Smartphone, IRSC-App's login screen will be pop-up. If user do first-login, account and password of this login will set to account and password for next times login. In other words, the first-login equal register action.

After login, in Manage Devices Screen, user can add a device, control a device that is existing on system, delete a device or synchronize data with IRSC-Box.

4.3. Detailed Design of IRSC-Box's hardware

4.3.1. Hardware components

4.3.1.1. Arduino Mega 2560

4.3.1.1.1. Overview

Arduino MEGA 2560 designs for more complex project. It is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

4.3.1.1.2. Summary

CHARACTERISTICS	VALUE
Microcontroller	ATmega2560
Operating Voltage	5 V
Input Voltage (recommended)	7-12 V
Input Voltage (limits)	6-20 V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3 V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

Table 4-1: Arduino Mega 2560 summary

4.3.1.1.3. Schematic

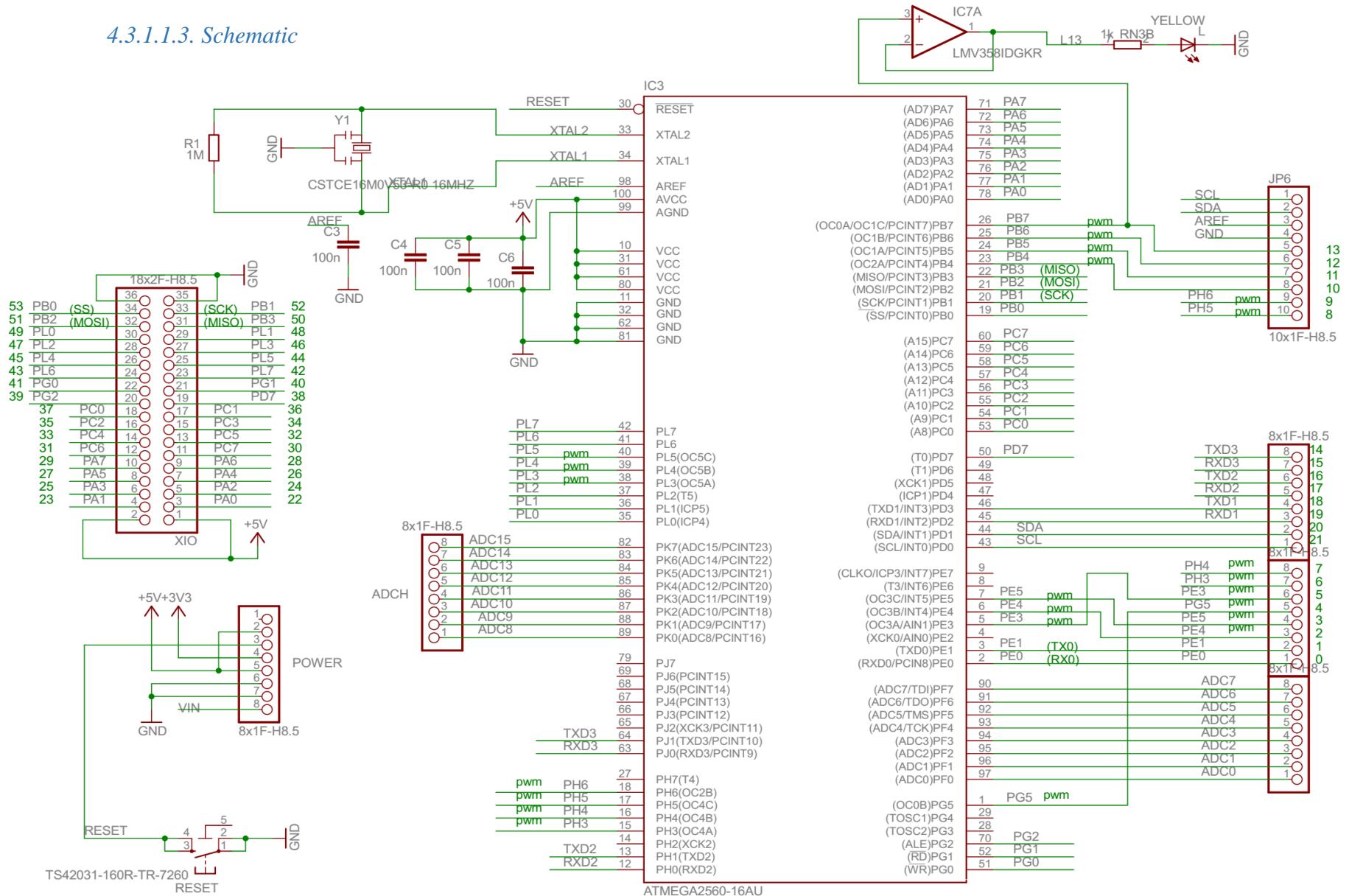


Figure 4-3: Arduino Mega 2560 schematic

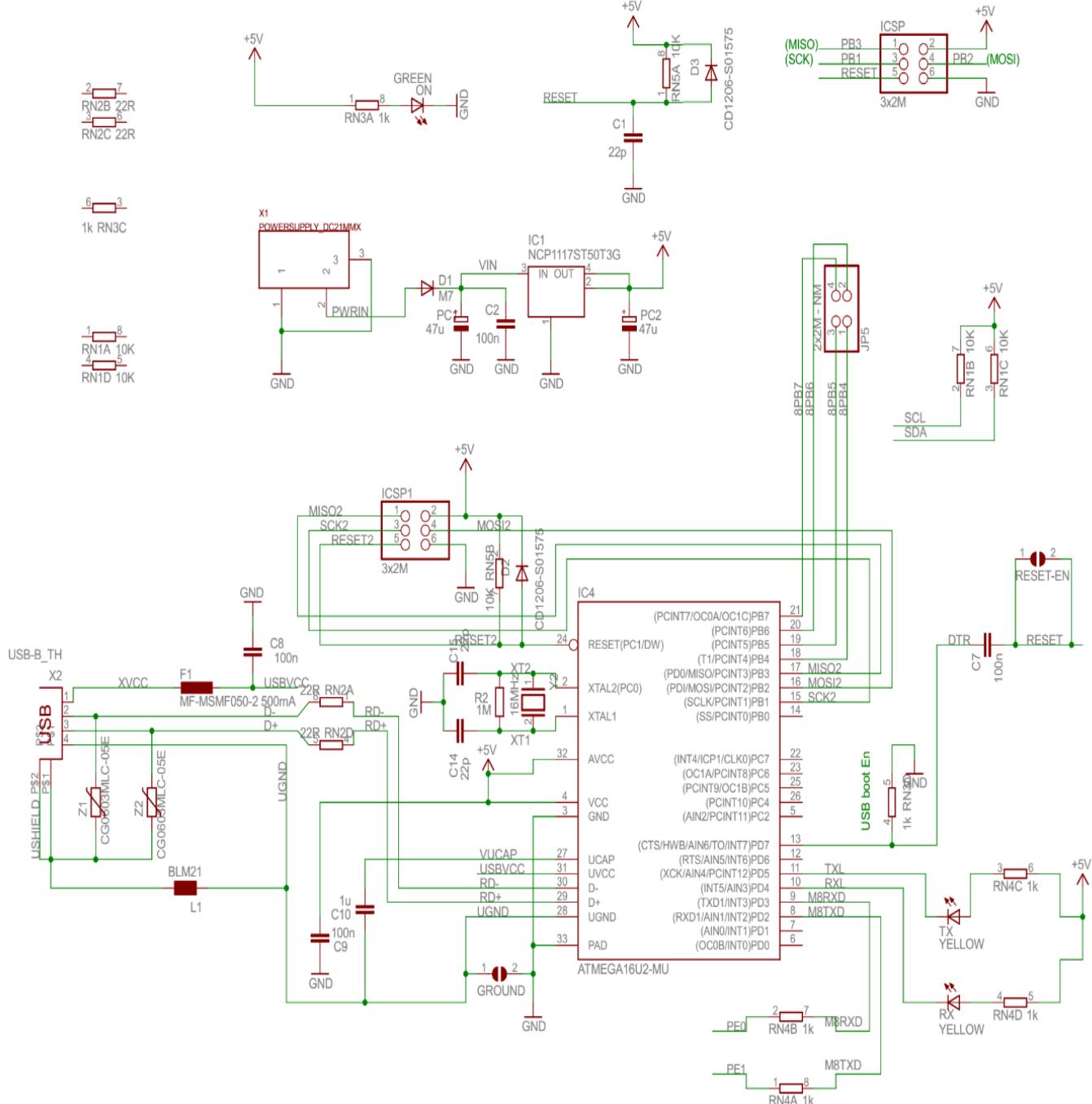
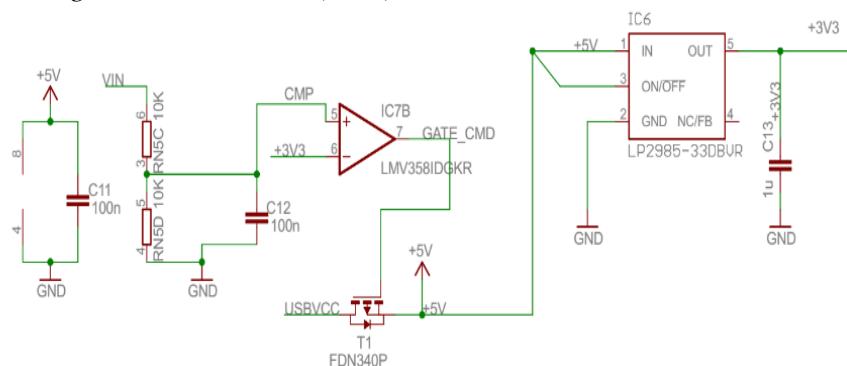


Figure 4-4: Arduino Mega 2560 schematic (cont)



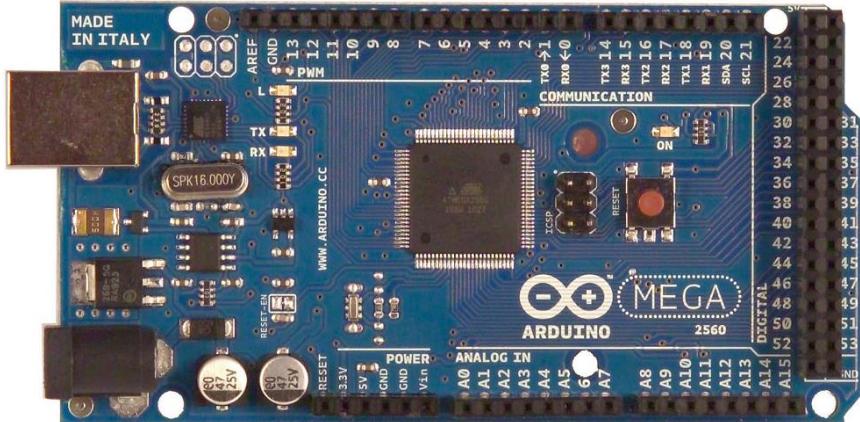


Figure 4-5: Arduino Mega 2560 front end

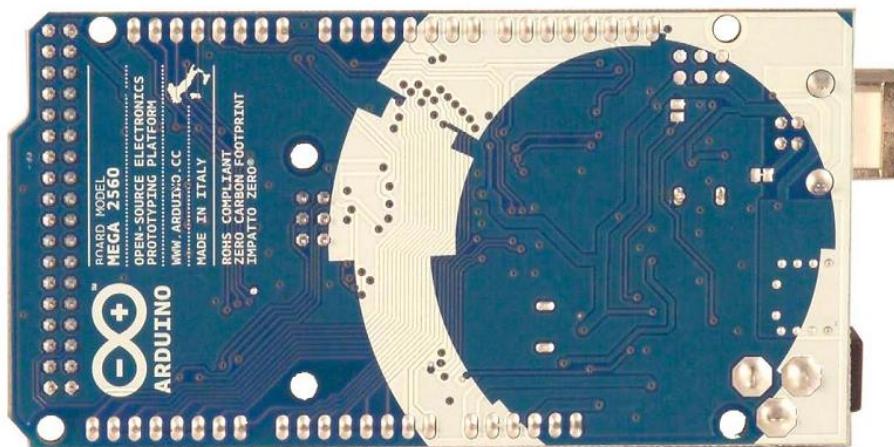


Figure 4-6: Arduino Mega 2560 back end

4.3.1.2. Wireless shield Hi-Link HLK-RM04

4.3.1.2.1. Overview

HLK-RM04 is a new low-cost embedded UART-ETH-WIFI module (Serial port - Ethernet - Wireless network) developed by Shenzhen Hi-Link (HK) co., Ltd

This product is an embedded module based on the universal serial interface network standard, built-in TCP/IP protocol stack, enabling the user serial port, Ethernet, wireless network (Wi-Fi) interface between the conversions.

Through the HLK-RM04 module, the traditional serial devices do not need to change any configuration; data can be transmit through the Internet network. Provide a quick solution for the user's serial devices to transfer data via Ethernet.

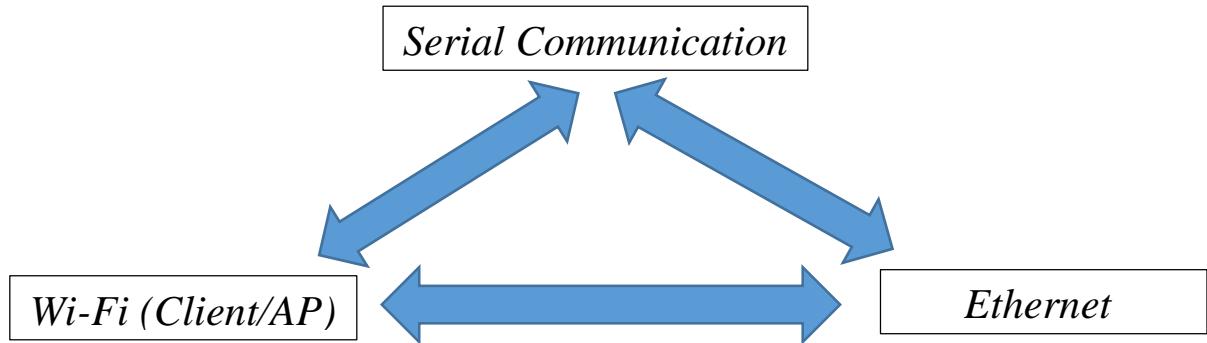


Figure 4-7: Hi-Link HLK-RM04 Communication Structure

4.3.1.2.2. Summary

Network standard	Wireless: IEEE 802.11n, IEEE 802.11g, IEEE 802.11b Wired: IEEE 802.3, IEEE 802.3u
Wireless transmission rate	11n: maximum up to 150 Mbps 11g: maximum up to 54 Mbps 11b: maximum up to 11 Mbps
Tracks number	1-14
Frequency range	2.4 – 2.4835 G
Emission power	12 – 15 dBm
Interface	2 Ethernet, 2 Serial, 1 USB (Host/Slave), GPIO
Antenna type	Onboard antenna / External antenna

Table 4-2: Hi-Link HLK-RM04 Technical Specifications

Functional Parameters	
WI-FI work mode	Client/AP/Router
WDS Function	Support WDS wireless bridge connection
	Wireless MAC address filtering
	Wireless security function switch
Wireless security	64/128/152 bit WEP encryption
	WPA-PSK/WPA2-PSK, WPA/WPA2 security mechanism
	Remote Web management
Network management	Configuration file import and export
	WEB software upgrade
Serial to Ethernet	
Maximum transmission rate	230400 bps
TCP connection	Max connection number > 20
UDP connection	Max connection number > 20
Serial baud rate	50 ~ 230400 bps
Other Parameters	
Status indicator	LEDs status indicator
	Operating temperature: -20 – 70°C
	Operating humidity: 10% - 90% RH (noncondensing)
Environmental standard	Storage temperature: -40 – 80°C
	Storage humidity: 5% - 90% RH (noncondensing)
Additional properties	Frequency bandwidth optional: 20 MHz, 40 MHz, Automatic

Table 4-3: Hi-Link HLK-RM04 Technical Specifications (continue)

4.3.1.2.3. Schematic

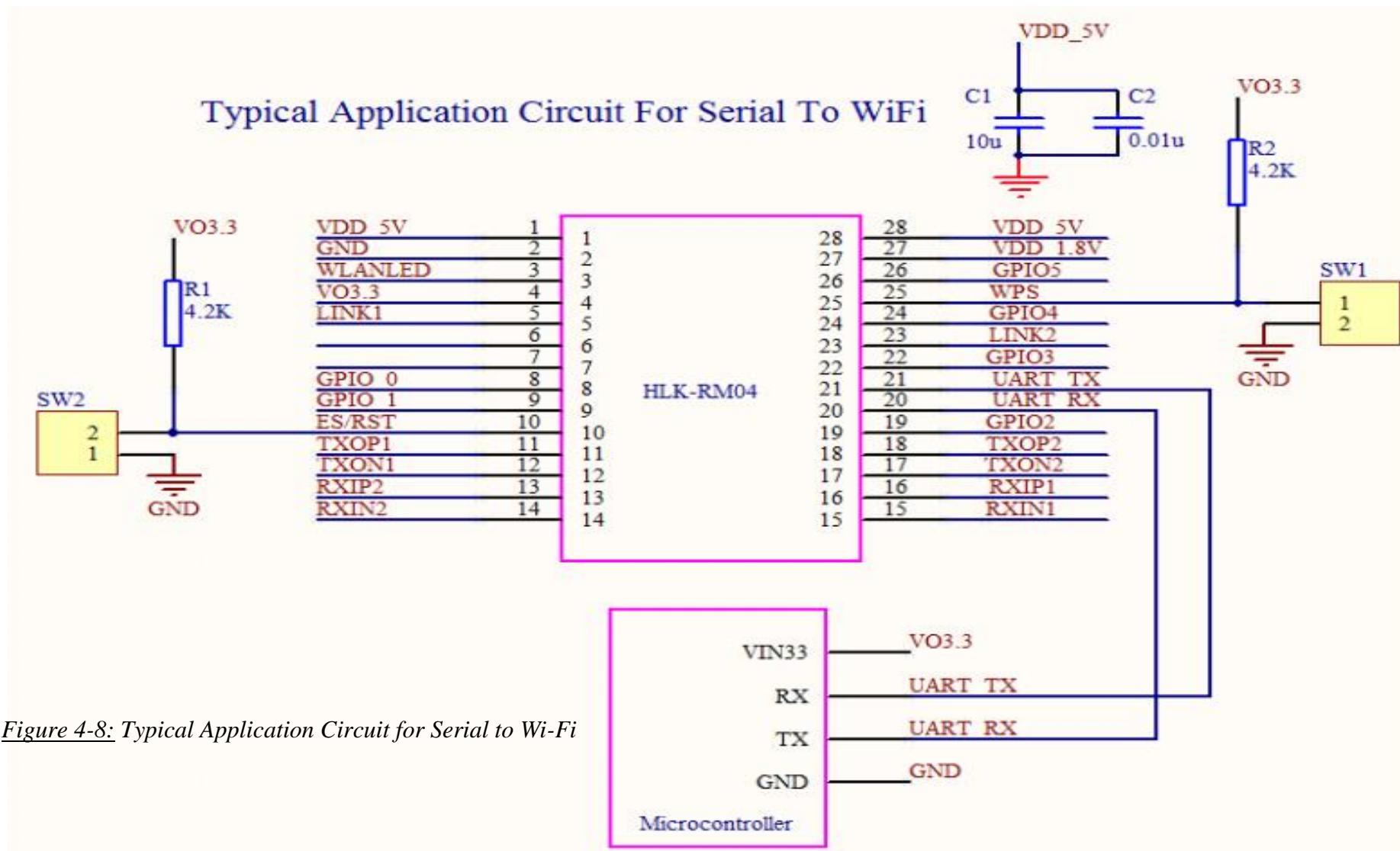


Figure 4-8: Typical Application Circuit for Serial to Wi-Fi

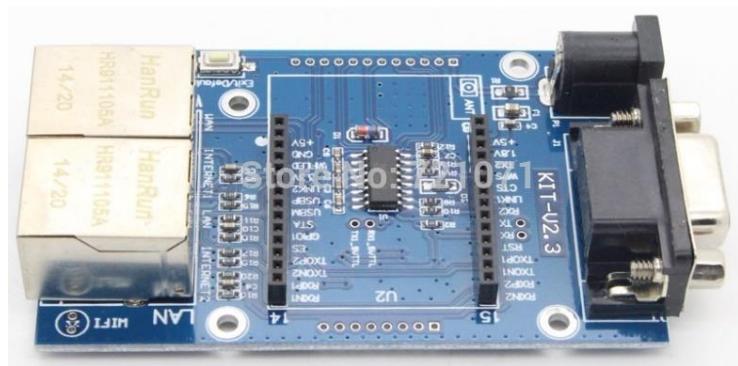


Figure 4-9: Hi-Link HLK-RM04 board



Figure 4-10: Hi-Link HLK-RM04 UART WI-FI module



Figure 4-11: Hi-Link HLK-RM04 full assemble module

4.3.1.3. Infrared Ray Receiver Module 1838T

4.3.1.3.1. Specification

- ✓ Small design
- ✓ Built-in chip
- ✓ Wide-angle and long distance reception
- ✓ With strong anti-jamming capability
- ✓ Anti-jamming from the light
- ✓ Low voltage working

4.3.1.3.2. Dimension

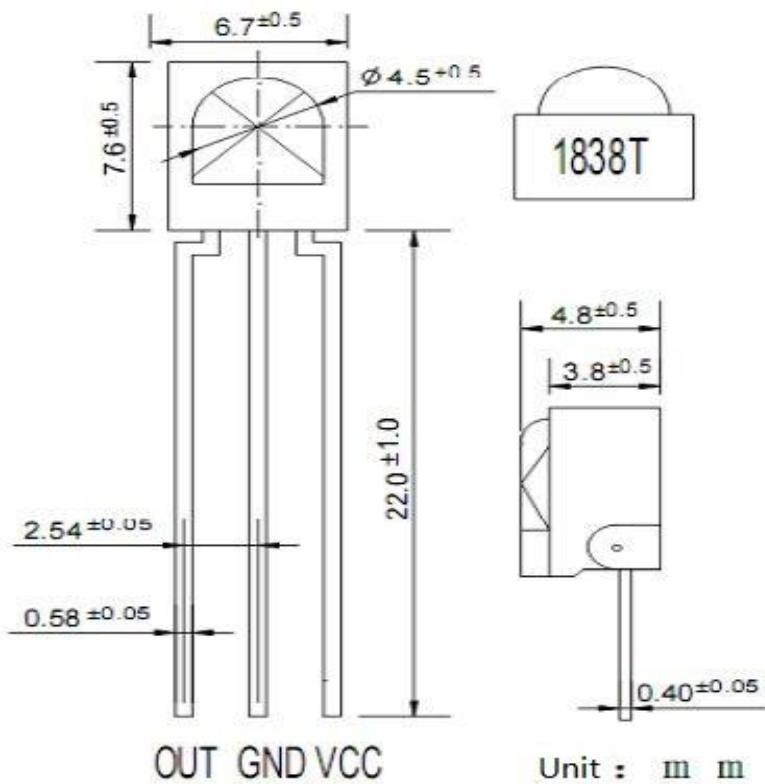


Figure 4-12: Infrared ray receiver 1838T dimension

4.3.1.3.3. Application Circuit

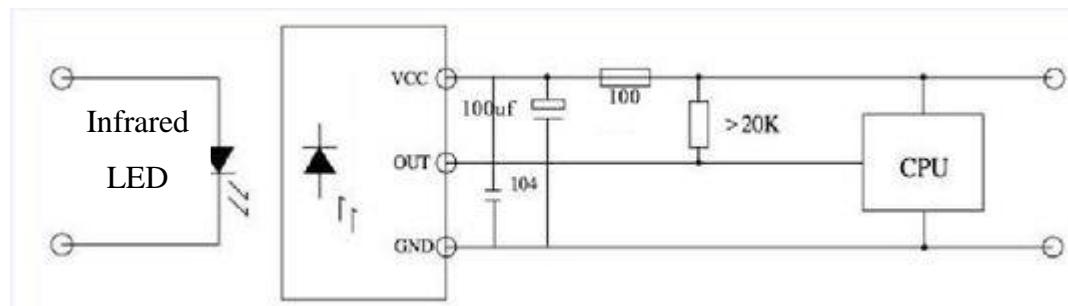


Figure 4-13: Infrared ray receiver 1838T Circuit

4.3.1.3.3. Characteristics Curve

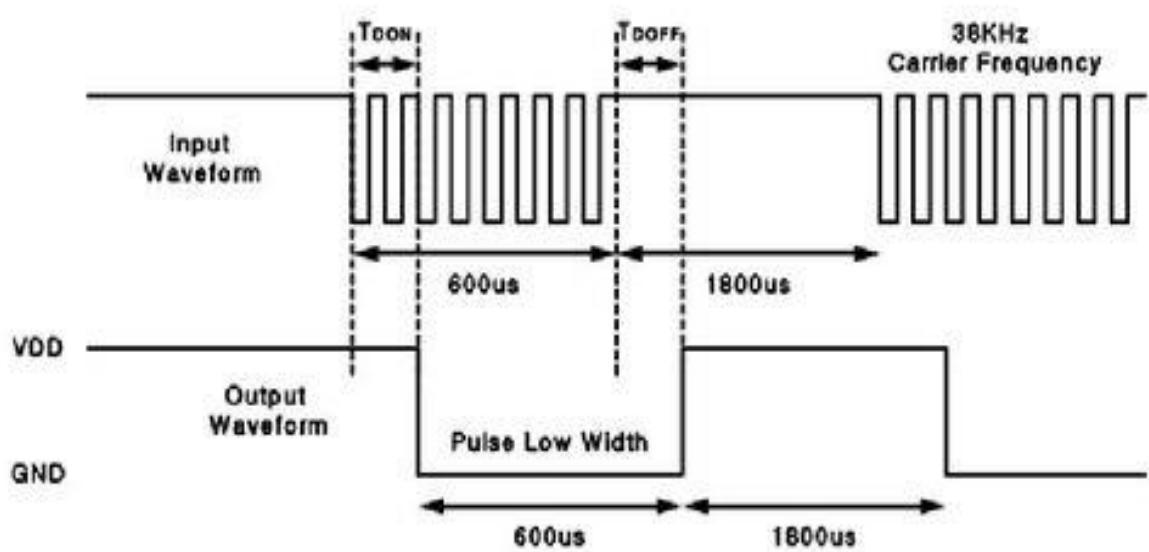


Figure 4-14: Infrared ray receiver 1838T Characteristics Curve

4.3.1.3.4. Parameters

Parameters	Mark	Test condition	Min	Type	Max	Unit
Working voltage	Vcc		2.7		5.5	V
Working Current	Icc		0.6	0.8	-	mA
Quiescent Current	Ice	Without signal	0.1		0.5	mA
Receive distance	L		20	23		M
Receive angle	$\theta_{1/2}$		$+/- 60$			Deg
Carrier frequency	f _o		36.7/38			kHz
BMP width	f _{BW}	-3dB Bandwidth	-	8	-	kHz
Low output	V _{OL}	V _{in} = 0 V _{cc} = 5			0.4	V
High output	V _{OH}	V _{cc} = 5	V _{cc} - 0.3		V _{cc}	V
Output pulse Width	T _{PWL}	V _{in} = 50mVp-p	500	600	700	μ S
	T _{PWH}	V _{in} = 50mVp-p	540	640	740	μ S

Table 4-4: Infrared ray receiver 1838T parameters

4.3.1.4. Infrared Led IR333C-F

4.3.1.4.1. Features

- ✓ High reliability
- ✓ 2.54mm lead spacing
- ✓ Low forward voltage
- ✓ Good spectral matching to Si photodetector
- ✓ High radiant intensity
- ✓ Pb free
- ✓ The product itself will remain within RoHS compliant version.

4.3.1.4.2. Description

EVERLIGHT's infrared emitting (IR333-F SERIES) is a high intensity diode, molded in a plastic package. The device is spectrally matched with phototransistor, photodiode and infrared receive module.

Chip Material of IR333C-F emitting Led is GaAlAs and Lend color is water clear.

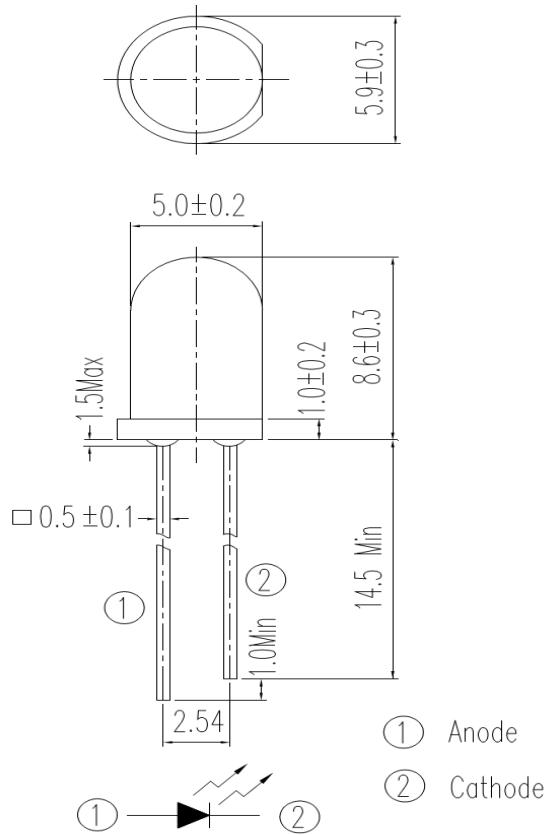
Parameter	Symbol	Rating	Unit
Continuous Forward Current	I _F	100	mA
Peak Forward Current	I _{FP}	1.0	A
Reverse Voltage	V _R	5	V
Operating Temperature	T _{opr}	-40 ~ +85	°C
Storage Temperature	T _{stg}	-40 ~ +100	°C
Soldering Temperature	T _{sol}	260	°C
Power Dissipation at (or below) 25°C Free Air Temperature	P _d	150	mW

Table 4-5: Infrared Led IR333C-F Absolute Maximum Ratings (at Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Peak Wavelength	λ_p	-	940	-	Nm	$I_F = 20mA$
Spectral Bandwidth	$\Delta\lambda$	-	45	-	Nm	$I_F = 20mA$
Forward Voltage	V_F	-	1.2	1.5	V	$I_F = 20mA$
		-	1.4	1.8		$I_F = 100mA$
Reverse Current	I_R	-	-	10	μA	$V_R = 5V$

Table 4-6: Infrared Led IR333C-F Electro-Optical Characteristics (at $T_a=25^\circ C$)

4.3.1.4.3. Package Dimension

Notes:

1. All dimensions are in millimeters
2. Tolerances unless dimensions ± 0.25 mm

Figure 4-14: Infrared ray receiver 1838T Package Dimension

4.3.1.5. Power

Power of IRSC-Box was provided by a AC 220V – DC 5V 1A mobile phone charge adapter. USB port of Arduino MEGA 2560 as a bridge from power adapter to all of components in system of IRSC-Box.

4.3.2. IRSC-Box circuit

4.3.2.1. IRSC-Box schematic

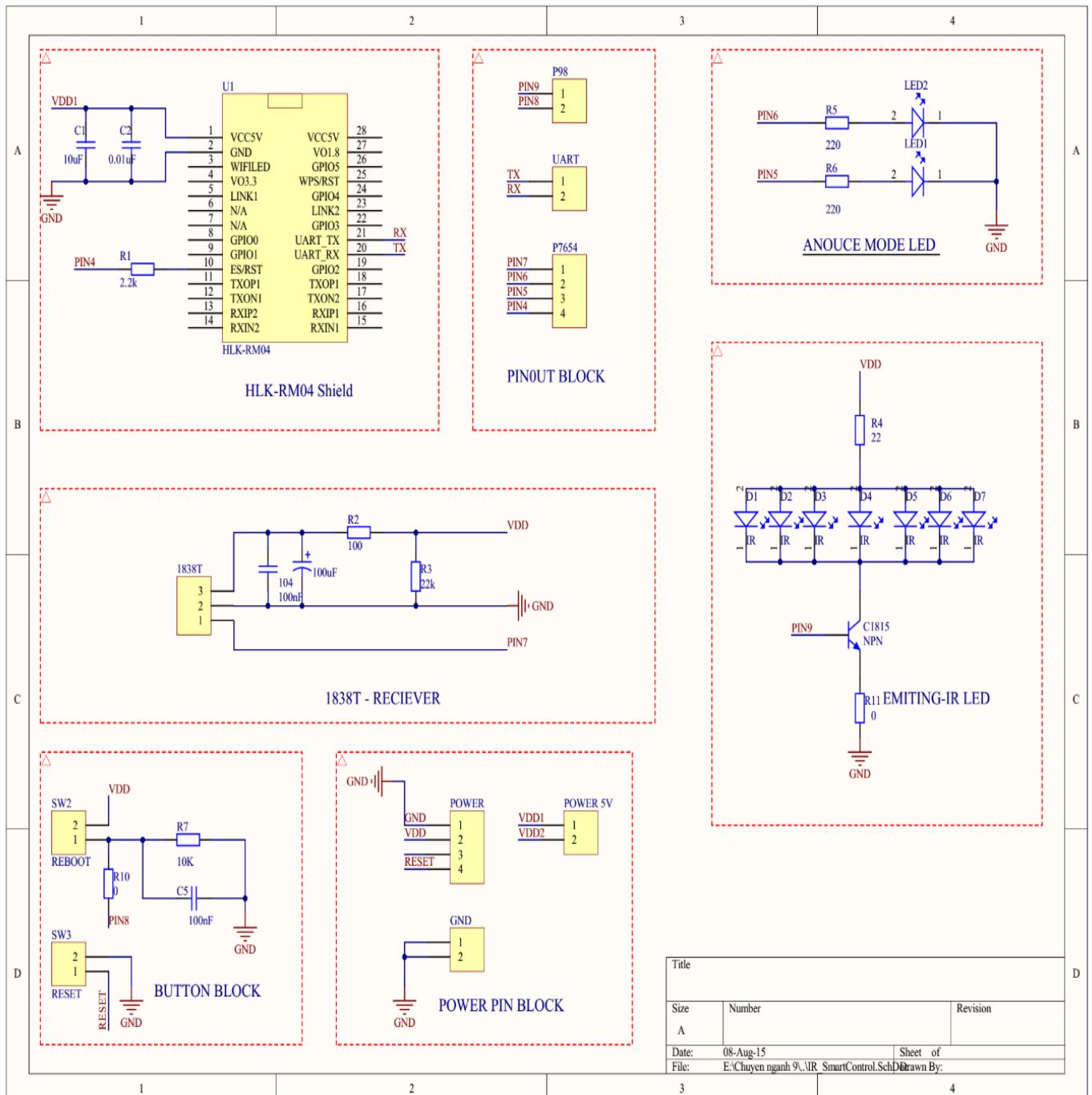


Figure 4-15: IRSC-Box schematic

4.3.2.2. IRSC-Box Printed Circuit Board

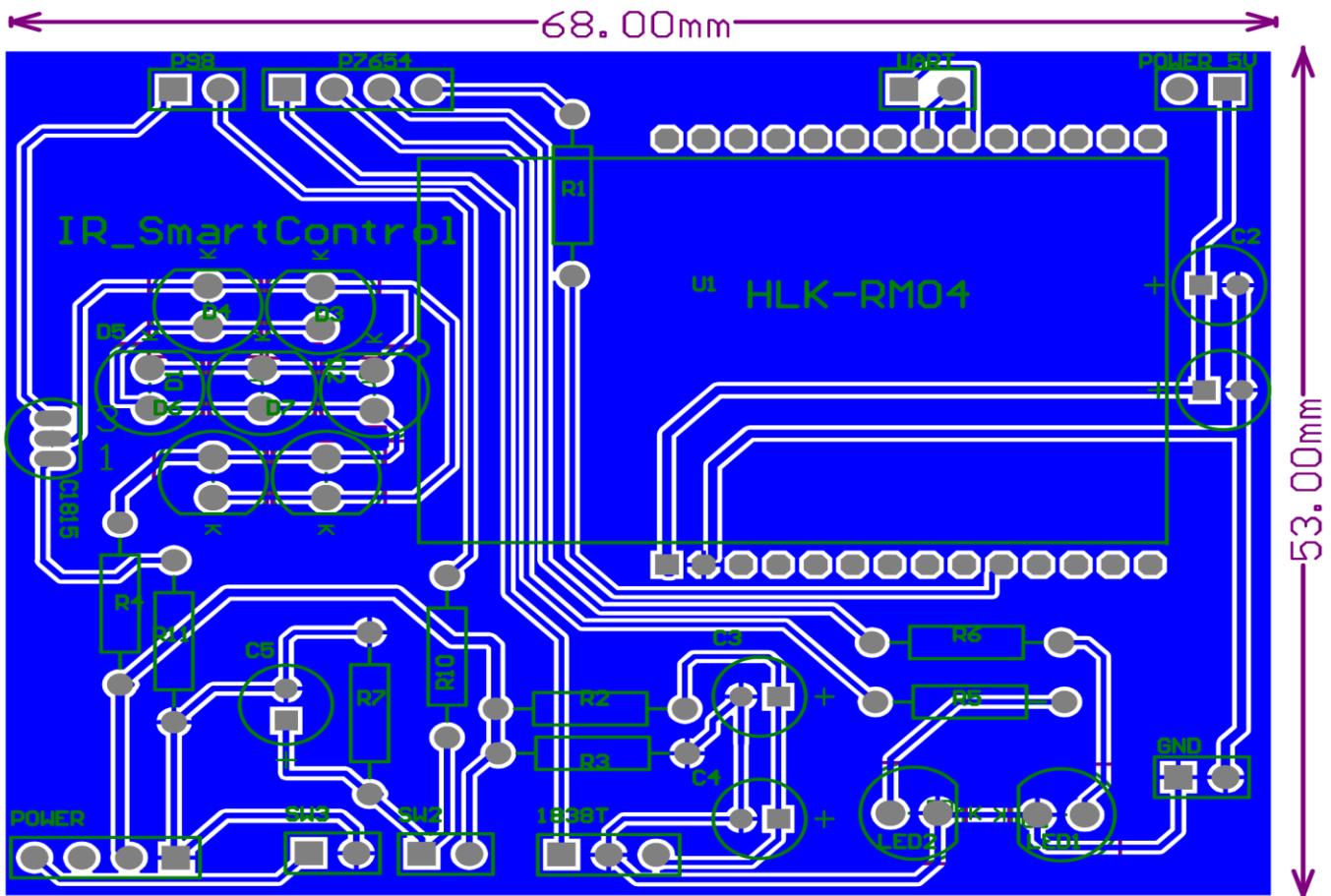


Figure 4-16: IRSC-Box Printed Circuit Board

4.4. Detailed Design of IRSC-Box's embedded software

4.4.1. Some background of IR signals

An IR remote works by turning the LED on and off in a particular pattern. However, to prevent interference from IR sources such as sunlight or lights, the LED is not turned on steadily, but turned on and off at a modulation frequency (typically 36, 38, or 40 KHz). The time when a modulated signal send, would be call a mark, and when the LED is off will be call a space.

Each key on the remote has a particular code (typically 12 to 32 bits) associated with it, and broadcasts this code when the key is pressed. If the key is held down. The remote usually repeatedly broadcasts the key code. For an NEC remote, a special repeat code sent as the key held down rather than repeatedly sending the code. For Philips RC5 or RC6 remotes, a bit in the code is toggled each time a key is pressed; the receiver uses this toggle bit to determine when a key is pressed down a second time.

On the receiving end, the IR detector demodulates the signal, and outputs a logic-level signal indicating if it is receiving a signal or not. The IR detector will work best when its frequency matches the sender's frequency, but in practice, it does not matter a whole lot.

4.4.2. Arduino-IRremote-master library

The easiest way to obtain codes to work with your device is to use this library to decode and print the codes from your existing remote.

Various libraries of codes are available online, often in proprietary formats. However, *Arduino-IRremote-master* is an open library that allows you to decode and send infrared signals of many (but not all) commonly used remote controls. We decide to use *IRremote* library version 0.11 August, 2009, Copyright 2009 by Ken Shirriff to develop our capstone project.

4.4.2.1. Details of the receiving library

The *IRrecv* library consists of two parts. An interrupt routine is called every 50 microseconds, measures the length of the marks and spaces, and saves the durations in a buffer. The user calls a decoding routine to decode the buffered measurements into the code value that was sent (typically 11 to 32 bits).

The decode library tries decoding different protocols in succession, stopping if one succeeds. It returns a structure that contains the raw data, the decoded data, the number of bits in the decoded data, and the protocol used to decode the data. For decoding, the *MATCH* macro determine if the measured mark or space time is approximately equal to the expected time.

The RC5/6 decoding is a bit different from the others because RC5/6 encode bits with mark + space or space + mark, rather than by durations of marks and spaces. The *getRClevel* helper method splits up the durations and gets the mark/space level of a single time interval.

For repeated transmissions (button held down), the decoding code will return the same decoded value over and over. The exception is NEC, which sends a special repeat code instead of repeating the transmission of the value. In this case, the decode routine returns a special *REPEAT* value.

In more detail, the receiver's interrupt code is called every time the *TIMER1* overflows, which is set to happen after 50 microseconds. At each interrupt, the input status is checked and the timer counter is incremented. The interrupt routine times the durations of marks (receiving a modulated signal) and spaces (no signal received), and records the durations in a buffer. The

first duration is the length of the gap before the transmission starts. This is followed by alternating mark and space measurements. All measurements are in "ticks" of 50 microseconds.

The interrupt routine is implemented as a state machine. It starts in *STATE_IDLE*, which waits for the gap to end. When a mark is received, it moves to *STATE_MARK* which times the duration of the mark. It then alternates between *STATE_MARK* and *STATE_SPACE* to time marks and spaces. When a space of sufficiently long duration is received, the state moves to *STATE_STOP*, indicating a full transmission is received. The interrupt routine continues to time the gap, but blocks in this state.

The *STATE_STOP* is used as a flag to indicate to the decode routine that a full transmission is available. When processing is done, the *resume()* method sets the state to *STATE_IDLE* so the interrupt routine can start recording the next transmission. There are a few things to note here. Gap timing continues during *STATE_STOP* and *STATE_IDLE* so an accurate measurement of the time between transmissions can be obtained. If *resume()* is not called before the next transmission starts, the partial transmission will be discarded. The motivation behind the stop/resume is to ensure the receive buffer is not overwritten while it is still being processed; debugging becomes very difficult if the buffer is constantly changing.

4.4.2.2. Details of the sending library

The transmission code is straightforward. To ensure accurate output frequencies and duty cycles, we use the PWM timer, rather than delay loops to modulate the output LED at the appropriate frequency. At the low level, *enableIROut* sets up the timer for PWM output on pin 3 at the proper frequency. The *mark()* method sends a mark by enabling PWM output and delaying the specified time. The *space()* method sends a space by disabling PWM output and delaying the specified time.

The IRremote library treats the different protocols, for example:

- NEC: 32 bits are transmitted, most-significant bit first.
- Sony: 12 or more bits are transmitted, most-significant bit first. Typically 12 or 20 bits are used. Note that the official protocol is least-significant bit first.
- RC5: 12 or more bits are transmitted most-significant bit first. The message starts with the two start bits, which are not part of the code values.

- RC6: 20 (typically) bits are transmitted, most-significant bit first. The message starts with a leader pulse, and a start bit, which is not part of the code values. The fourth bit is transmitted double-wide, since it is the trailer bit.

For Sony and RC5/6, each transmission must be repeated 3 times as specified in the protocol. The transmission code does not implement the RC5/6 toggle bit; that is up to the caller.

4.4.2.3. Handling raw codes

The library provides support for sending and receiving raw durations. This intend mainly for debugging, but can also be use for protocols the library does not support, or to provide universal remote functionality.

The raw data for received IR measures the duration of successive spaces and marks in 50 μ s ticks. The first measurement is the gap, the space before the transmission starts. The last measurement is the final mark.

The raw data for sending IR holds the duration of successive marks and spaces in microseconds. The first value is the first mark, and the last value is the last mark.

4.4.3. Detailed Design of embedded software

4.4.3.1. Detailed Design of embedded software

When program on Arduino MEGA 2560 start, program is reading EEPROM to load data on it to turning them into system working data that lie on the SRAM of Arduino.

After load data from EEPROM, Arduino go to infinite loop function. It always listen data packet from IRSC-App sent to it via Wi-Fi of module HLK-RM04 that contain command code. Depending on command code, Arduino will execute corresponding task. After system finish this task, Arduino go to infinite loop function and listen another command code again.

We have eight command codes. They are:

*** Please see next page for Command code table ***

Command Code	Function
11	Check validity of account and password to accept or do not accept a Smart phone login into system
22	Synchronize data from IRSC-Box to IRSC-App on Smart phone
33	Change login's account and password
44	Reset system to factory default mode
99	Change Wi-Fi's name and password
66	Add new device or learn a new button's IR signal
77	Delete a device
88	Emit IR ray to control a device

*Table 4-7: Detail of command code**4.4.3.2. Flow chart*

*** Please see next page for Flow chart of Arduino Embedded software ***

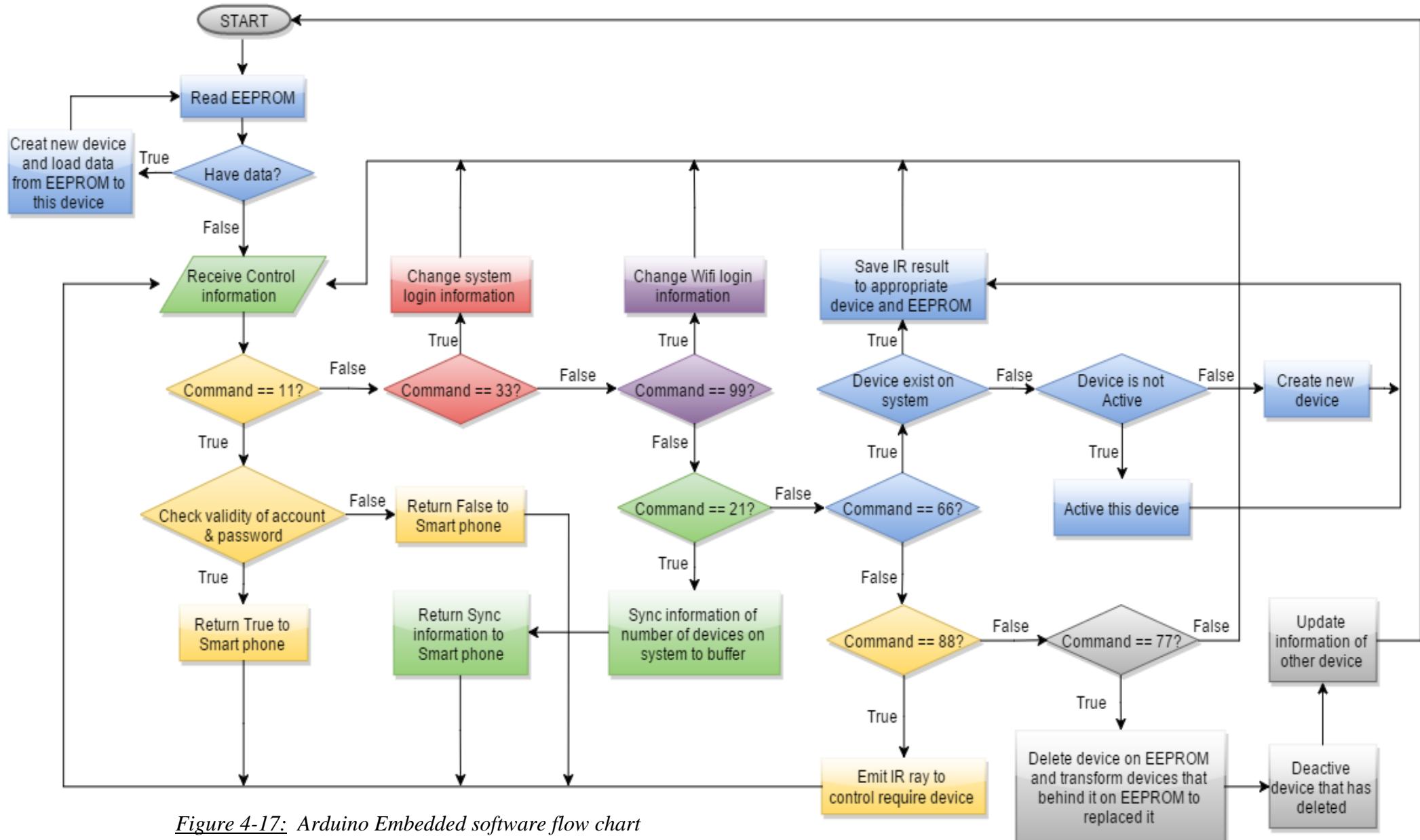


Figure 4-17: Arduino Embedded software flow chart

4.4. Detailed Design of IRSC-App

4.4.1. Technical

4.4.1.1. Communication

Send data is multi-byte stream that Android send to board module. It uses UDP network protocol to communicate through UDP port, configure socket port optional, for example: port 2390.

The user's request will send from android application to Wi-Fi module. Data will converts to a packet of bytes and moved to controller. Network protocol through UDP and configure ports socket optionally.

4.4.1.2. Processing

In IRSC-App, we process data and store data in Shared Preferences. Shared Preferences allow you to save and retrieve data in the form of key, value pair. In order to use shared preferences, you have to call a method `getSharedPreferences()` that returns a `SharedPreference` instance pointing to the file that contains the values of preferences.

4.4.2. Sequence diagram

**** Please see next page for Sequence diagram of IRSC-App ****

4.4.2.1. Overview of Device Manage

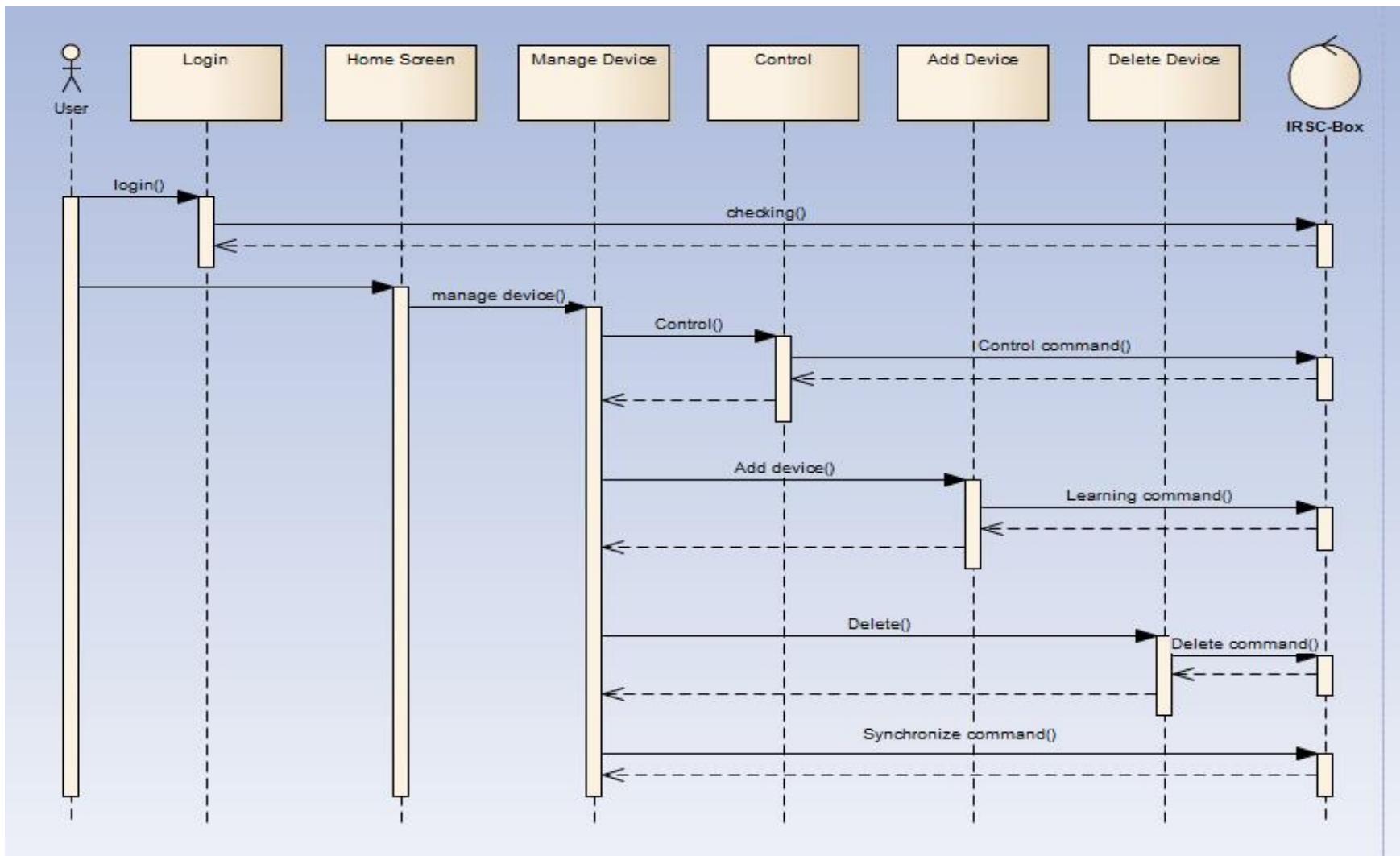


Figure 4-18: Device Manage sequence diagram

4.4.2.2. Login

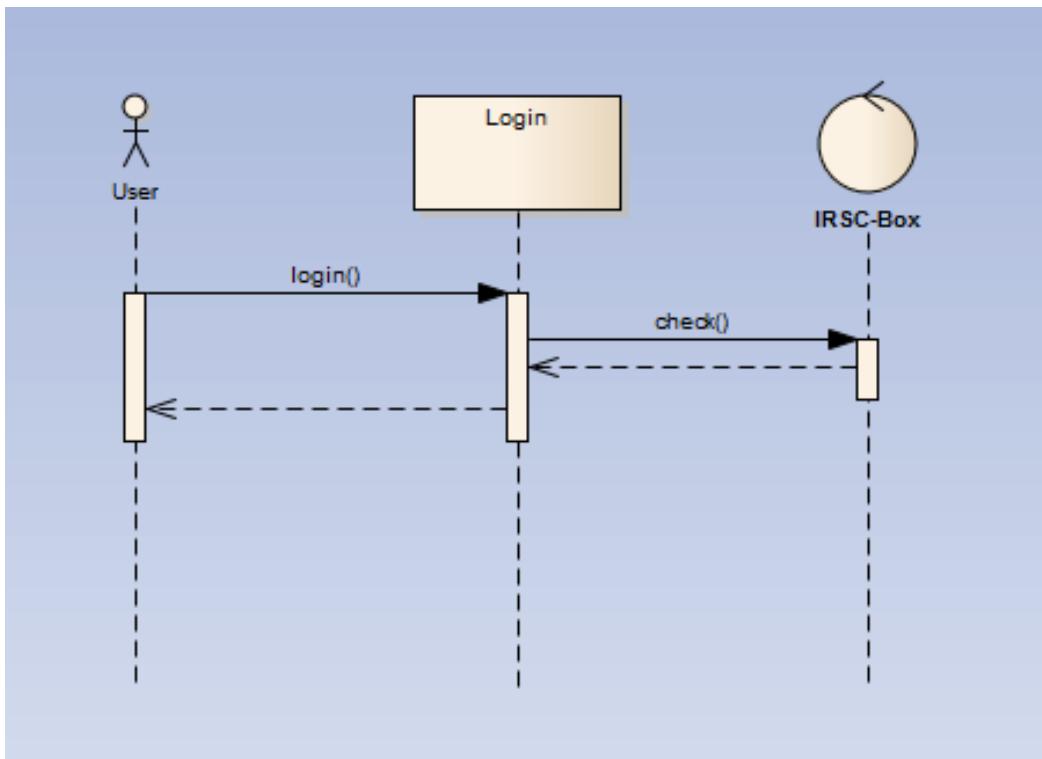


Figure 4-19: Login sequence diagram

4.4.2.3. Add new device

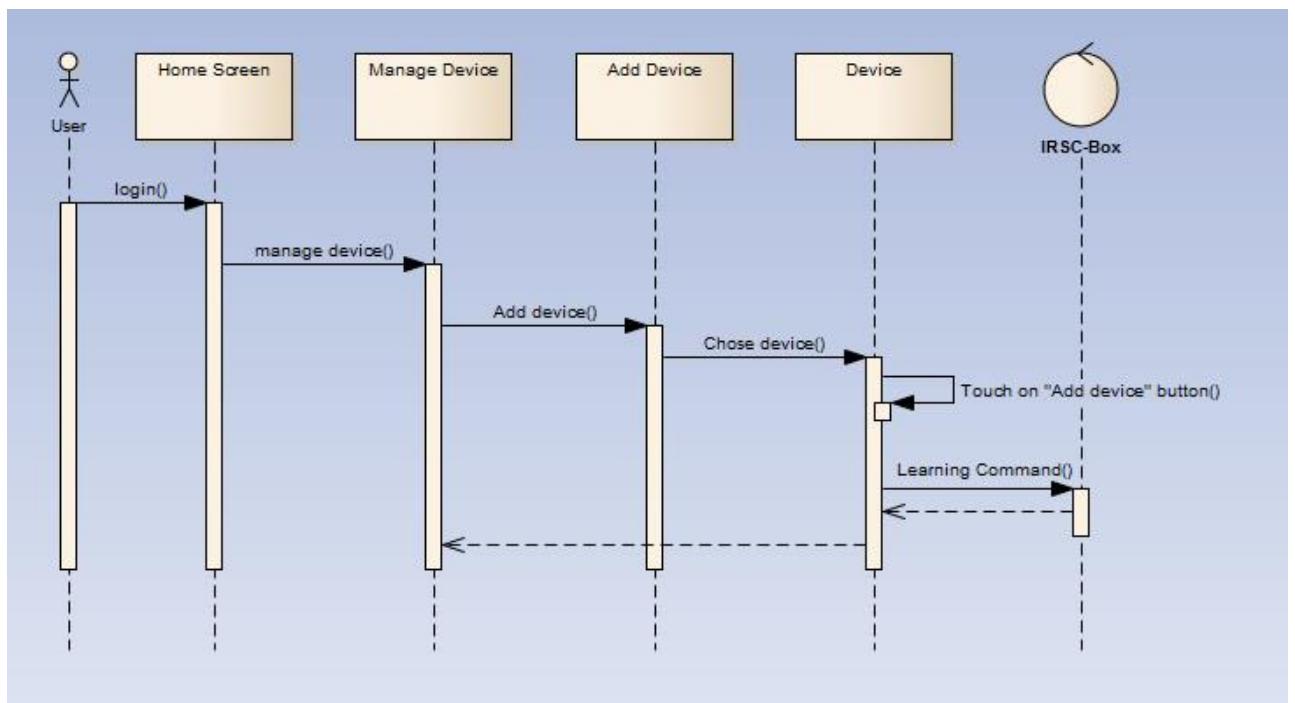


Figure 4-20: Add new device sequence diagram

4.4.2.4. Learn new IR signal

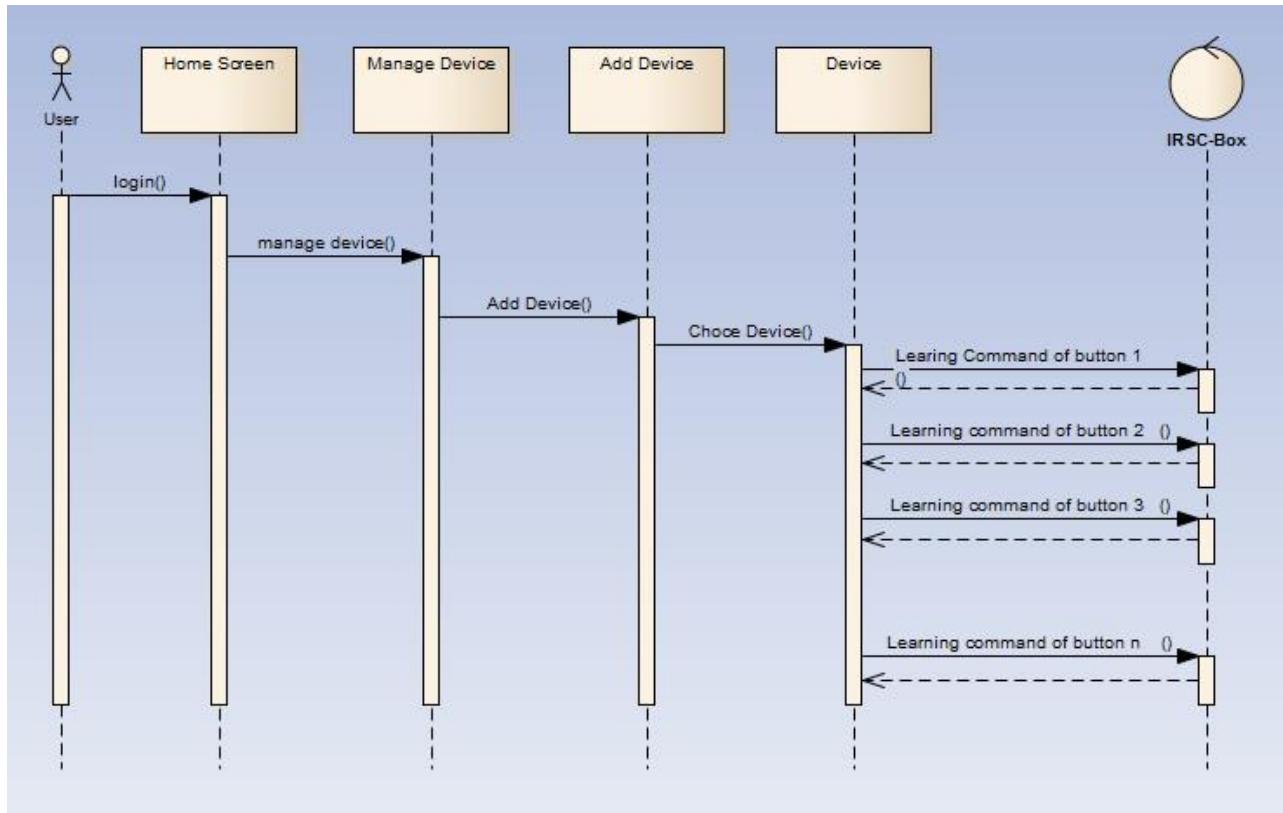


Figure 4-21: Learn new IR signal sequence diagram

4.4.2.5. Control a device

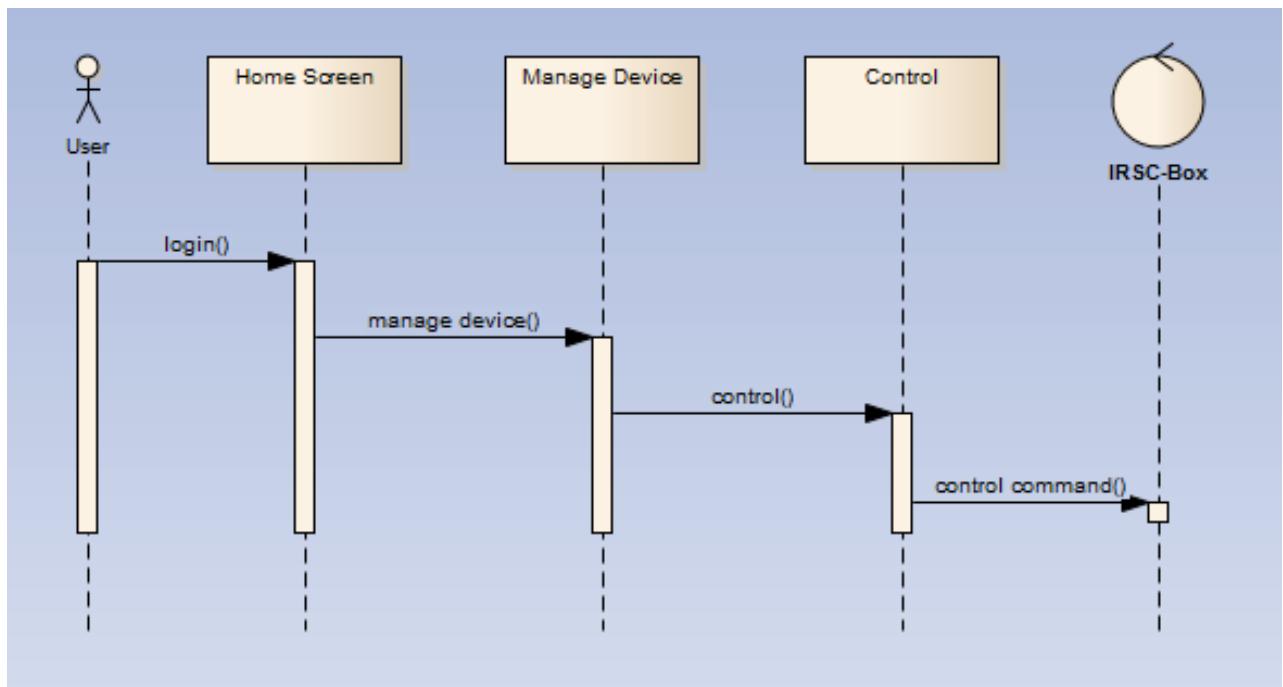


Figure 4-22: Control a device sequence diagram

4.4.2.6. Delete a device

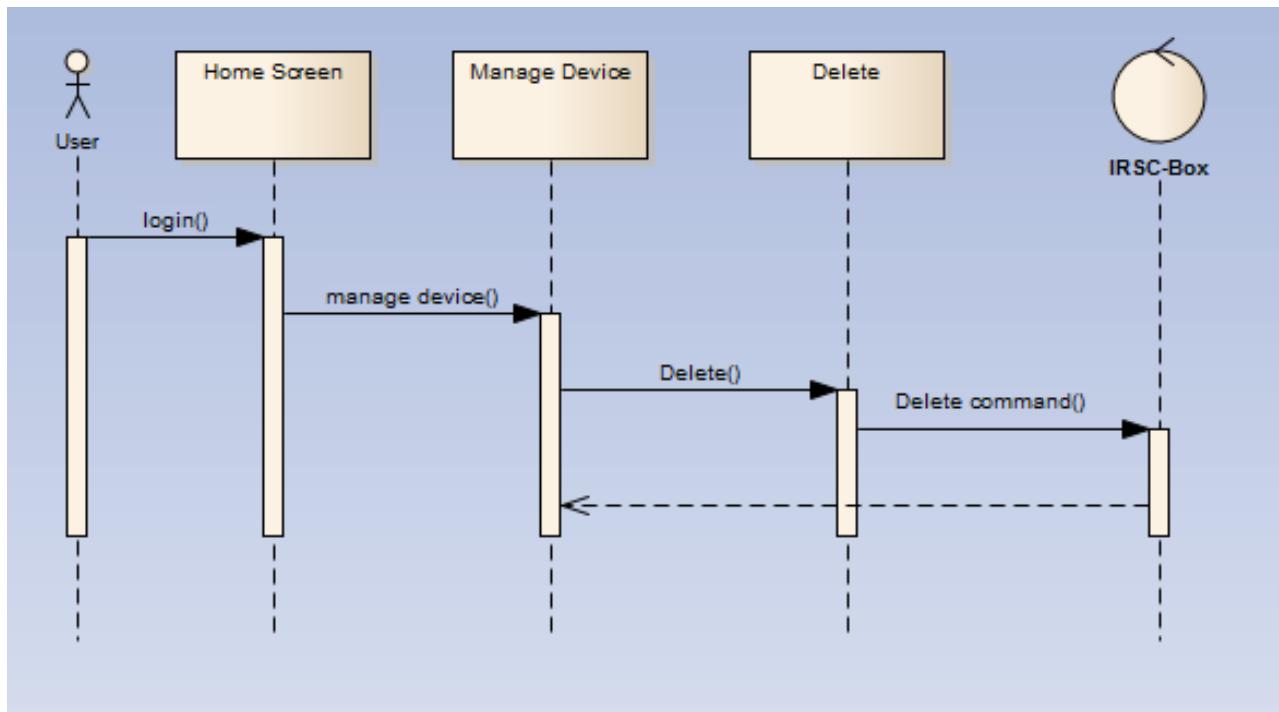


Figure 4-23: Delete a device sequence diagram

4.4.2.7. Synchronize

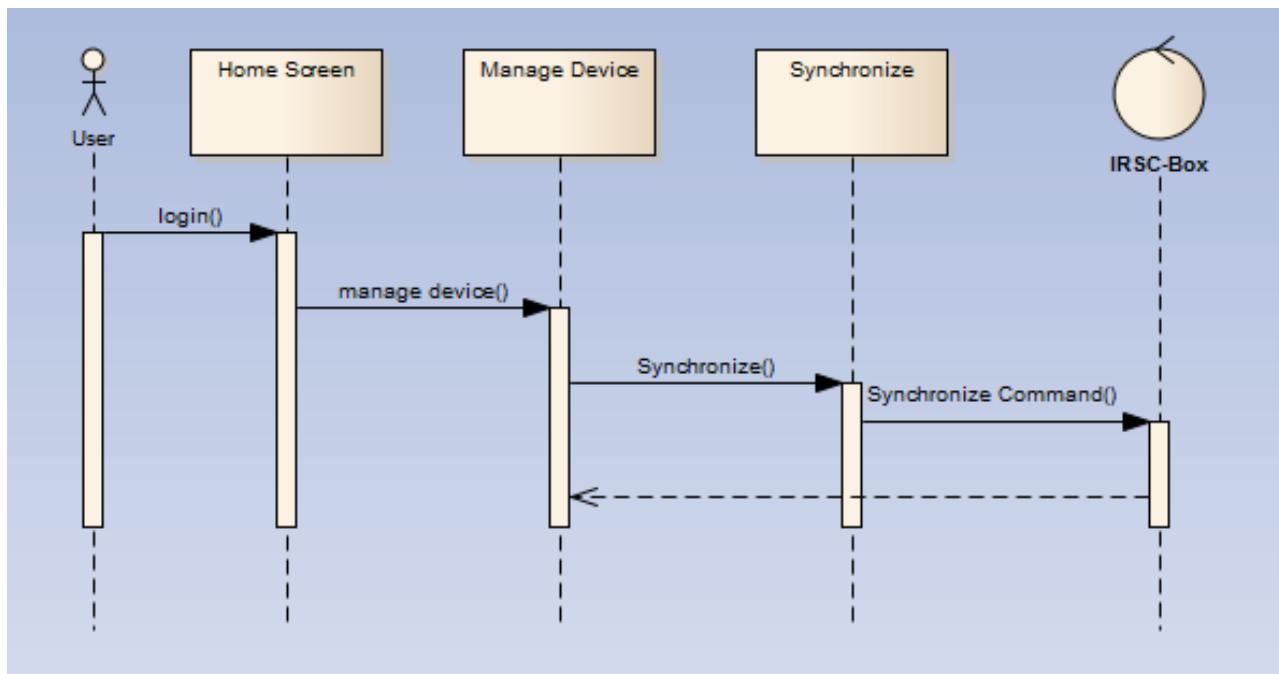


Figure 4-24: Synchronize sequence diagram

4.4.2.8. Overview of Accounts manage

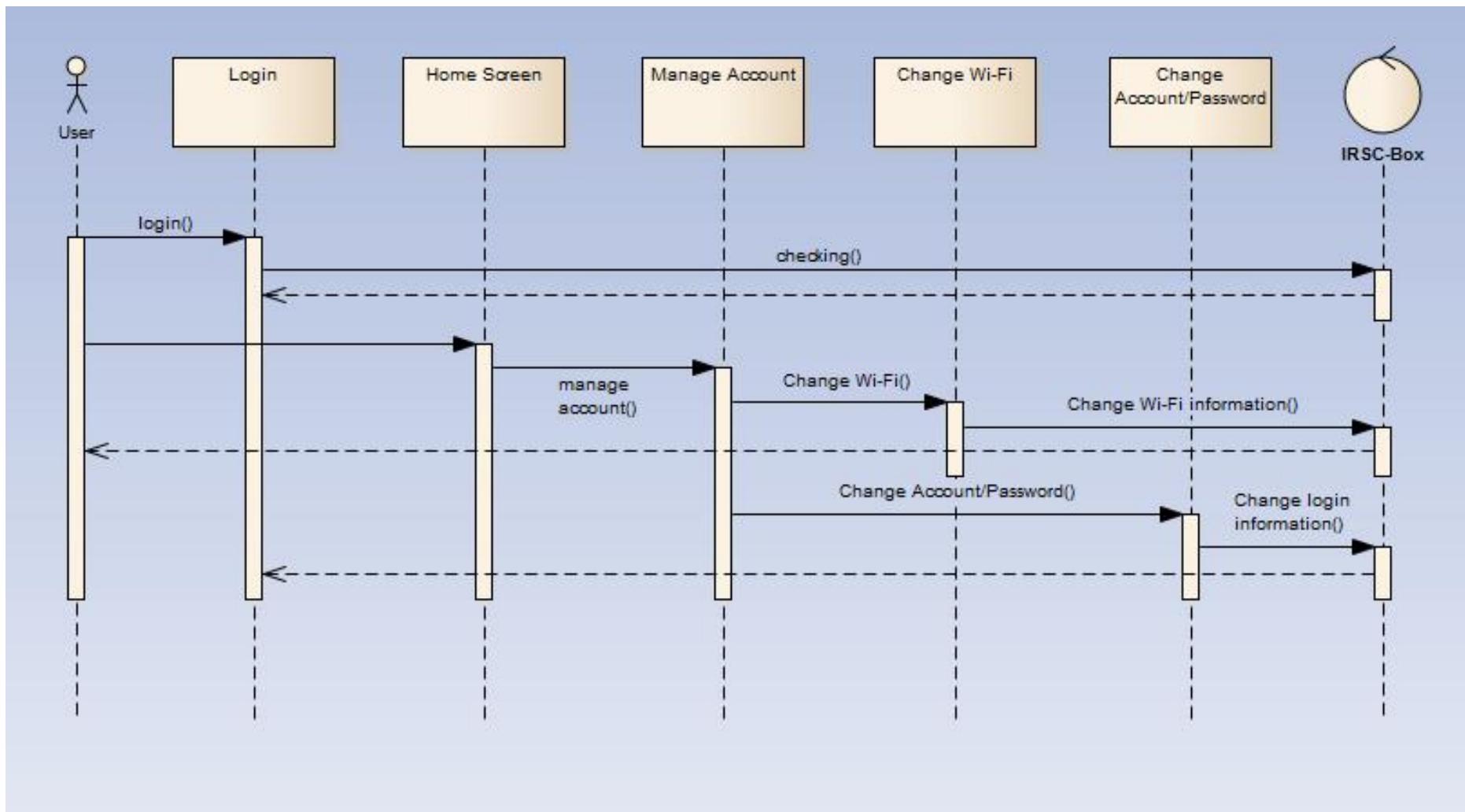


Figure 4-25: Accounts manage sequence diagram

4.4.2.9. Change Login Account & Password

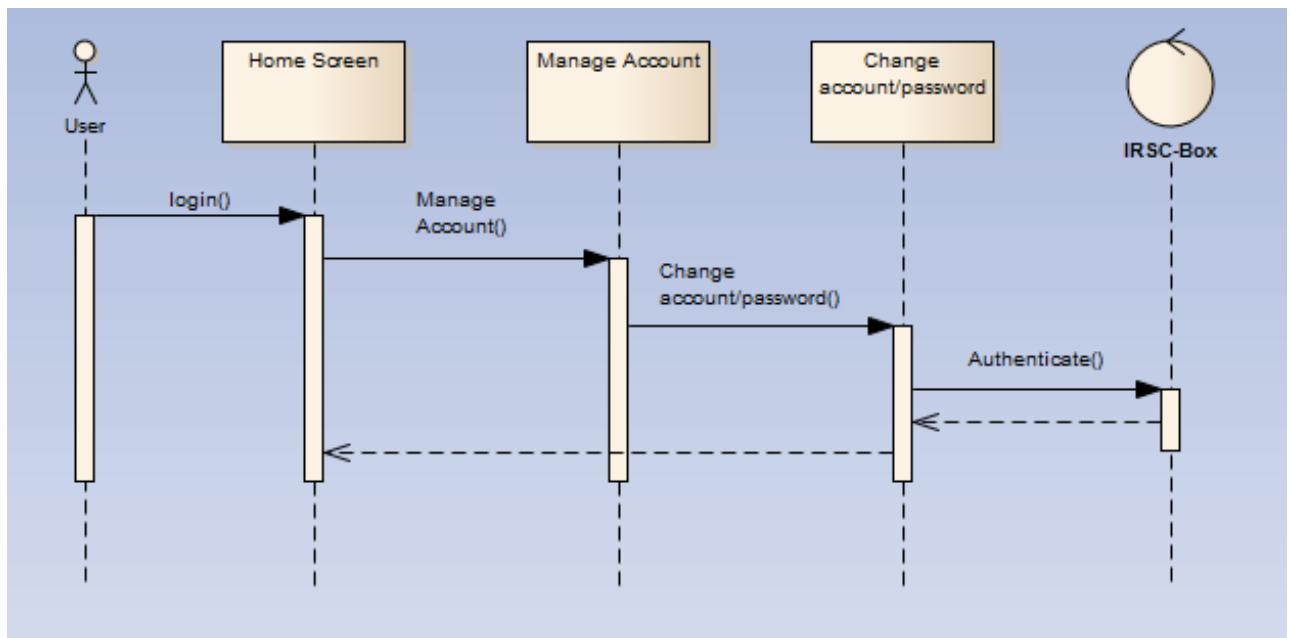


Figure 4-26: Change Login Account & Password sequence diagram

4.4.2.10. Change Wi-Fi Account & Password

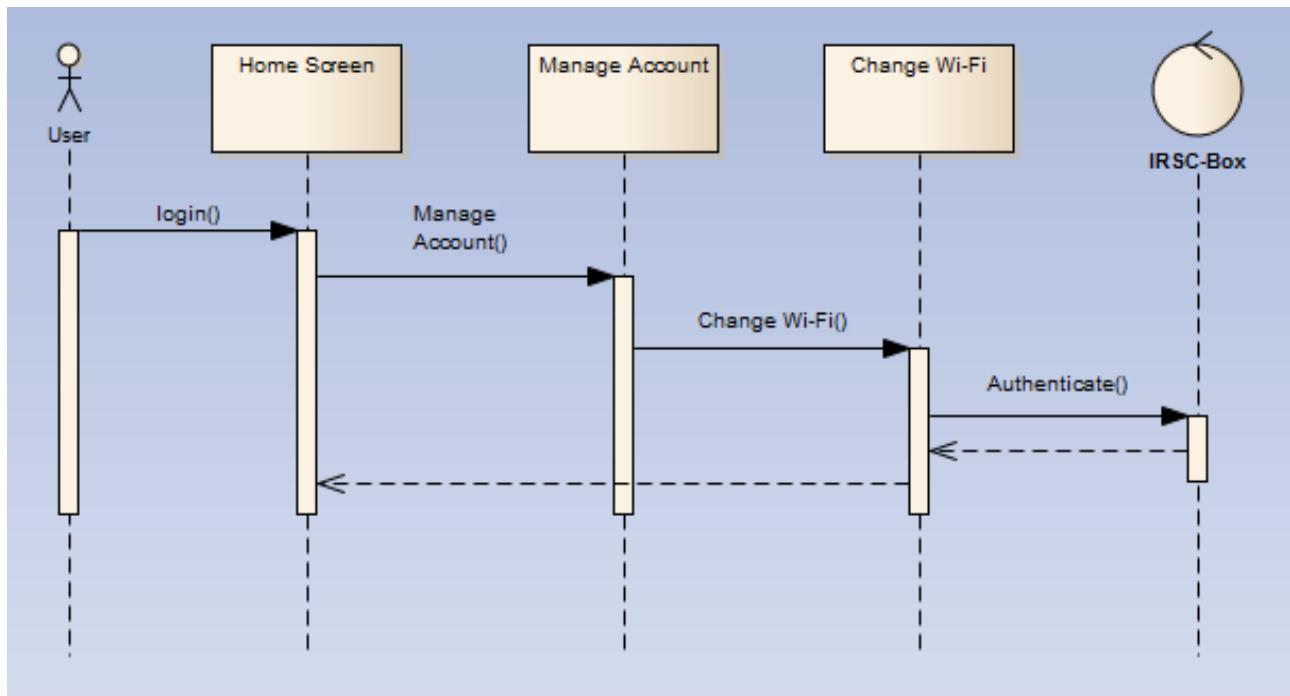


Figure 4-27: Change Wi-Fi Account & Password sequence diagram

4.4.2.11. View user manual

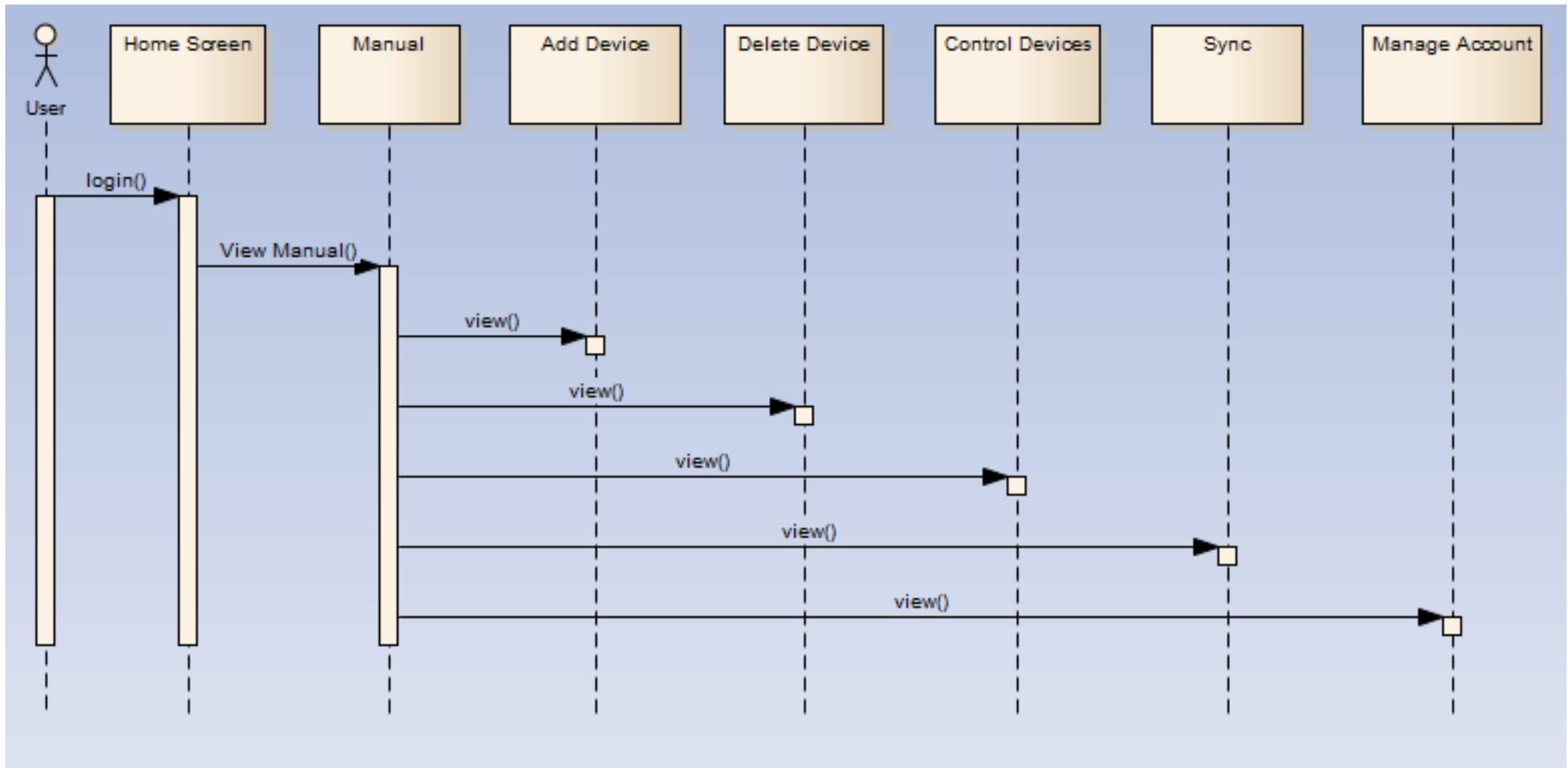


Figure 4-28: View user manual sequence diagram

4.5. User Interface Design

4.5.1 Description of the User Interface

We had chosen “*Material design*” to design user interface of IRSC-App. But, what is “*Material design*”? What are outstanding features? The following reasons explain why we chose this design style.

4.5.1.1. Introduction of Material design

Material Design is a design language designed what apply to Android 5.0 Lollipop by Google, marking the start of a revolution in terms of the interface on Android devices. They impress users by emphasize the bold colors, flat shapes, strange floating details.

Material Design was born with an important mission: unified application interfaces design across different types of devices - phones, tablets, computers, wearable devices, televisions...

4.5.1.2. Advantages of Material Design.

This style is the common standard for the application interfaces design from third parties, and the hardware partners who are participating in the Google ecosystem.

Material Design aims for simple, user-friendly, stand out in bold colors, impress users when they start to experience application. It create a friendly sense and interfaces are throughout the multiple different devices.

4.5.1.3. Trend of using Material design in product design

Flat design has achieved many breakthroughs in 2014 and continues to be the trend in the new year. However, the new phenomenon in product design in 2015 will come from Material Design what promises to have more and more powerful breakthrough.

With these advantages, more friendly to developers, beautiful interface, throughout, get more sympathy from user. Moreover, also has the strong support from the large and powerful developer team of Google. The Material Design will appear more and more in the future.

4.5.2. Screen Images

4.5.2.1. Login screen

4.5.2.1.1. Design of login screen

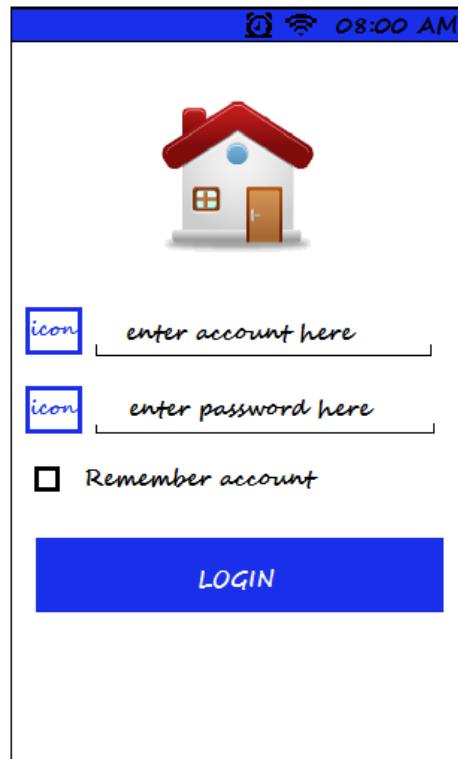


Figure 4-29: Design of login screen

4.5.2.1.2. Actual login screen

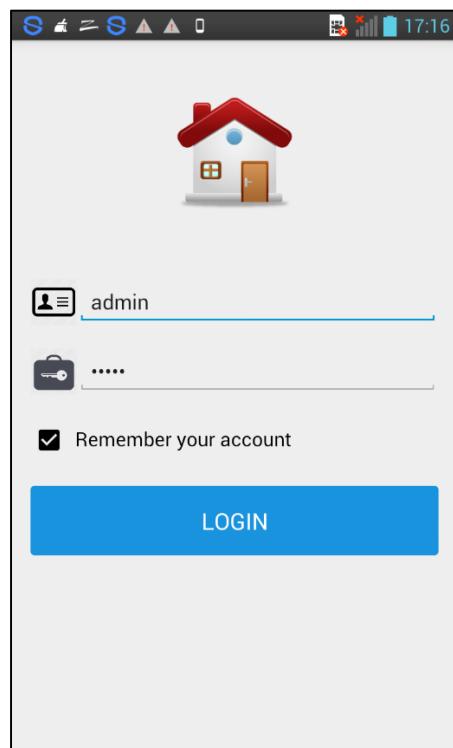


Figure 4-30: Actual login screen

4.5.2.2. Home Screen

4.5.2.2.1. Design of Home screen



Figure 4-31: Design of home screen

4.5.2.2.2. Actual Home screen

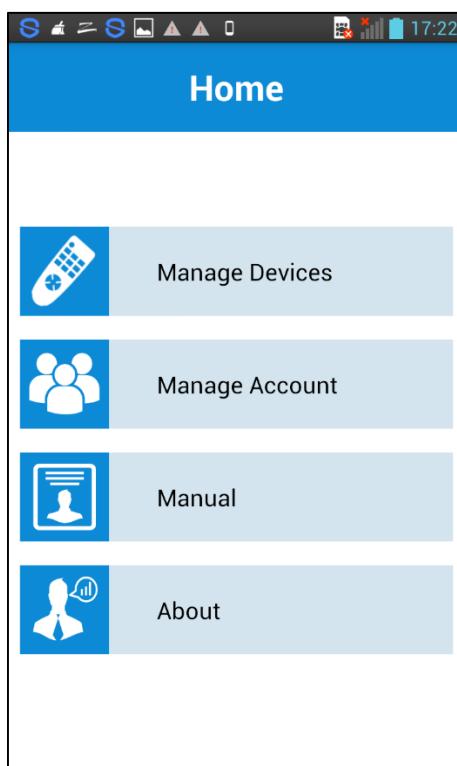


Figure 4-32: Actual home screen

4.5.2.3. Manage devices screen

4.5.2.3.1. Design of Manage devices screen

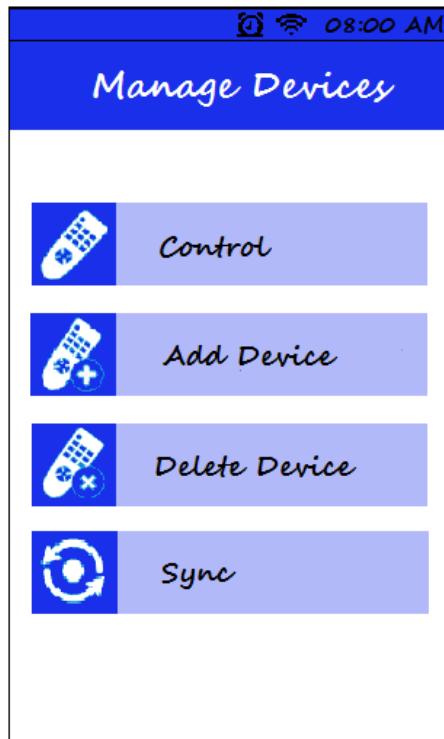


Figure 4-33: Design of Manage devices screen

4.5.2.3.2. Actual Manage devices screen

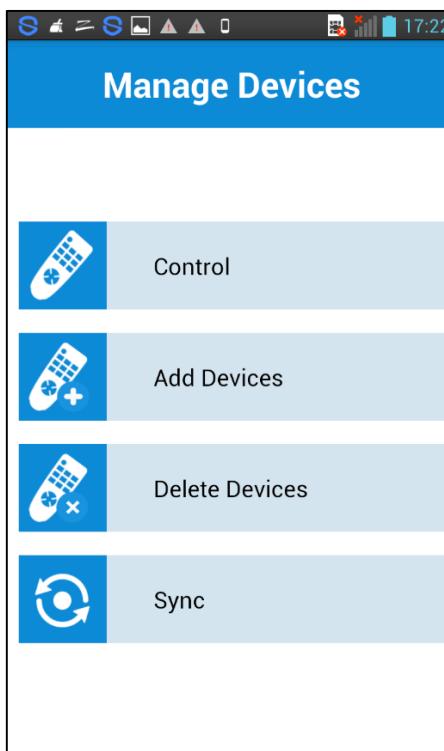


Figure 4-34: Actual Manage devices screen

4.5.2.4. Add or Delete Devices screen

4.5.2.4.1. Design of Add or Delete Devices screen

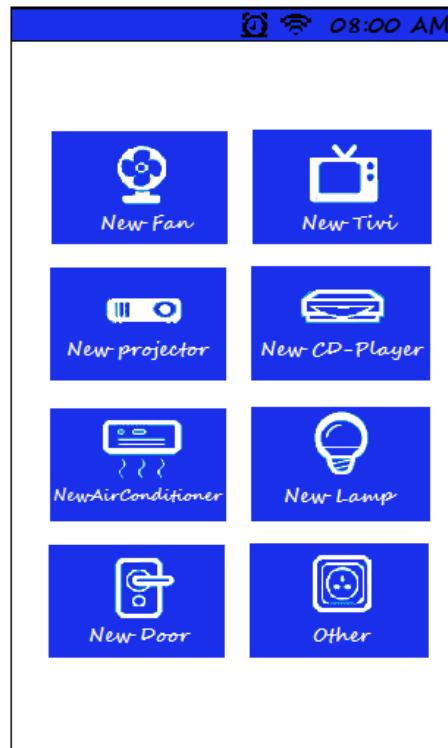


Figure 4-35: Design of Add or Delete Devices screen

4.5.2.4.2. Actual Add or Delete Devices screen

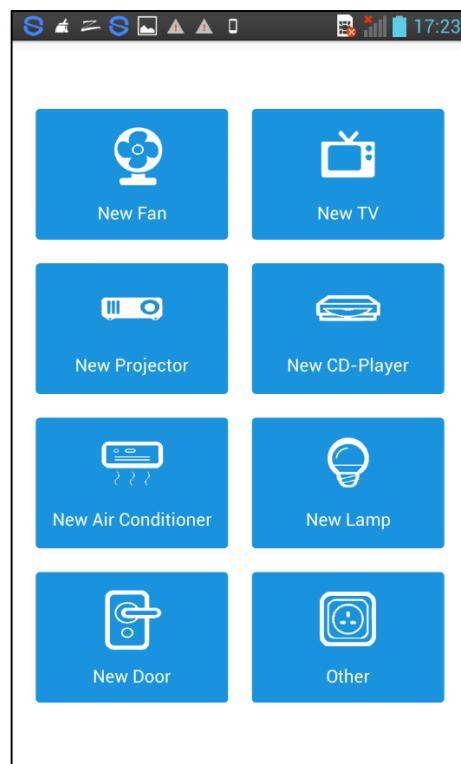


Figure 4-36: Actual Add or Delete Devices screen

4.5.2.5. Add a device screen

4.5.2.5.1. Design of Add a device screen

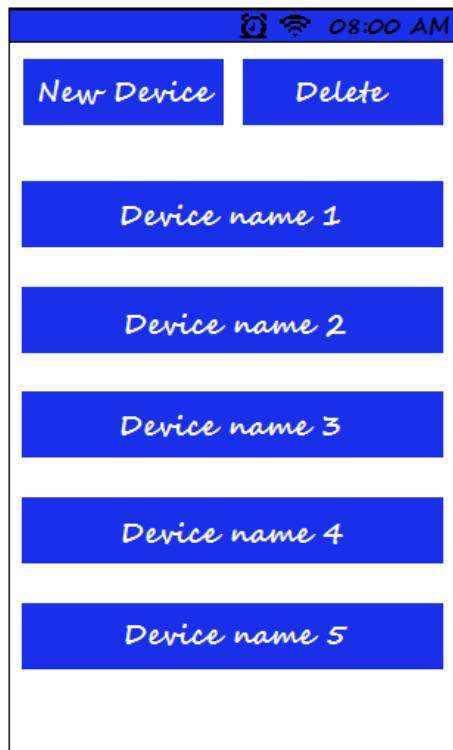


Figure 4-37: Design of Add a device screen

4.5.2.5.2. Actual Add a device screen

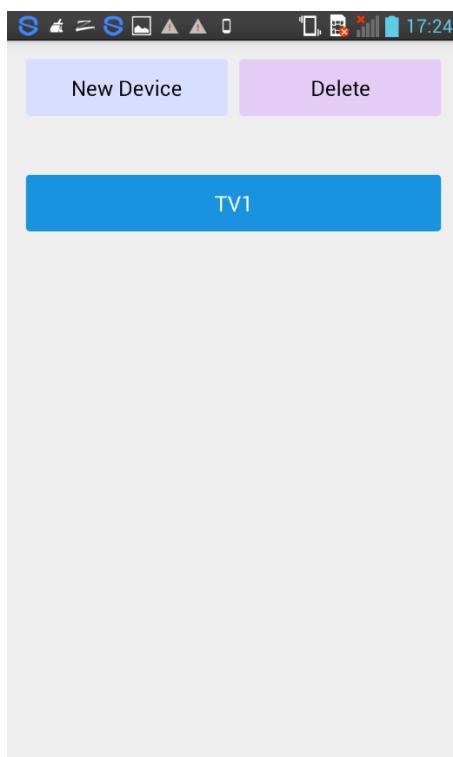


Figure 4-38: Actual Add a device screen

4.5.2.6. Delete Screen

4.5.2.6.1. Design of Delete screen

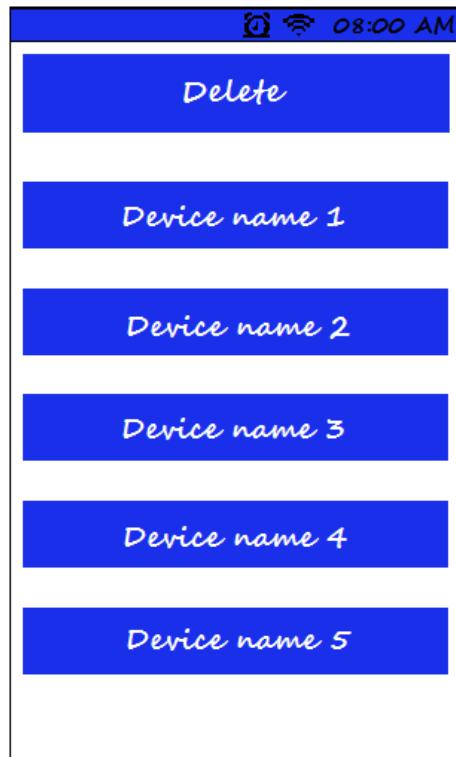


Figure 4-39: Design of Delete screen

4.5.2.6.2. Actual Delete screen

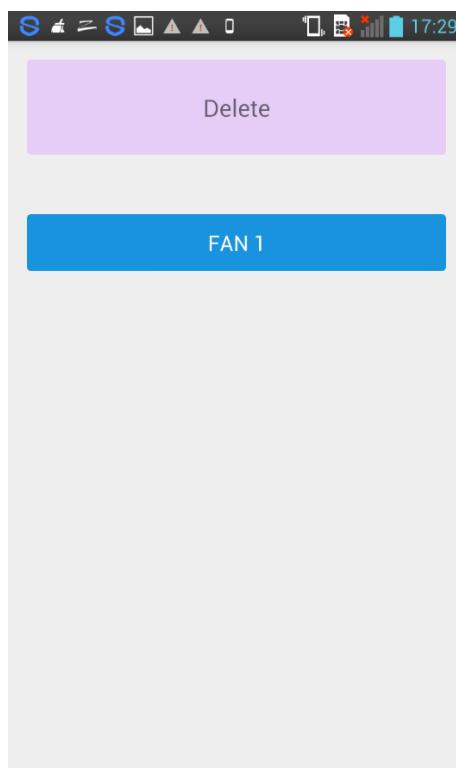


Figure 4-40: Actual Delete screen

4.5.2.7. Control Devices screen

4.5.2.7.1. Design of Control Devices screen



Figure 4-41: Design of Control Devices screen

4.5.2.7.2. Actual Control Devices screen

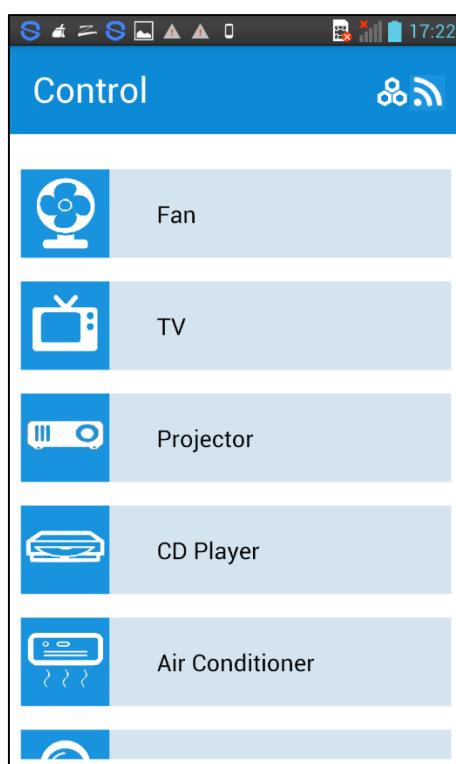


Figure 4-42: Actual Control Devices screen

4.5.2.8. Control a device screen

4.5.2.8.1. Design of Control a device screen

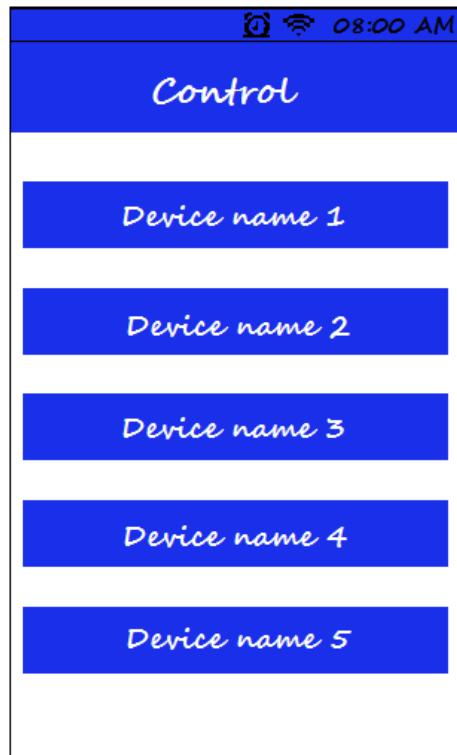


Figure 4-43: Design of Control a device screen

4.5.2.8.2. Actual Control a device screen

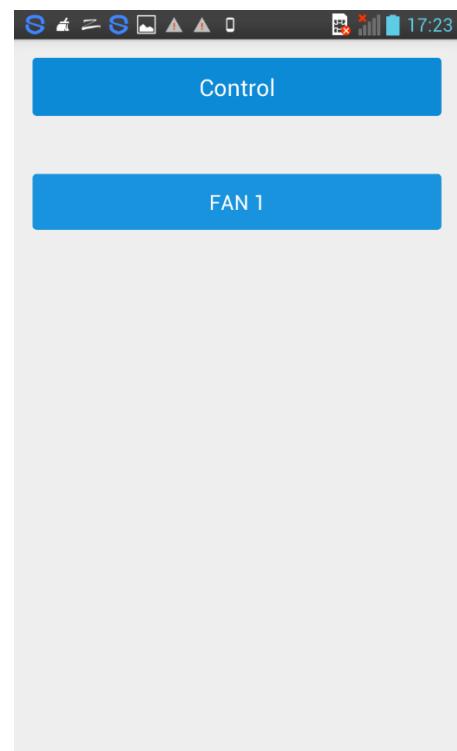


Figure 4-44: Actual Control a device screen

4.5.2.9. Manage Account screen

4.5.2.9.1. Design of Manage Account screen

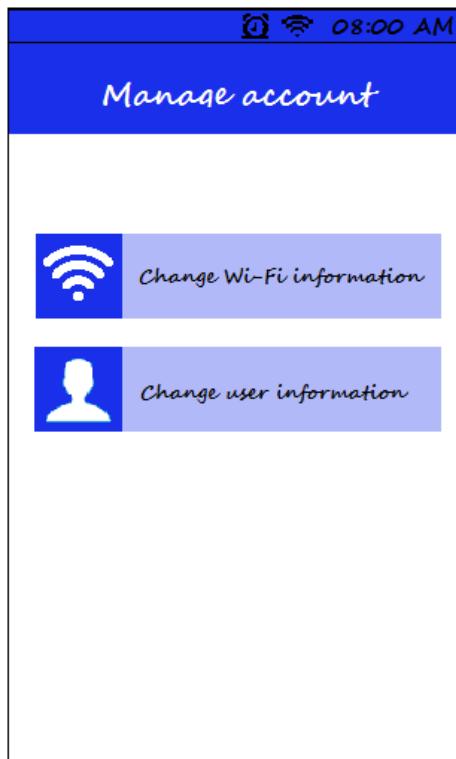


Figure 4-45: Design of Manage Account screen

4.5.2.9.2. Actual Manage Account screen



Figure 4-46: Actual Manage Account screen

4.5.2.10. Change Wi-Fi information screen

4.5.2.10.1. Design of Change Wi-Fi information screen



Figure 4-47: Design of Change Wi-Fi information screen

4.5.2.10.2. Actual Change Wi-Fi information screen

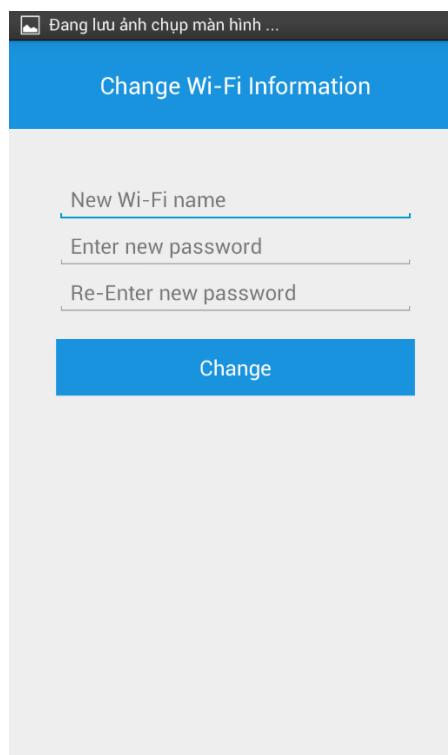


Figure 4-48: Actual Change Wi-Fi information screen

4.5.2.11. Change account screen

4.5.2.11.1. Design of Change account screen

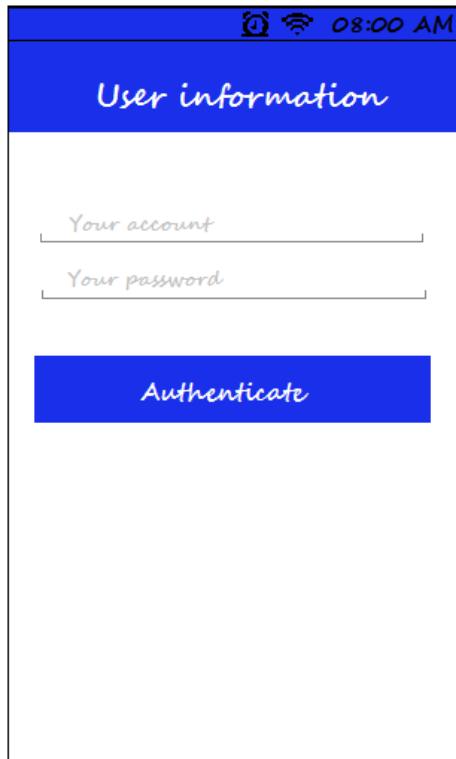


Figure 4-49: Design of Change account screen

4.5.2.11.2. Actual Change account screen

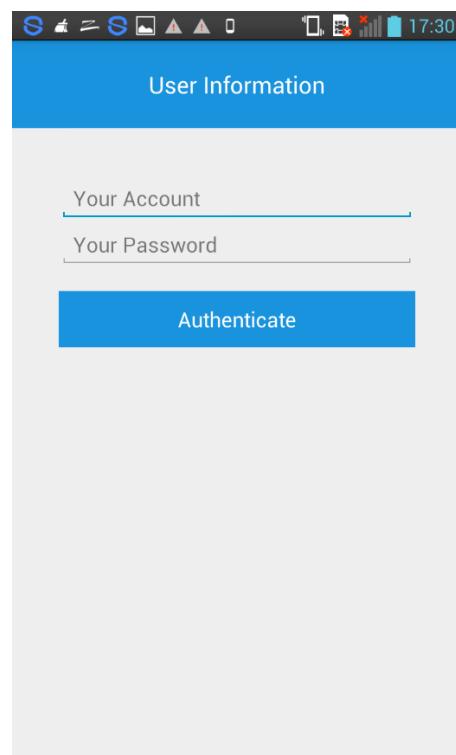


Figure 4-50: Actual Change account screen

4.5.2.12. Manual screen

4.5.2.12.1. Design of Manual screen



Figure 4-51: Design of Manual screen

4.5.2.12.2. Actual Manual screen

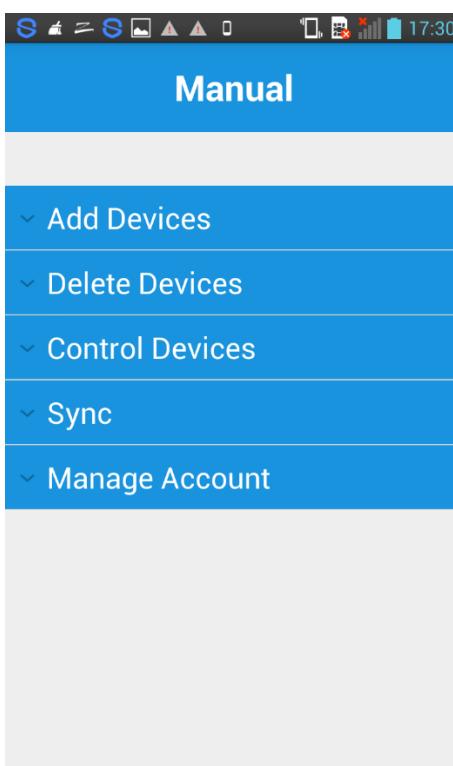


Figure 4-52: Actual Manual screen

4.5.2.13. Manual view mode screen

4.5.2.13.1. Design of Manual view mode screen

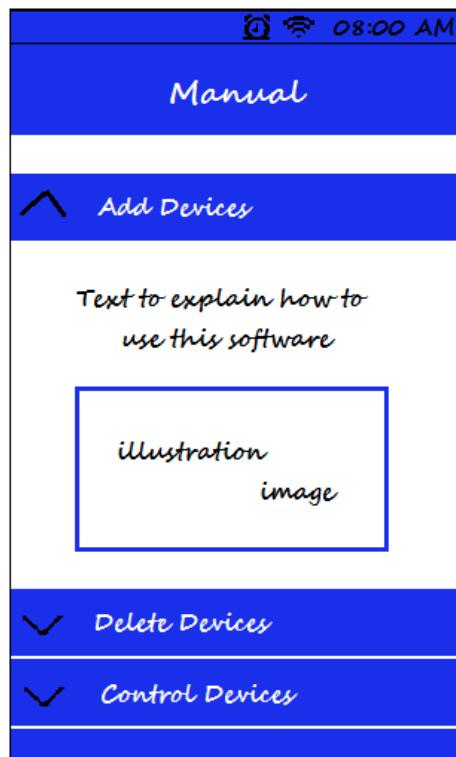


Figure 4-53: Design of Manual view mode screen

4.5.2.13.2. Actual Manual view mode screen

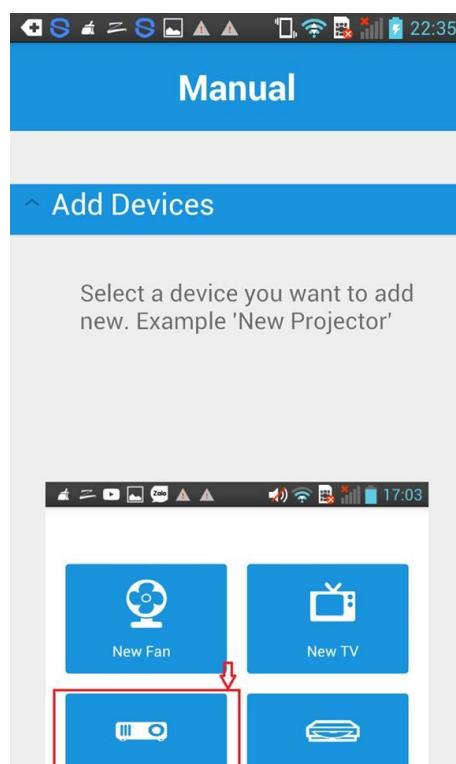


Figure 4-54: Actual Manual view mode screen

4.5.2.14. Control Fan screen

4.5.2.14.1. Design Control Fan screen

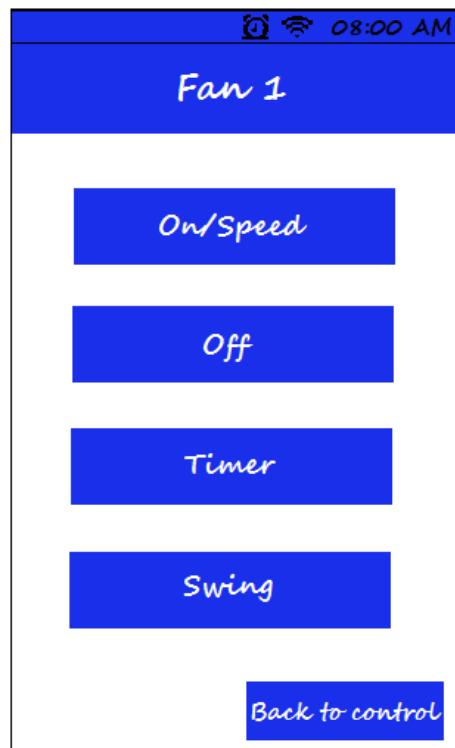


Figure 4-55: Design Control Fan screen

4.5.2.14.2. Actual Control Fan screen

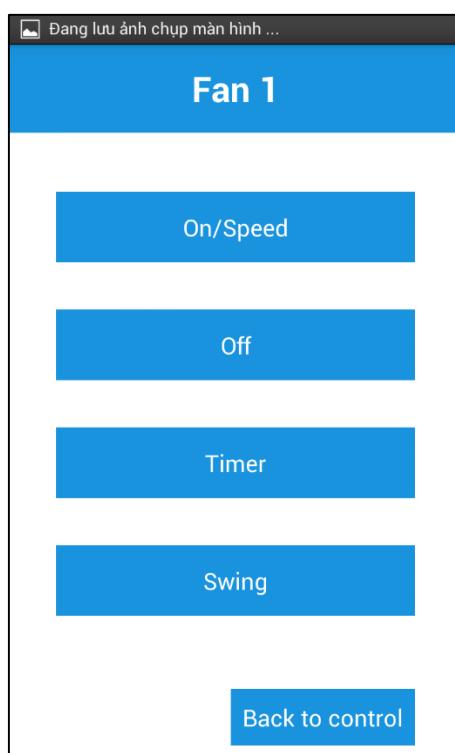


Figure 4-56: Actual Control Fan screen

4.5.2.15. Control Tivi screen

4.5.2.15.1. Design of Control Tivi screen

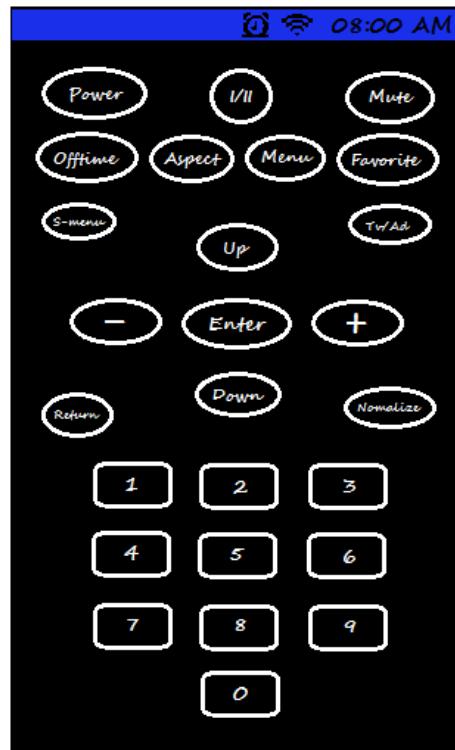


Figure 4-57: Design of Control Tivi screen

4.5.2.15.2. Actual Control Tivi screen

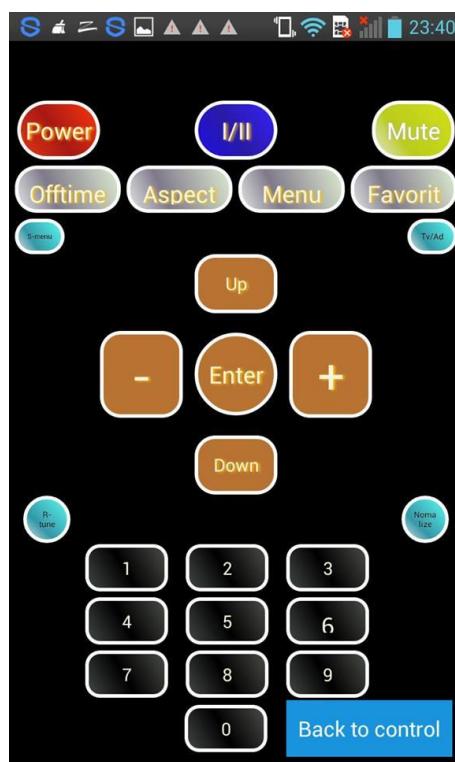


Figure 4-58: Actual Control Tivi screen

4.5.2.16. Control Projector screen

4.5.2.16.1. Design of Control Projector screen



Figure 4-59: Design of Control Projector screen

4.5.2.16.2. Actual Control Projector screen

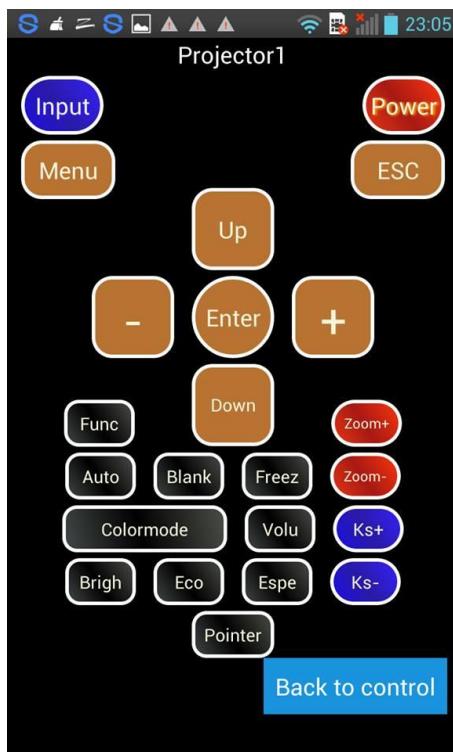


Figure 4-60: Actual Control Projector screen

4.5.2.17. Control CD-Player screen

4.5.2.17.1. Design of Control CD-Player screen

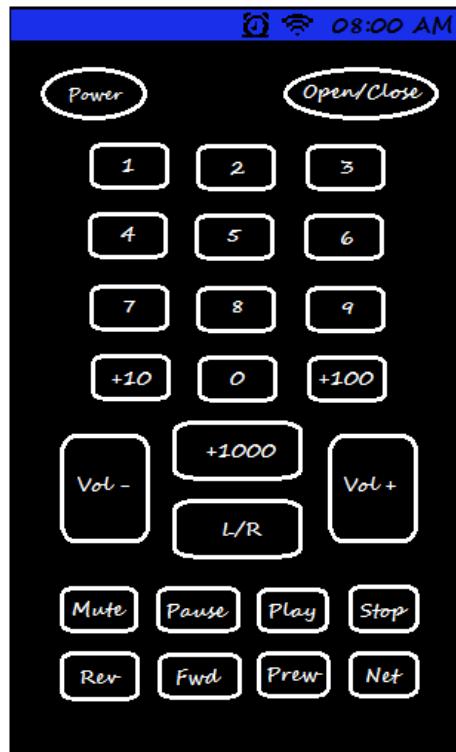


Figure 4-61: Design of Control CD-Player screen

4.5.2.17.2. Actual Control CD-Player screen

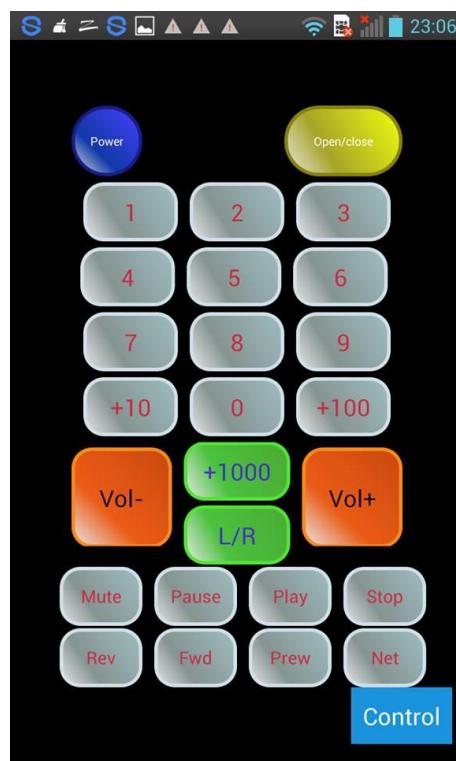


Figure 4-62: Actual Control CD-Player screen

4.5.2.18. Control Air Conditioner screen

4.5.2.18.1. Design of Control Air Conditioner screen

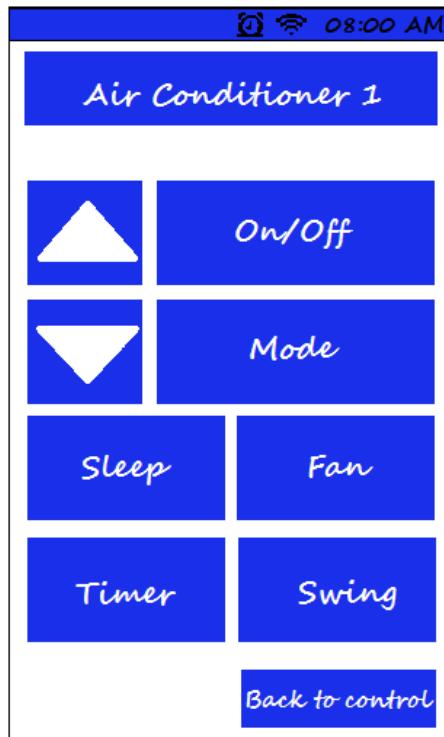


Figure 4-63: Design of Control Air Conditioner screen

4.5.2.18.2. Actual Control Air Conditioner screen

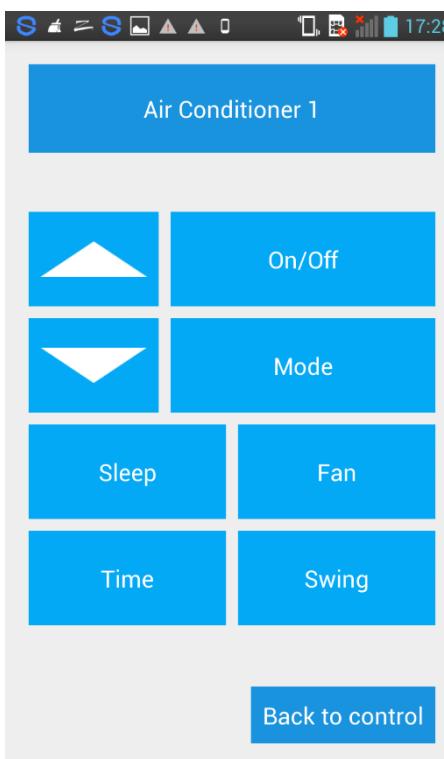


Figure 4-64: Actual Control Air Conditioner screen

4.5.2.19. Control Lamp screen

4.5.2.19.1. Design of Control Lamp screen

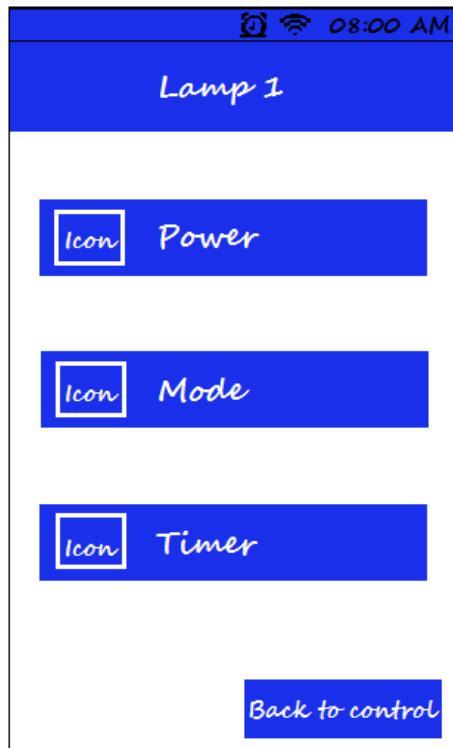


Figure 4-65: Design of Control Lamp screen

4.5.2.19.2. Actual Control Lamp screen

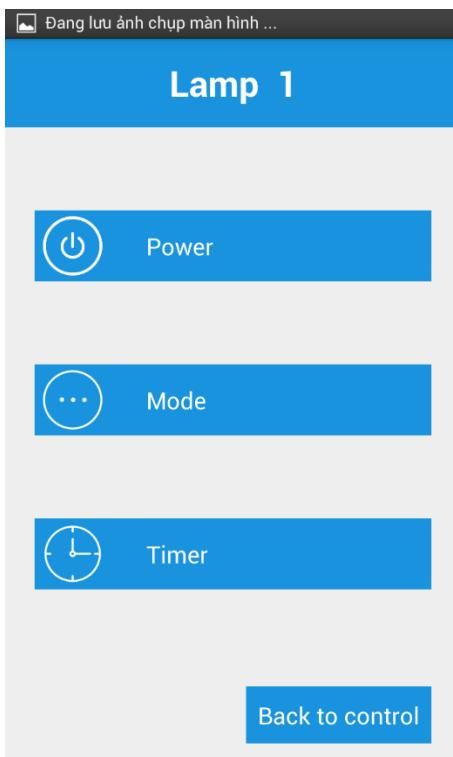


Figure 4-66: Actual Control Lamp screen

4.5.2.20. Control Door screen

4.5.2.20.1. Design of Control Door screen

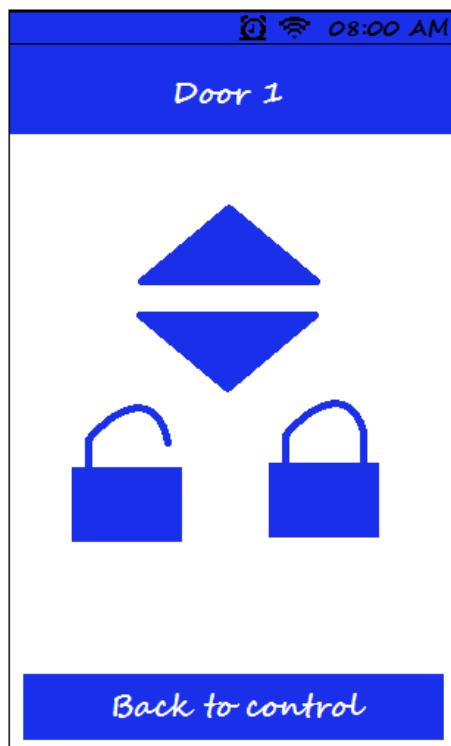


Figure 4-67: Design of Control Door screen

4.5.2.20.2. Actual Control Door screen



Figure 4-68: Actual Control Door screen

4.5.2.21. Control Other screen

4.5.2.21.1. Design of Control Other screen

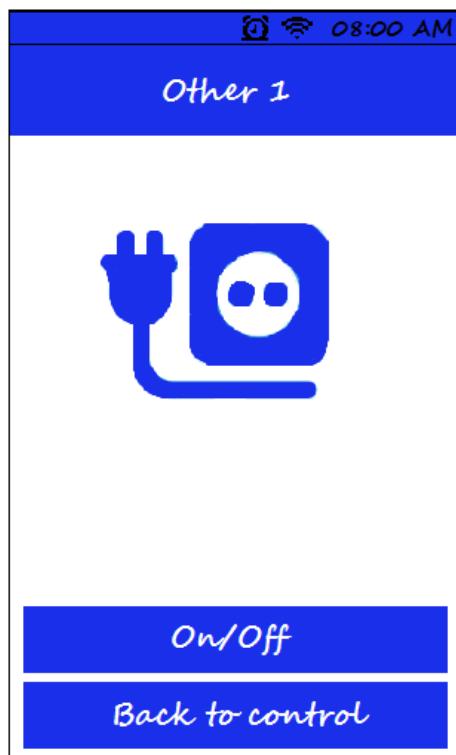


Figure 4-69: Design of Control Other screen

4.5.2.21.2. Actual Control Other screen

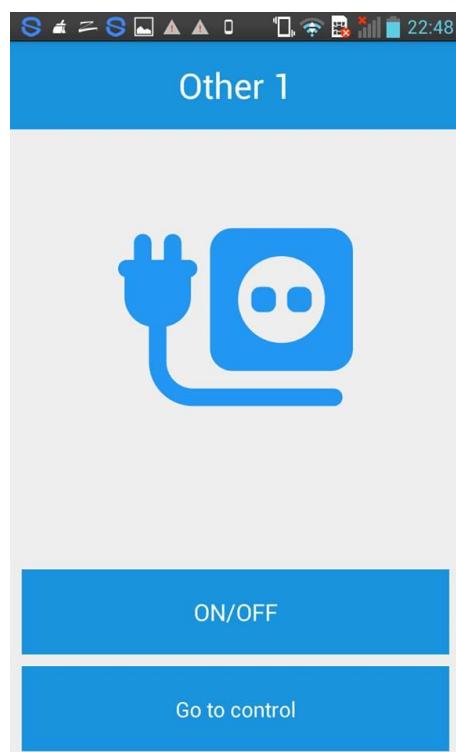


Figure 4-70: Actual Control Other screen

4.5.2.22. About screen

4.5.2.22.1. Design of About screen



Figure 4-71: Design of About screen

4.5.2.22.2. Actual About screen



Figure 4-72: Actual About screen

4.6. Data Structures

4.6.1. Command Structure

To give orders to IRSC-Box, IRSC-App use a specific command structure. We have seven command codes what are header of a command. Each command code has a distinct tail. A head and a tail put together to made a command.

In IRSC system, both in IRSC-App and IRSC-Box, we use different numbers to coding different type of devices. They are:

Device Code	Device	Device Code	Device
01	Television	05	Air Conditioner
02	Fan	06	Lamp
03	Projector	07	Door
04	CD-Player	08	Other devices

Table 4-8: Detail of device codes

4.6.1.1. Command code 11

This command code to check validity of account and password to accept or do not accept a Smart phone login into system. Structure of this command is 11account~password. Inside it:

- account is account that user entered.
- password is password that user entered.
- account and password must be large than 0 and less than 13 characters.

4.6.1.2. Command code 22

This command code to synchronize data from IRSC-Box to IRSC-App on Smart phone. Structure of this command is 22. Inside it does not need more different element.

4.6.1.3. Command code 33

This command code to change login's account and password. Structure of this command is 33account~password. Inside it:

- account is new account that user entered.
- password is new password that user entered.
- account and password must be large than 0 and less than 13 characters.

4.6.1.4. Command code 44

This command code to reset system to factory default mode. Structure of this command is 44. Inside it does not need more different element.

4.6.1.5. Command code 99

This command code to change Wi-Fi's name and password. Structure of this command is 99wifi~password. Inside it:

- wifi is new Wi-Fi name that user entered.
- password is new password that user entered.
- wifi must be large than 0 and less than 13 characters and password must be large than 7 and less than 13 characters.

4.6.1.6. Command code 66

This command code to add new device or learn a new button's IR signal. Structure of this command is 66aabbcC. Inside it:

- aa is device code
- bb is ordinal number of this device
- cc is button ordinal number of this device

4.6.1.7. Command code 77

This command code to delete a device. Structure of this command is 77aabbb. Inside it:

- aa is device code
- bb is ordinal number of this device

4.6.1.7. Command code 88

This command code to emit IR ray to control a device. Structure of this command is 88aabbcC. Inside it:

- aa is device code
- bb is ordinal number of this device
- cc is button ordinal number of this device

4.6.2. Data structures

To ensure that the system works smoothly, we some struct of data. They are:

- Struct Devices, inside it have:
 - ✓ Device Code (in byte type)
 - ✓ Ordinal number of this device (in byte type)
 - ✓ Status (in byte type) status = 111 if this device is active or it is existing on system and status = 0 if this device was deleted by user and it is not active.
 - ✓ Location (in byte type) is order of this device on EEPROM if device is active and equal 99 if device is not active.
 - ✓ Address (in int type) is actual address of this device on EEPROM if device is active and equal 9999 if device is not active.
- Struct CODE, inside it have:
 - ✓ Command (in byte type) is command code
 - ✓ Device Code (in byte type)
 - ✓ Ordinal number of this device (in byte type)
 - ✓ Button Ordinal number of this device (in byte type)
- Struct Tivi, Fan, Projector, CDPlayer, AirConditioner, Lamp, Door, Other. Inside they have:
 - ✓ Address (in int type) is actual address of this device on EEPROM
 - ✓ Type (in byte type) is infrared rays protocol code that regulate by *IRremote* library
 - ✓ DTLength (in byte type) is length calculate in bit of decoding infrared data.
 - ✓ Array BC [*Number of button of this device type*] (in unsigned long type) is variable to save decoding infrared data.
- Struct UNK_Tivi, UNK_Fan, UNK_Projector, UNK_CDPlayer, UNK_AirConditioner, UNK_Lamp, UNK_Door, UNK_Other. Inside they have:
 - ✓ DTLength (in byte type) is length calculate in bit of decoding infrared data.
 - ✓ Tow dimension array BC [*Number of button of this device type*] [*Number of integer to save raw infrared data*] (in unsigned int type) is variable to save decoding infrared data.

4.6.3. Data Structures on Arduino's EEPROM

4.6.3.1. EEPROM Data Memory

The Arduino MEGA 2560 base on ATmega2560 microcontroller what contains 4Kbytes of data EEPROM memory. It organizes as a separate data space, in which single bytes can read and write. The EEPROM has an endurance of at least 100,000 write/erase cycles. The access between the

EEPROM and the CPU describe in the following, specifying the EEPROM Address Registers, the EEPROM Data Register, and the EEPROM Control Register.

4.6.3.2. EEPROM Saved Data partition.

ATmega2560 microcontroller contains 4Kbytes or 4096 bytes of data EEPROM memory. From byte 0 to byte 3799, we use to save data of devices what are existing on IRSC system. If a device has infrared protocol what IRremote library do not support, after data of this device is struct of data unknown correlative device.

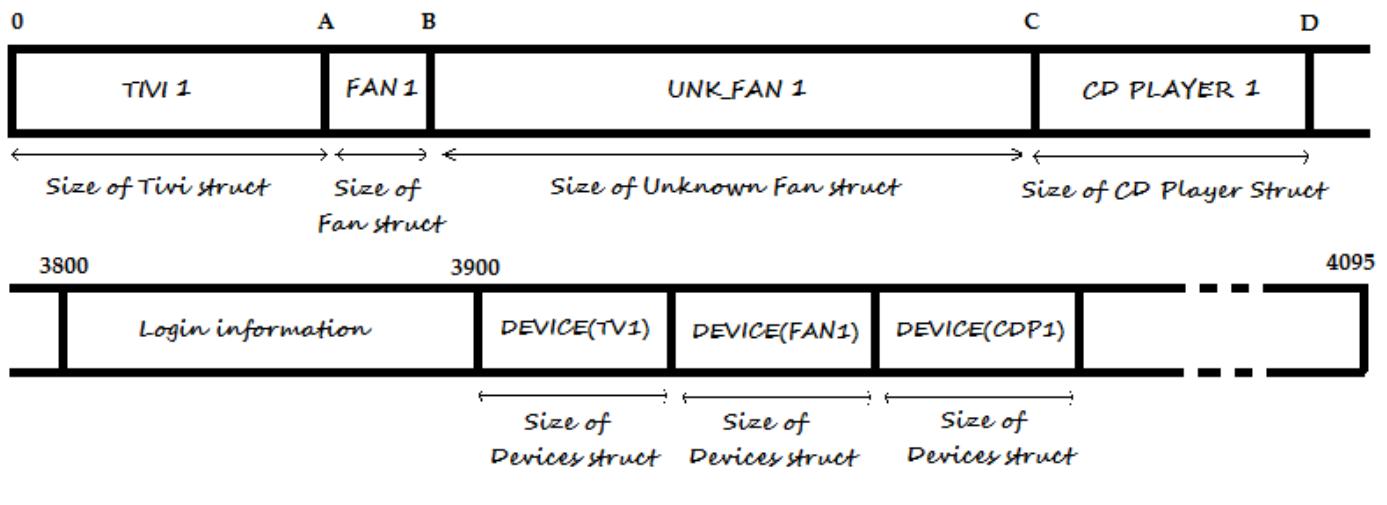
From byte 3800 to byte 3899, we use to save data of login information. Account and password were delimited by a special character (character ~).

From byte 3900 to byte 4095, we use to save declare information data of devices what has existed on system.

4.6.3.3. Saved Data structure example

For example, in system has a Tivi, a Fan and a CD-Player. Tivi and CD-Player's infrared protocol was support by IRremote library. System cannot determine the infrared protocol of the Fan, so system created UNK_Fan to save raw infrared data of Fan. Figure below describe Saved data on EEPROM.

**** Please see next page for example of Saved Data structure****



Note: TV1: Address = 0;
 FAN1: Address = A; Infrared protocol is unknown type
 CDP1: Address = C;
 Address variable in DEVICE(TV1) = 0
 Address variable in DEVICE(FAN1) = A
 Address variable in DEVICE(CDP1) = C

Address A = 0 + Size of Tiri struct
 Address B = A + Size of Fan struct
 Address C = B + Size of UNK_Fan struct
 Address D = C + Size of CDP struct

Figure 4-73: Saved data on EEPROM

Chapter 5: System Implement and Testing

5.1. Introduction

This chapter is the comprehensive implement plan and test plan of the Infrared Ray Smart Control project. The purpose of the chapter describes step of implement, scopes of test and activity which need to be token during test process of project.

It contains the following sections:

- Step of implement
- Scopes of testing
- Requirements for Testing
- Test Strategy: Test approach, test stages
- Test schedule
- Feature to be tested
- Feature not to be test
- Defect Log
- Test report

5.1.1 System Overview

Infrared Ray Smart Control system consist two main parts: Android App, Embedded Software and Hardware. The first part is Android app that uses by user to manage, learn signal and control device. It is the user interface, direct communication with user. Android App send request to Hardware and receive result to display.

The second part is Embedded Software that receive, analyze and implement command. It allocates memory for each type of devices.

The last part hardware: it contains Arduino mega 2560; RM04 Wifi Shield communicates between Arduino and Android App; a circuit that include Infrared LEDs block to emit Infrared control ray, IR receiver block to receive Infrared ray form IR remote in learning mode, mode announce LEDs and other components (resistors, capacitors, transistors, ...).

Overview of test document will describes the approach and methodologies used to test IRSC system. This document contains test plan, organize, execute, and manage the testing of this system. Besides, it describes implement details of environment to test our system or technical details of how the product features should work.

5.1.2 Test Approach

- **Scope of testing**

There are four phases in Testing Process: Unit testing, Integration testing, System testing and Acceptance testing.

ID	Test Stages	Description
1	Unit Testing	Unit testing will be done by the developer and approved by the development team leader.
2	Integration testing	Integration testing will be performed by testers. Requirements of the system will be tested in functional flow. Starting after unit testing complete for each flow. Focuses on specific areas of uses case when all requirement are completed, integration test should be performed to ensure all components incorporate well.
3	System testing	System Testing will be performed by the tester and development team leader with assistance from the individual developers as required. No specific test tools are available for this project. Programs will enter into System/Integration test after all critical defects have been correct.
4	Acceptance testing	Acceptance testing consist of Alpha Test and Beta Test will be executed by all team members, stand at end user point of view. Determine whether a system satisfies the requirement analysis phase. Finding defects is not the main focus in this stage. Acceptance testing will access the system's readiness for deployment and using.

Table 5-1: Stages of testing

5.2. Testing Plan

5.2.1 Features to be tested

Developer will be performed unit test to ensure that all function are working as expected.

The test team will undertaking the responsibility of testing and validating the operation of the part that developed. The functions developed requires completing design and execution of function tests to ensure proper coverage.

Following are items that will need to be test by tester:

No.	Component	Feature Name	Function to be tested
1	Electronic Components	Infrared LED LED Resistor Arduino Mega 2560 Wi-Fi Shield RM-04	Operability Checking components that can operate following their characteristics in datasheet.
2	User's Interface	Form (screen elements)	Checking the display of element
3	Function in Android App	Authentication Management Account Management Device Management	Testing a certain number of cases when user want to: <ul style="list-style-type: none">• Log in• Log out Testing a certain number of cases when user want to: <ul style="list-style-type: none">• Change User Password• Change User name• Change Wi-Fi name• Change Wi-Fi password Testing a certain number of cases when user want to: <ul style="list-style-type: none">• Add new device• Learning• Try to control• Delete device• Control device• Synchronous
4	Function in Hardware	User's interaction on circuit	Testing a certain number of cases when user want to: <ul style="list-style-type: none">• Reset (Factory Default)• Reboot

Table 5-2: Feature to be test

5.2.2 Features not to be tested

Security: all function relates to security are not to be test.

5.2.3 Testing Tools and Environment

❖ Testing tools

In this project, the testing process does not use any testing tool.

❖ Environment

The product need to test in some hardware devices:

- IRSC App:

- LG E975 Smartphone
- Processor : Snapdragon S4 Pro
- Memory: 2GB
- Display: 4.7-inches, full HD, 768x1280 pixels
- Wi-Fi: 802.11 a/b/n/g
- Android version: 4.1.2 Jelly Bean

- IRSC Hardware:

- Window 8.1 Professional 32-bit
- Memory: 2GB
- Intel® Core™ i5, 2.1Ghz
- Intel® Core™ i3, 2.1Ghz
- Arduino IDE 1.6.4, 1.6.5

5.3 Test Cases

5.3.1 Function in Android App

❖ Authentication Management

Test case ID	Test case title	Test procedure	Expected result	Result	Test date	Assign
Authentication Management						
User Role: User						
Precondition: IRSC App has been installed Smartphone has been connected to Wi-Fi of IRSC system						
Login						
[IRSC_Login_1]	Login successfully with length of each account and password in [1, 12] equal register.	1. Open IRSC app 2. Enter valid Account and password into textbox 3. Touch on “Login” button	1. Login screen is displayed 3. Received response from Hardware. Redirect to Home screen and all function are enable.	Pass	16- July-15	AnhPV & TruongTX
[IRSC_Login_2]	Login unsuccessfully with length of each account and password out of range [1, 12]	1. Open IRSC app 2. Enter invalid Account and password <out of range> into textbox 3. Touch on “Login” button	1. Login screen is displayed 3. Toast error “Length of account or password is out of range. Please try again!”	Pass	16- July-15	AnhPV & TruongTX

[IRSC_Login_3]	Login unsuccessfully with length of each account or password out of range [1, 12]	<ol style="list-style-type: none"> 1. Open IRSC app 2. Enter invalid Account or password <out of range> into textbox 3. Touch on “Login” button 	<ol style="list-style-type: none"> 1. Login screen is displayed 3. Toast error “Length of account or password is out of range. Please try again!” 	Pass	16- July-15	AnhPV & TruongTX
[IRSC_Login_4]	Login unsuccessfully with incorrect Account and password	<ol style="list-style-type: none"> 1. Open IRSC app 2. Enter invalid Account and password into textbox 3. Touch on “Login” button 	<ol style="list-style-type: none"> 1. Login screen is displayed 3. Receive response from Hardware. <p>Toast error “Incorrect account or password. Please try again!”</p>	Pass	16- July-15	AnhPV & TruongTX
[IRSC_Login_5]	Login unsuccessful in case: Incorrect password	<ol style="list-style-type: none"> 1. Open IRSC app 2. Enter invalid password into textbox 3. Touch on “Login” button 	<ol style="list-style-type: none"> 1. Login screen is displayed 3. Receive response from Hardware. <p>Toast error “Incorrect account or password. Please try again!”</p>	Pass	16- July-15	AnhPV & TruongTX
[IRSC_Login_6]	Login unsuccessful in case: Incorrect account	<ol style="list-style-type: none"> 1. Open IRSC app 2. Enter invalid account into textbox 3. Touch on “Login” button 	<ol style="list-style-type: none"> 1. Login screen is displayed 3. Receive response from Hardware. <p>Toast error “Incorrect account or password. Please try again!”</p>	Pass	16- July-15	AnhPV & TruongTX

❖ Account Management

Test case ID	Test case title	Test procedure	Expected result	Result	Test date	Assign
Account Management						
User Role: User						
Precondition: IRSC App has been installed						
Smartphone has been connected to Wi-Fi of IRSC system						
Having account/ password to log in IRSC app						
Change User Account/Password						
[IRSC_UIF_1]	Change Account and password successfully	1. User touches on “Change User Information” on Manage Account screen. 2. User touches on “Your Account” to type old account and “Your Password” to type old password in User information screen 3. Touch on Authenticate to verify user 4. User touches on “New Account” to type new account, “Enter New Password” to type new password and “Re-Enter New Password” to re-type new password. 5. Touch on “Change” button	1. Redirect to User Information screen. 3. Authentication successfully and redirect to Change User Information screen. 5. Change user account and password successfully inform show and redirect to Login screen to re-login. And login successfully with new account and new password	Pass	1-Aug-15	AnhPV& TruongTX

[IRSC_UIF_2]	Change user Account and password with incorrect old account or password.	<p>1. User touches on “Change User Information” on Manage Account screen.</p> <p>2. User touches on “Your Account” to type invalid old account or “Your Password” to type invalid old password in User information screen</p> <p>3. Touch on Authenticate to verify user</p>	<p>1. Redirect to Change user information screen.</p> <p>3. Authentication unsuccessfully and error “Username or password is incorrect. Please try again!”</p>	Pass	1-Aug-15	AnhPV& TruongTX
[IRSC_UIF_3]	Change Account and password unsuccessfully with empty account and password	<p>1. User touches on “Change User Information” on Manage Account screen.</p> <p>2. User touches on “Your Account” to type old account and “Your Password” to type old password in User information screen</p> <p>3. Touch on Authenticate to verify user</p> <p>4. Empty in “New Account”, “Enter New Password” and “Re-Enter New Password” place</p> <p>5. Touch on “Change” button</p>	<p>1. Redirect to Change user information screen.</p> <p>3. Authentication successfully and redirect to Change User Information screen.</p> <p>5. Change user account and password unsuccessfully and error “New account and new password is out of the range [1-12]. Please try again!” appears.</p>	Pass	1-Aug-15	AnhPV& TruongTX

Change Wi-Fi Information						
[IRSC_WIF_1]	Change name and password of Wi-Fi successfully	1. User touches on “Change Wi-Fi Information” on Manage Account screen. 2. User touches on “New Wi-Fi name” to type new Wi-Fi name and “Enter new password ” to type new password and “Re-Enter new password” 3. Touch on “Change” button	1. Redirect to Change Wi-Fi Information screen. 3. Change Wi-Fi name and password successfully and redirect to Home screen.	Pass	1-Aug-15	TungNT& DucLQ

[IRSC_WIF_3]	Change name and password of Wi-Fi unsuccessfully with difference confirm password	<p>1. User touches on “Change Wi-Fi Information” on Manage Account screen.</p> <p>2. User touches on “New Wi-Fi name” to type new Wi-Fi and “Enter new password ” to type new password and type difference password to “Re-Enter new password”</p> <p>3. Touch on “Change” button</p>	<p>1. Redirect to Change Wi-Fi information screen.</p> <p>3. Change Wi-Fi SSID and password unsuccessfully and show error “Confirm new password is difference with new password. Please try again! ”.</p>	Pass	1-Aug-15	TungNT& DucLQ
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❖ Device Management

Test case ID	Test case title	Test procedure	Expected result	Result	Test date	Assign
Device Management						
User Role: User						
Precondition: IRSC App has been installed						
<p>Smartphone has been connected to Wi-Fi of IRSC system</p> <p>Having account/ password to log in IRSC app and User is on Add new screen</p>						
Add new devices						

[IRSC_Add_1]	Add new TV successfully	1. Touch on “New TV” button 2. Touch on “New Device ” button to add	1. Redirect to Add new TV screen 2. New TV-n is visible on Add new TV screen	Pass	16-July-15	AnhPV& DuNT
[IRSC_Add_2]	Add new Fan successfully	1. Touch on “New Fan” button 2. Touch on “New Device ” button to add	1. Redirect to Add new Fan screen 2. New Fan-n is visible on Add new Fan screen	Pass	16-July-15	AnhPV& DuNT
[IRSC_Add_3]	Add new Projector successfully	1. Touch on “New Projector ” button 2. Touch on “New Device ” button to add	1. Redirect to Add new Projector screen 2. New Projector -n is visible on Add new Projector screen	Pass	16-July-15	AnhPV& DuNT
[IRSC_Add_4]	Add new CD - player successfully	1. Touch on “New CD-player” button 2. Touch on “New Device ” button to add	1. Redirect to Add new CD-player screen 2. New CD-player -n is visible on Add new CD-player screen	Pass	16-July-15	AnhPV& DuNT

[IRSC_Add_5]	Add new Air Conditioner successfully	1. Touch on “New Air Conditioner ” button 2. Touch on “New Device ” button to add	1. Redirect to Add new Air Conditioner screen 2. New Air Conditioner -n is visible on Add new Projector screen	Pass	16-July-15	AnhPV& DuNT
[IRSC_Add_6]	Add new Lamp successfully	1. Touch on “New Lamp” button 2. Touch on “New Device ” button to add	1. Redirect to Add new Lamp screen 2. New Lamp -n is visible on Add new Lamp screen	Pass	16-July-15	AnhPV& DuNT
[IRSC_Add_7]	Add new Door successfully	1. Touch on “New Door” button 2. Touch on “New Device ” button to add	1. Redirect to Add new Door screen 2. New Door-n is visible on Add new Projector screen	Pass	16-July-15	AnhPV& DuNT
[IRSC_Add_8]	Add new other device successfully	1. Touch on “Other” button 2. Touch on “New Device ” button to add	1. Redirect to Add new other screen 2. New other-n is visible on Add new Projector screen	Pass	16-July-15	AnhPV& Du NT

Learning						
[IRSC_Learn_1]	Learning Infrared signal successfully for buttons of Fan 1 device	1. Touch “Fan 1” button on Add New Fan screen. 2. Touch in sequence each button on Fan 1 screen. 3. Press correspond button on Fan1 remote.	1. Redirect to Fan 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turned off and the button is changed color to Blue.	Pass	17-July-15	TungNT&TruongTX
[IRSC_Learn_2]	Learning Infrared signal successfully for buttons of TV 1 device	1. Touch “TV 1” button on Add New TV screen. 2. Touch in sequence each button on TV 1 screen. 3. Press correspond button on TV 1 remote.	1. Redirect to TV 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turned off and the button is changed color to Blue.	Pass	17-July-15	TungNT&TruongTX

[IRSC_Learn_3]	Learning Infrared signal successfully for buttons of Projector 1 device	1. Touch “Projector 1” button on Add New Projector screen. 2. Touch in sequence each button on Projector 1 screen. 3. Press correspond button on Projector 1 remote.	1. Redirect to Projector 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turned off and the button is changed color to Blue.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Learn_4]	Learning Infrared signal successfully for buttons of CD-Player 1 device	1. Touch “CD-player 1” button on Add New CD-Player screen. 2. Touch in sequence each button on CD-player 1 screen. 3. Press correspond button on CD-player 1 remote.	1. Redirect to CD-Player 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turned off and the button is changed color to Blue.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Learn_5]	Learning Infrared signal successfully for buttons of Air Conditioner 1 device	1. Touch “Air Conditioner 1” button on Add New Air Conditioner screen. 2. Touch in sequence each button on Air Conditioner 1 screen. 3. Press correspond button on Air Conditioner 1 remote.	1. Redirect to Air Conditioner 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turned off and the button is changed color to Blue.	Pass	17-July-15	TungNT& TruongTX

[IRSC_Learn_6]	Learning Infrared signal successfully for buttons of Lamp 1 device	1. Touch "Lamp 1" button on Add New Lamp screen. 2. Touch in sequence each button on Lamp 1 screen. 3. Press correspond button on Lamp 1 remote.	1. Redirect to Lamp 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turned off and the button is changed color to Blue.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Learn_7]	Learning Infrared signal successfully for buttons of Door 1 device	1. Touch "Door 1" button on Add New Door screen. 2. Touch in sequence each button on Door 1 screen. 3. Press correspond button on Door 1 remote.	1. Redirect to Door 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turn off and the button is changed color to Blue.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Learn_8]	Learning Infrared signal successfully for buttons of Other 1 device	1. Touch "Other 1" button on Add New Other screen. 2. Touch in sequence each button on Other 1 screen. 3. Press correspond button on Other 1 remote.	1. Redirect to Other 1 Remote Learning screen 2. Yellow LED on hardware system turned on. 3. Yellow LED turned off and the button is changed color to Blue.	Pass	17-July-15	TungNT& TruongTX

Try to control							
[IRSC_Try_1]	Try to control successfully while learning Fan 1 device	1. Touch “Go to control” button on Fan 1 Remote control screen 2. Touch in the button user want to control	1. Redirect to Fan 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT&TruongTX	
[IRSC_Try_2]	Try to control successfully while learning TV 1 device	1. Touch “Go to control” button on TV 1 Remote control screen 2. Touch in the button user want to control	1. Redirect to TV 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT&TruongTX	

[IRSC_Try_3]	Try to control successfully while learning Projector 1 device	1. Touch “Go to control” button on Projector 1 Remote control screen 2. Touch in the button user want to control	1. Redirect to Projector 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Try_4]	Try to control successfully while learning CD-Player 1 device	1. Touch “Go to control” button on CD-Player Remote control screen 2. Touch in the button user want to control	1. Redirect to CD-Player 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Try_5]	Try to control successfully while learning Air Conditioner 1 device	1. Touch “Go to control” button on Air Conditioner Remote control screen 2. Touch in the button user want to control	1. Redirect to Air Conditioner 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT& TruongTX

[IRSC_Try_6]	Try to control successfully while learning Lamp 1 device	1. Touch “Go to control” button on Lamp Remote control screen 2. Touch in the button user want to control	1. Redirect to Lamp 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Try_7]	Try to control successfully while learning Door 1 device	1. Touch “Go to control” button on Door 1 Remote control screen 2. Touch in the button user want to control	1. Redirect to Door 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT& TruongTX
[IRSC_Try_8]	Try to control successfully while learning Other 1 device	1. Touch “Go to control” button on Other 1 Remote control screen 2. Touch in the button user want to control	1. Redirect to Other 1 Remote control screen 2. Yellow LED in hardware system blinks. Event of the button acts same with event of correspond physic button on real remote.	Pass	17-July-15	TungNT& TruongTX

Delete devices						
[IRSC_Del_1]	Delete a Fan device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete Fan” button on Delete Devices screen</p> <p>3. Touch on button of existed Fan want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Delete Fan Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Active”</p>	Pass	18-July-15	DucLQ& DuNT
[IRSC_Del_2]	Delete a TV device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete TV” button on Delete Devices screen</p> <p>3. Touch on button of existed TV want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Delete TV Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Activated”.</p>	Pass	18-July-15	DucLQ& DuNT

[IRSC_Del_3]	Delete a Projector device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete Projector” button on Delete Devices screen</p> <p>3. Touch on button of existed Projector want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Delete Projector Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Activated”.</p>	Pass	18-July-15	DucLQ& DuNT
[IRSC_Del_4]	Delete a CD-Player device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete CD-Player” button on Delete Devices screen</p> <p>3. Touch on button of existed CD-Player want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Delete CD-Player Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Activated”.</p>	Pass	18-July-15	DucLQ& DuNT

[IRSC_Del_5]	Delete an Air Conditioner device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete Air Conditioner” button on Delete Devices screen</p> <p>3. Touch on button of existed Air Conditioner want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Delete Air Conditioner Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Activated”.</p>	Pass	18-July-15	DucLQ& DuNT
[IRSC_Del_6]	Delete an Lamp device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete Lamp” button on Delete Devices screen</p> <p>3. Touch on button of existed Lamp want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Delete Lamp Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Activated”.</p>	Pass	18-July-15	DucLQ& DuNT

[IRSC_Del_7]	Delete an Door device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete Door” button on Delete Devices screen</p> <p>3. Touch on button of existed Door want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Door Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Activated”.</p>	Pass	18-July-15	DucLQ& DuNT
[IRSC_Del_8]	Delete an Other device successfully	<p>1. Touch “Delete Devices” button on Manage Devices screen.</p> <p>2. Touch on “Delete Other” button on Delete Devices screen</p> <p>3. Touch on button of existed Door want to delete.</p>	<p>1. Redirect to Delete Devices Screen</p> <p>2. Redirect to Delete Other Devices Screen</p> <p>3. The button of device is invisible and redirect to Manage Devices screen.</p> <p>Yellow LED blinks, all data of this device is deleted in EEPROM and serial monitor show this device is “NOT Activated”.</p>	Pass	18-July-15	DucLQ& DuNT

Control						
[IRSC_Ctr_1]	Control a Fan device successfully	1. Touch “Control” button on Manage Devices screen. 2. Touch on “Fan” button on Control Devices screen 3. Touch on the Fan that wants to control. 4. Touch on button in Fan Remote screen wants to control.	1. Redirect to Control Devices Screen 2. Redirect to Fan Control Devices screen 3. Redirect to Fan Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote.	Pass	19-July-15	DucLQ& TungNT
[IRSC_Ctr_2]	Control a TV device successfully	1. Touch “Control” button on Manage Devices screen. 2. Touch on “TV” button on Control Devices screen 3. Touch on the TV that wants to control. 4. Touch on button in TV Remote screen wants to control.	1. Redirect to Control Devices Screen 2. Redirect to TV Control Devices screen 3. Redirect to TV Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote.	Pass	19-July-15	DucLQ& TungNT

[IRSC_Ctr_3]	Control a Projector device successfully	1. Touch “Control” button on Manage Devices screen. 2. Touch on “Projector” button on Control Devices screen 3. Touch on the Projector that wants to control. 4. Touch on button in Projector Remote screen wants to control.	1. Redirect to Control Devices Screen 2. Redirect to Projector Control Devices screen 3. Redirect to Projector Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote.	Pass	18-July-15	DucLQ& TungNT
[IRSC_Ctr_4]	Control a CD-Player device successfully	1. Touch “Control” button on Manage Devices screen. 2. Touch on “CD-Player” button on Control Devices screen 3. Touch on the CD-Player that wants to control. 4. Touch on button in CD-Player Remote screen wants to control.	1. Redirect to Control Devices Screen 2. Redirect to CD-Player Control Devices screen 3. Redirect to CD-Player Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote.	Pass	18-July-15	DucLQ& TungNT

[IRSC_Ctr_5]	Control an Air Conditioner device successfully	<ol style="list-style-type: none"> 1. Touch “Control” button on Manage Devices screen. 2. Touch on “Air Conditioner” button on Control Devices screen 3. Touch on the Air Conditioner that wants to control. 4. Touch on button in Air Conditioner Remote screen wants to control. 	<ol style="list-style-type: none"> 1. Redirect to Control Devices Screen 2. Redirect to Air Conditioner Control Devices screen 3. Redirect to Air Conditioner Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote. 	Pass	18-July-15	DucLQ& TungNT
[IRSC_Ctr_6]	Control a Lamp device successfully	<ol style="list-style-type: none"> 1. Touch “Control” button on Manage Devices screen. 2. Touch on “Lamp” button on Control Devices screen 3. Touch on the Lamp that wants to control. 4. Touch on button in Lamp Remote screen wants to control. 	<ol style="list-style-type: none"> 1. Redirect to Control Devices Screen 2. Redirect to Lamp Control Devices screen 3. Redirect to Lamp Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote. 	Pass	18-July-15	DucLQ& TungNT

[IRSC_Ctr_7]	Control a Door device successfully	1. Touch “Control” button on Manage Devices screen. 2. Touch on “Door” button on Control Devices screen 3. Touch on the Door that wants to control. 4. Touch on button in Door Remote screen wants to control.	1. Redirect to Control Devices Screen 2. Redirect to Door Control Devices screen 3. Redirect to Door Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote.	Pass	18-July-15	DucLQ& TungNT
[IRSC_Ctr_8]	Control a Other device successfully	1. Touch “Control” button on Manage Devices screen. 2. Touch on “Other” button on Control Devices screen 3. Touch on the Other that wants to control. 4. Touch on button in Other Remote screen wants to control.	1. Redirect to Control Devices Screen 2. Redirect to Other Control Devices screen 3. Redirect to Other Remote screen. 4. Yellow LED blinks once time, event of this button is same with event of this button on physic remote.	Pass	18-July-15	DucLQ& TungNT

<p>Synchronous</p> <p>Pre-conditioner: Using 2 Android Smartphones have been installed IRSC App to test this function</p> <p style="text-align: center;">Second Android smartphone is on Manage Device screen</p>							
[IRSC_Syn_1]	Synchronous	<ol style="list-style-type: none"> 1. Using the first Android Smartphone to create device 2. In the second Android smartphone, touch on “Synchronize” button in Manage Device screen and wait a few seconds 3. Touch on “Control” button on Manage Device screen and Touch on type of device name to view or control. 	<ol style="list-style-type: none"> 1. Hardware system and first smartphone have data of new devices. 2. Data of existing devices in hardware system is send to second smartphone. 3. All of devices existed in second smartphone is the same within the first smartphone. 	Pass	31-July-15	DuNT& AnhPV, DucLQ	

5.3.2 Function in Hardware

- ❖ User's interaction on circuit

Test case ID	Test case title	Test procedure	Expected result	Result	Test date	Assign
❖ User's interaction on circuit						
User Role: User						
Precondition: Hardware of IRSC System is running. Serial monitor is open in computer						
Reset system (Factory default)						
[IRSC_Reset_1]	Reset system successfully to factory default.	1. Press the reset button in hardware circuit.	1. Yellow LED turns on, all data in EEPROM is clear. In serial monitor, “DONE” is appear. LED 2, 3 on RM04 is off and RM04 starts to restart. After, green LED is blinking and turning on.	Pass	20-July-15	TruongTX & DucLQ
Reboot						
[IRSC_Reboot_1]	Reboot system successfully	1. Press the reboot button in hardware circuit.	1. Green, Yellow LED blinks, then turns on. In serial monitor, “EEPROM reading” is appear.	Pass	20-July-15	TruongTX & DucLQ

5.4 Test report

No	Module	Pass	Fail	Untested	N/A	Number of test case
1	Electronic Component	30	0	0	0	16
2	User Interface	45	0	0	0	20
3	Function of Android App	55	0	0	0	55
4	Function in hardware	2	0	0	0	2

Test coverage: 100%

Test successful coverage: 100%

Chapter 6: System User's Manual

6.1 Setting up hardware

1. Plugging the USB cable in to USB port on IRSC box.

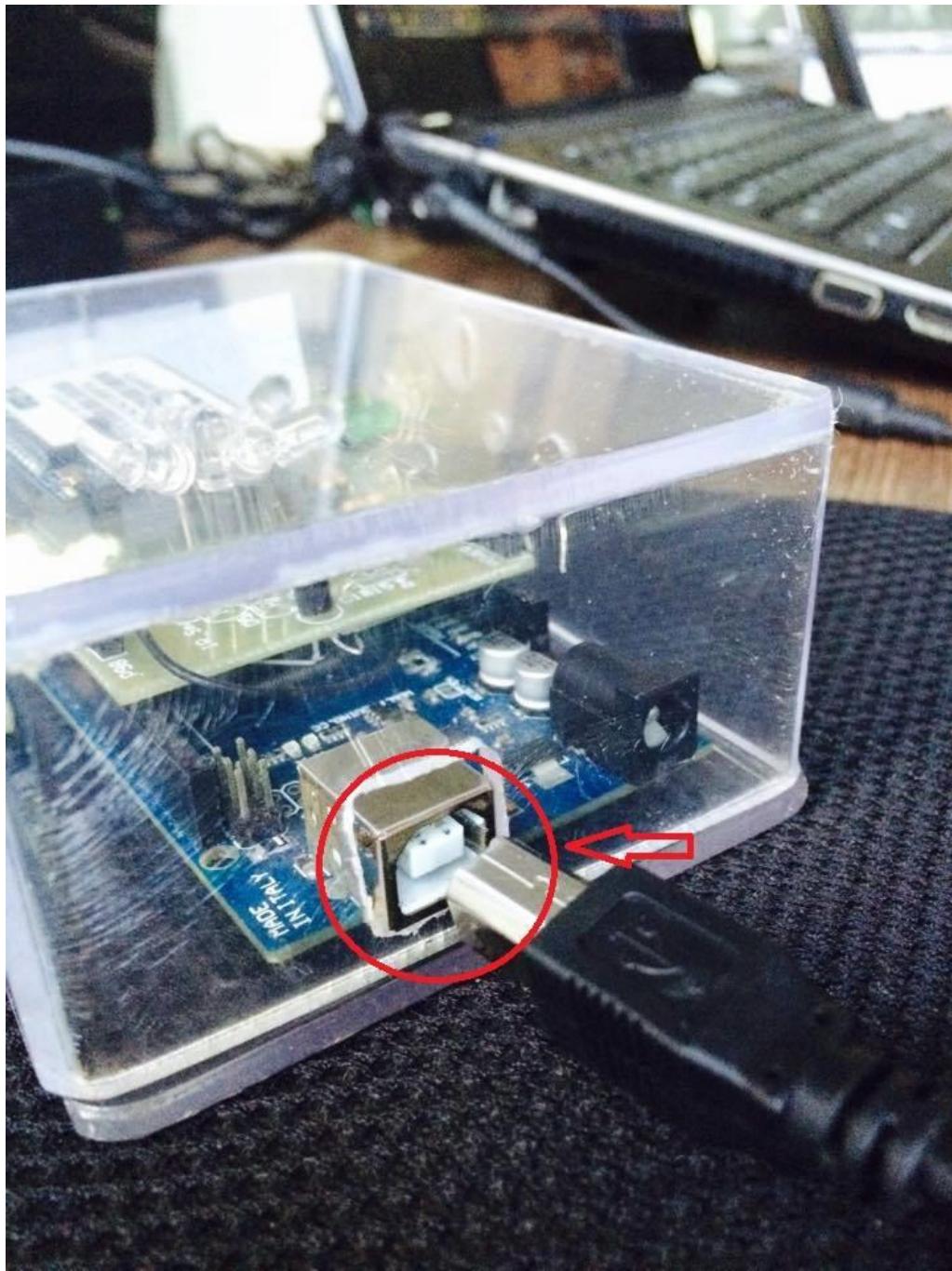


Figure 6-1: Plugging IRSC Box

2. Plugging Adapter into electric socket – 220V

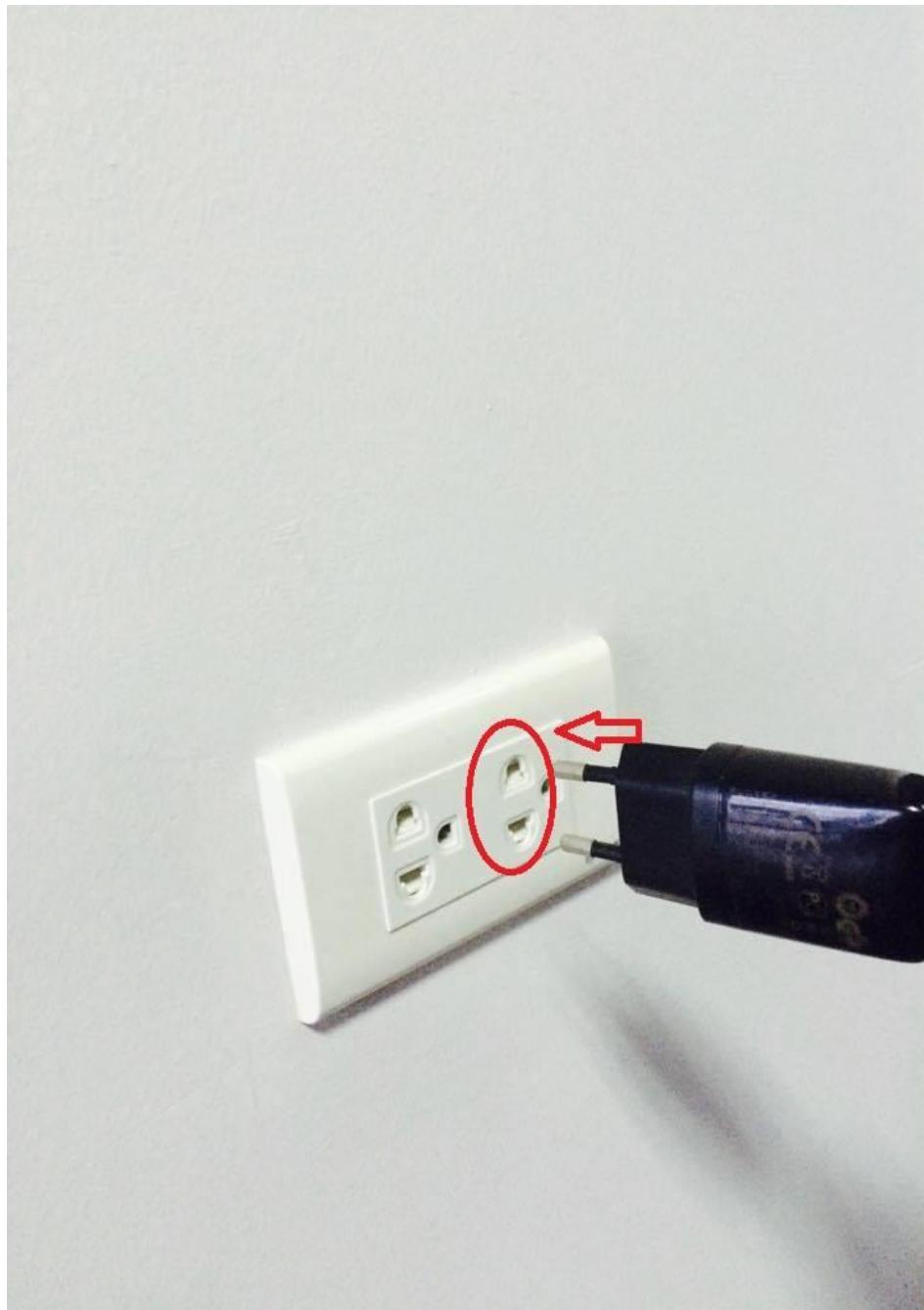


Figure 6-2: Plugging Adapter of IRSC Box

6.2 Android App

6.2.1 Login

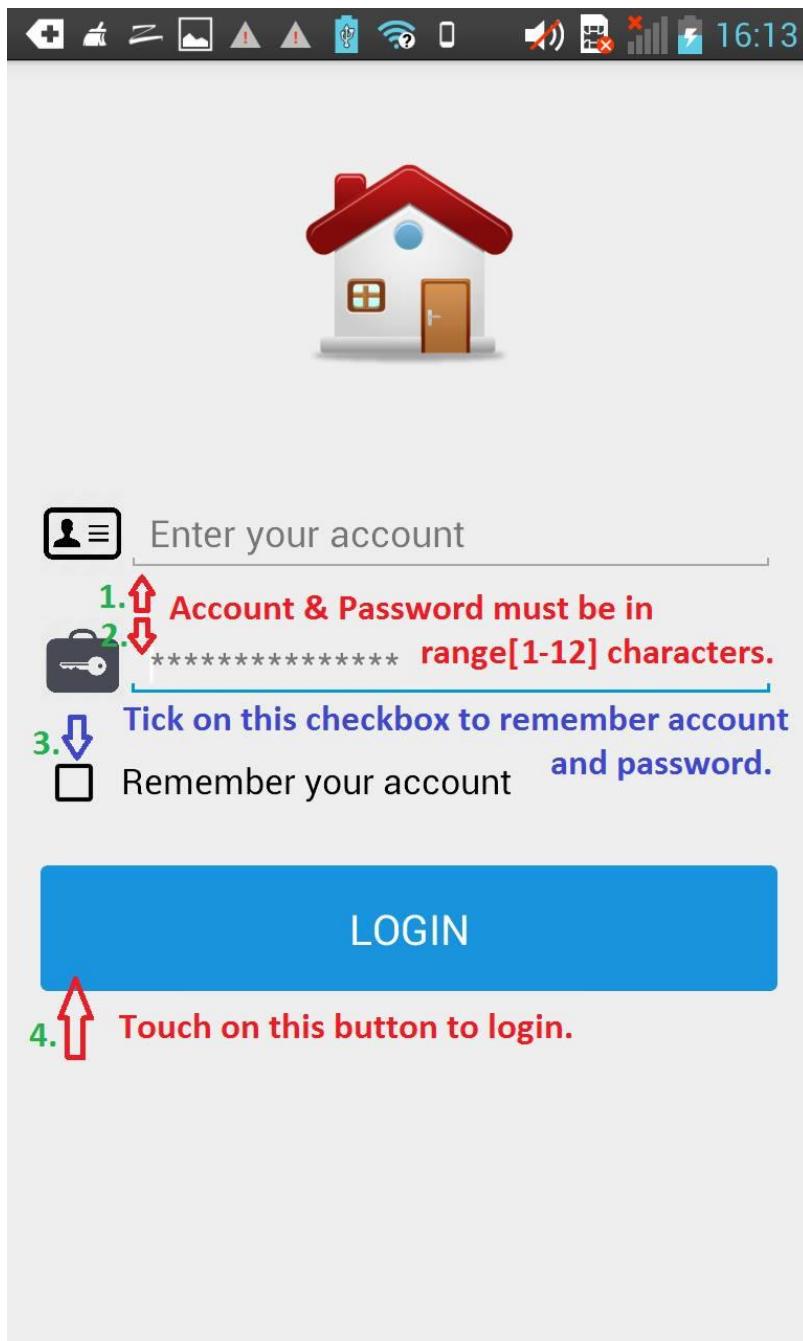


Figure 6-3: Login Screen

1. Open IRSmartControl App
2. Enter your account and your password in account and password field. Remember account/password must be larger than 1 character and less than or equal 12 characters.
3. You can tick on checkbox to remember your account for the next login times.
4. Touch on Login button to login system and go to Home screen

6.2.2 Adding device

1. User touch on Manage Devices button on Home screen to go to Manage Devices screen that contains adding device function.

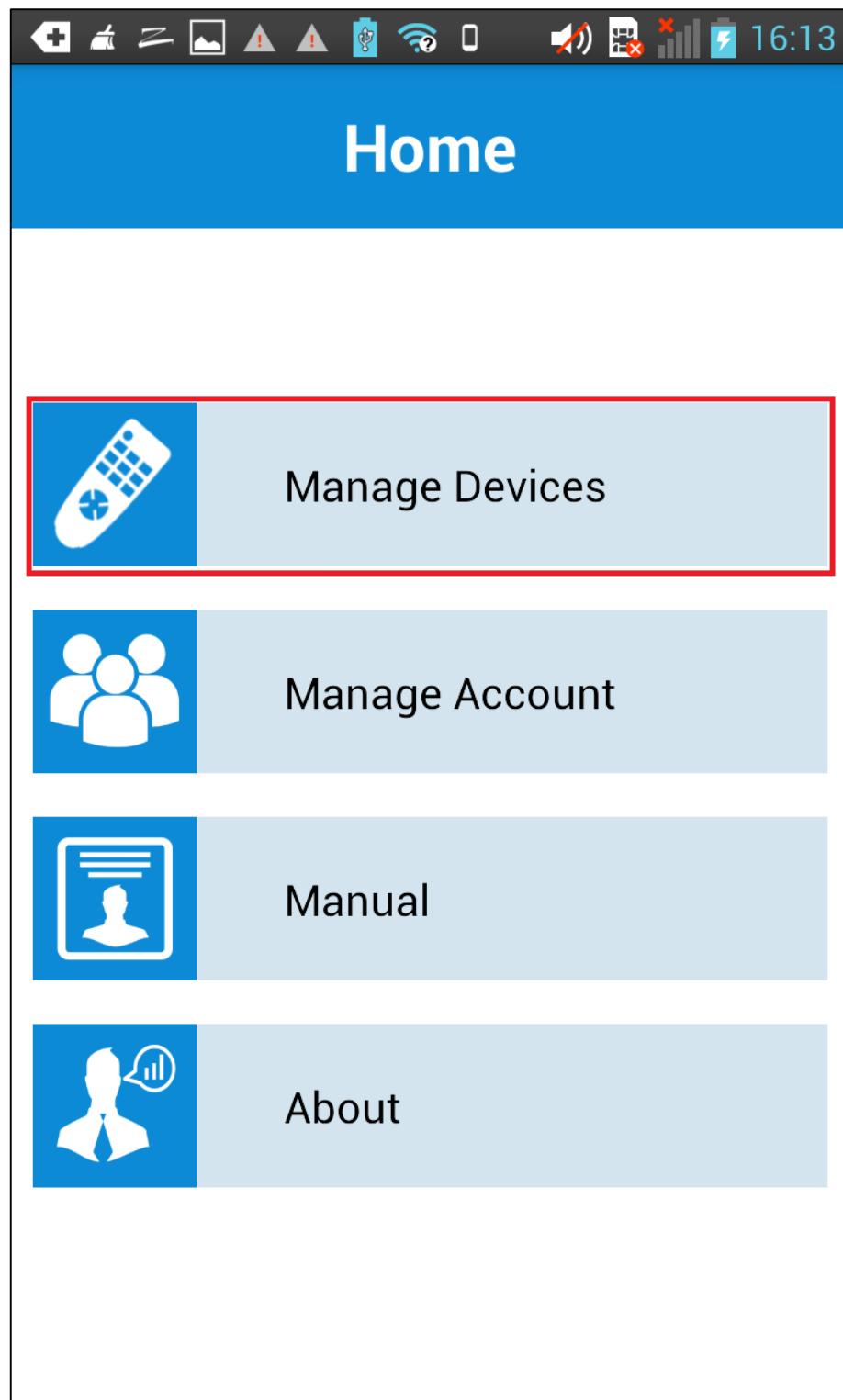


Figure 6-4: Home Screen

2. In Manage Devices screen, touch on Add Devices button to go to Add Devices screen.

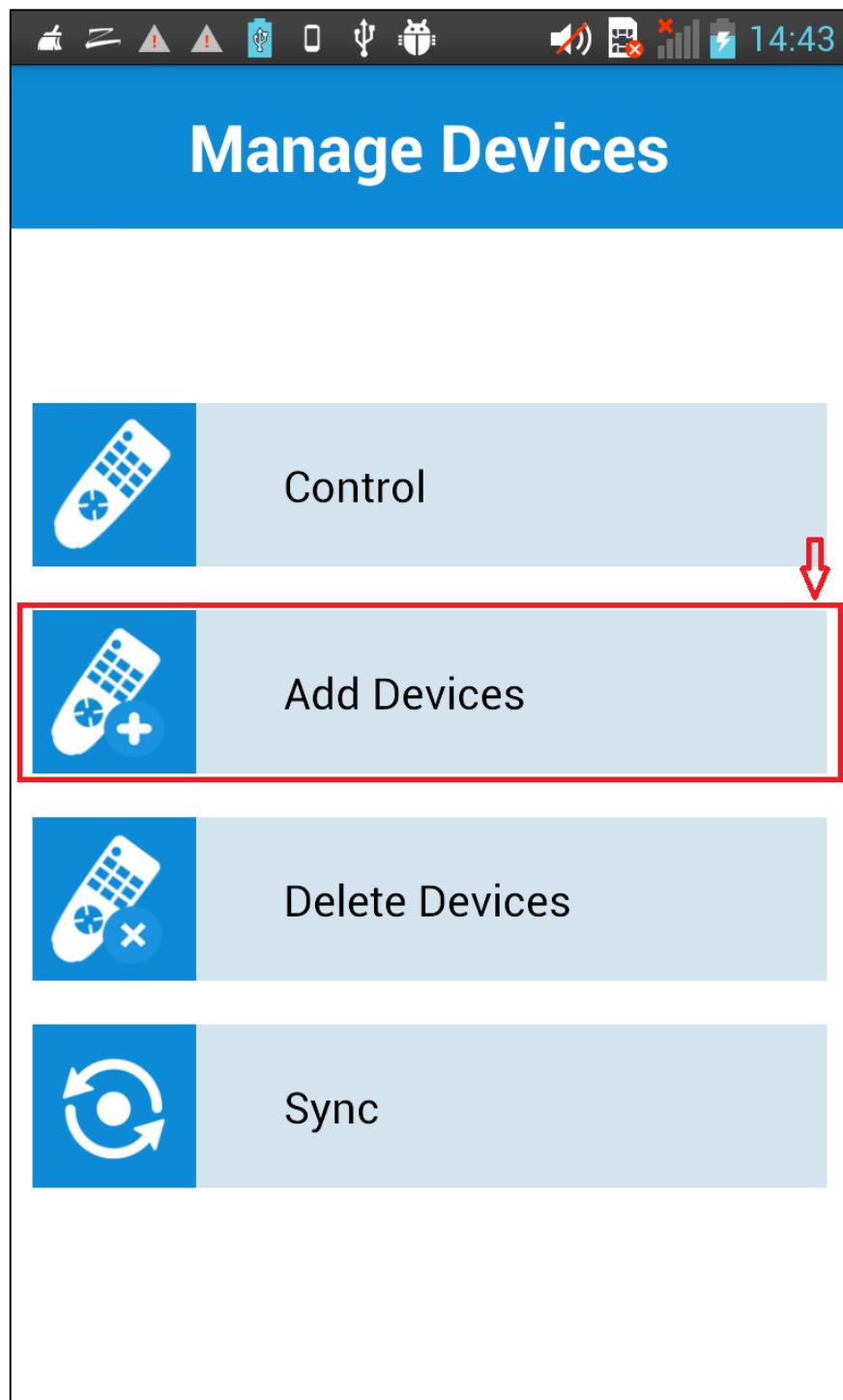


Figure 6-5: Manage Devices Screen

3. In Add new device, example you want to add new projector, let's touch on New Projector button

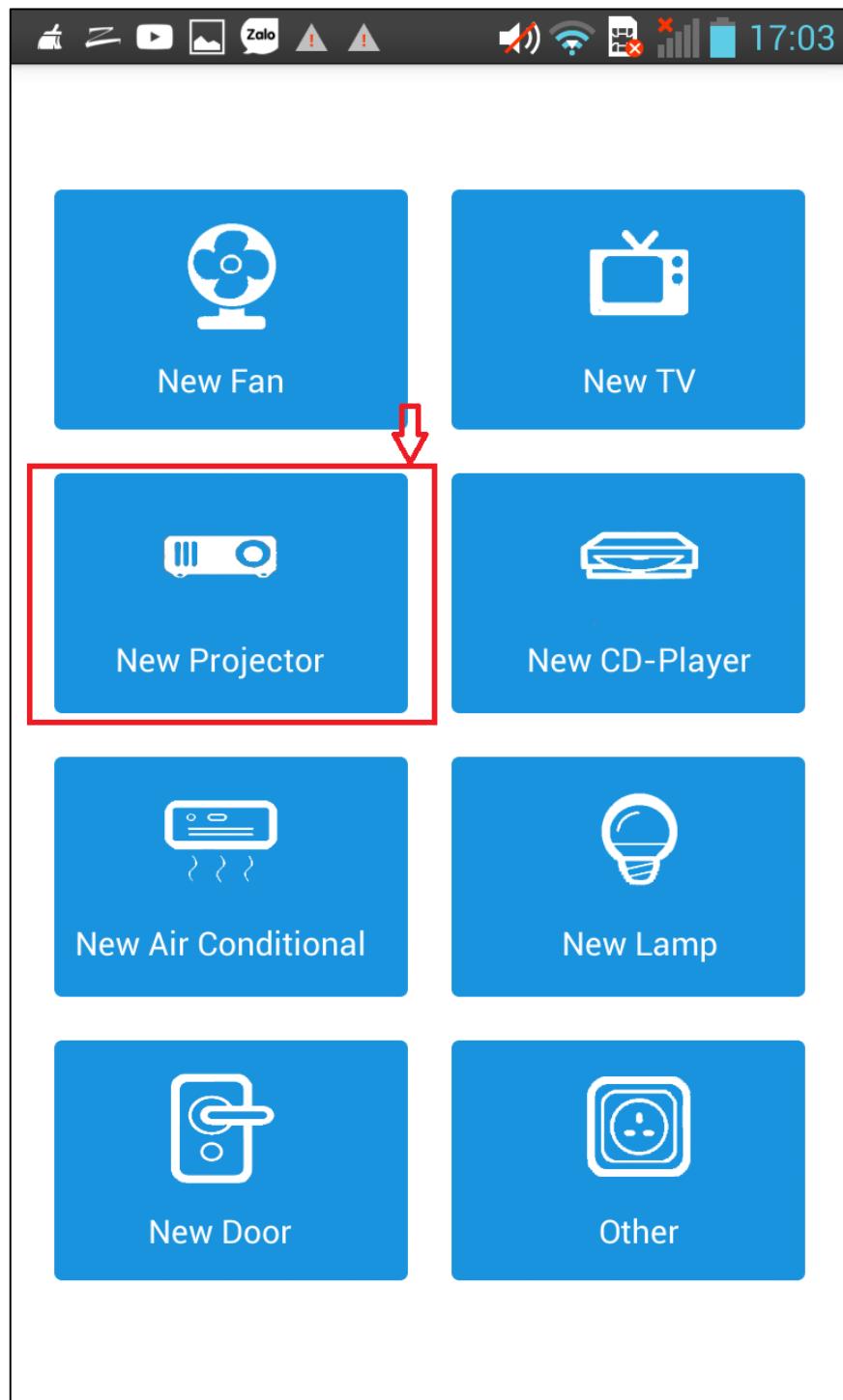
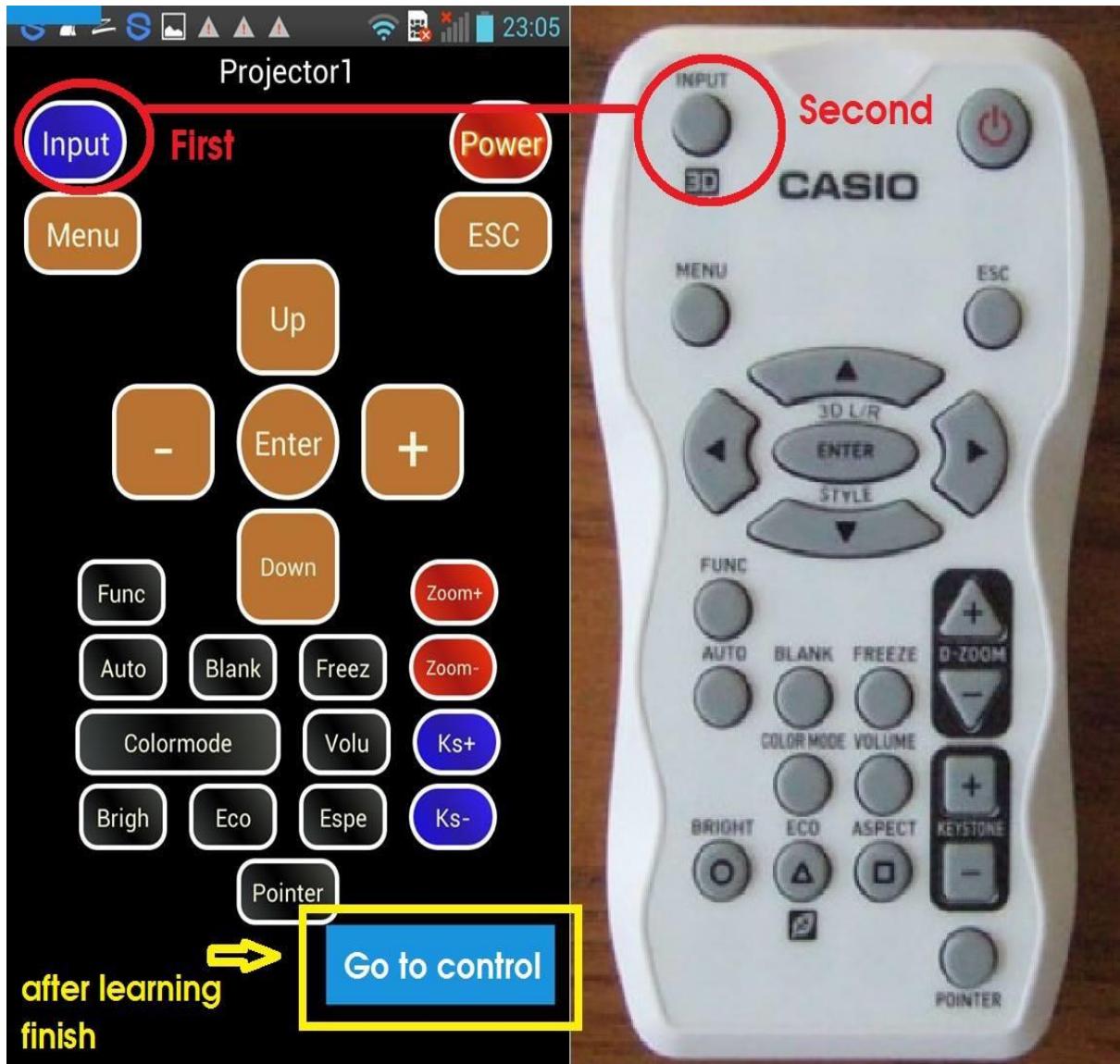


Figure 6-6: Add New Screen

4. Projector 1 will appear. Touch on “Projector 1” button to learn control signal for all button of projector 1.



Figure 6-7: Add New Projector Screen

*Figure 6-8: Learning Method*

5. In projector 1's remote screen, Touch on one button that you want to learn then press correspond button on physic remote and the learned button will change color if it learns successful or appears error message for learning fail.

Notice: Touch on "Go to control" button if you want to control this device.

6.2.3 Control device

1. User touch on “Control” button in Manage Devices screen to go to Control screen.

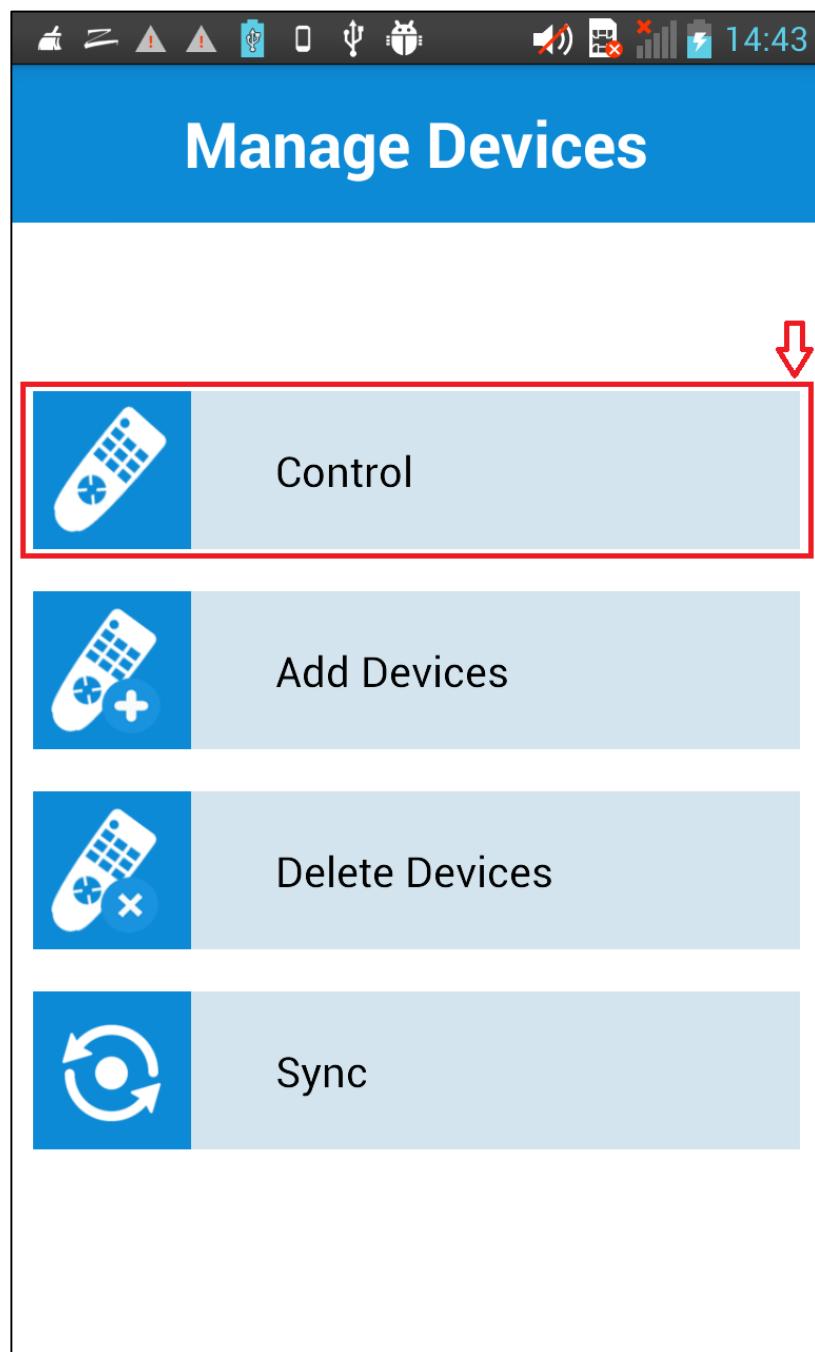


Figure 6-9: Manage Devices

2. Control screen will appear and contains list kind of devices. Touch on type of devices you want to control. For example Projector.

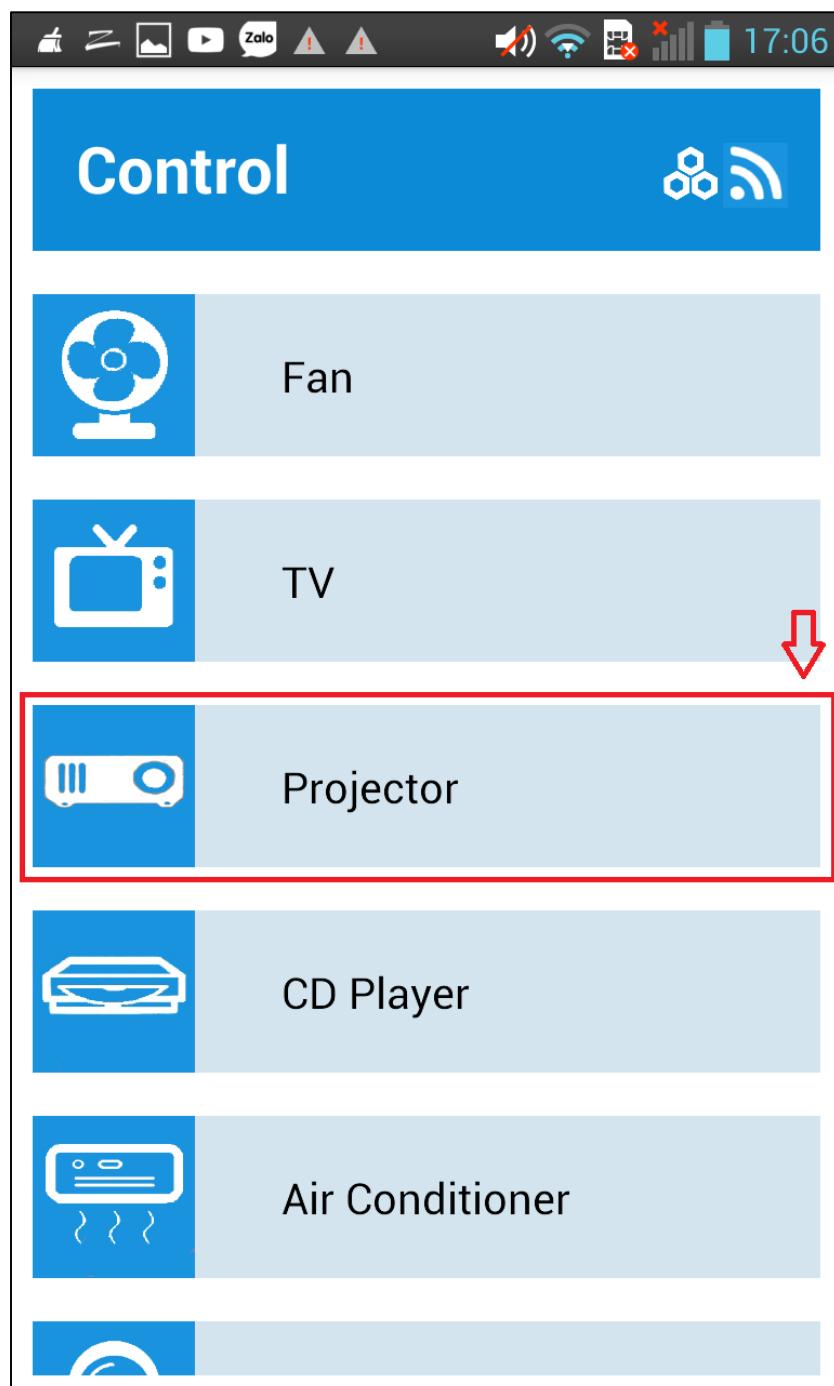


Figure 6-10: Control Screen

3. Choose device you would like to control by touch on its button. For example, we select Projector 1

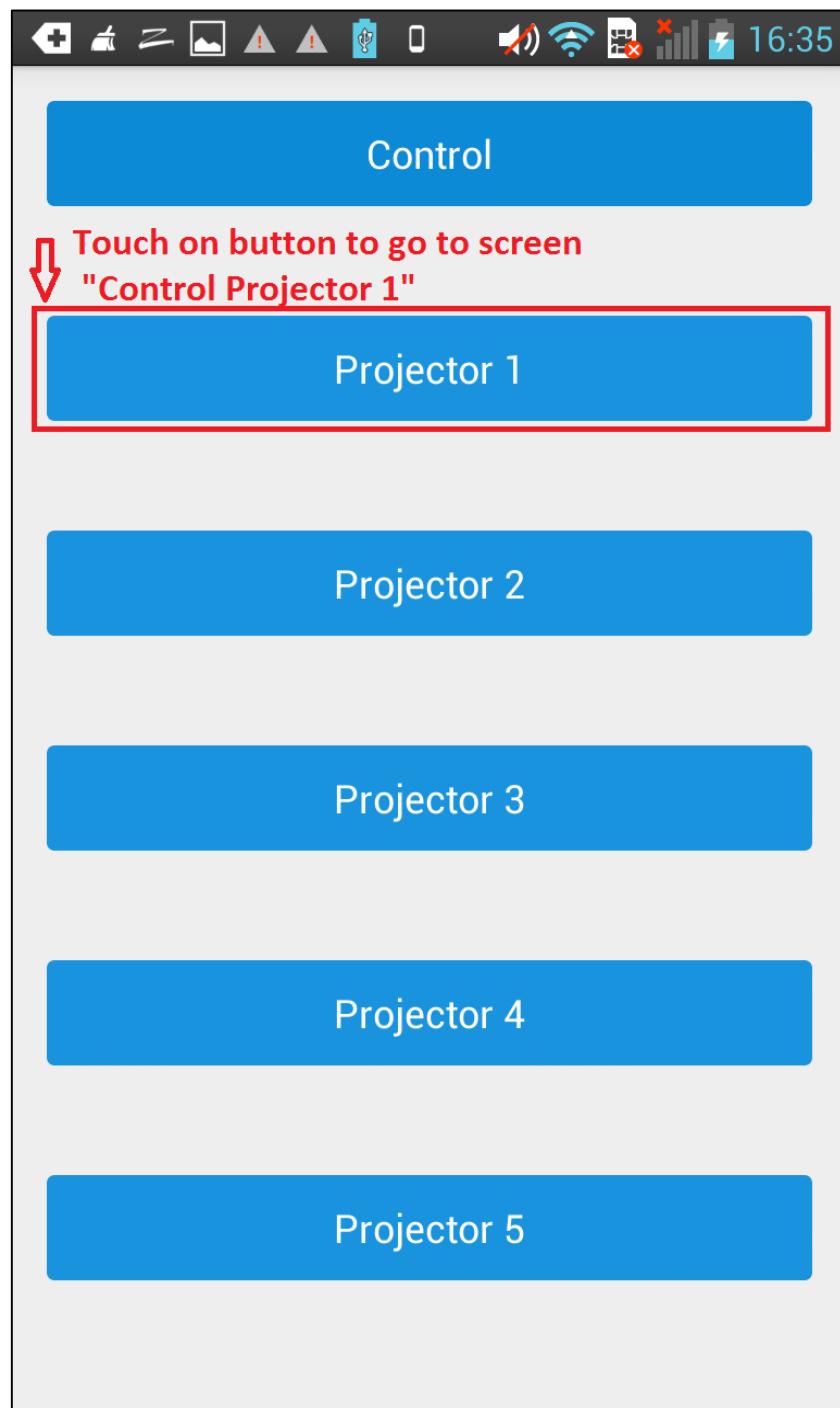


Figure 6-11: Control Projector Screen

4. The remote screen of Projector 1 is displayed, by touching on button, you can use virtual remote as a physical remote.

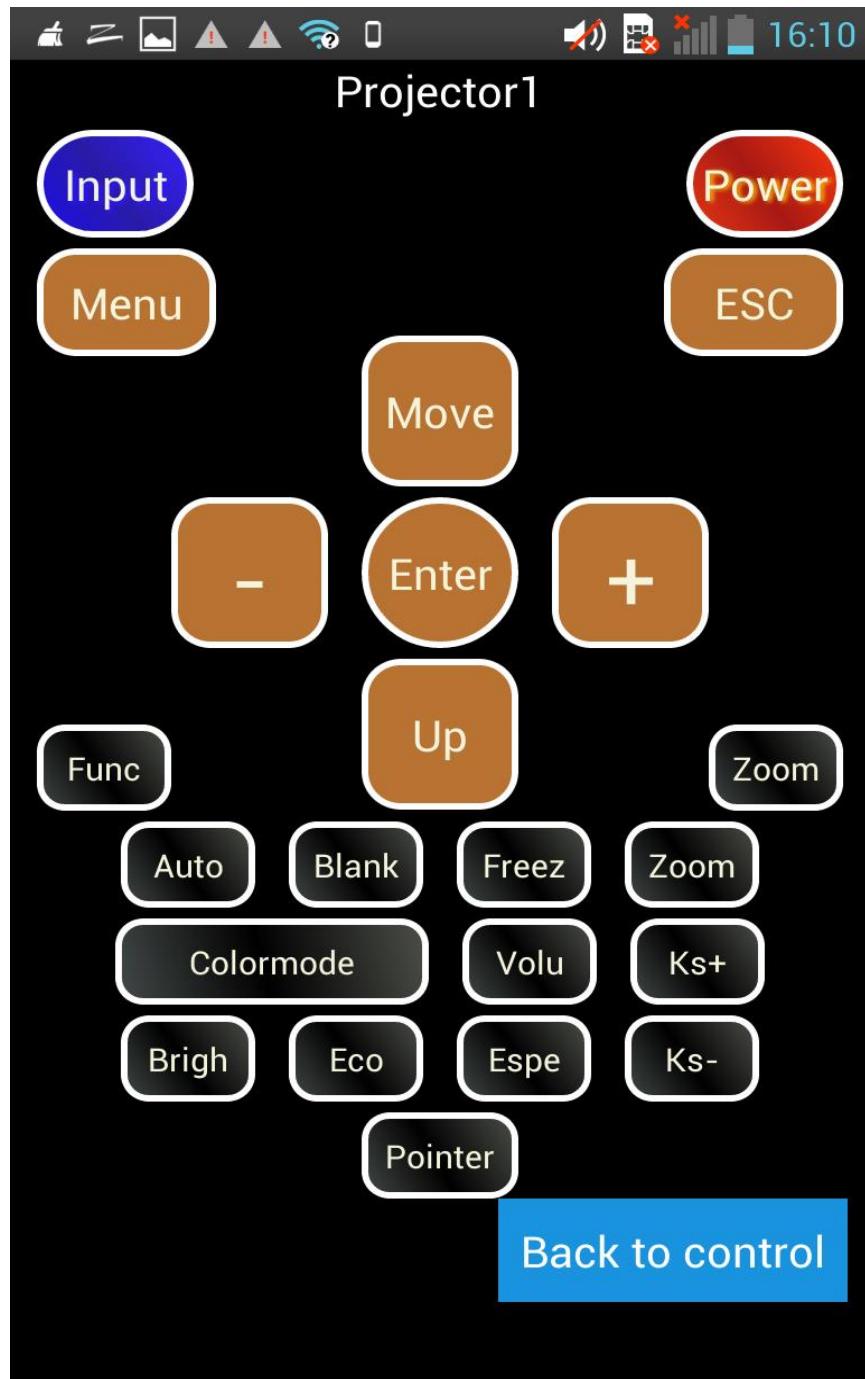


Figure 6-12: Projector virtual remote screen

Note: You can come back to Control screen to control other device by touching on “Back to control” button and implement same as above steps.

6.2.4 Delete exist device

1. Touching on the “Delete Devices” in Manage Device screen to delete device

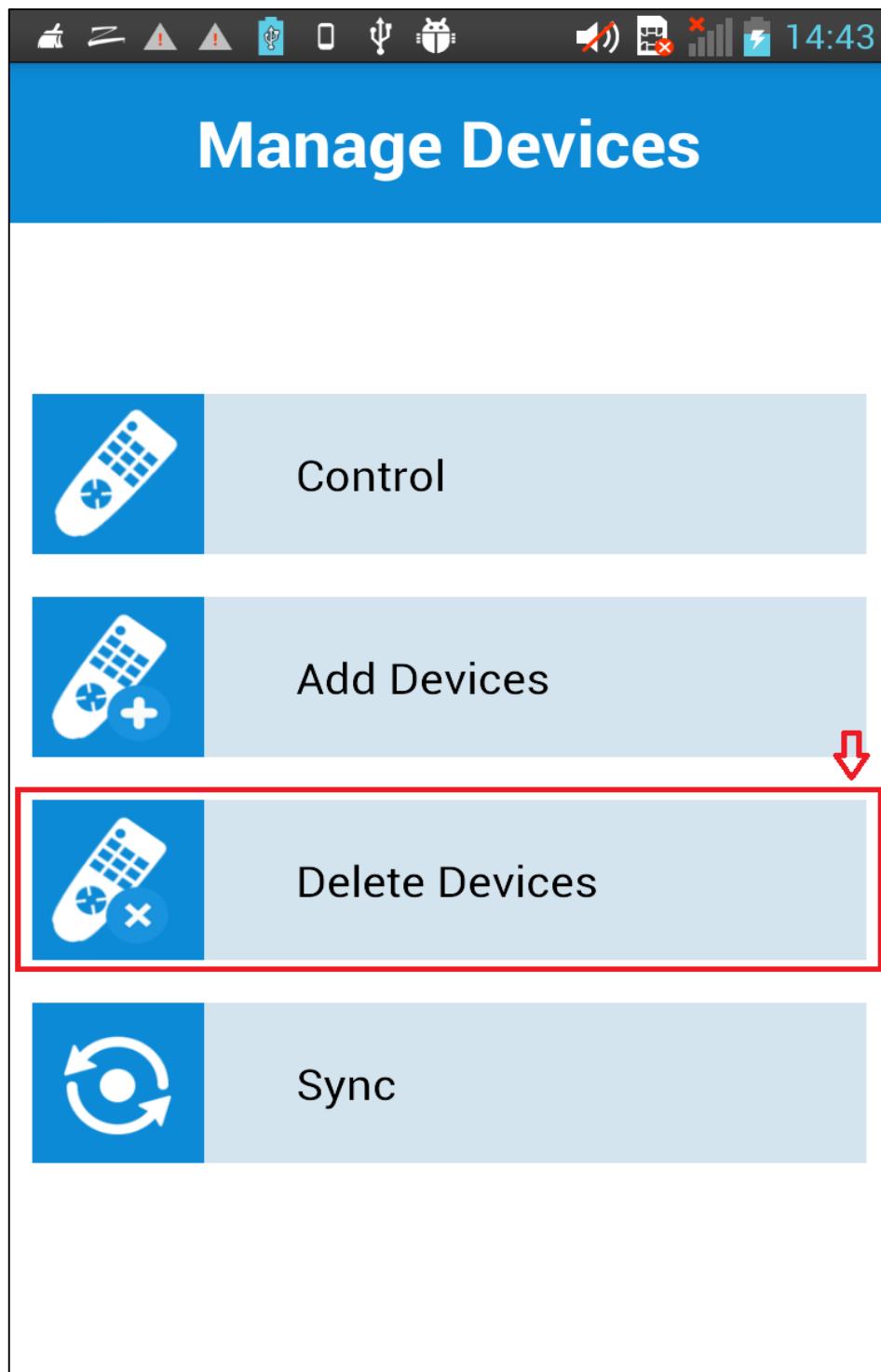


Figure 6-13: Manage Devices Screen

2. Delete screen will show with all kind of devices you can delete. Touch on device type to delete. For example Projector by touch on “Delete Projector” button.

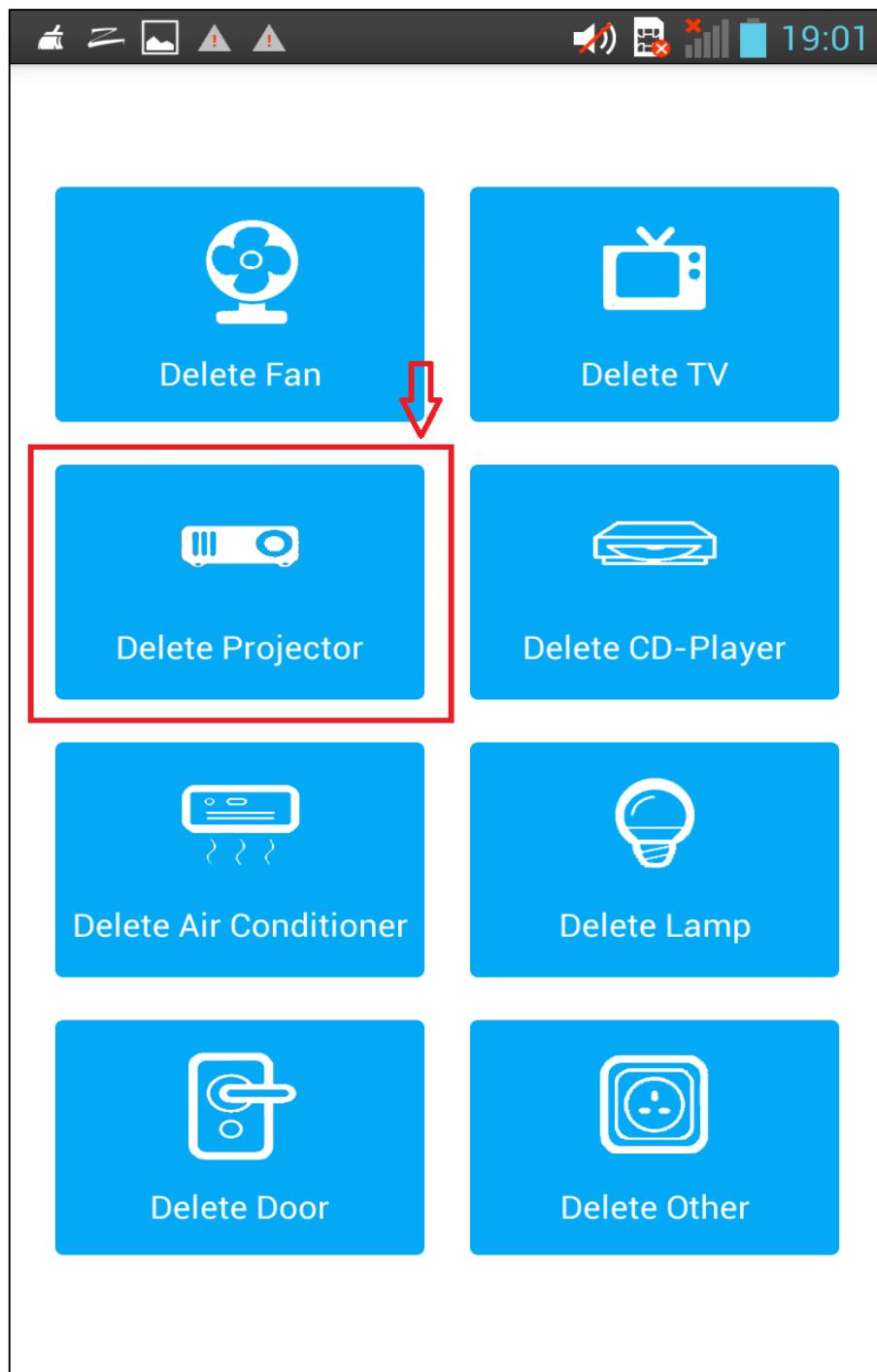


Figure 6-14: Delete Screen

3. List of all exist projector is showed in Delete Projector screen. Choose one of them to delete, for example, you can select Projector 1 or Projector 2.

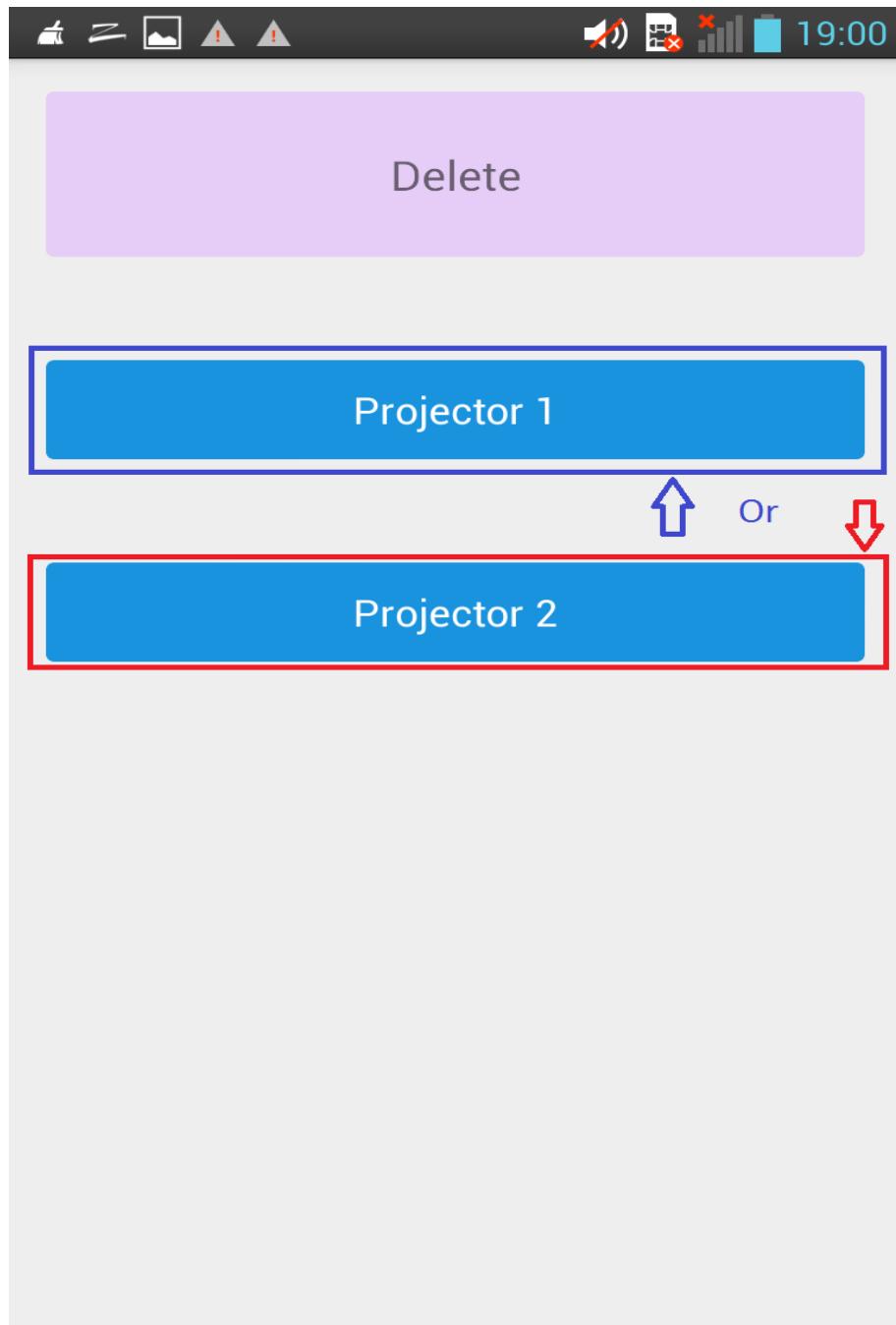


Figure 6-15: Delete Projector Screen

4. Device which is selected will disappear and delete successful message is show.

Notes: Also, you can delete device by touching “Delete” button in Add new Device screen.

But, you only choose one type of device that list in its Add new screen and implement same as all previous steps to delete device.

6.2.5 Synchronous device

1. Touching on “Sync” button in Manage Devices screen to synchronous all data form IRSC-Box to others android smartphone that wasn’t used to create, add, delete, modified ...

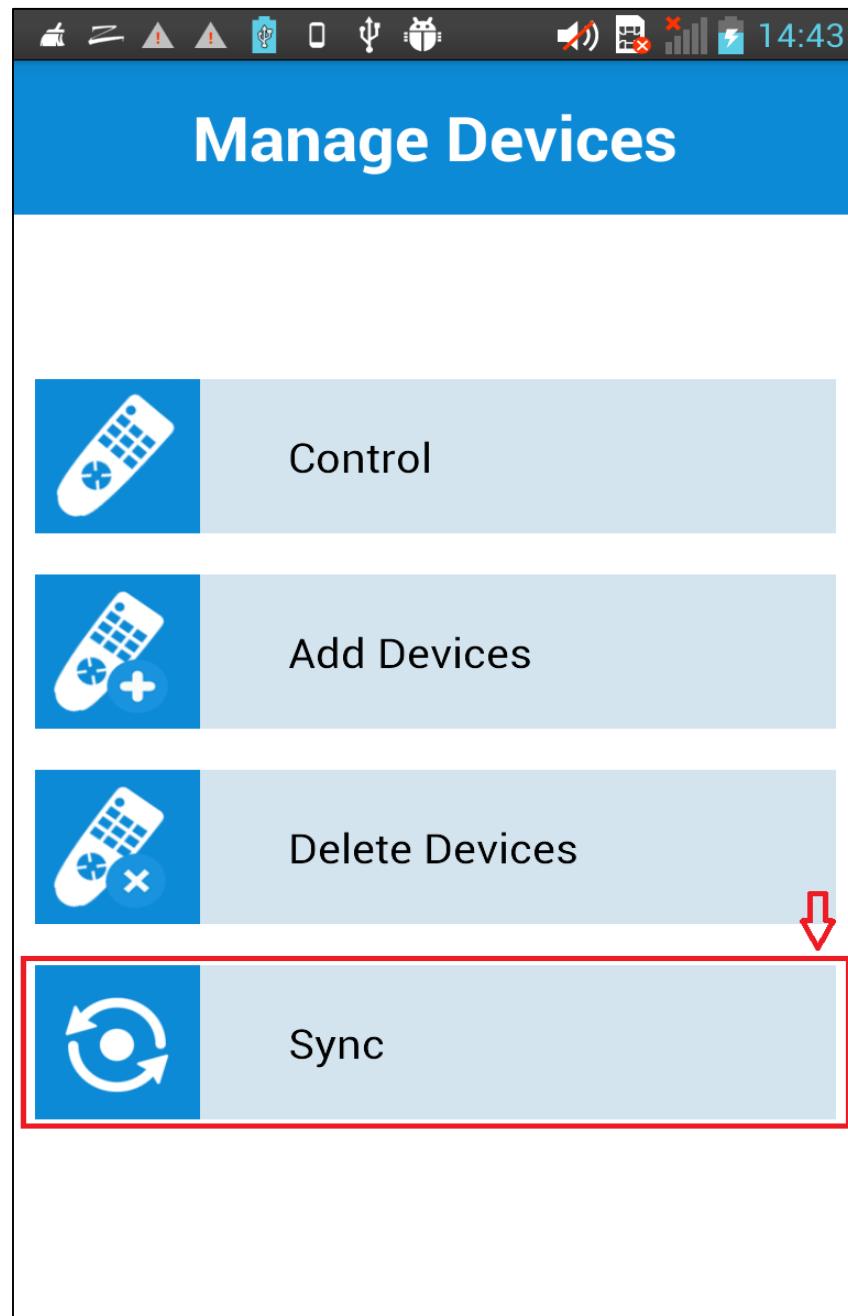


Figure 6-16: Manage Device Screen with clicking “Sync” button

Waiting about 3 seconds to synchronous process take place and successful synchronous message will appear.

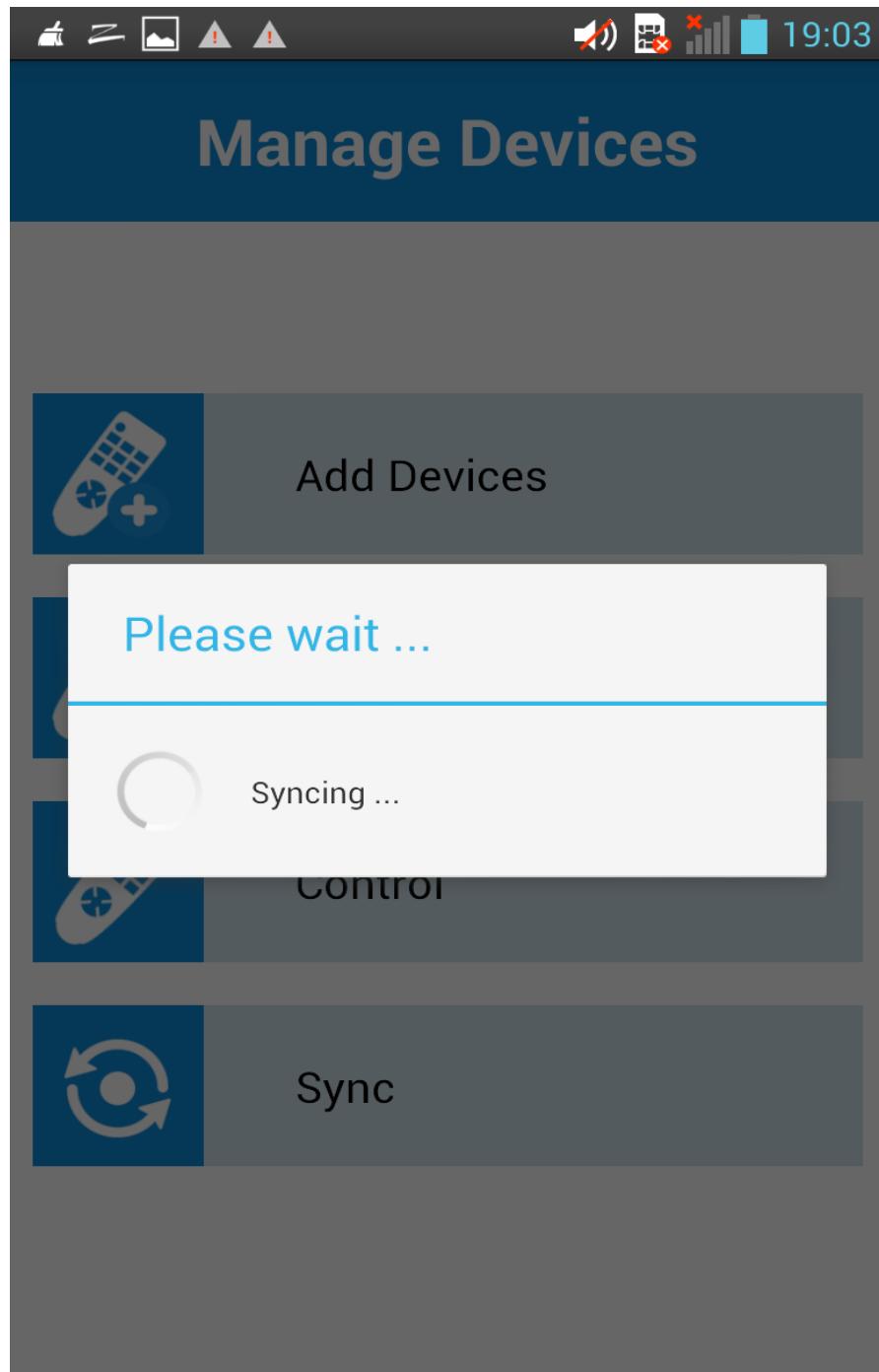


Figure 6-17: Screen of Synchronizing

You can go to Control screen, choose type of device and device to control as Control guideline above.

6.2.6 Change Wi-Fi information

1. Touching on “Manage Account” button in Home screen and going to Manage Account screen.

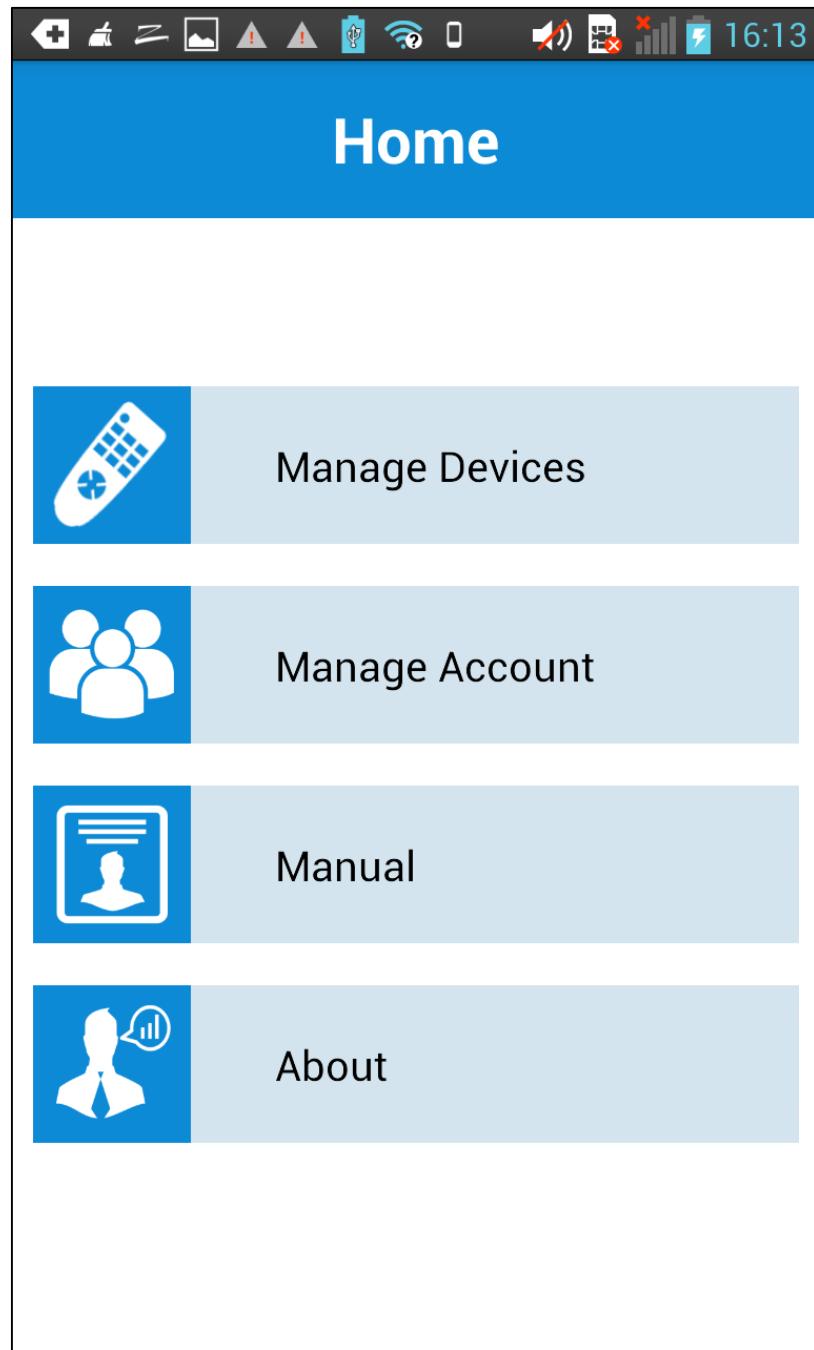


Figure 6-18: Home Screen

2. Touch on “Chang Wi-Fi information” button to change Wi-Fi information.

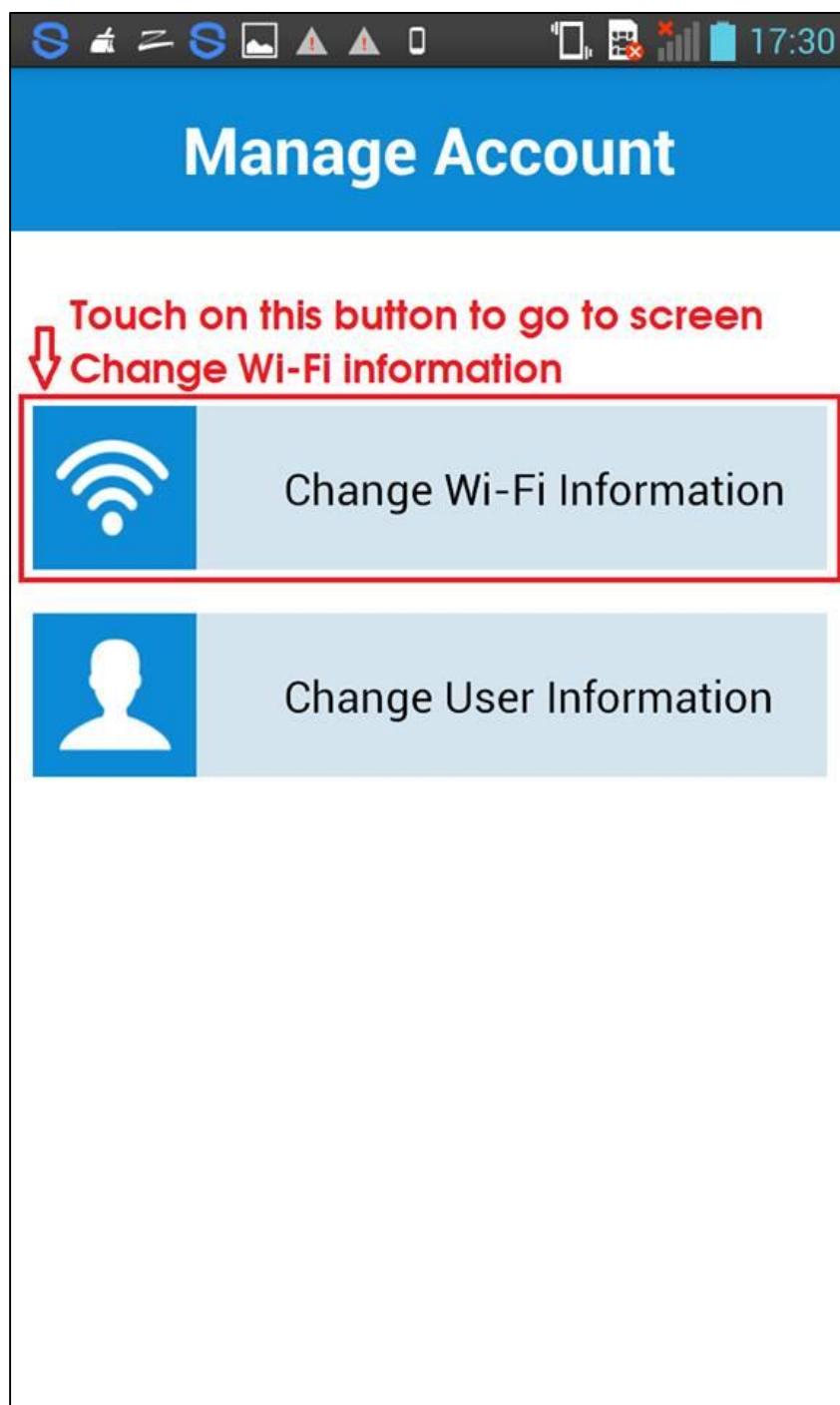


Figure 6-19: Manage Account Screen

3. Typing new Wi-Fi name in “New Wi-Fi name” box, new password into “Enter new password” box and confirm new password into “Re- Enter new password”.

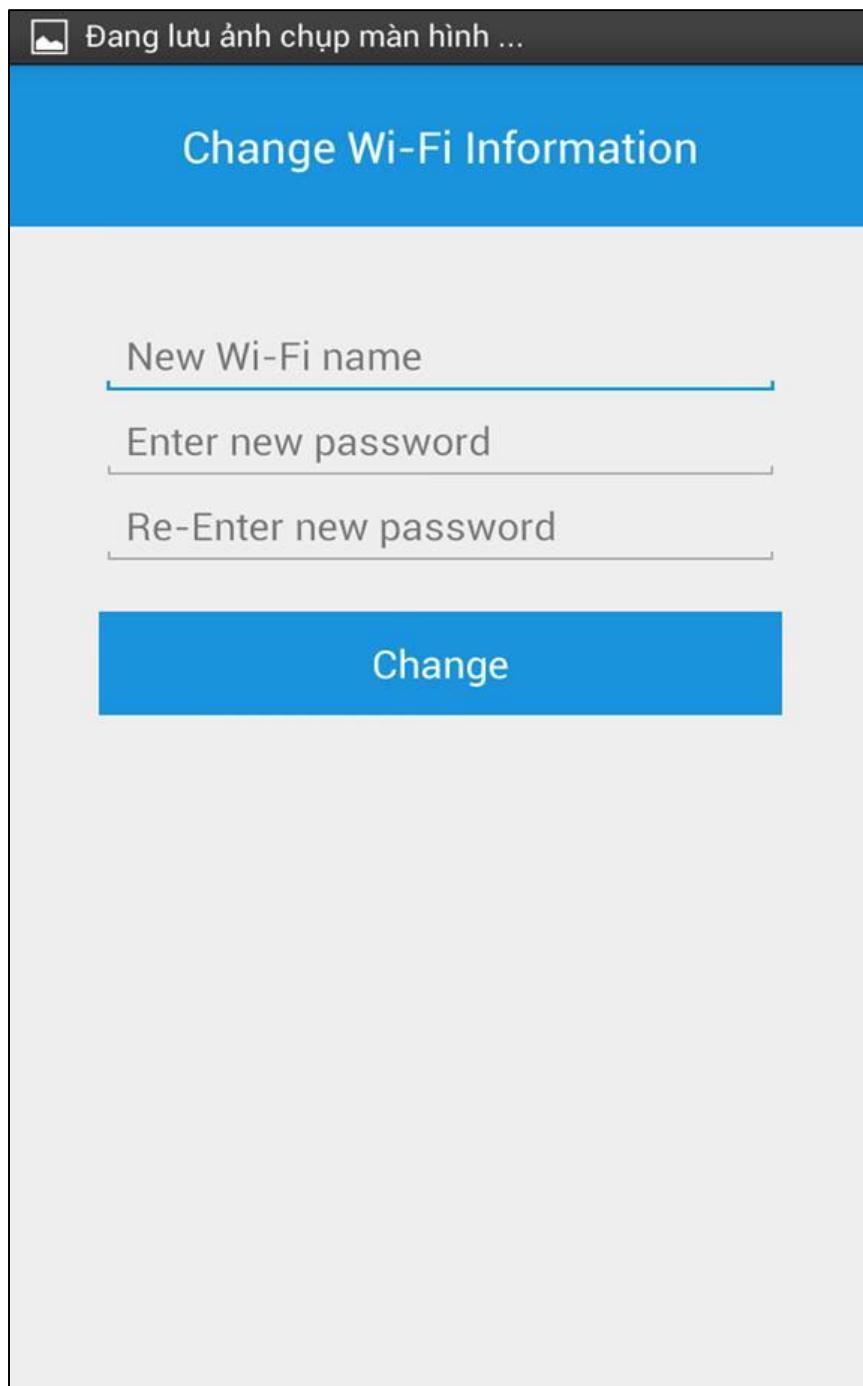


Figure 6-20: Change Wi-Fi Information Screen

Notice: Length of Wi-Fi name must in [1-12] characters password is [8-12] characters and confirm new password match to new password.

6.2.7 Change User information

1. Touch on “Manage Account” button in Home screen and go to Manage Account screen.

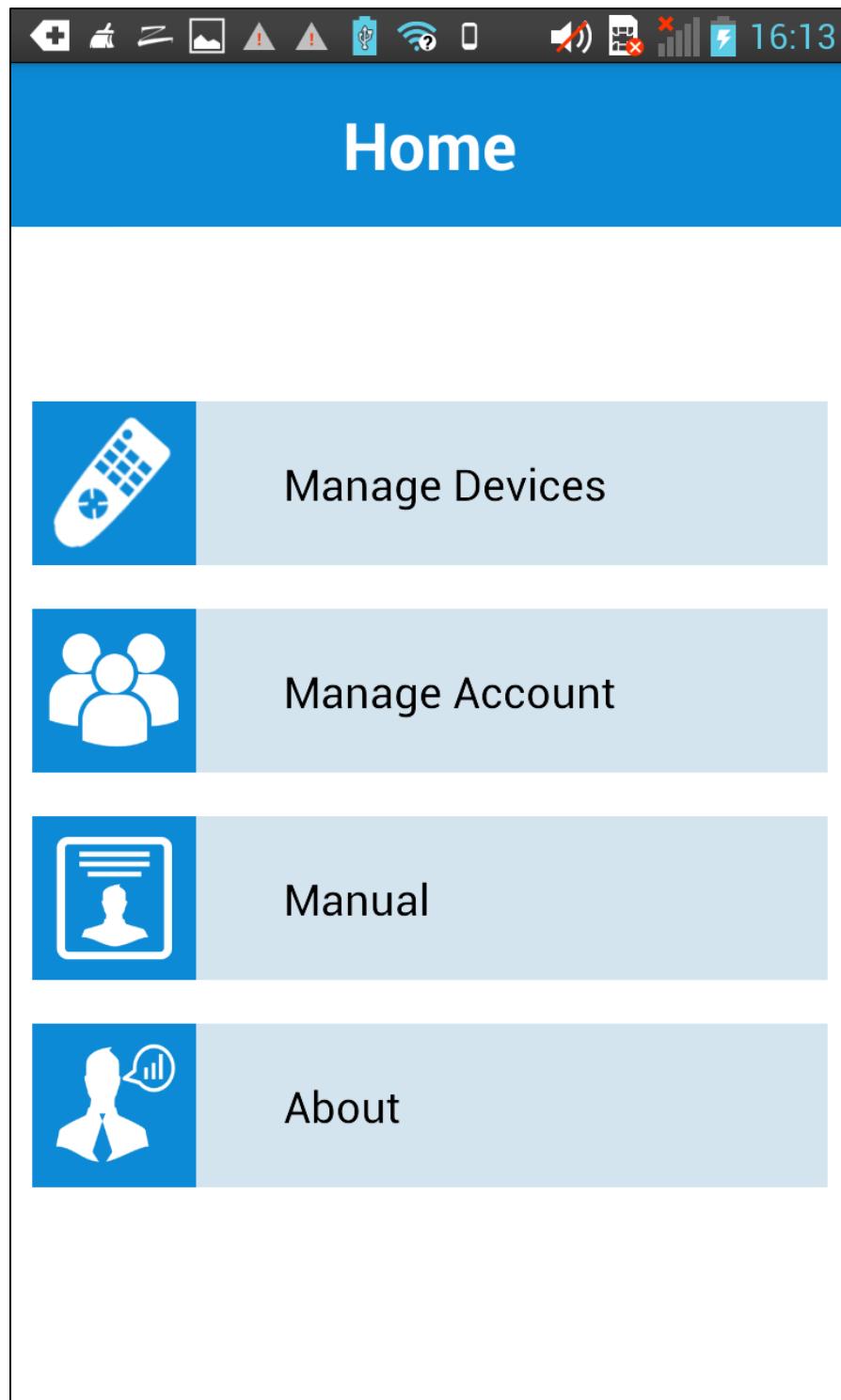


Figure 6-21: Home Screen

2. Touch on “Chang User information” button to go to User information screen.

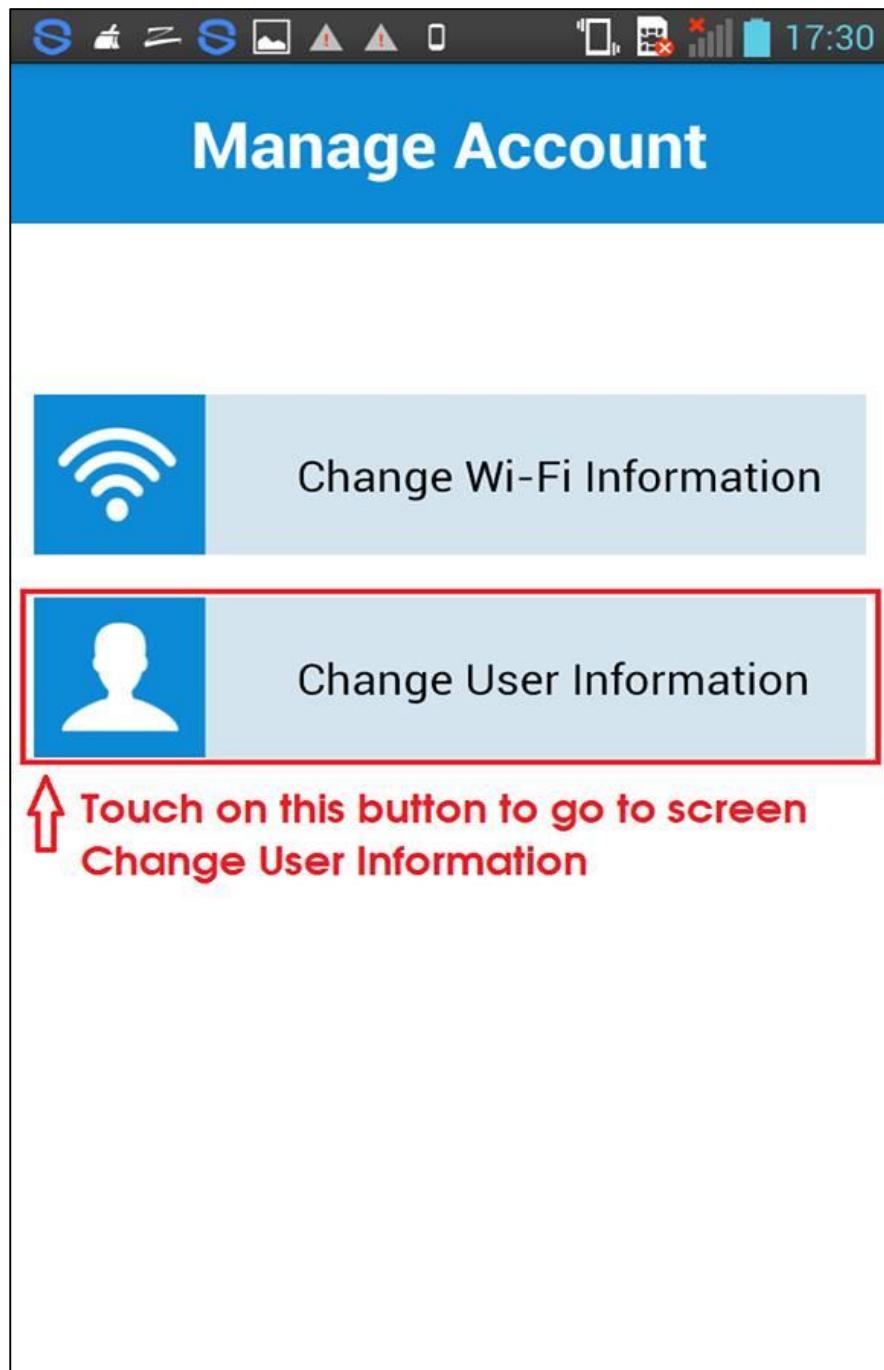


Figure 6-22: Manage Account Screen

3. Typing old account into “Your Account” box, old password into “Your Password” box and touch on “Authenticate” button to verify account and password.

If verification is successful, the Change User Information screen is appear.

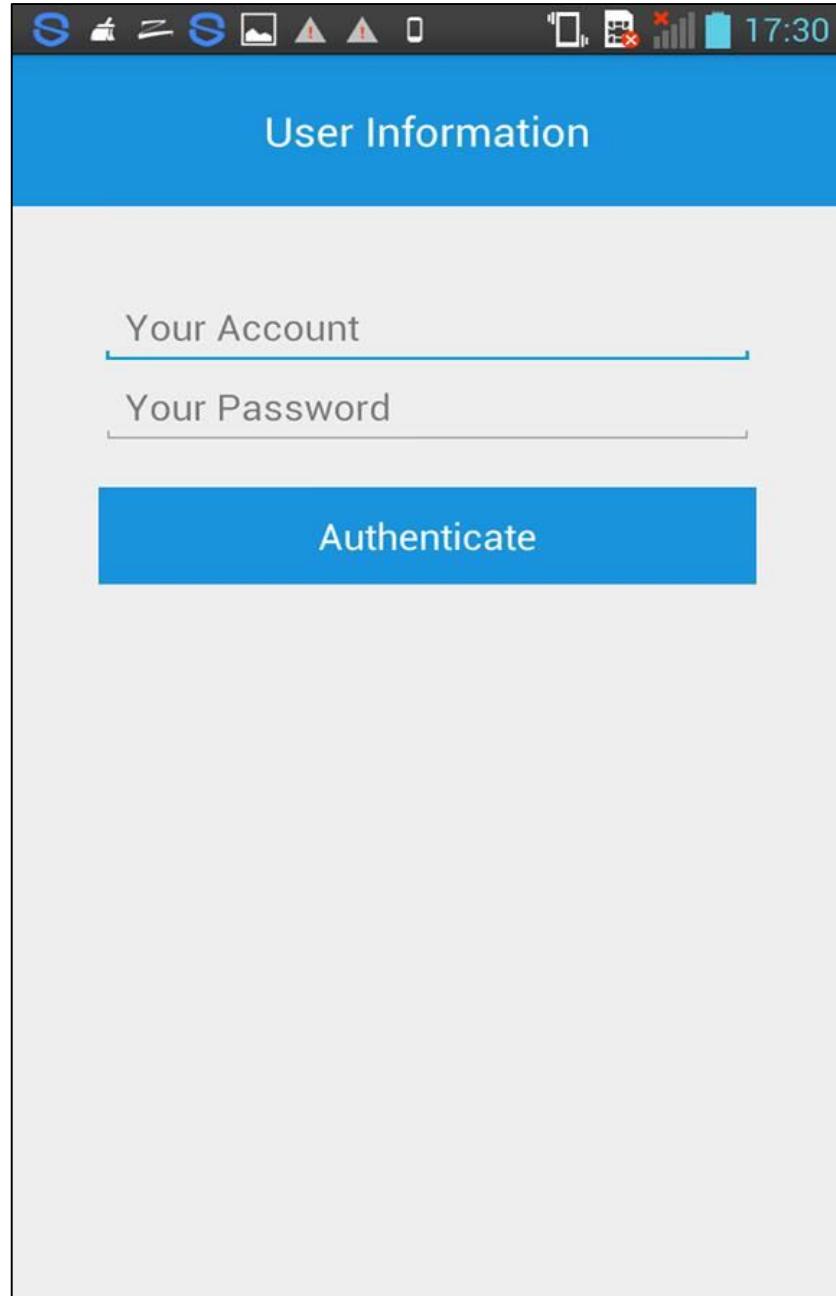


Figure 6-23: Old User Information Screen

4. Type new Account into “New Account” box, new password into “Enter new password” box and confirm new password into “Re- Enter new password”.

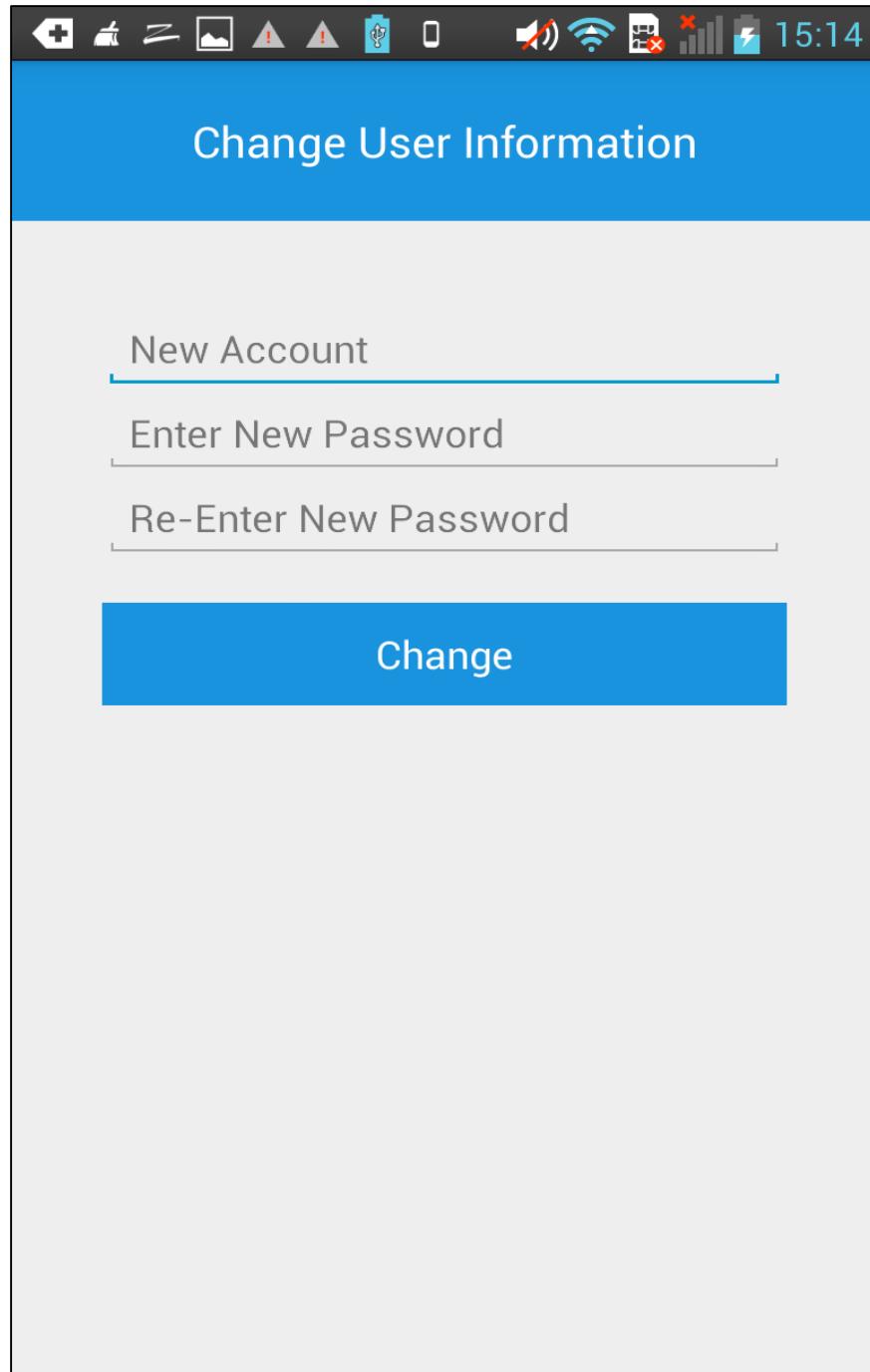


Figure 6-24: New Information of User Screen

Notice: Length of Wi-Fi name must in [1-12] characters password is [8-12] characters and confirm new password match to new password.

5. Touch on “Change” button to change user log in information, successful message is show and redirect to Log in screen to re-Log in.

Reference

1. Android Knowledge: <http://developer.android.com/index.html>
2. IRKit. Masakazu Ohtsuka: *What's IRKit?* <http://getirkit.com/en/>
3. Broadlink Pro. Broadlink Malasia: <http://www.broadlink.my/page-23096.html>
4. Arduino datasheet: <http://adruino.cc/>
5. TSOP 1838T datasheet: <http://www.alldatasheet.com/view.jsp?Searchword=1838T>
6. C1815 datasheet:
<http://www.alldatasheet.com/datasheetpdf/pdf/30084/TOSHIBA/C1815.html>
9. Document Capstone project:
<https://www.dropbox.com/sh/jkhu03e43wqa2uq/AADZFkSebxPwyBsaw5zeGmEba?dl=0>
https://drive.google.com/a/fpt.edu.vn/folderview?id=0B7VtAJjJBIC8ODN0alI2MzQyMlk&usp=drive_web&tid=0B-b_Rii5Co1_YVoweHI3d3R4aFE
10. Hi-Link: *HLK-RM04 Data sheet – HLK-RM04-DS V1.2 11/20/2012*
11. EVERLIGHT ELECTRONICS CO., LTD. Office: No 25, Lane 76, Sec 3, Chung Yang Rd: Technical Data Sheet - *5mm Infrared LED, T-1 3/4 IR333-F SERIES*
12. SHENZHEN LFN TECHNOLOGY CO., LTD: Products specification – *Model: 1838T*
13. Ken Shirriff: A Multi-Protocol Infrared Remote Library for the Arduino -
<http://www.righto.com/2009/08/multi-protocol-infrared-remote-library.html>
14. Google Inc.: Material design - *Introduction* –
- <https://www.google.com/design/spec/material-design/introduction.html>
15. Atmel Corporation 1600 Technology Drive, San Jose, CA 95110 USA: DATASHEET - *Atmel ATmega640/V-1280/V-1281/V-2560/V-2561/V*