UTM
UNIVERSITI TEKNOLOGI MALAYSIA

SCHOOL OF COMPUTING
Faculty of Engineering

SEMESTER I 2021/2022

SUBJECT :

TECHNOLOGY AND INFORMATION SYSTEMS (SECP1513)

SECTION :

10

LECTURER :

DR. NAGHMEH NIKNEJAD

TASK :

PROJECT - LOW FIDELITY PROTOTYPE PART 2

GROUP :

7

GROUP MEMBERS :

CHIA JEE LIANG A20EE0029
HUAM JUN XIANG A21EC0031
KRISTY YAP JING WEI A21EC0191
WAI JIA WEN A21EC0139 (L)

TABLE OF CONTENT

1.0 INTRODUCTION

This project was related to the Fourth Industry Revolution Technologies, Internet of Things (IoT) Smart Home. This project aimed to develop a low fidelity prototype that can provide solutions for the problems stated by the client. Since finding a client was difficult in reality, the study was carried out from an imaginary client viewpoint to determine the issues of their current Smart Home application. The service used to design the architecture of the entire ecosystem was Amazon Web Services (AWS). The first part of the project had a detailed explanation of the chosen technology and the design of the back end system.

In the second part of this project, we included the activity log journal of our team progress. Besides, we explained the problems faced by the client, our solutions to every issue, and our teamwork in more detail. Next, we showcased the entire ecosystem using AWS Architecture Design from the first part of the project. After that, we made a business process flow diagram along with descriptions to briefly describe the business flow of our Smart Home application. A business process flow diagram is a diagram that shows the internal flow of activities that occur in an organization or business entity. Then, the low fidelity mock-up provided in this report was to illustrate the project's result. Each application page has some connections to another page according to its functions. In the final part, each member reflected on the project journey.

2.0 ACTIVITY LOG JOURNAL

Name of members:	**Matric numbers:**
CHIA JEE LIANG	A20EE0029
HUAM JUN XIANG	A21EC0031
KRISTY YAP JING WEI	A21EC0191
WAI JIA WEN	A21EC0139

Record of activities :

Date	Activity	Remarks
21st October 2021	The students of SECP1513-10 were divided into several groups with four members in each group. Group 7 of 4 members consisting of: 1. Wai Jia Wen (Leader) 2. Chia Jee Liang 3. Huam Jun Xiang 4. Kristy Yap Jing Wei Our lecturer, Dr Naghmeh divided the group only but did not give the topic of the project.	
11st November 2021	Dr Naghmeh provided the description file of project part 1 and part 2 in E-learning. The task of this project was to produce a low fidelity prototype and propose a cloud architecture for the project. The selected project must be based on Fourth Industry Revolution (IR4.0) technologies such as Artificial Intelligence & Machine Learning, The Internet of Things (IoT), Big Data Analytics, and High-speed mobile Internet.	

9th December 2021	Discussion carried out to choose the topic for the project in Telegram group chat. Leader led the discussion and asked the opinions of each member. Leader suggested to choose IoT Smart Home or Smart Watch. After voting, the topic chosen was Smart Home. Then, leader assigned tasks of project part 1 to each member. Project part 1 need to include the explanation of chosen technology, client details who provide the problems and cloud architecture design for the solution. 1. Wai Jia Wen – Description for IoT Smart Home, architecture planning and design 2. Chia Jee Liang – Architecture planning and design 3. Huam Jun Xiang – Make an imaginary client 4. Kristy Yap Jing Wei – Introduction and conclusion	
13th December 2021	Each member researched academic articles and journals related to the cloud architecture of Smart Home. At the same time, all members also referred to the notes of AWS Academy and AWS websites on IoT systems. The description of IoT Smart Home was written based on the articles and journals. Architecture planning and design were also done by referring to the system structure of Smart Home.	
14th December 2021	Discussion with Dr Naghmeh to discuss the imaginary client. The way to write the client's problems was changed according to the lecturer advice. The selected imaginary client was VYROX, the best IoT smart home system provider in Malaysia.	

18th December 2021	The introduction, description of technology chosen, client problems, solutions, architecture planning and design, conclusion, and references were completed and finalized into one report.	
22nd December 2021	The architecture design was modified to become more accurate. The architecture changed to be more focused on cloud architecture. General AWS architecture diagram of the entire back-end system for IoT devices obtained from AWS websites was modified and labelled. Descriptions about each AWS service used were included.	
23rd December 2021	The discussion with Dr Naghmeh was carried out to check the final report for the low fidelity prototype project part 1. After the lecturer commented and approved, project part 1 was submitted in E-learning after done corrections.	
6th January 2022	The leader distributed the tasks of project part 2 to each member. Project part 2 need to include the AWS Architecture Design of the entire ecosystem, a business process flow diagram with description, and the low-fidelity mock-ups for the mobile app. Researched to find the examples of the business flow diagram and user interface of existing Smart Home apps. All members were involved in researching and generating ideas for the low fidelity prototype and business flow diagram.	
13rd January 2022	Two members (Jia Wen and Jun Xiang) combined the ideas generated and sketched the drafts for the low fidelity mock-ups. Two members (Jee Liang and Jun Xiang) sketched drafts for the business flow diagram.	

17th January 2022	Three members (Jia Wen, Kristy and Jee Liang) designed the interactive low fidelity prototype in Canva. Two members (Jee Liang and Jun Xiang) drew the business flow diagram in the report file.	
18th January 2022	Moved the prototype created in Canva into the final report file in Microsoft Word. Wrote the descriptions on the business flow diagram drawn. The contents on introduction, problems, solutions, team working, AWS architecture design, and reflections were also included in the report. Every member wrote own reflection according to the journey in producing this project.	
20th January 2022	Made a final discussion with Dr Naghmeh to check the final report for the low fidelity prototype part 2. Each member was involved in the preparation of project-related video and presentation slides. The project-related video showed the steps in completing the project. The introduction, problems, solutions, team working, and interactive prototype was included in the presentation slides.	
22nd January 2022	After made corrections and modifications, the final report was submitted through E-learning.	

3.0 PROBLEM

VYROX is the best IoT smart home system provider in Malaysia. Besides, it is also one of the top 10 IoT smart home system integration companies in South-East Asia [1]. Lately, VYROX is planning to develop an application for its newest smart home system. The newest application will be the updated version of the old application which will solve the problems that exist.

The first problem that exists in the old application is that there is a lot of steps and times required to install a new smart device. To ensure security and privacy, the users have to key in both password and pin numbers every time they open the application. The users have to accept some permissions in "Settings" such as "Camera", "Location", "Microphone", "Storage" and so on. After connecting the Wi-Fi and Bluetooth on the smartphone, the application will start detecting the device chosen. This step always takes the most time to conduct due to network latency or overcrowded of data in the application.

Besides, the previous application cannot connect to some specific brands' smart devices. For instance, Xiaomi, Hisense and Toshiba are electronic devices that are undetectable in VYROX's old application. It is because of the device incompatibility which the application's developers had blocked the connection between the application and the specific brands' devices. Therefore, the users cannot find the devices in the previous application and connect them to control in long-distance. Apart from that, the users are unable to connect the devices due to the missing features of devices such as Bluetooth or Wi-Fi connection.

Furthermore, there are some feedbacks from the users saying that the old application has complex navigation and settings that usually confused them a lot. Navigation and settings are known to be the backbone of an application. However, these functions are lacking in VYROX's old application. As an example, the application does not consider the account for finger and hand positioning causes the users to waste time tapping the icons repeatedly because the size of buttons is too small for some users. The settings page options appear cluttered and confuse the users to set the setting as their need directly.

Finally, there are a lot of complaints received from users about the advertisements in the old application. They need to wait for about 30 seconds every time they log in to the application. There is a lot of in-app advertisements that appear as a strategic business to help the company wants to reach their target audiences, boost sales and educate consumers on their products and services. This had made the users feel impatient and wasting time on it. Those who are usually rushing on time had stopped using the VYROX application because there are too many advertisements that interference with their precious times.

4.0 SOLUTION

We develop a new IoT infrastructure for the VYROX smart home system to solve the problems that existed in the old version application. We designed a system architecture for the smart home system by using Amazon Web Services (AWS).

The primary service in the system is AWS IoT Core which permits the connection of various devices to the cloud. IoT Core will transmit and receive updates based on the data accepted from the devices. The devices are connected with AWS IoT Greengrass Core or IoT device SDK to gain access to AWS IoT Core. The new system allows to remote more different brands of smart devices. By adding these functions, the application's users can save time to install new smart devices as the installing steps were reduced. The users can connect the smart devices to the cloud by just scanning the QR code in the application. Moreover, AWS Cognito also enables the users of the mobile application to access the control of the smart devices. The users can directly sign up or log in to the application through their e-mail address, phone number, Facebook account or Google account. We also provided helps to users to retrieve their password by phone number or email address if they lose it.

We had designed a new prototype to simplify the navigation and settings of the application. The new version of the prototype was designed to provide a better user interface with useful functions and appealing visuals. The application users can edit the application interface according to their own preferences as we synchronized the colour theme, button size, symbol and more.

Lastly, the new application also provides higher security to prevent the spam of advertisements that affect the users' experiences. The system designed includes AWS IoT Device Defender which will keep examining the users' devices to make sure they do not diverge from the best security practices. If there are any security problems that occur, the device defender will immediately generate a notification and send it to the users through Amazon SNS which functions to distribute messages from smart devices to mobile applications. Therefore, the irrelevant or useless advertisements will be filtered out before being displayed. The users can have more comfortable and safer experiences using the smart home application.

5.0 TEAM WORKING

Team work is one of the essential elements in a group assignment. In this project, we cooperate with each member to achieve our goal which is the Low Fidelity Prototype project.

First of all, we had a discussion together on the selection of the topic for our project. After deciding the topic, the leader, Jia Wen assigned the tasks of project part 1 into a few parts to make it easier and fairer for us to work in a team. The tasks were divided into four parts and each of the members had picked one part and be responsible for it. As an illustration, Kristy did the introduction and conclusion, Jia Wen described the IoT Smart Home and architecture planning and design, Jun Xiang created the imaginary client and Jee Liang handled the architecture planning and design.

During the process, we usually discussed in the group when we met difficulties to come up with the best solution. Everyone was active and willing to share ideas with each other. Project part 1 was submitted by our leader in the E-learning system after we do the error checking and corrections.

Next, we proceed with part 2 of the project immediately. As before, the leader was responsible for the distribution of labour and shared a Microsoft Word file to the group as the report file to edit together at the same time. At the beginning of the report, Jun Xiang typed the introduction while Jia Wen listed down detailed steps and descriptions related to the project and AWS architecture design that showcases the entire ecosystem. Besides, Kristy did a detailed description of problems, solutions and team working. Jee Liang and Jun Xiang sketched the drafts for the business flow diagram and then drew it in the report file.

We had provided low fidelity mock-ups in this project. In this case, Jia Wen and Jun Xiang had combined the ideas generated and sketched the drafts for the low fidelity mock-ups. After that, Jia Wen, Kristy and Jee Liang designed the interactive low fidelity by using Canva. We helped each other when facing problems and finished our group project on time due to our team working and responsibilities.

Lastly, all members were involved in the preparation of the project-related video and presentation slides. We finished the Low Fidelity Prototype project together with a lot of effort and team working as we have the ability to cooperate with other people in a group setting to achieve a goal together.

6.0 AWS ARCHITECTURE DESIGN OF THE ENTIRE ECOSYSTEM

Diagram 1 exemplifies cloud back end system for smart home application adopted from [2].

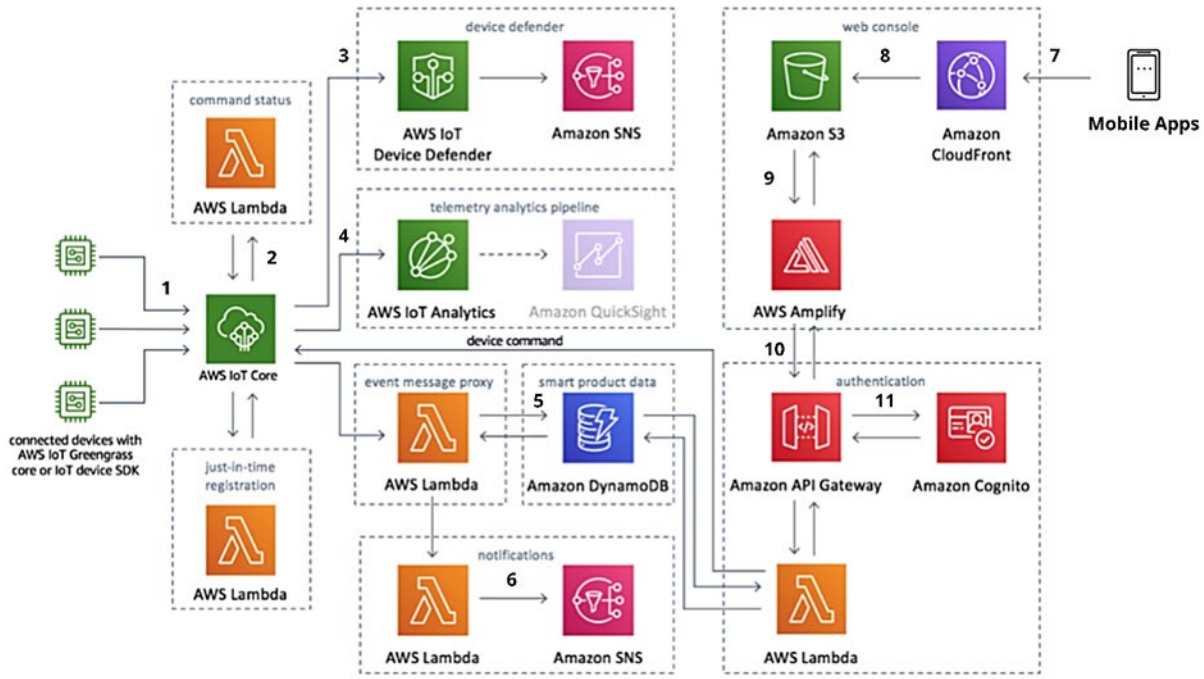
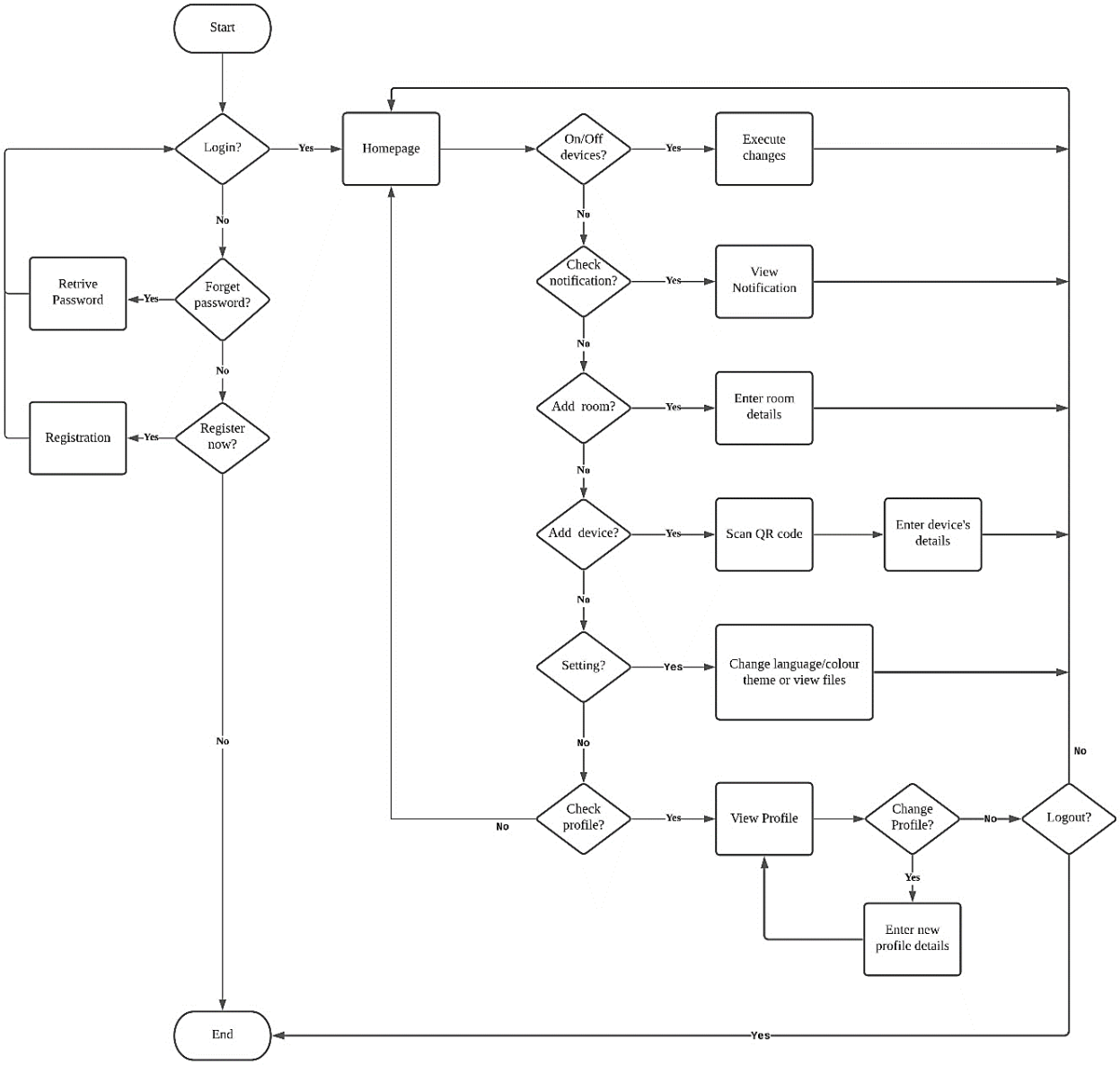


Diagram 1

AWS IoT Core permits the connection of the devices to the cloud. The devices connected with **AWS IoT Greengrass core** or **IoT device SDK** to gain access to AWS IoT Core. **AWS Lambda** is the rule engine to extract necessary data from the messages and routes the info to the solution's microservices to operate. **AWS IoT Device Defender** makes sure the devices always perform the best security practices. **AWS IoT Analytics** functions to analyze data received from the IoT devices and generate more precise orders for IoT devices. **Amazon DynamoDB** is the document database. It backups data and caches command from users or devices. **Amazon SNS** sends messages from smart devices to mobile application users. The front end mobile apps users can monitor their house condition through the **Amazon CloudFront**. Amazon Simple Storage Service (**Amazon S3**) stores and protects the mobile application users data. **AWS Amplify** is used to create the front end user interface (UI). **Amazon API Gateway** hosts the authentication of the identity of users to access the control, receives commands from front end mobile apps users and triggers the AWS Lambda function to fulfil the requests. **Amazon Cognito** functions include users signing up, log in, and permitting the users of the mobile apps to access the control of the smart devices through the mobile app.

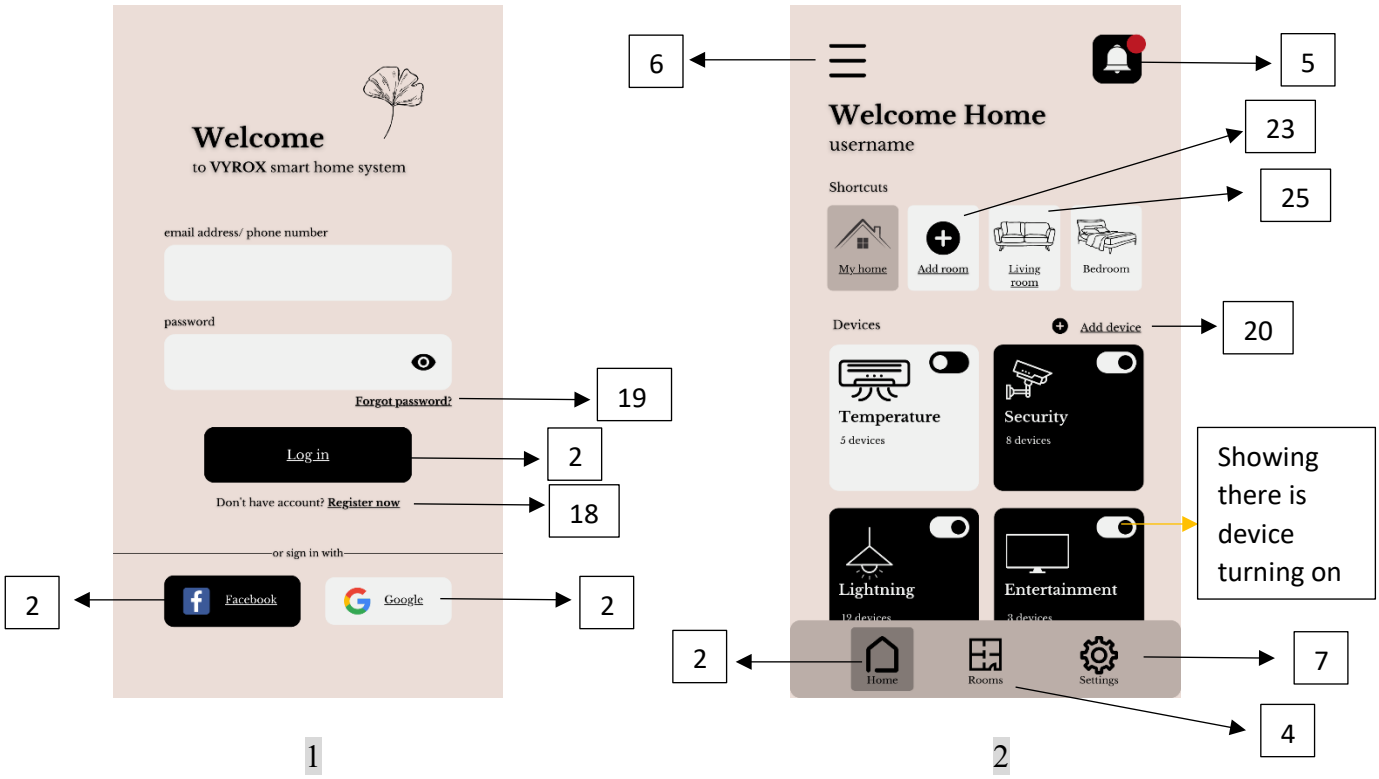
7.0 BUSINESS PROCESS FLOW DIAGRAM AND DESCRIPTION



The first page of this app is the login page when we first launch the smart home app. User can register their account and retrieve their password if they forgot their current account password at the login page. After login, user will advance to the main menu of the smart home app. There are a lot of function that user can use such as user can on/off their devices, check new notification from smart devices, add more room and smart device by scanning their QR code, and change the setting for this application. For example, user can change the language, colour theme and view files of this application. User can also check and change their profile details if there is any change. Lastly, user can log out from their profile page for another user to login his/her account.

8.0 LOW-FIDELITY UI MOCK-UPS

The design of the smart home app user interface (UI) was inspired by the previous works of other designers obtained from [3], [4], and [5].



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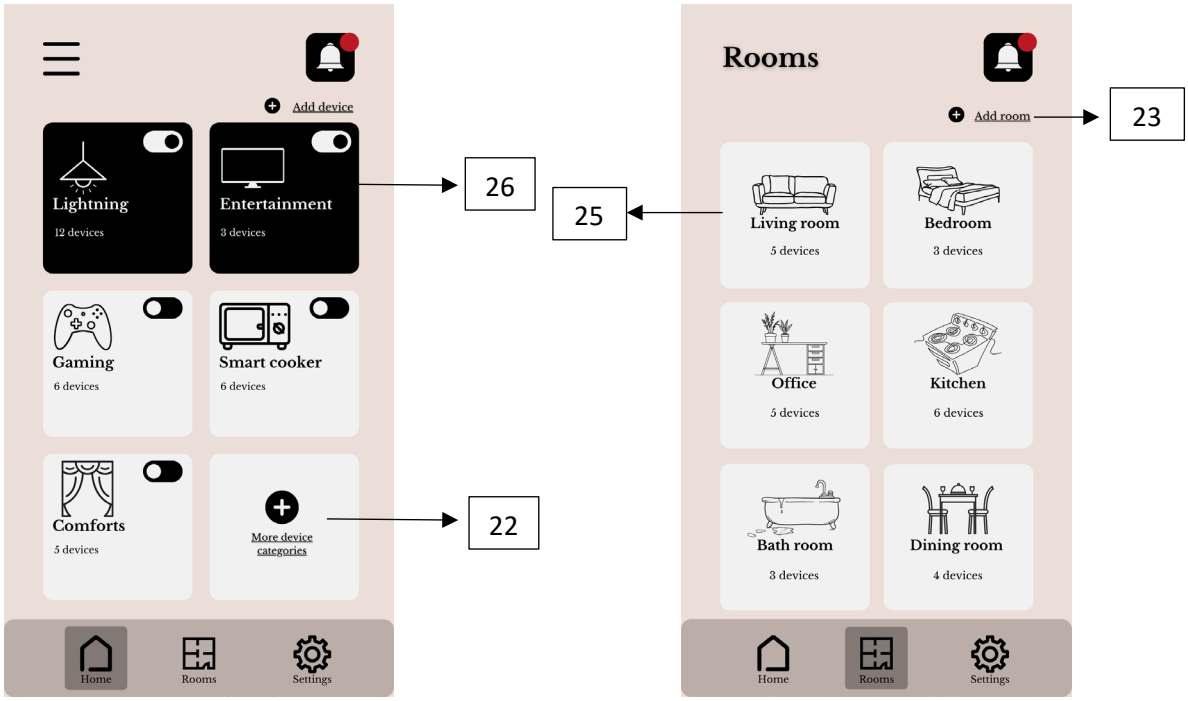

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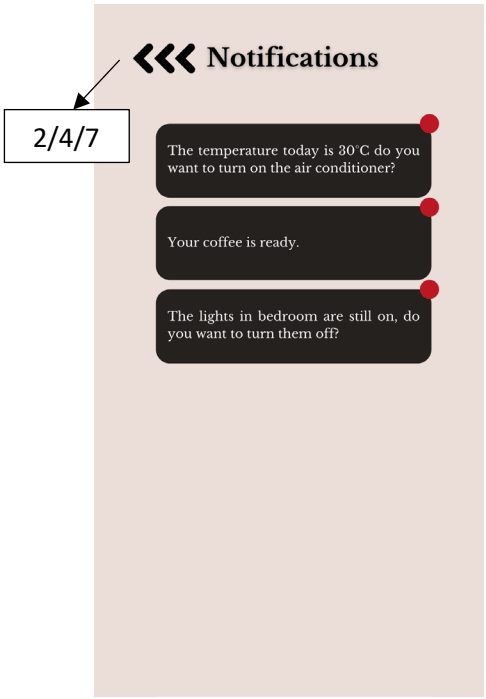
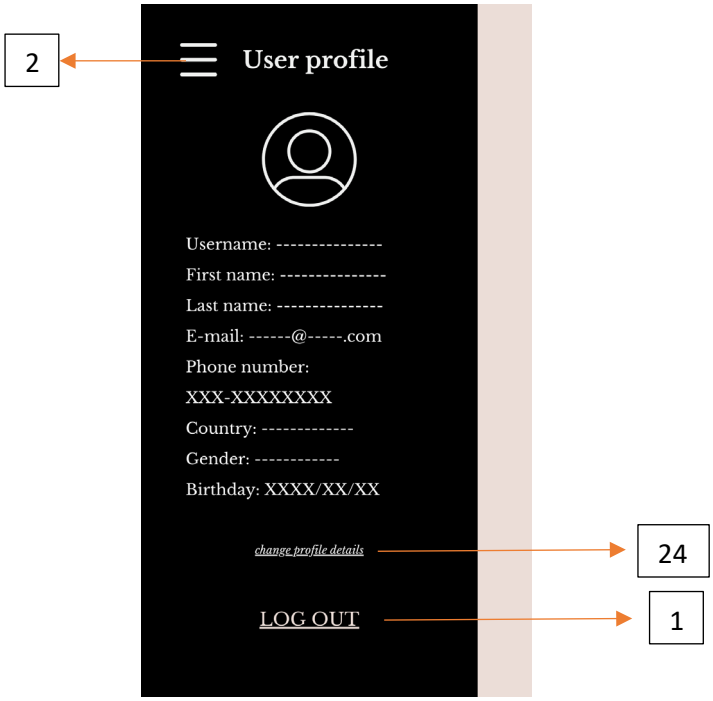
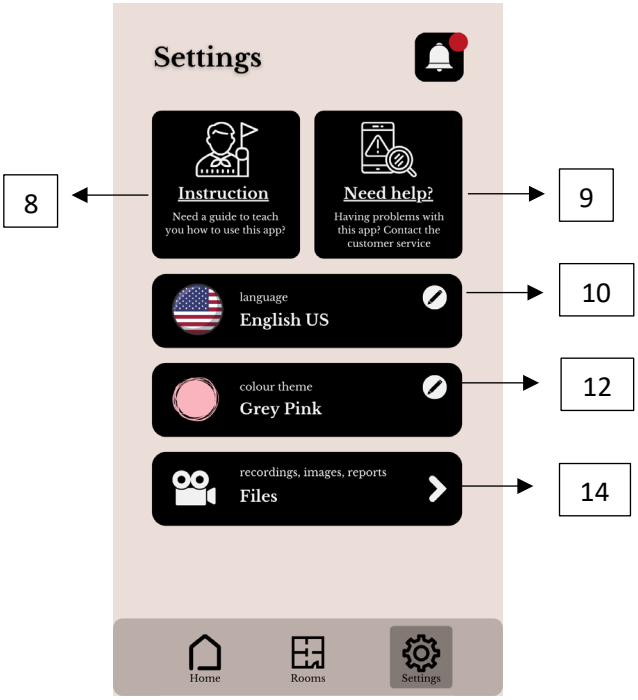

Notifications
2/4/7
The temperature today is 30°C do you want to turn on the air conditioner?
Your coffee is ready.
The lights in bedroom are still on, do you want to turn them off?

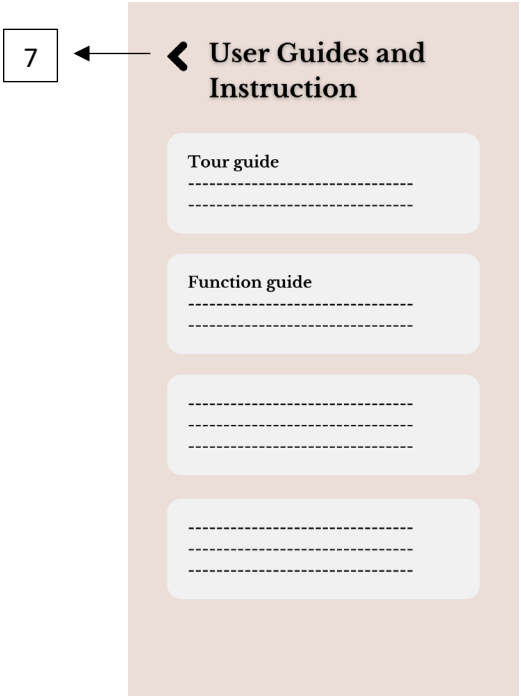
5


2
User profile
Username: ----------
First name: ----------
Last name: ----------
E-mail: ------@-----.com
Phone number:
XXX-XXXXXXXX
Country: ----------
Gender: ----------
Birthday: XXXX/XX/XX
change profile details
24
LOG OUT
1

6


Settings
8
Instruction
Need a guide to teach you how to use this app?
Need help?
Having problems with this app? Contact the customer service
9
language
English US
10
colour theme
Grey Pink
12
recordings, images, reports
Files
14
Home
Rooms
Settings

7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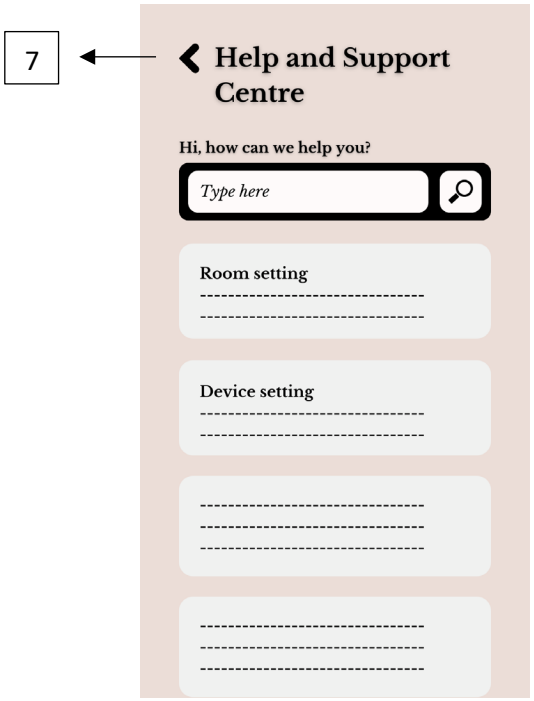
User Guides and Instruction
Tour guide
Function guide

8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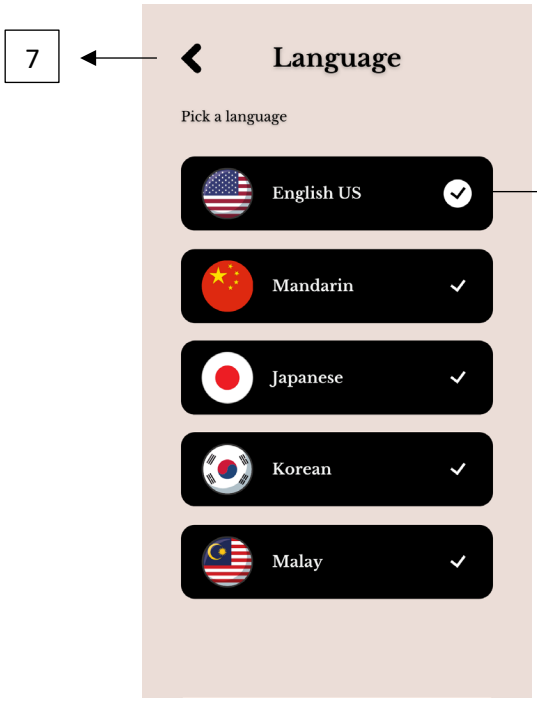
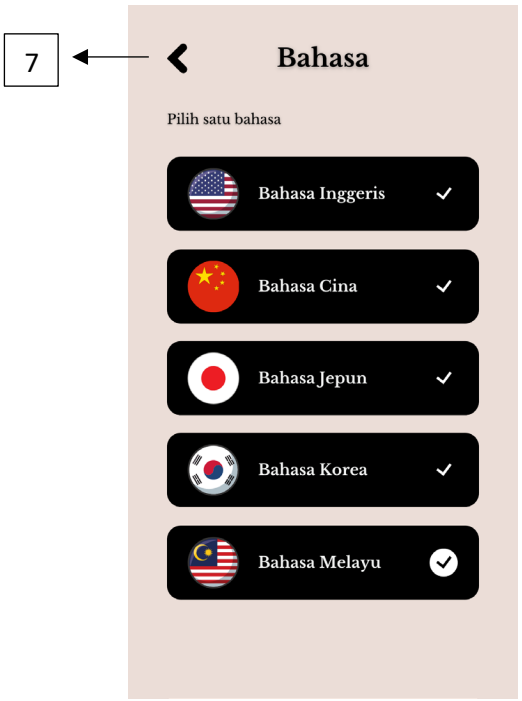
Help and Support Centre
Hi, how can we help you?
Type here
Room setting
Device setting

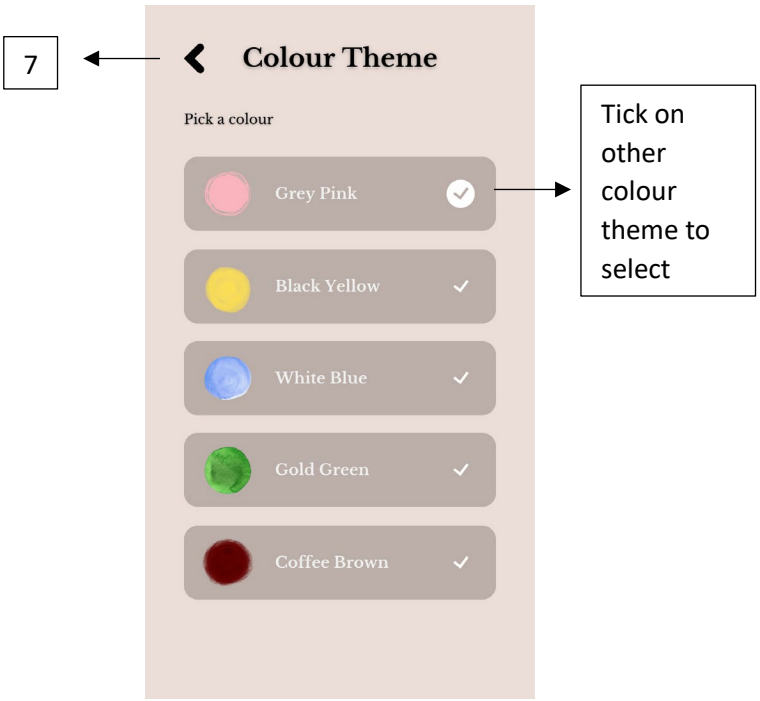
9


7
Language
Pick a language
English US
Mandarin
Japanese
Korean
Malay
Tick on other language to select

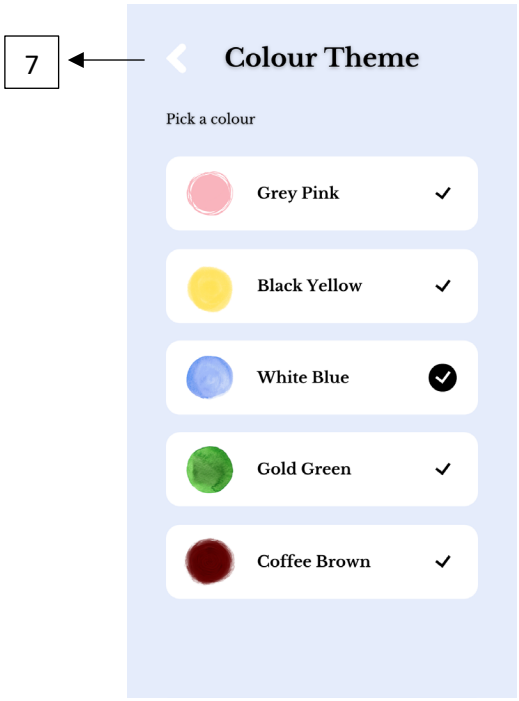
10


7
Bahasa
Pilih satu bahasa
Bahasa Inggeris
Bahasa Cina
Bahasa Jepun
Bahasa Korea
Bahasa Melayu

11


7
Colour Theme
Pick a colour
Grey Pink
Black Yellow
White Blue
Gold Green
Coffee Brown
Tick on other colour theme to select

12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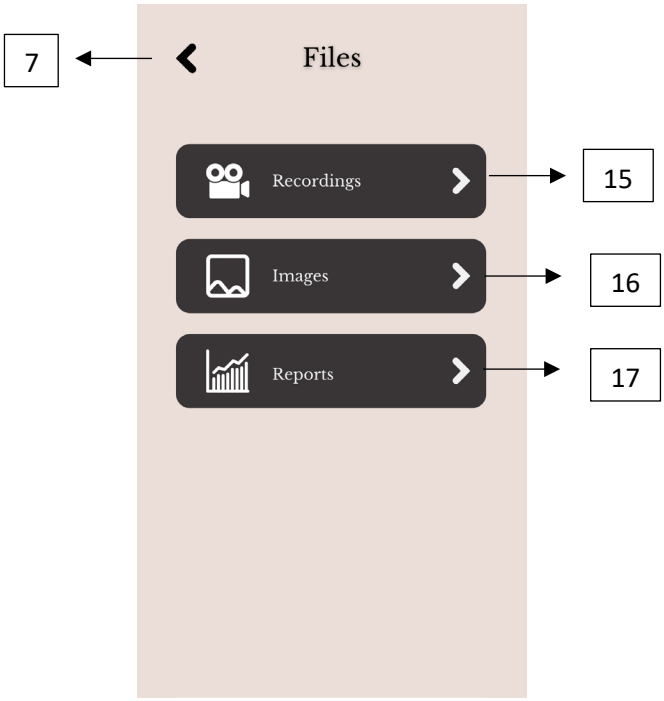
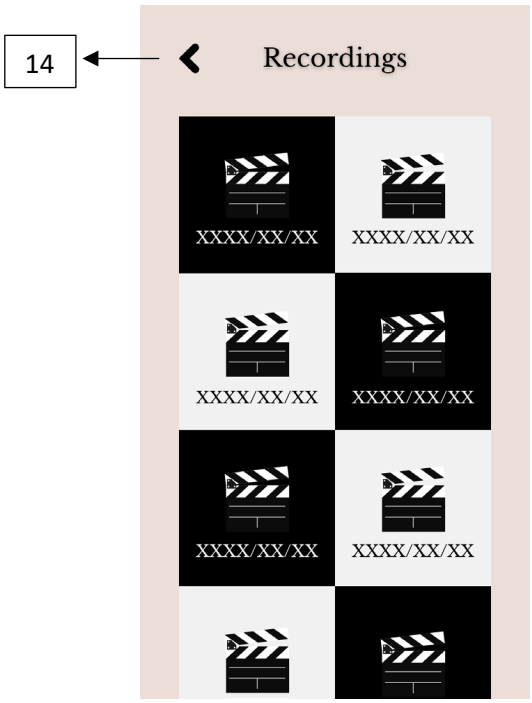
Colour Theme
Pick a colour
Grey Pink
Black Yellow
White Blue
Gold Green
Coffee Brown

13


7
Files
Recordings
Images
Reports
15
16
17

14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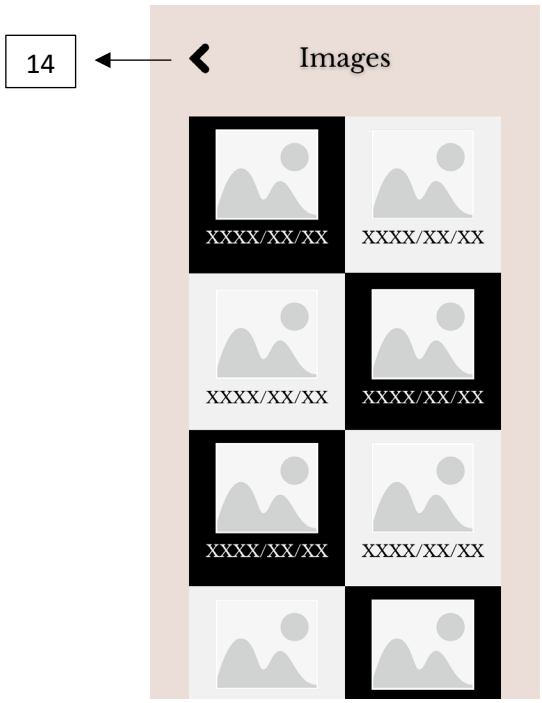
Recordings
XXXX/XX/XX
XXXX/XX/XX
XXXX/XX/XX
XXXX/XX/XX
XXXX/XX/XX
XXXX/XX/XX

15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XXXX/XX/XX
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XXXX/XX/XX

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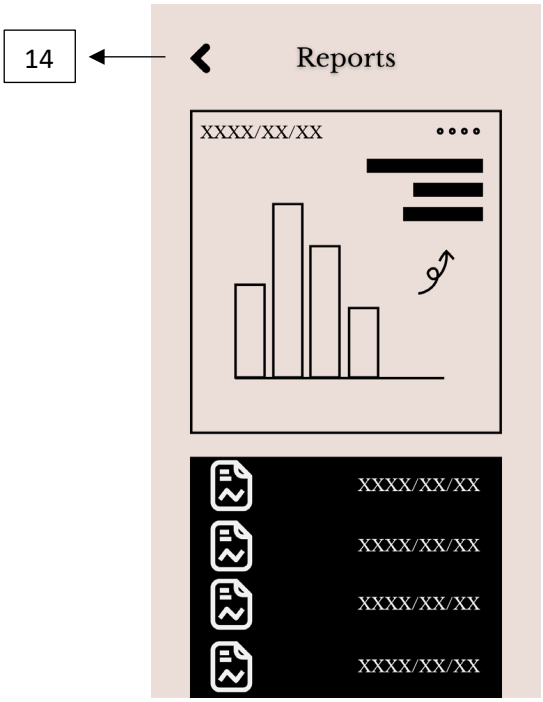
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XXXX/XX/XX
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XXXX/XX/XX

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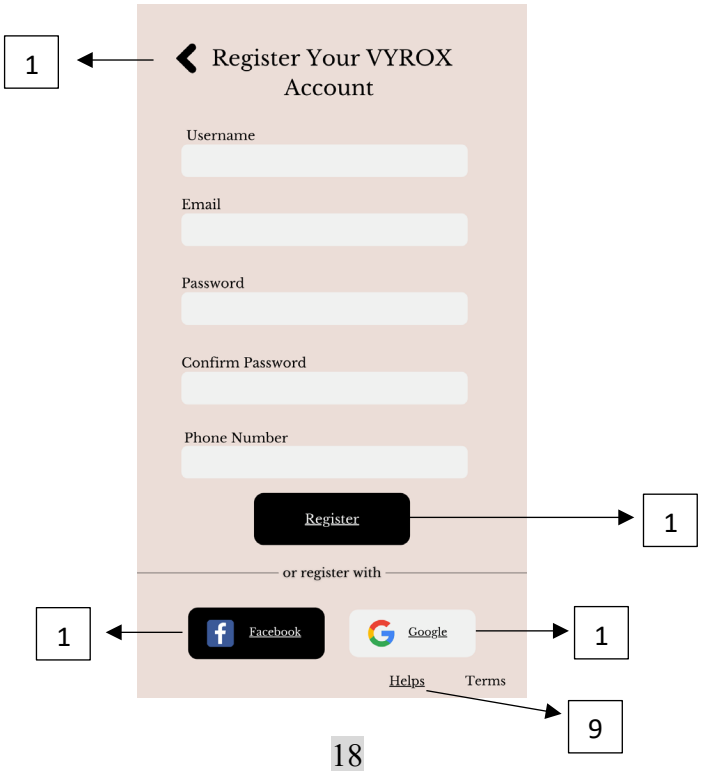
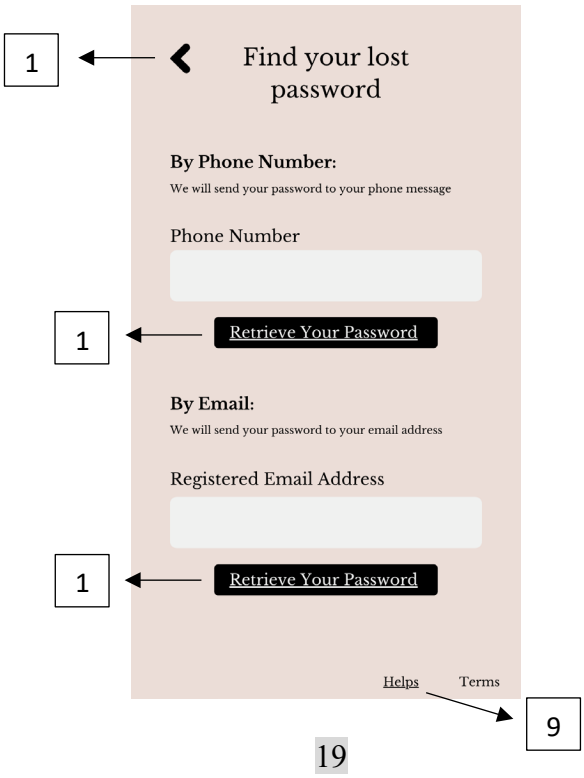
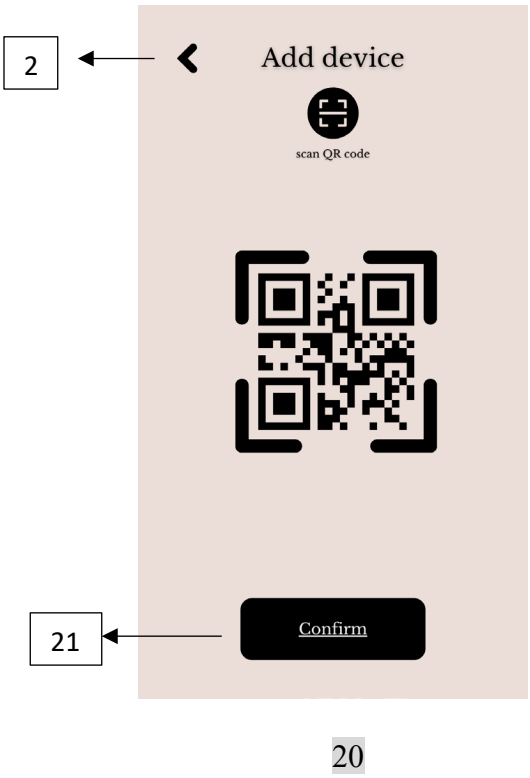

1
Register Your VYROX Account
Username
Email
Password
Confirm Password
Phone Number
Register
1
or register with
1
Facebook
Google
1
Helps
Terms
9

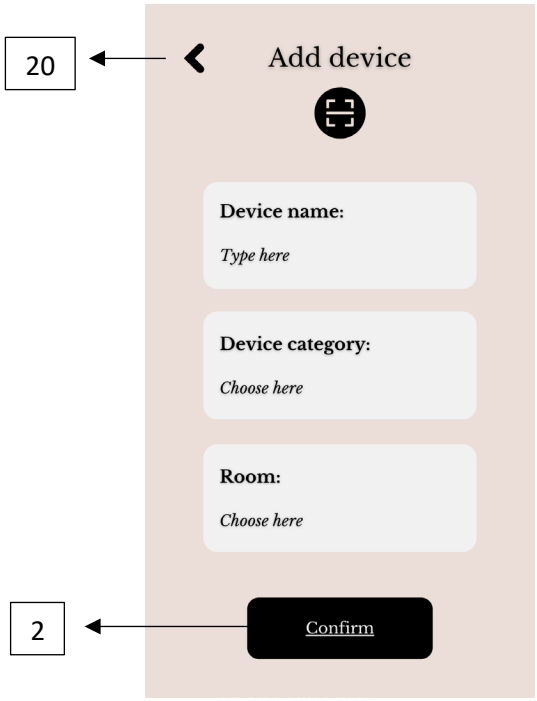
18


1
Find your lost password
By Phone Number:
We will send your password to your phone message
Phone Number
1
Retrieve Your Password
By Email:
We will send your password to your email address
Registered Email Address
1
Retrieve Your Password
Helps
Terms
9

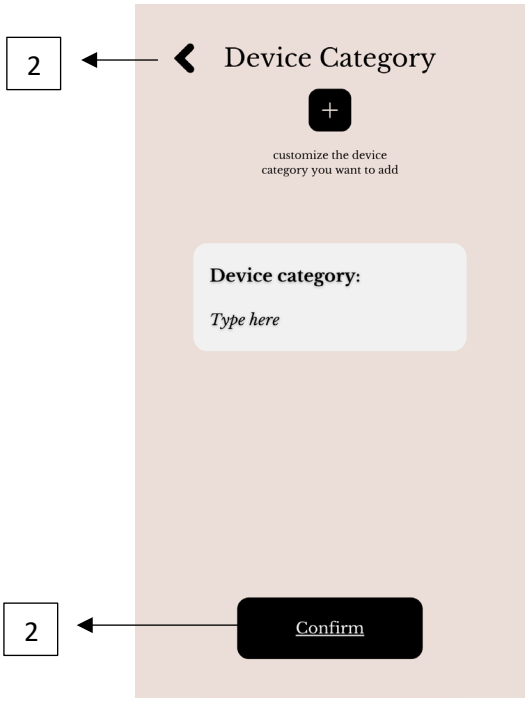
19


2
Add device
scan QR code
21
Confirm

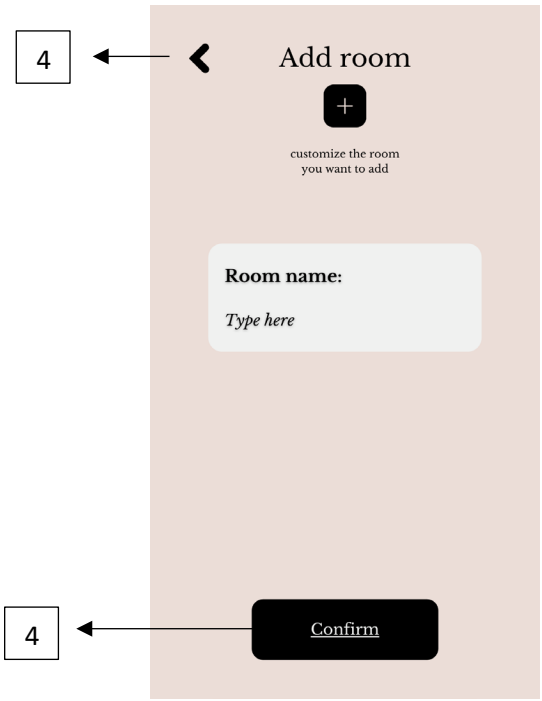
20


20
Add device
Device name:
Type here
Device category:
Choose here
Room:
Choose here
2
Confirm

21


2
Device Category
customize the device
category you want to add
Device category:
Type here
2
Confirm

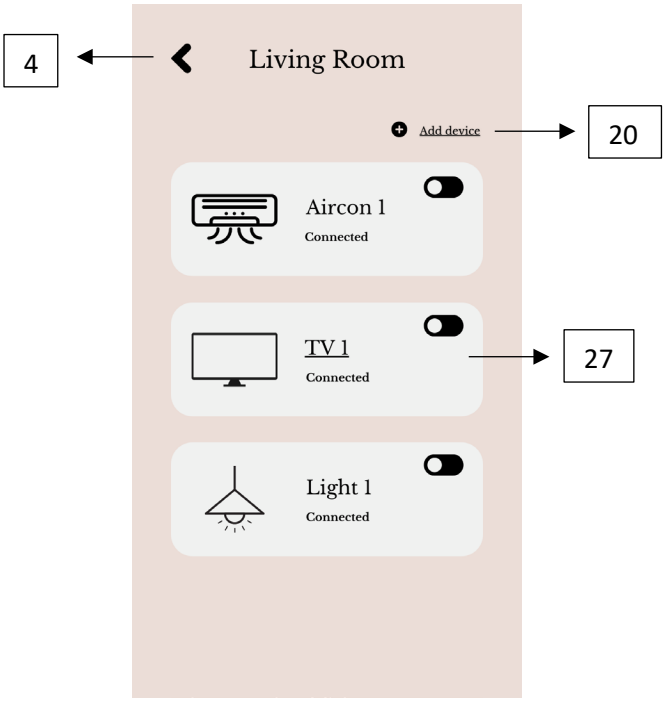
22


4
Add room
customize the room
you want to add
Room name:
Type here
4
Confirm

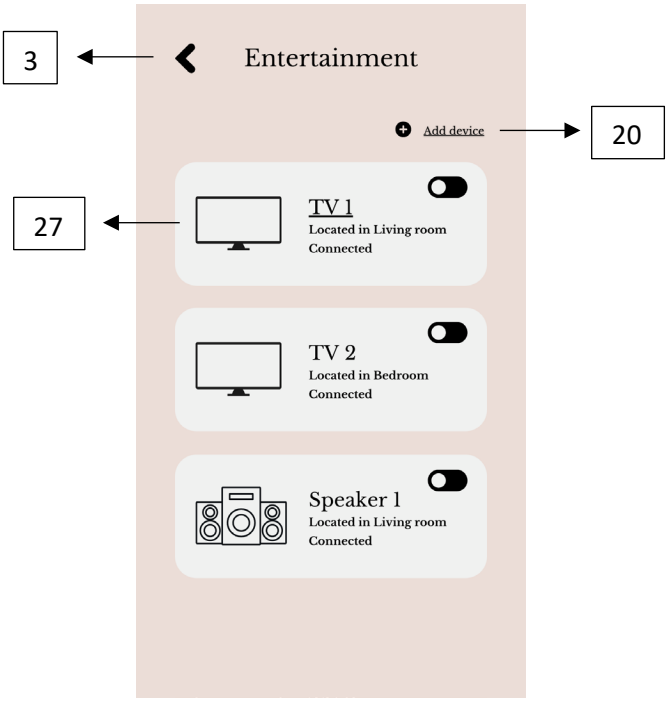
23


6
User profile
upload picture from your device
Username: Type here
First name: Type here
Last name: Type here
E-mail: Type here
Phone number: Type here
Country: Choose here
Gender: Choose here
Birthday: XXXX/XX/XX
6
Confirm

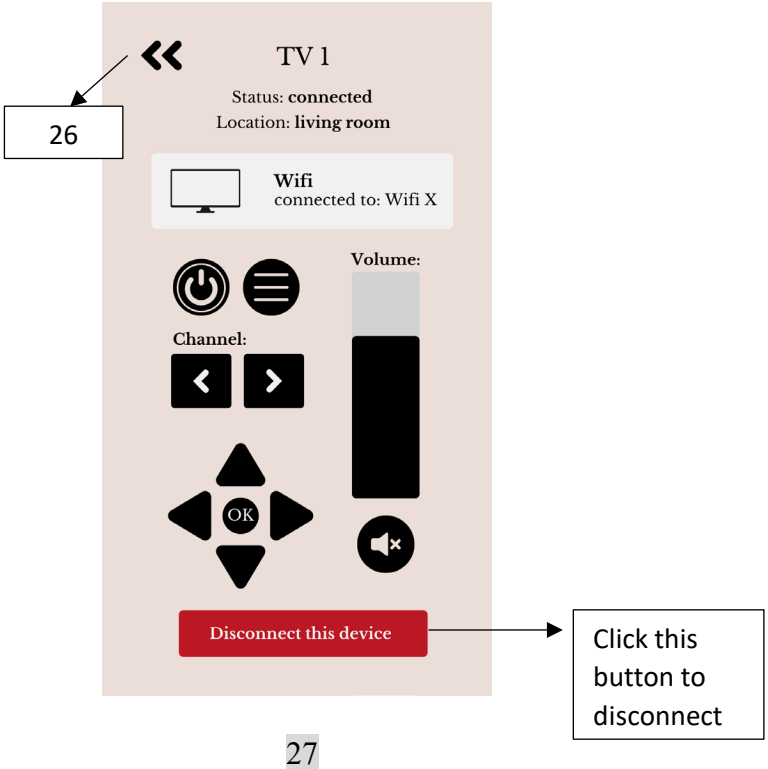
24


4
Living Room
Add device
20
Aircon 1
Connected
TV 1
Connected
27
Light 1
Connected

25


3
Entertainment
Add device
20
27
TV 1
Located in Living room
Connected
TV 2
Located in Bedroom
Connected
Speaker 1
Located in Living room
Connected

26


26
TV 1
Status: connected
Location: living room
Wifi
connected to: Wifi X
Volume:
Channel:
OK
Disconnect this device
Click this button to disconnect

27

9.0 REFLECTIONS

9.1 CHIA JEE LIANG

Throughout this project, I have learnt how to build a Cloud Architecture and Low Fidelity Prototype and from the beginning. My motivation to complete this project is because I found that it was interesting to build a prototype to communicate with the users. As a user, I always complaining about an app that is not user friendly. Therefore, when I was creating the prototype, I will stand at the user view to make sure that our interface is attractive and user friendly.

The biggest issue of this project is that we lack knowledge and experience about Cloud Architecture and Low Fidelity Prototype. To encounter this problem, my groupmates and I spent a lot of time on researching online resources about these topics. I also use AWS module as a reference because one of the chapters in AWS module is about Cloud Architecture. Besides, communication problems also occurred in our group. We couldn't understand the requirements of the project because there are many "new terms" that we never seen before such as Business Flow Diagram, Architecture Design and many more. To overcome this problem, our Group leader Jia Wen asked a lot of questions to our lecturer Dr Naghmeh to make sure that we have no misunderstanding about the requirements of the project. Dr Naghmeh also patiently explained about everything we had asked.

After completing this project, I feel more interesting about this industry and the knowledge behind it. My aim is to build a High-Fidelity Prototype in the future because it has more realistic user interactions (keyboard and mouse).

For me, I will try to improve my potential in this industry by improving my programming skills. I will also try to learn different programming language because each language has its own advantages. By learning different programming language, I am able to fulfil the requirement in each situation in the industry. To achieve this, I always try to find online resources such as YouTube and Stack Overflow to learn extra knowledge and skills.

9.2 HUAM JUN XIANG

I learned knowledge of Cloud Architecture and Low Fidelity Prototype from this project. My motivation to complete this project is my curiosity toward prototype. I wonder what the function of prototype is when we start to develop something from zero and what's the importance about it.

For me, the issue when making this project is the lack of knowledges for this project. There are a lot of new terms and concepts that I never heard before. It is a challenge for me to take a huge effort to learn and remember the new terms and concepts such as prototyping, cloud computing, business process flow diagrams and AWS architecture. I try to find the information online to slightly cover the unfamiliar knowledges. I also try to reach out my other team members to get help from them. It is a good method as my team members really helped me a lot by teaching me the ways to complete this project.

My next direction after completing this project is I will try to develop my own prototype as this project provides me a lot of experiences and knowledges.

I will continue explore new things in this industry as there are still many new invention and technology in this industry. I will follow new news from this industry to expand my vision. I will also improve my programming skills by focus in programming class and try to practice it in leisure time.

9.3 KRISTY YAP JING WEI

Through this project, I had learned about how to complete a Low Fidelity Prototype by using Cloud Architecture. My motivation to complete this project is because I want to be responsible for all the tasks that have been assigned to me. Besides, I am also wondering about the challenges that may meet when producing the prototype and its report. I want to learn more about the knowledge and gain more experience in doing the project.

There were some issues during the process of doing this project. For me, the main issue is that I was unfamiliar with these topics such as cloud computing architecture, low fidelity prototype, business process flow diagram and so on. However, I put a lot of effort into doing research from different sources and asking members or friends, especially my group leader who had helped me a lot to solve my uncertainties and confusion. Other than that, the second issue that I had met in this project is time organization. Since it is a group project, I had to cooperate with other members but the hard is to gather all of us at one time as we are from various places and have different timetables. Therefore, we were forced to initiate the tasks given through a Telegram's group chat which usually resulted in ineffective communication between us. To solve this problem, we had conducted many discussions in detail and each of us was active and responsive during the discussion.

After completing this project, I learned to create a cloud computing architecture for the 4th IR Technology that we chose which is the IoT Smart Home although there is still a lot of room for progress in the low fidelity prototype that we had produced. Through this experience, prototyping had surprised me with its interesting knowledge which I had never expected before. In future, I will grab more chances to take part in these similar activities to enhance my knowledge so that I can find a job related to it after graduation.

There are some improvements necessary to improve my potential in the industry. First, I will always be alert to every single piece of knowledge that had passed on from my lecturer, Dr Naghmeh. Besides, I will try my best to enhance and strengthen my academic skills of technology and information system and also programming technique by having extra learning time with some tutorial videos online. In addition, I will take chances to develop my personal and work skills. For example, thinking skills, adaptability skills and others. I want to be more potential so that I can develop my career in this industry in future.

9.4 WAI JIA WEN

I learned how to create a low fidelity prototype and solve real-life problems by applying the knowledge gained from AWS cloud computing. My motivation to complete this project is the responsibility of being the group leader. In addition, I am curious about how to create an application on our own.

There were many issues at first as I was not familiar with cloud computing, prototyping, AWS architecture, and creating business process flow diagrams. All the members and friends of the same courses were also not clear about the requirements of this project. Therefore, I did a lot of research by referring to different research papers from websites, asking Dr Naghmeh questions and revising the notes of AWS Academy. Besides, another issue is the difficulty in carrying out discussions with teammates. Because of the pandemics, we had to study at home and did the group discussions virtually. Because we discussed our project through messaging, there may be some misunderstanding of tones and attitudes. Thus, we have to be more understanding, responsive and active to perform better teamwork.

After completing this project, I knew how to create a cloud architecture for Smart Home systems. I only had the general idea of creating a back end system but not in perfect form. Because I realized that prototyping is fun, I might find a job related to prototyping in the future.

To improve my potential in the industry, I will watch YouTube tutorial videos to strengthen my programming technique during my free time. I want to learn more programming languages to code many programs using different languages for different applications. Besides, I will develop my leadership skills further by being a better leader. I want to become more tolerant of my teammates and confident enough to lead other people. In addition, I plan to attend more talks related to IT to improve my knowledge in IT fields.

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