

Delivery 3 for SOEN 6481

SmartHome+ Project

Software Requirements

Specification

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Table of content

1. <u>Use Case Model</u>	3
2. <u>Supplementary Specification</u>	84
3. <u>Glossary</u>	99

SmartHome+ Use Case Model

Version <2.1>

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Revision History

Date	Rev.	Description	Author(s)
2020-08-01	1.0	Finish All Sections	Samuel Vineeth, Ravi Kadiwala, Tian Wang, Wenhui Guo, Tianlin Yang
2020-08-05	2.0	Added use cases, verification, actor goal list relatively.	All
2020-08-06	2.1	Fixed bugs, added additional diagrams.	All

Table of Content

Revision History	4
1. Actor-Goal List	9
2. Use Case Model	11
2.1 UML Use Case Diagram	11
2.2 UML Sequence Diagram	18
2.2.1 UC02 Sequence Diagram	18
2.2.2 UC03 Sequence Diagram	19
2.2.3 UC04 Sequence Diagram	20
2.2.4 UC05 Sequence Diagram	21
2.2.5 UC08 Sequence Diagram	22
2.2.6 UC09 Sequence Diagram	23
2.2.7 UC11 Sequence Diagram	24
2.2.8 UC13 Sequence Diagram	25
2.3 UML Activity Diagram	26
2.3.1 UC02 Activity diagram	26
2.3.2 UC03 Activity diagram	27
2.3.3 UC04 Activity diagram	28
2.3.4 UC05 Activity diagram	29
2.3.5 UC08 Activity diagram	30
2.3.6 UC09 Activity Diagram	31
2.3.7 UC11 Activity diagram	32
2.3.8 UC13 Activity diagram	33
2.4 UML State Machine Diagram	34
2.4.1 UC02 State Machine Diagram	34
2.4.2 UC03 State Machine Diagram	35
2.4.3 UC04 State Machine Diagram	36
2.4.4 UC05 State Machine Diagram	37
2.4.5 UC08 State Machine Diagram	38
2.4.6 UC09 State Machine Diagram	39
2.4.7 UC11 State Machine Diagram	40
2.4.8 UC13 State Machine Diagram	41
3. Package: Main	42
3.1 Availability	42
3.2 Security	48
3.3 Automation	54

3.4 Energy Efficiency	59
3.5 Environmental Considerations	65
3.6 Media and Entertainment	71
3.7 Brief Use Cases	77
4. Use Case Verification	79
Reference	85

1. Actor-Goal List

Based on the use cases from needs and features[1] of SmartHome+ platform, the Actor-Goal list could be derived as:

Actor	Goal	Use case
Primary actor: End-users	Users want SmartHome+ platform to meet 6 categories requirements and work properly, stable.	<ul style="list-style-type: none"> • Interacting with the platform to play music • Access monitors of house • Verify gate access • Generate devices health report • Use resource optimally • Control home temperature • Control purity level • Watch Movie/Series/News • Communicate via social media updates • Play video game remotely • Protect home from theft • Smart Lighting • Open/Close Doors and Windows automatically • Update News • Update Daily Weather • Update Traffic • Use water optimally • Use electricity optimally • Find my device • Set Alarms and Reminder • Set Parental Control • Set Sleep Tracker
Primary actor: SmartHome+ platform	SmartHome+ platform aims to provide functions to meet user needs, keep the house safe and smooth running with all smart devices.	<ul style="list-style-type: none"> • Execute Emergency Protocols • Do System Backup and Recovery automatically • Control kitchen devices state • Monitoring House • Notify residents CO(Carbon Monoxide) over the limit

Supporting actor: Sensors	Sensors aim to provide real-time and reliable data of users and the surrounding environment required by SmartHome+ platform.	<ul style="list-style-type: none"> • Support SmartHome+ platform with data I/O
Supporting actor: Smartphone	Smartphone provides an environment for SmartHome+ platform client-side App, it serves as a hardware interface with multi-inputs: voice, gesture and touch.	<ul style="list-style-type: none"> • Support SmartHome+ platform serves as the client-side • Display notification • Handle user inputs
Supporting actor: Speaker	Speaker aims to serve as I/O devices, mainly target to playback notifications and stream music ratio and news. It can capture users' comments via the built-in mic.	<ul style="list-style-type: none"> • Support SmartHome+ platform as an output device • Play notification • Handle media-sound
Supporting actor: Internet service provider	ISP aims to provide a stable internet with suitable bandwidth.	<ul style="list-style-type: none"> • Support SmartHome+ platform as an internet provider
Supporting actor: Construction worker	Construction workers aim to provide reliable and suitable installation of all hardware being used.	<ul style="list-style-type: none"> • Support SmartHome+ platform hardware installation
Supporting actor: Play devices(TV, Projector, Gaming)	Play devices aim to give the user a graphical stream context, it can display notification and streaming contents for entertainment reasons.	<ul style="list-style-type: none"> • Support SmartHome+ platform graphical display
Supporting actor: Cloud disk	The cloud disk aims to provide services for data backup.	<ul style="list-style-type: none"> • Support SmartHome+ platform backup and recovery

2. Use Case Model

2.1 UML Use Case Diagram

Above all, the use cases could be concluded as 6 categories from the SmartHome+ descriptions. In the use case diagram sections, considering page limit, complexity, and the "not easy to read" structure, the "Total use case diagram" has been separated to 6 "UC sub-diagrams" according to the category.

1. Total use case diagram, brief show as total view.

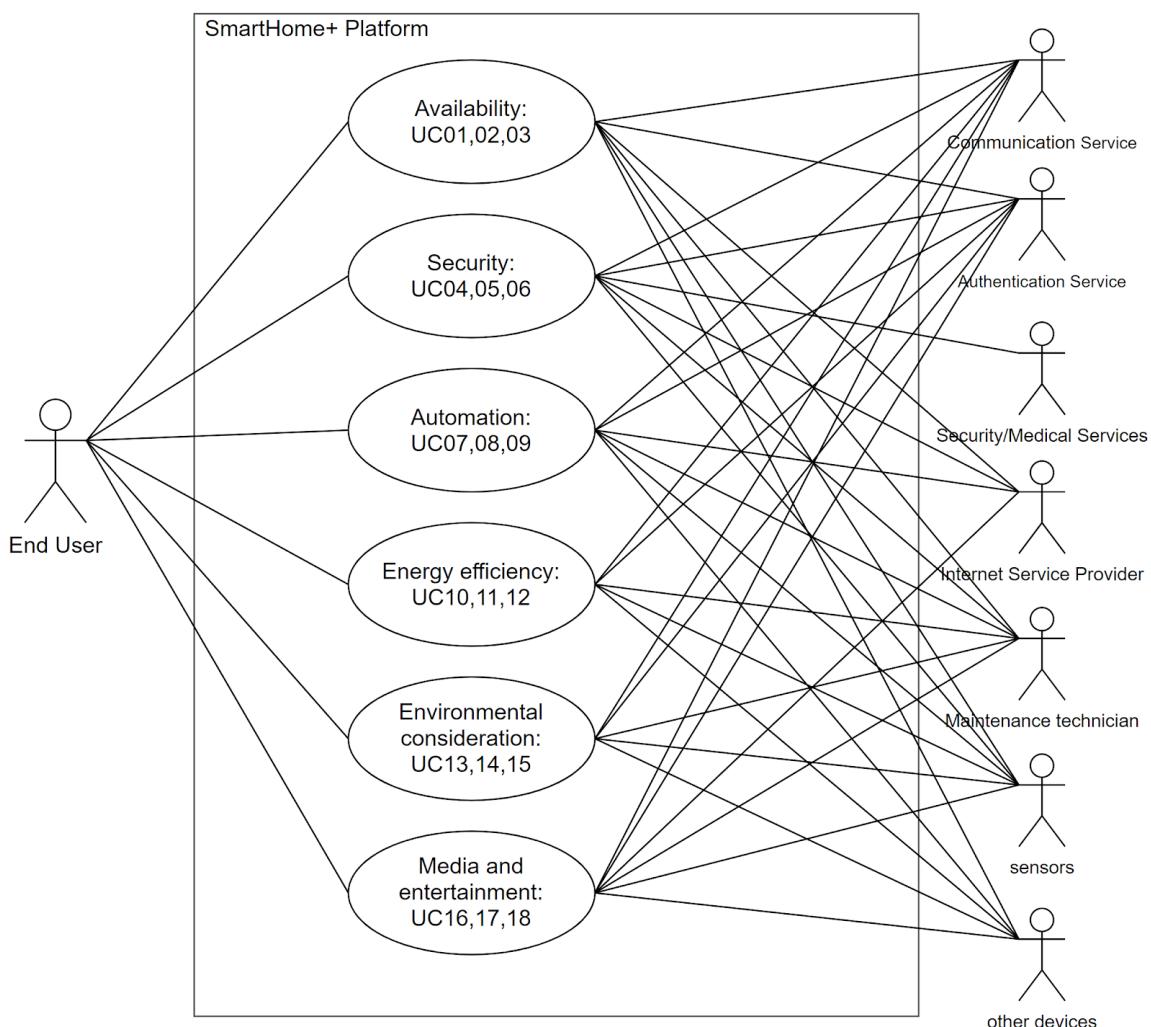


Figure.1 Total Use Case Diagram

2. Category 1: Availability. Includes UC01, UC02 and UC03.

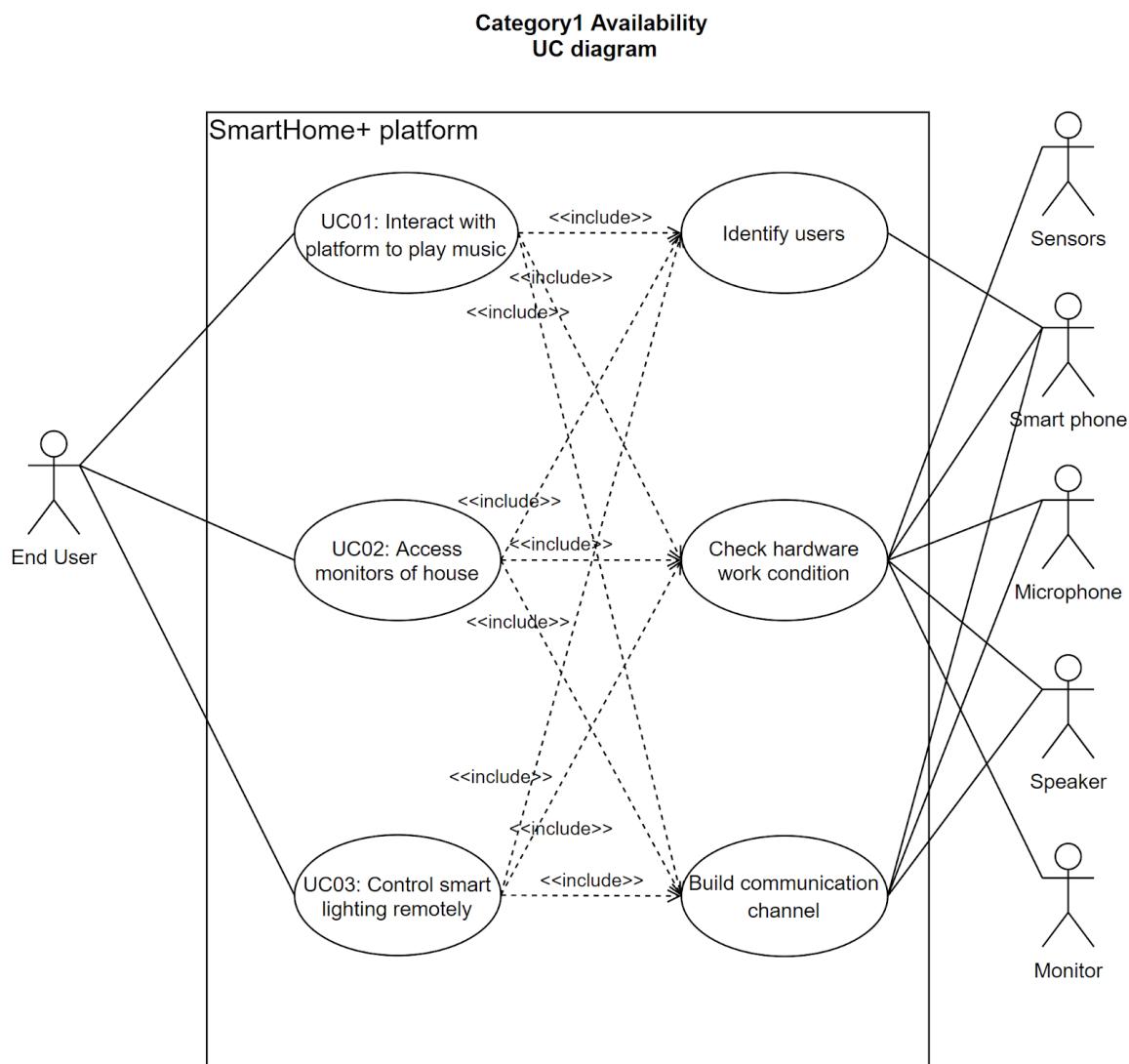


Figure.2 Availability Use Case Diagram

3. Category 2: Security. Includes UC04, UC05 and UC06.

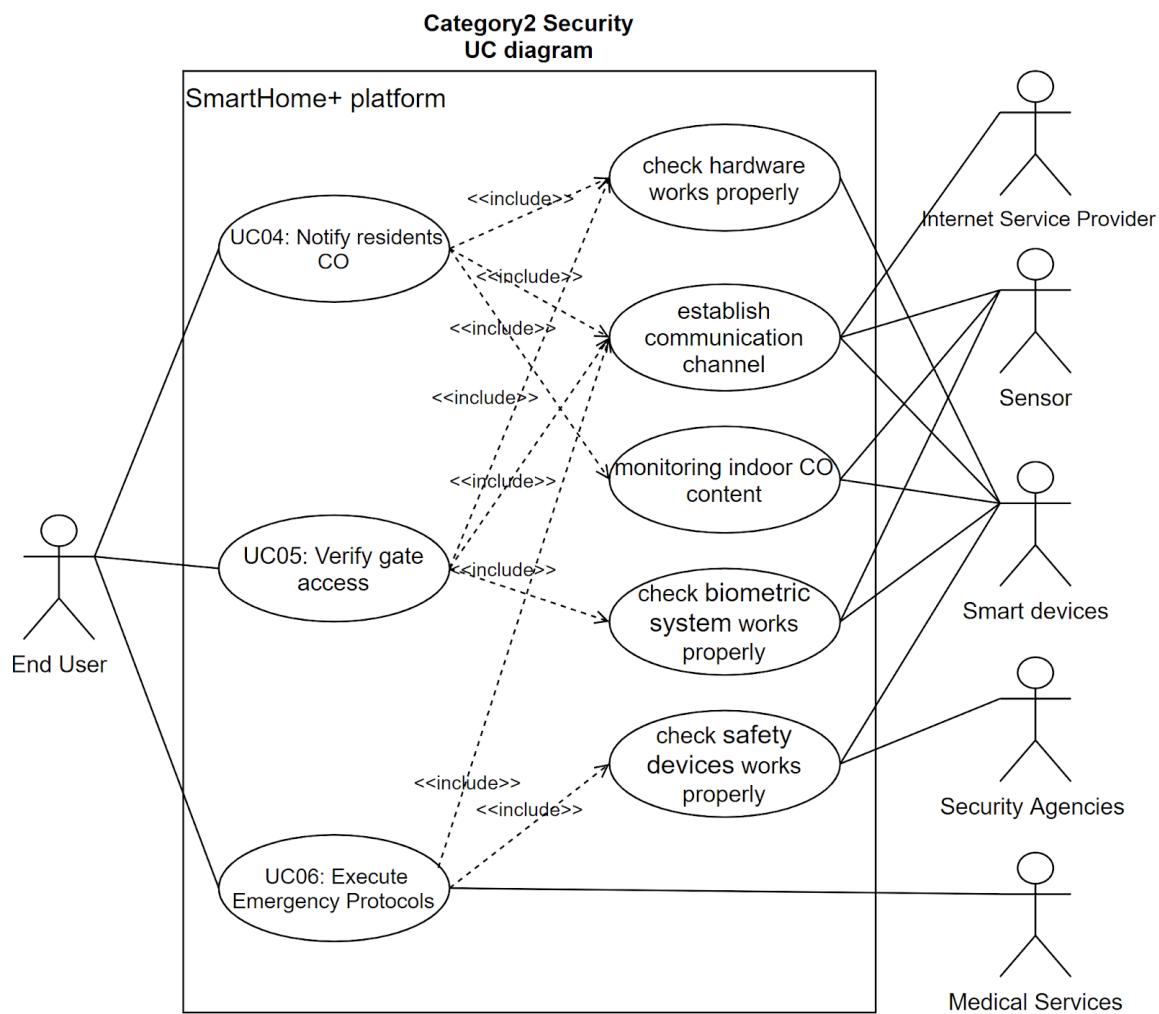


Figure.3 Security Use Case Diagram

4. Category 3: Automation. Includes UC07, UC08 and UC09.

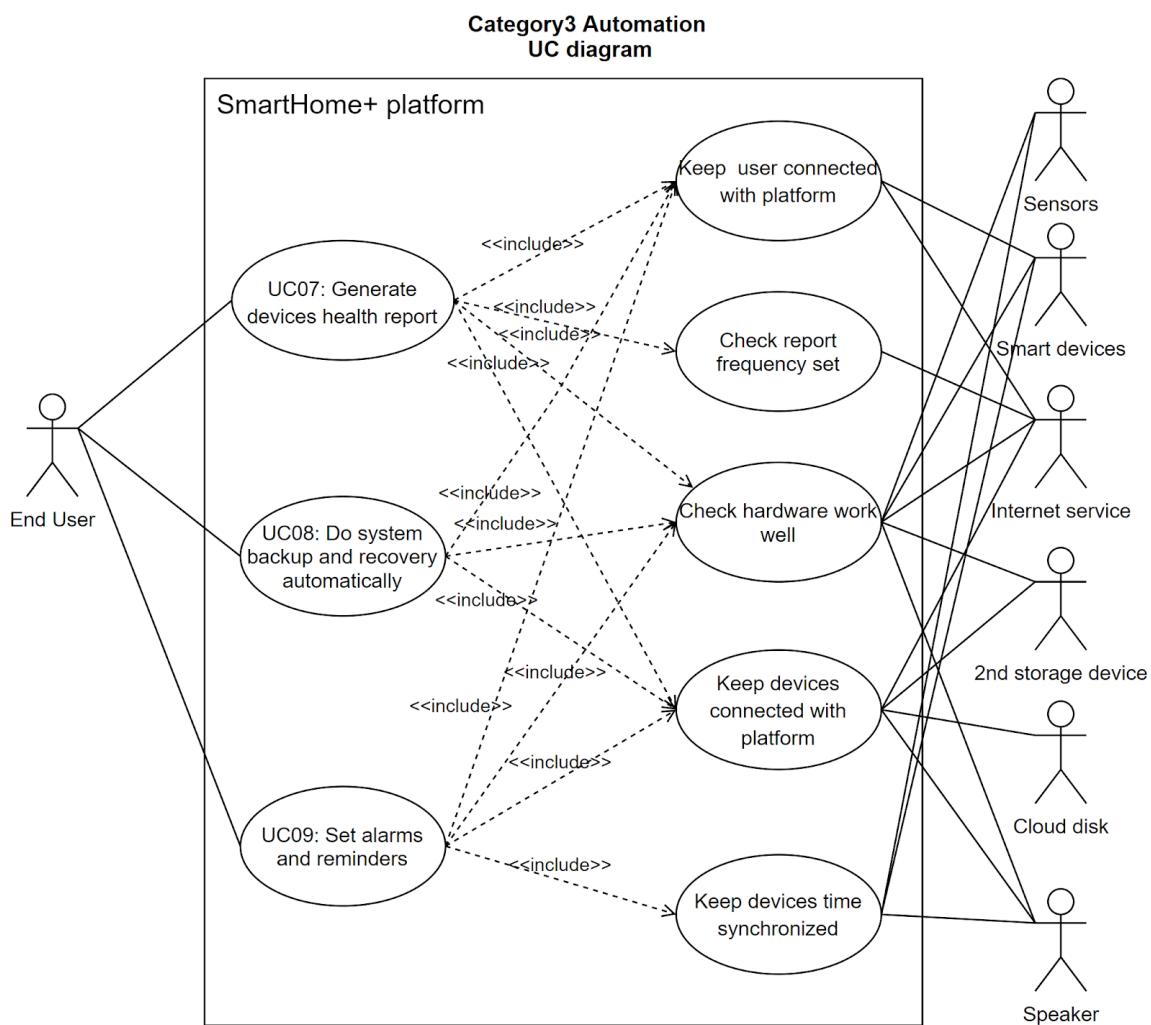


Figure.4 Automation Use Case Diagram

5. Category 4: Energy efficiency. Includes UC10, UC11 and UC12.

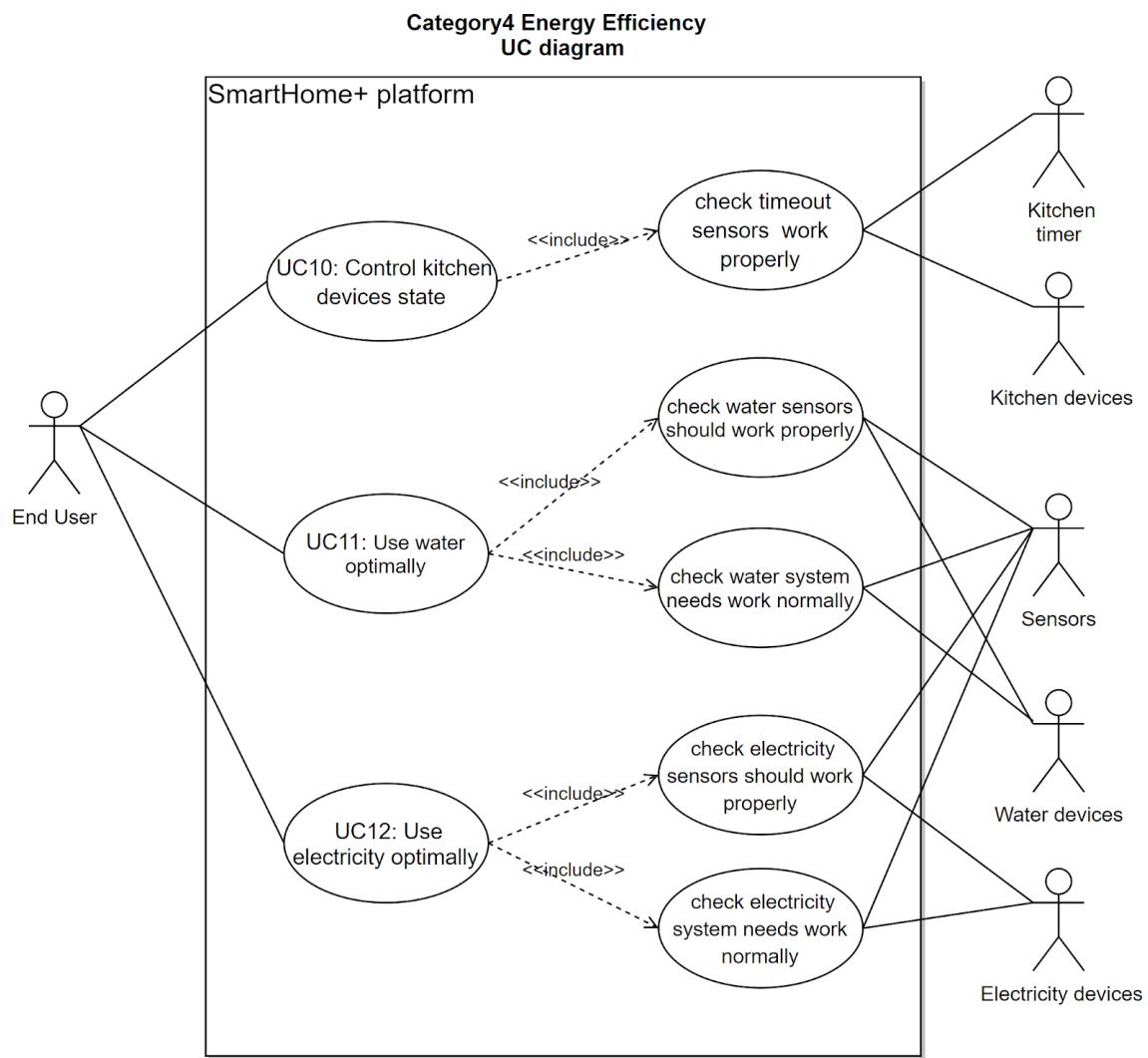


Figure.5 Energy Efficiency Use Case Diagram

6. Category 5: Environmental consideration. Includes UC13, UC14 and UC15.

Category5 Environmental consideration
UC diagram

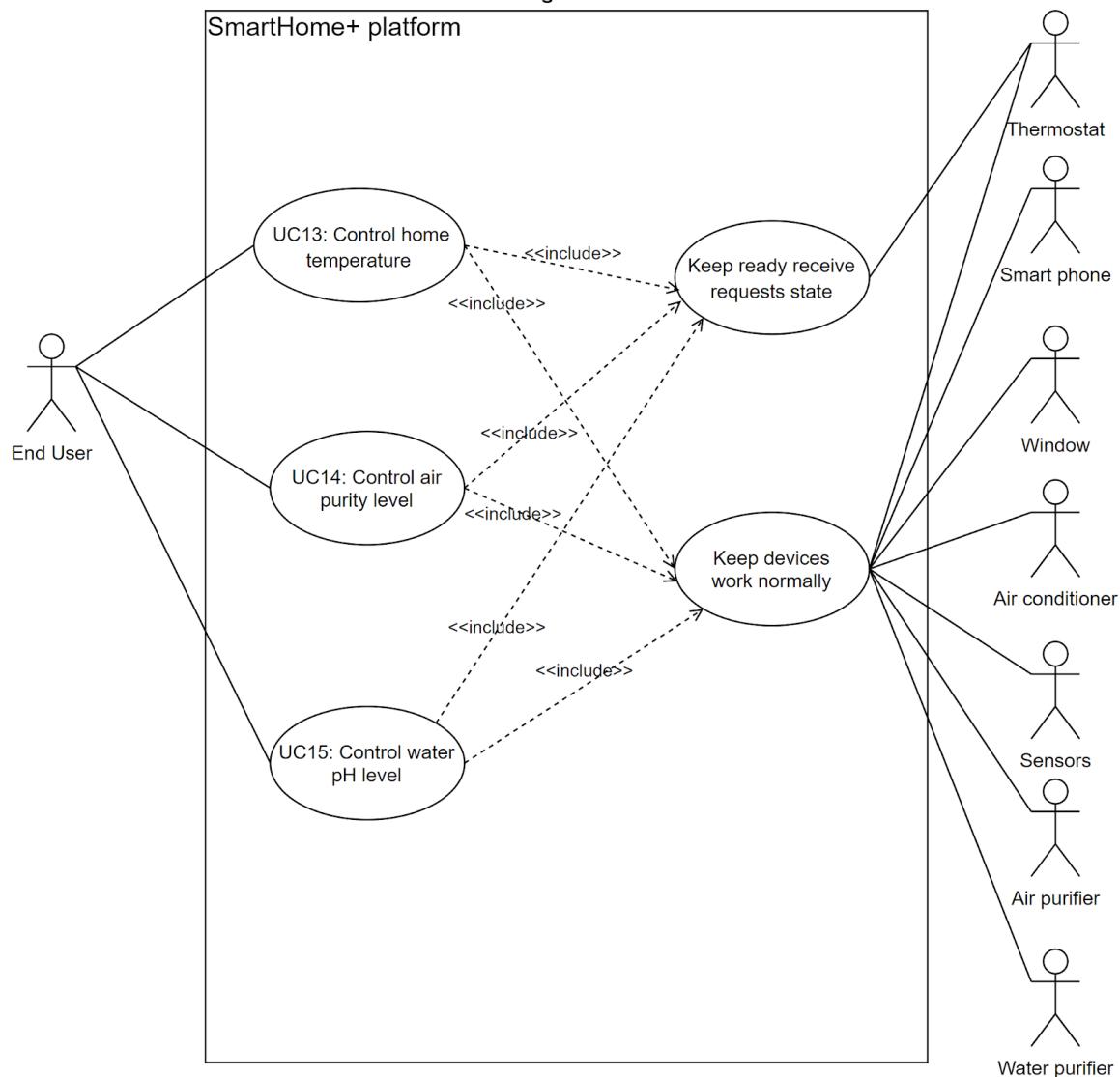


Figure.6 Environmental consideration Use Case Diagram

7. Category 6: Media and entertainment. Includes UC16, UC17 and UC18.

Category6 Media and entertainment
UC diagram

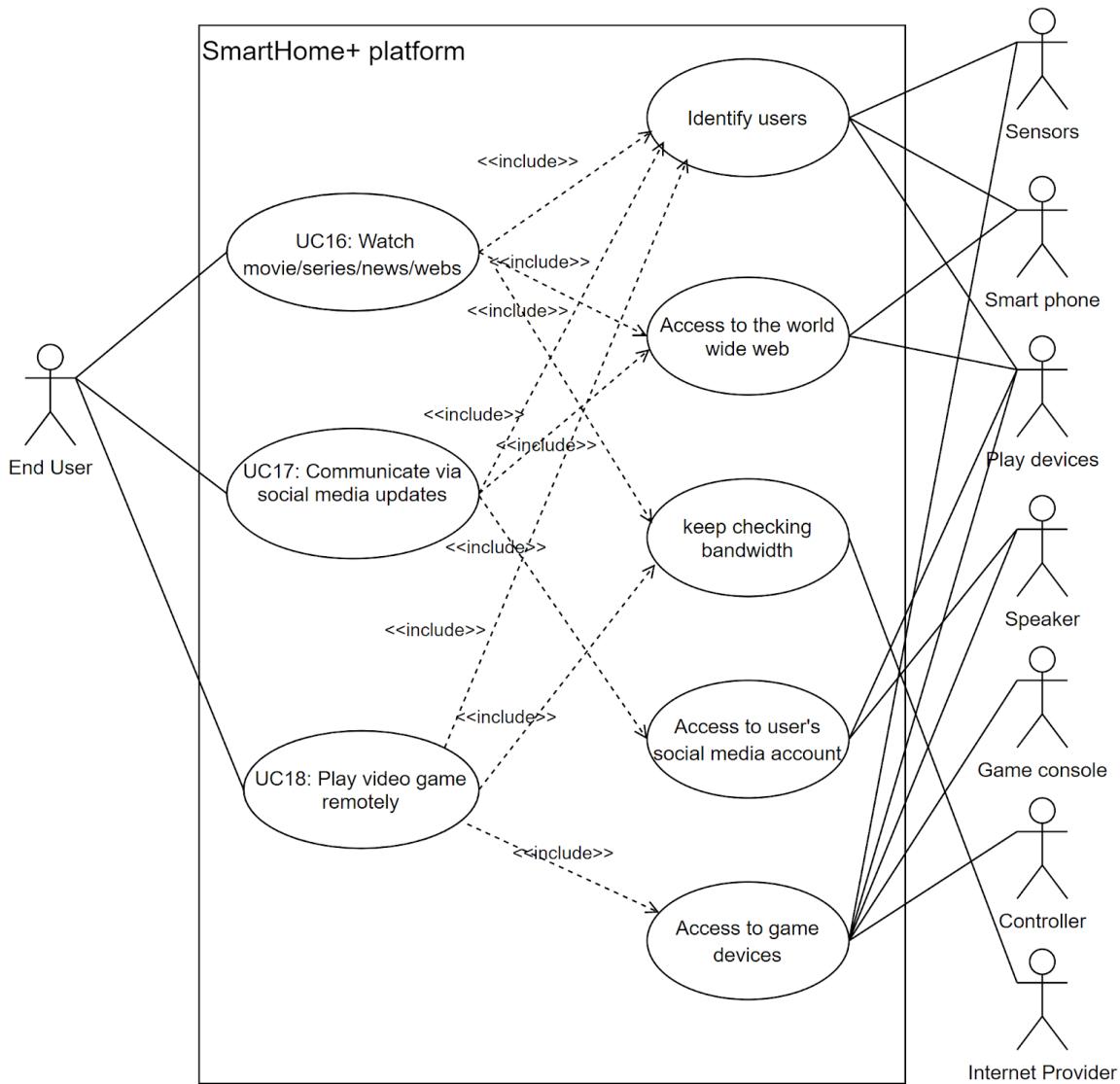


Figure.7 Media and Entertainment Use Case Diagram

2.2 UML Sequence Diagram

Based on sequence diagram definition[3], originally the UC02 has been selected to build “1.0 version” diagrams, in order to meet minimum requirements. After that, for “2.1 version” it extends the diagrams by adding 7 additional use cases. Therefore, a total 8 important use cases will be selected to build a relative sequence diagram. They serve as a representative for rest of use cases.

2.2.1 UC02 Sequence Diagram

For the sequence diagram, the UC02 has been selected to draw the sequence diagram. For sequence diagrams, the main flow need be considered only based on lecture slides[4]. The UC02 diagram has been shown in Figure.8.

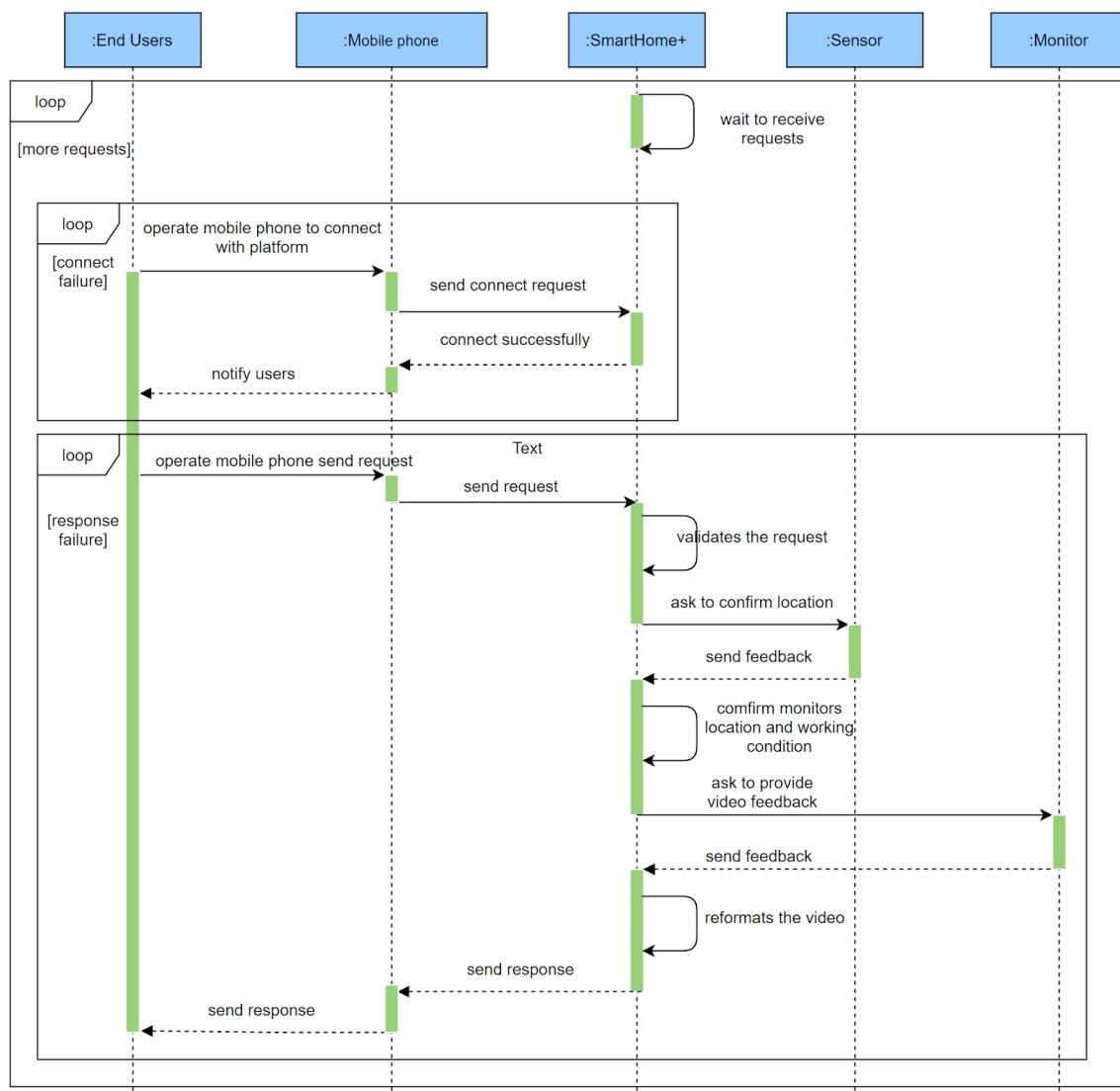


Figure.8 UC02 Sequence Diagram

2.2.2 UC03 Sequence Diagram

The UC03 has been selected to draw the 2nd sequence diagram. The UC03 diagram has been shown in Figure.9.

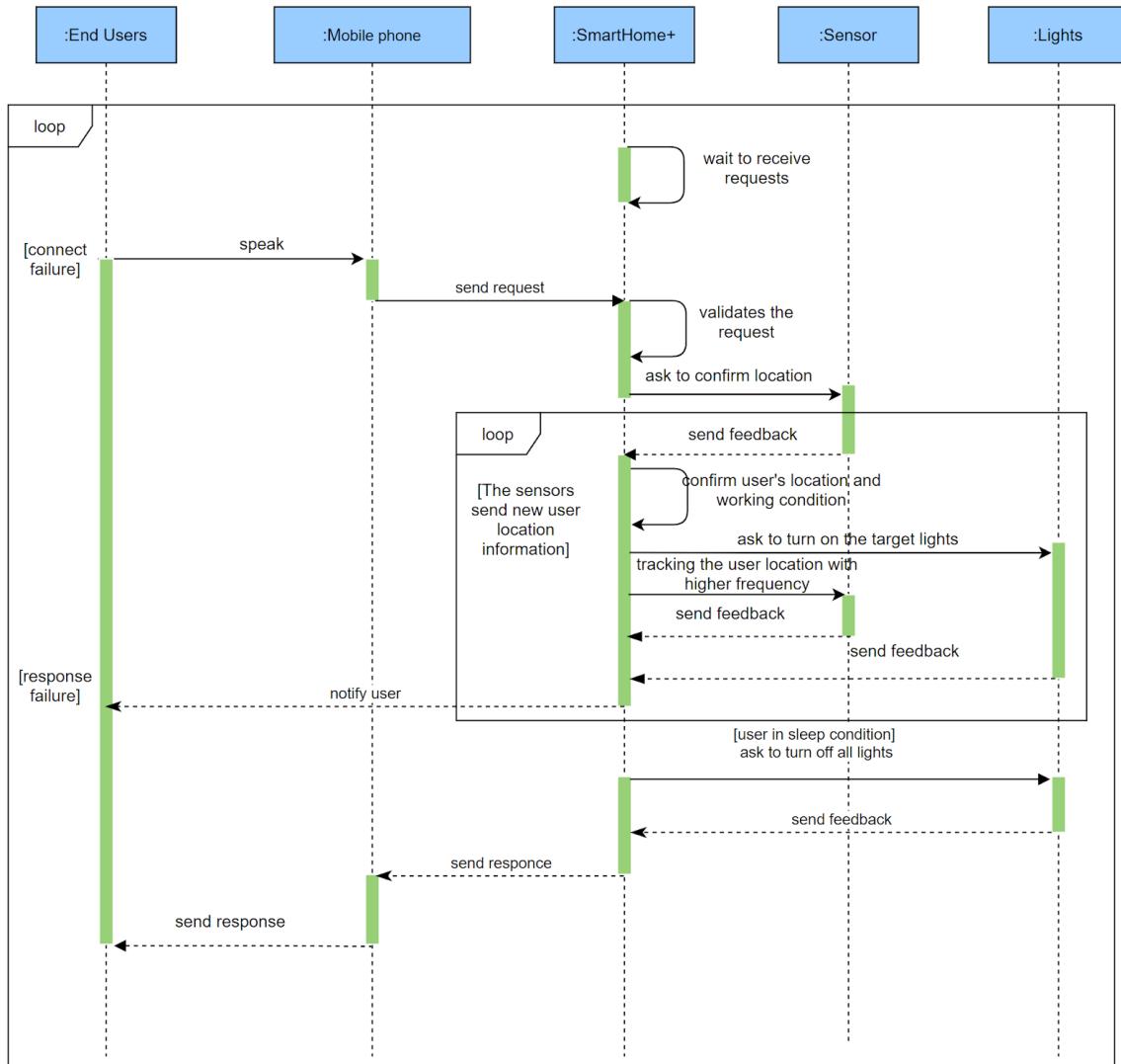


Figure.9 UC03 Sequence Diagram

2.2.3 UC04 Sequence Diagram

The UC04 has been selected to draw the 3rd sequence diagram. The UC04 diagram has been shown in Figure.10.

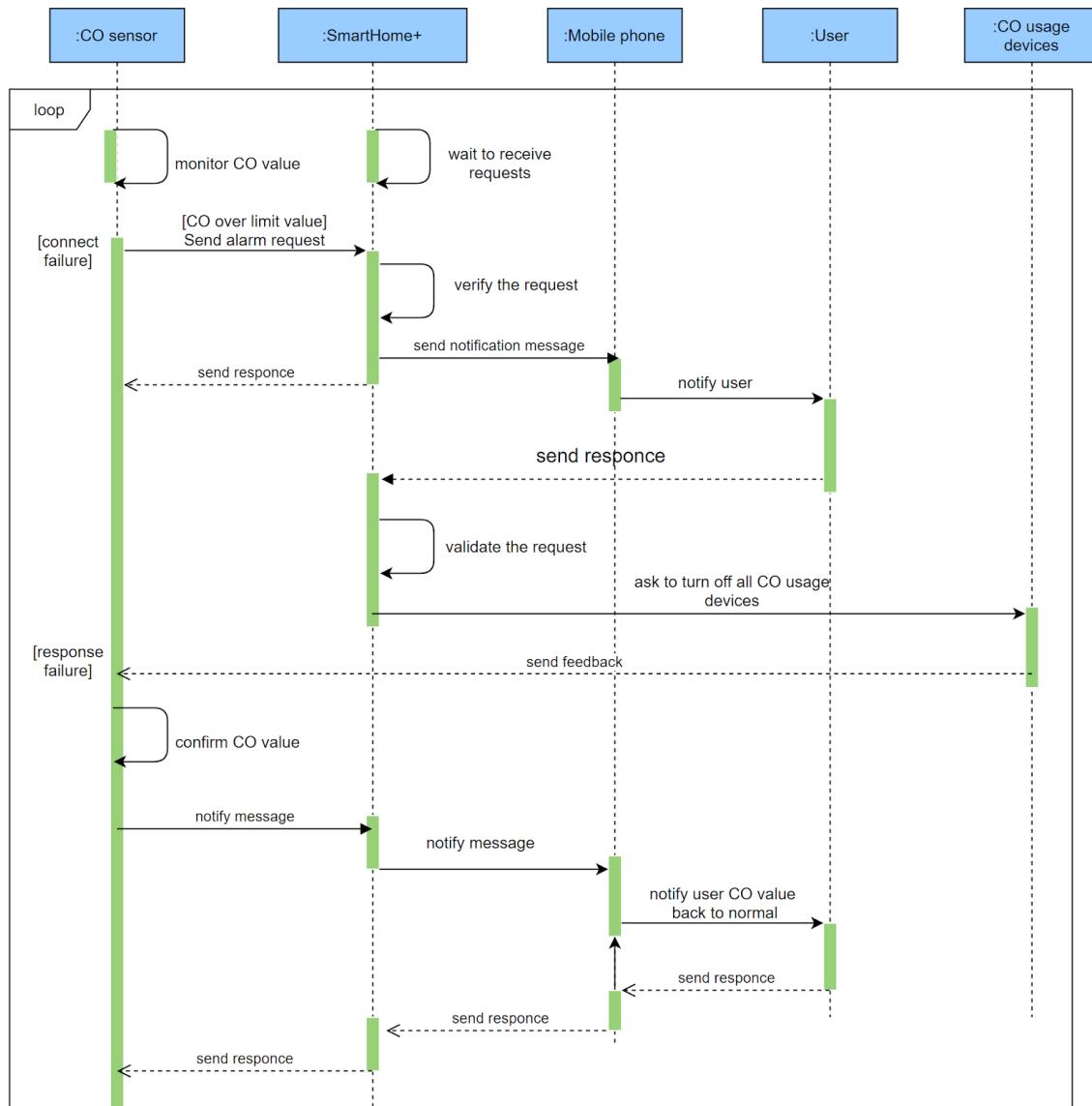


Figure.10 UC04 Sequence Diagram

2.2.4 UC05 Sequence Diagram

The UC05 has been selected to draw the 4th sequence diagram. The UC05 diagram has been shown in Figure.11.

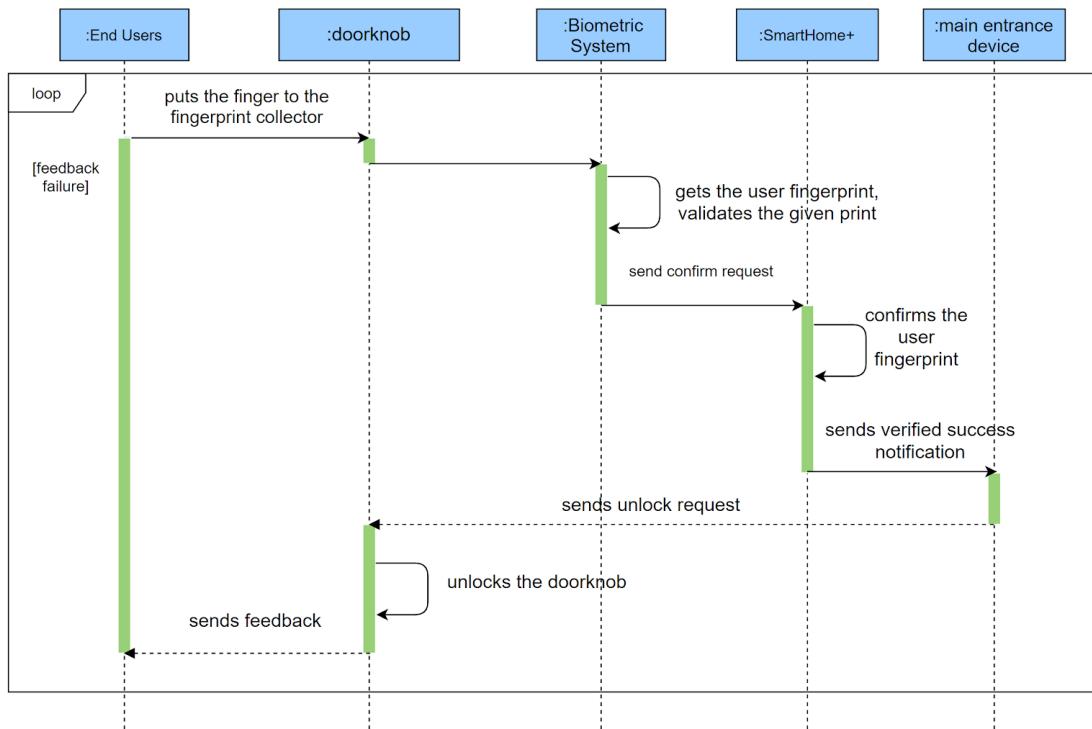


Figure.11 UC05 Sequence Diagram

2.2.5 UC08 Sequence Diagram

The UC08 has been selected to draw the 5th sequence diagram. The UC08 diagram has been shown in Figure.12.

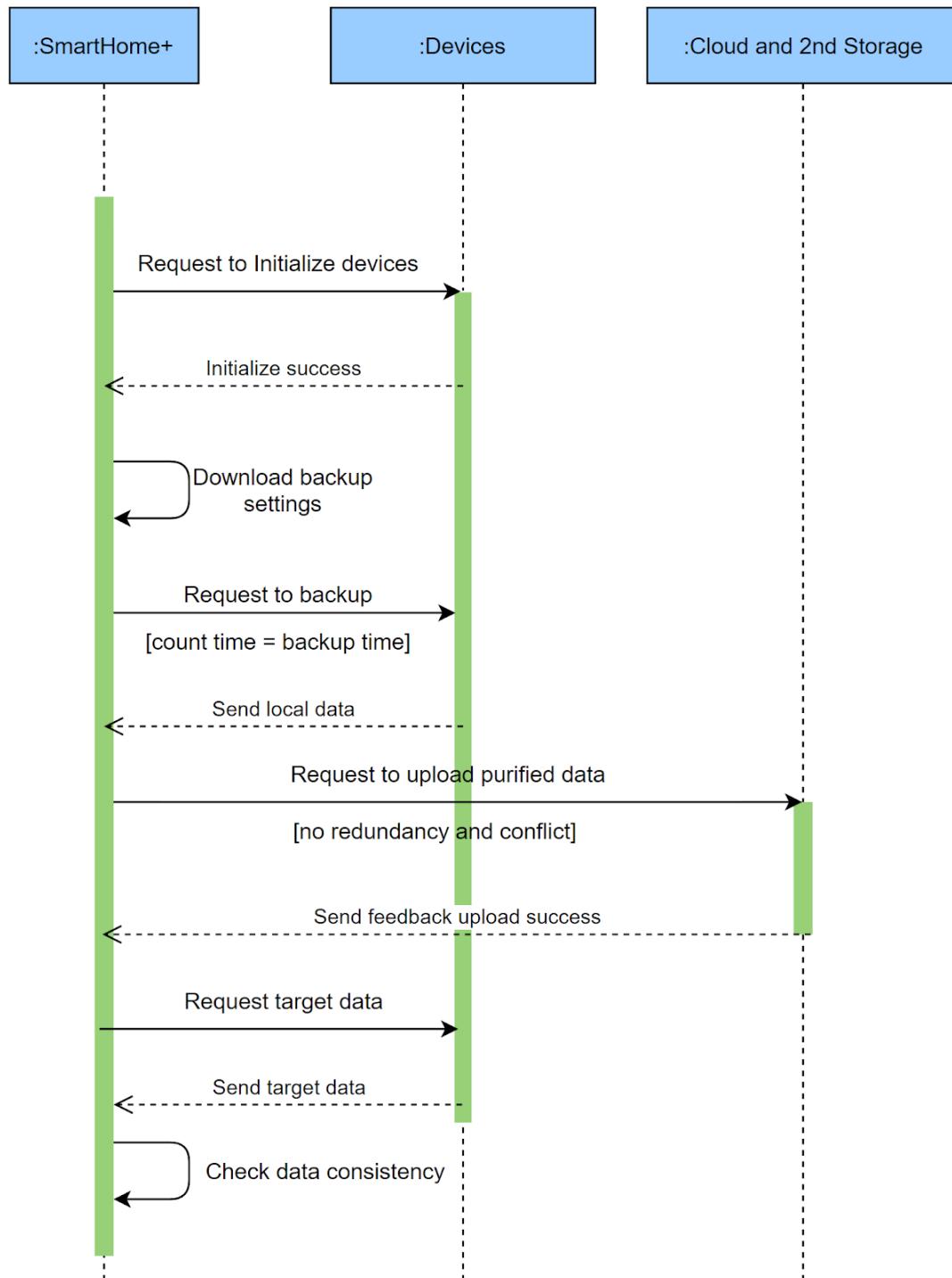


Figure.12 UC08 Sequence Diagram

2.2.6 UC09 Sequence Diagram

The UC09 has been selected to draw the 6th sequence diagram. The UC09 diagram has been shown in Figure.13.

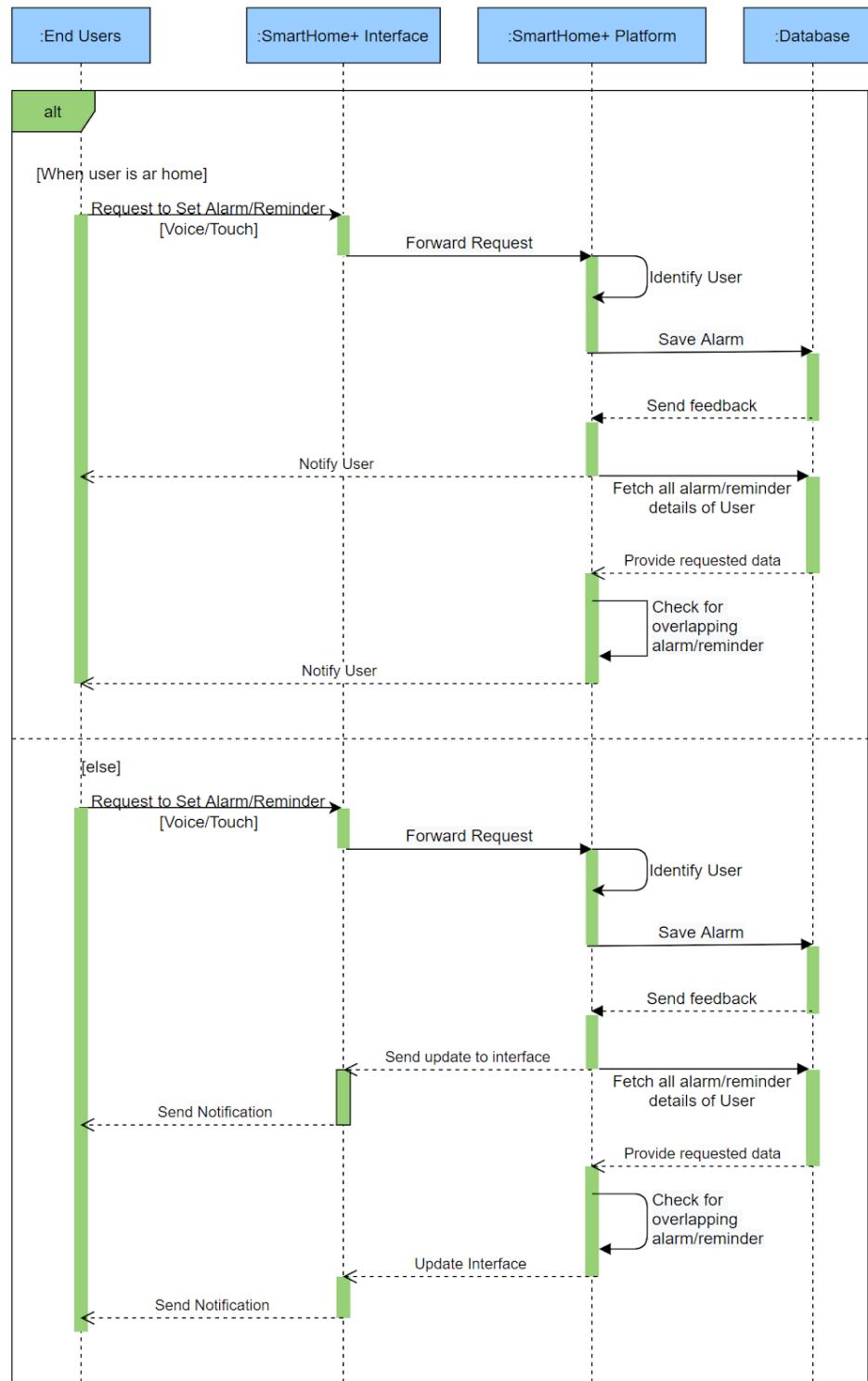


Figure.13 UC09 Sequence Diagram

2.2.7 UC11 Sequence Diagram

The UC11 has been selected to draw the 7th sequence diagram. The UC11 diagram has been shown in Figure.14.

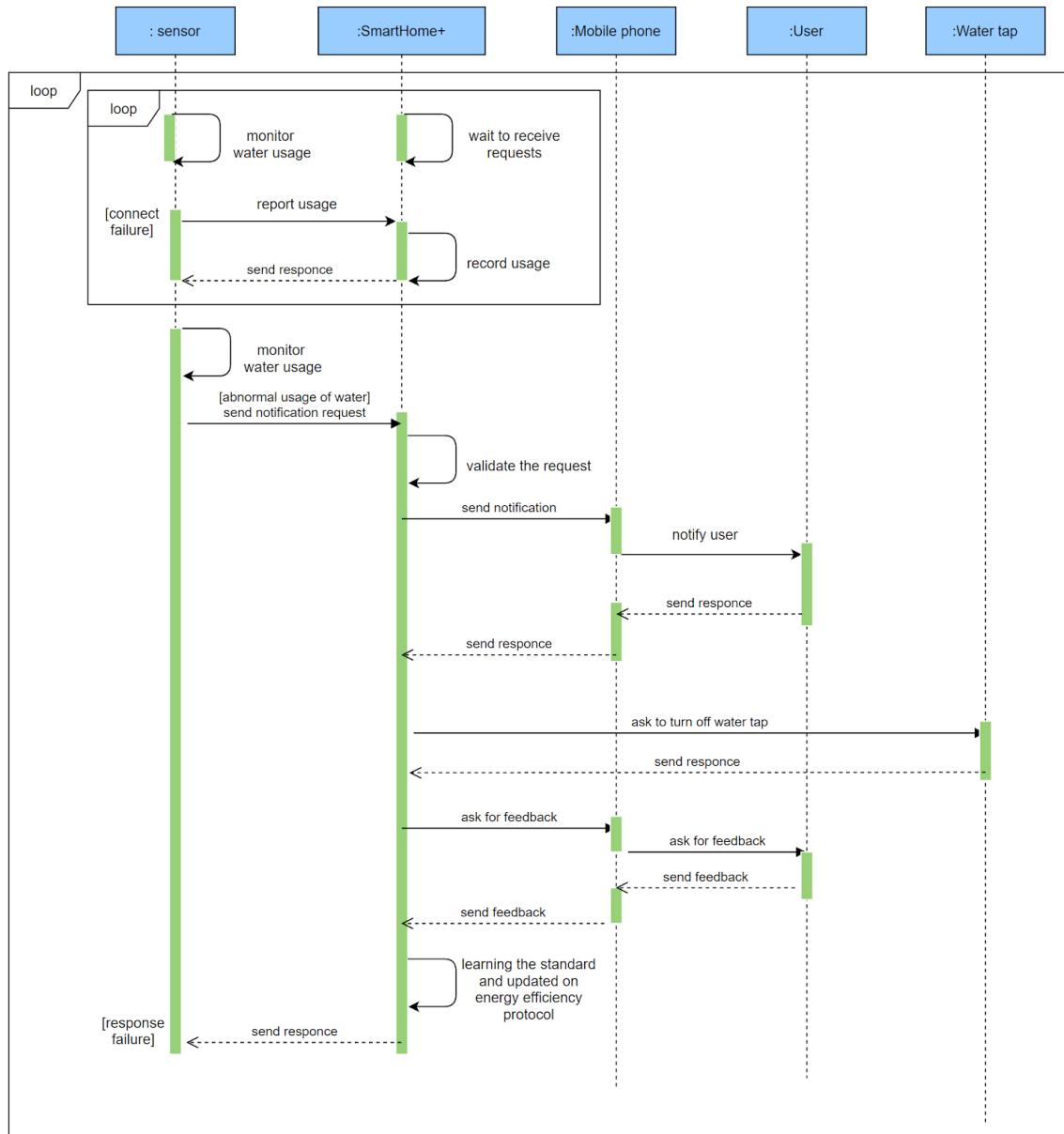


Figure.14 UC11 Sequence Diagram

2.2.8 UC13 Sequence Diagram

The UC13 has been selected to draw the sequence diagram. The UC13 diagram has been shown in Figure.15.

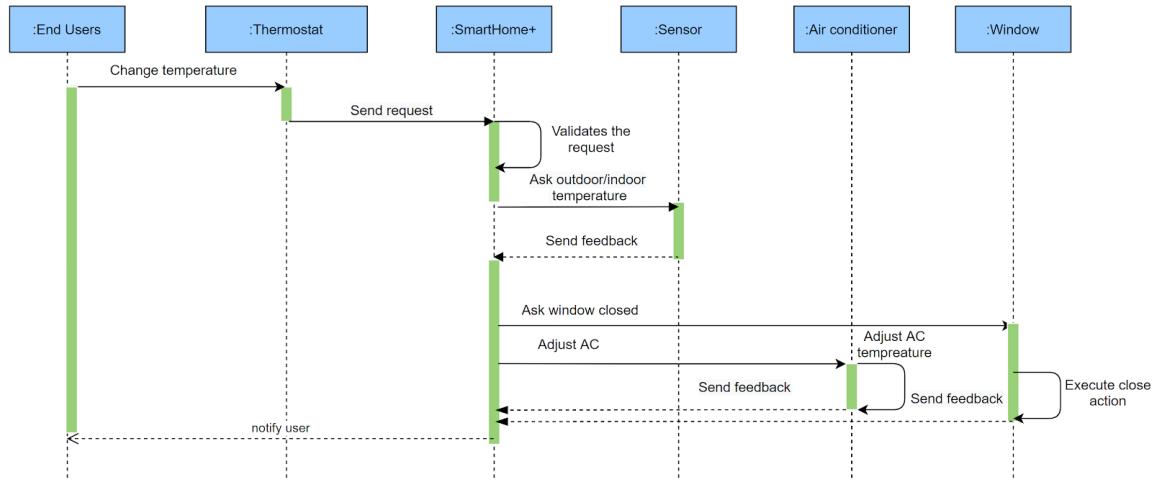


Figure.15 UC13 Sequence Diagram

2.3 UML Activity Diagram

2.3.1 UC02 Activity diagram

Based on the sequence diagram for UC02, the related activity diagram has been built.
The UC02 Activity diagram as shown below in Figure.16.

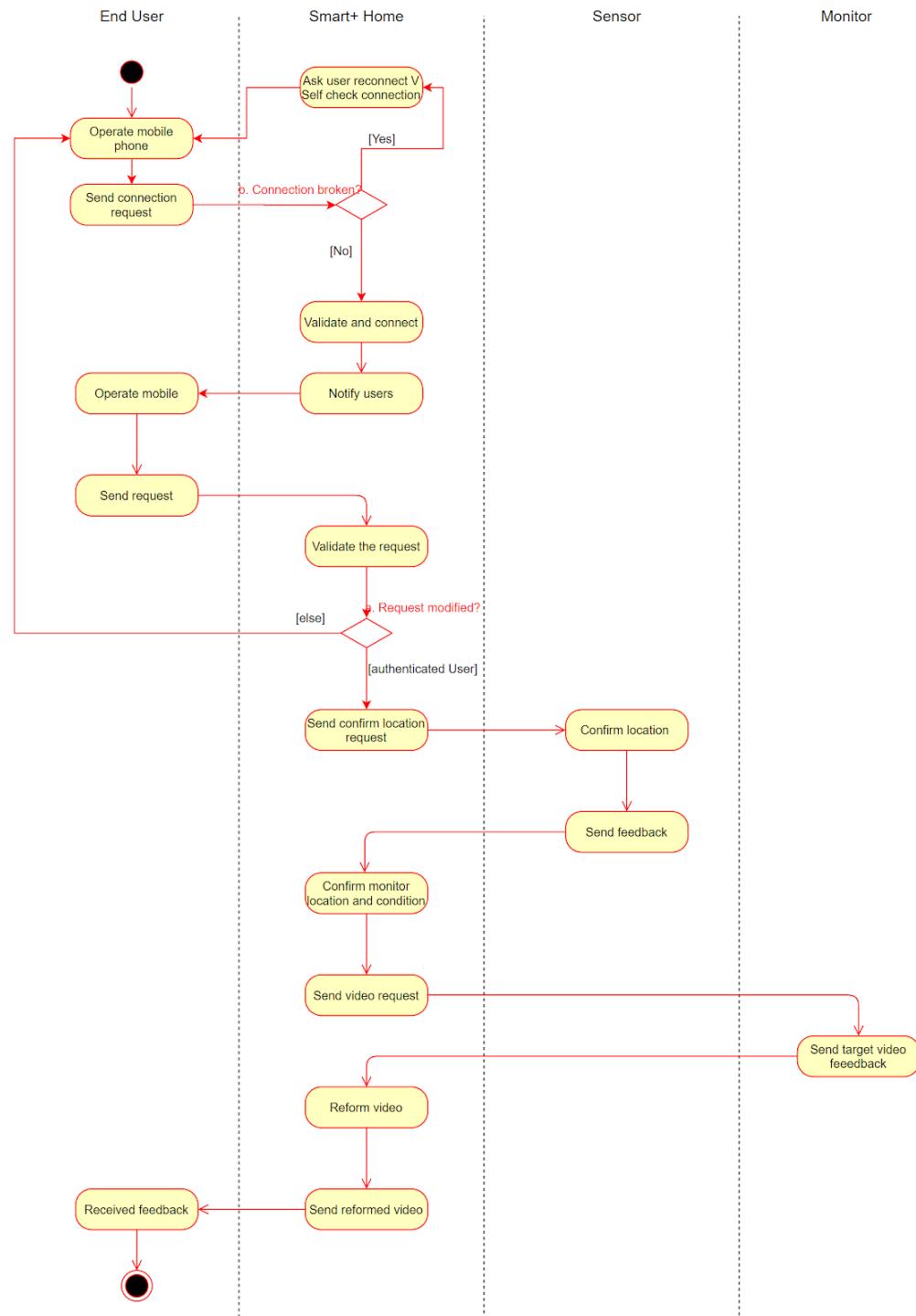


Figure.16 UC02 Activity Diagram

2.3.2 UC03 Activity diagram

Based on the sequence diagram for UC03, the related activity diagram has been built.
The UC03 Activity diagram as shown below in Figure.17.

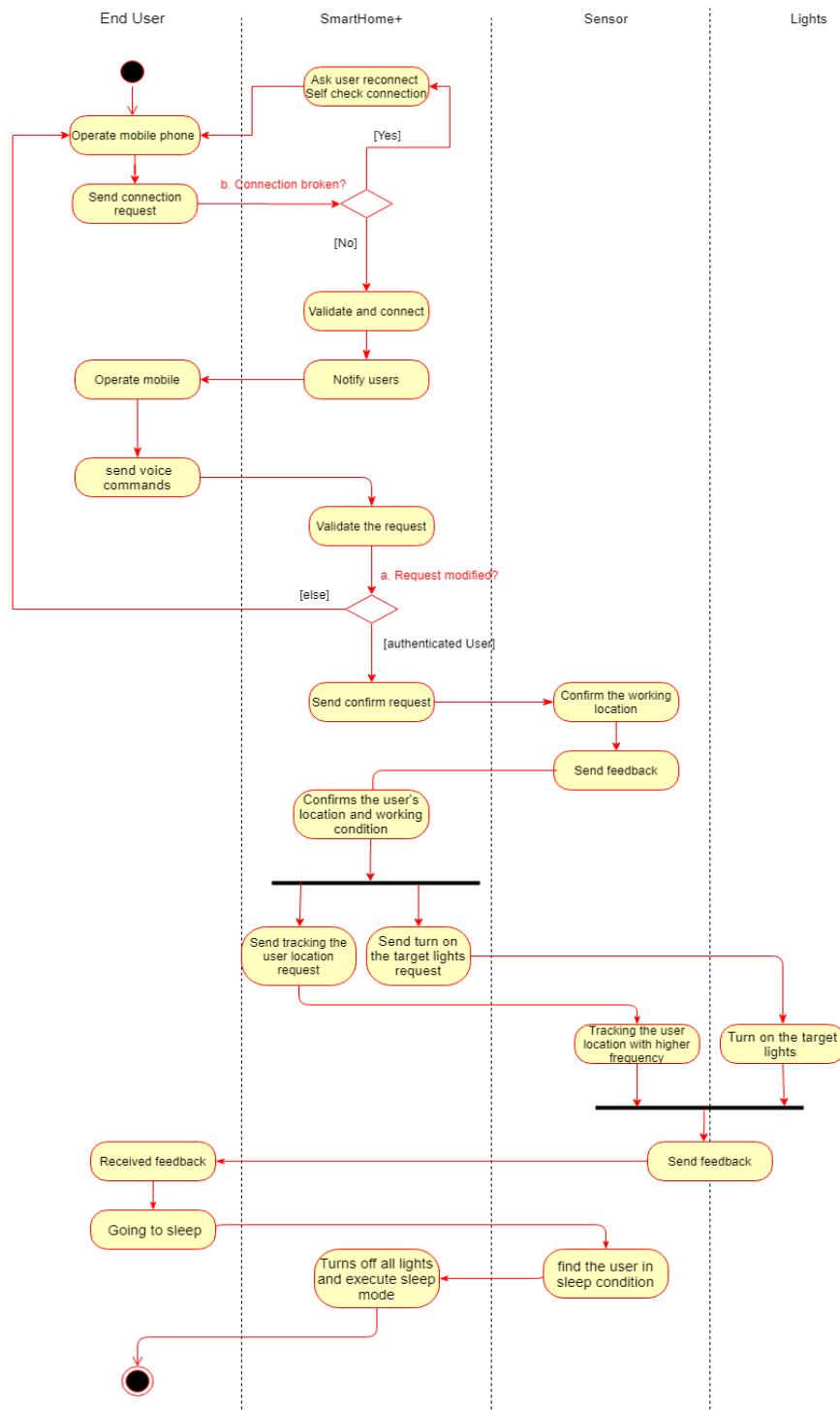


Figure.17 UC03 Activity Diagram

2.3.3 UC04 Activity diagram

Based on the sequence diagram for UC04, the related activity diagram has been built.
The UC04 Activity diagram as shown below in Figure.18.

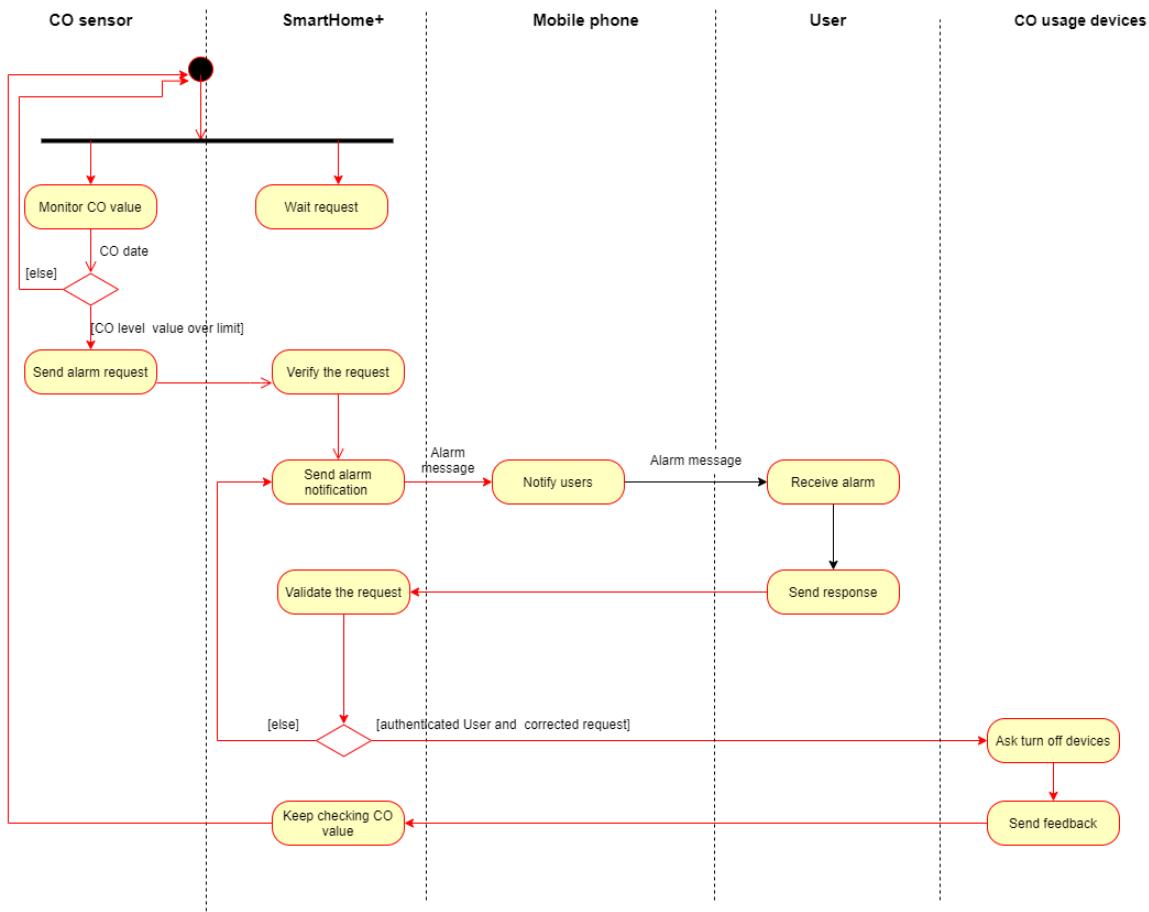


Figure.18 UC04 Activity Diagram

2.3.4 UC05 Activity diagram

Based on the sequence diagram for UC05, the related activity diagram has been built.
The UC05 Activity diagram as shown below in Figure.19.

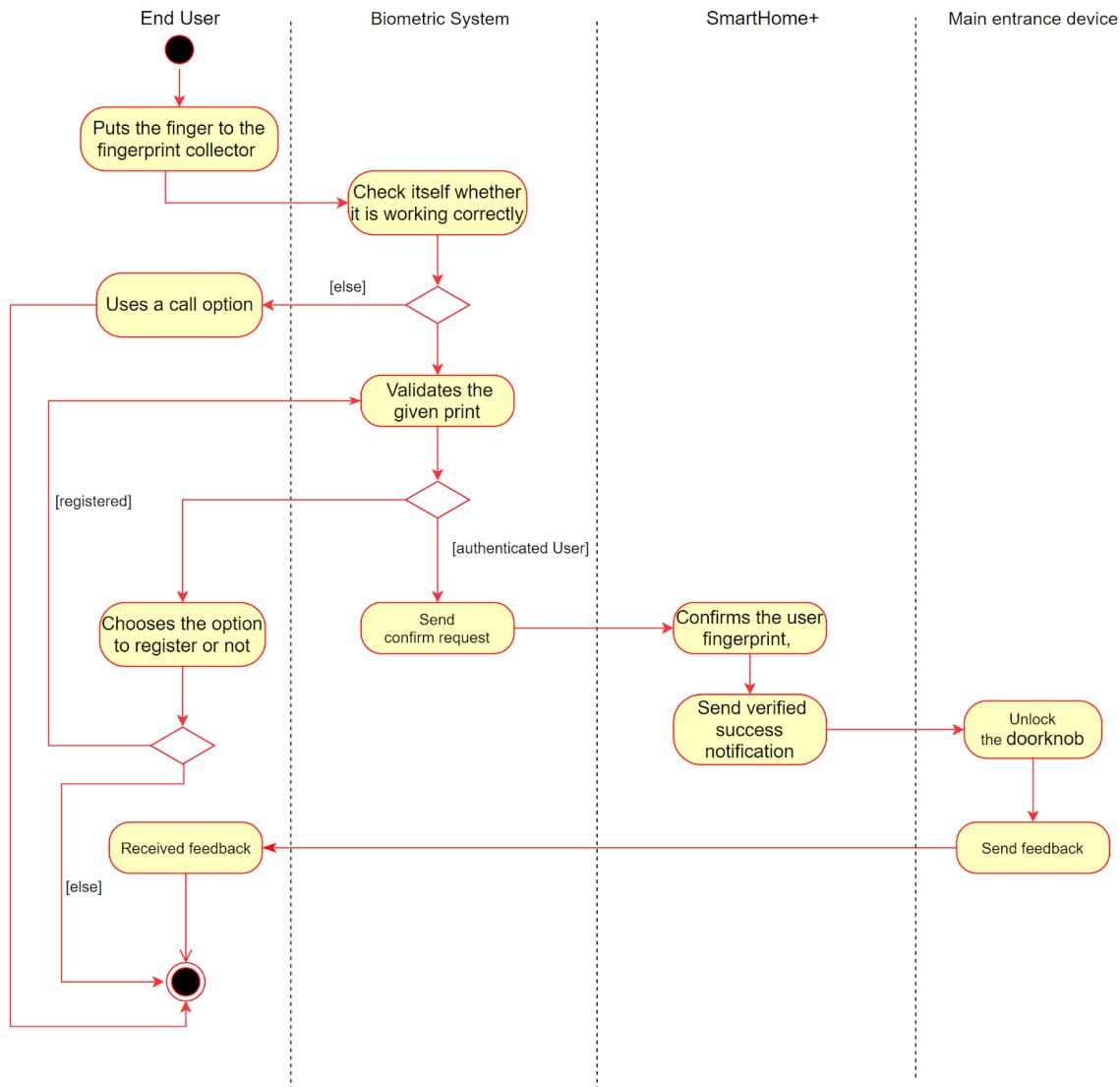


Figure.19 UC05 Activity Diagram

2.3.5 UC08 Activity diagram

Based on the sequence diagram for UC08, the related activity diagram has been built.
The UC08 Activity diagram as shown below in Figure.20.

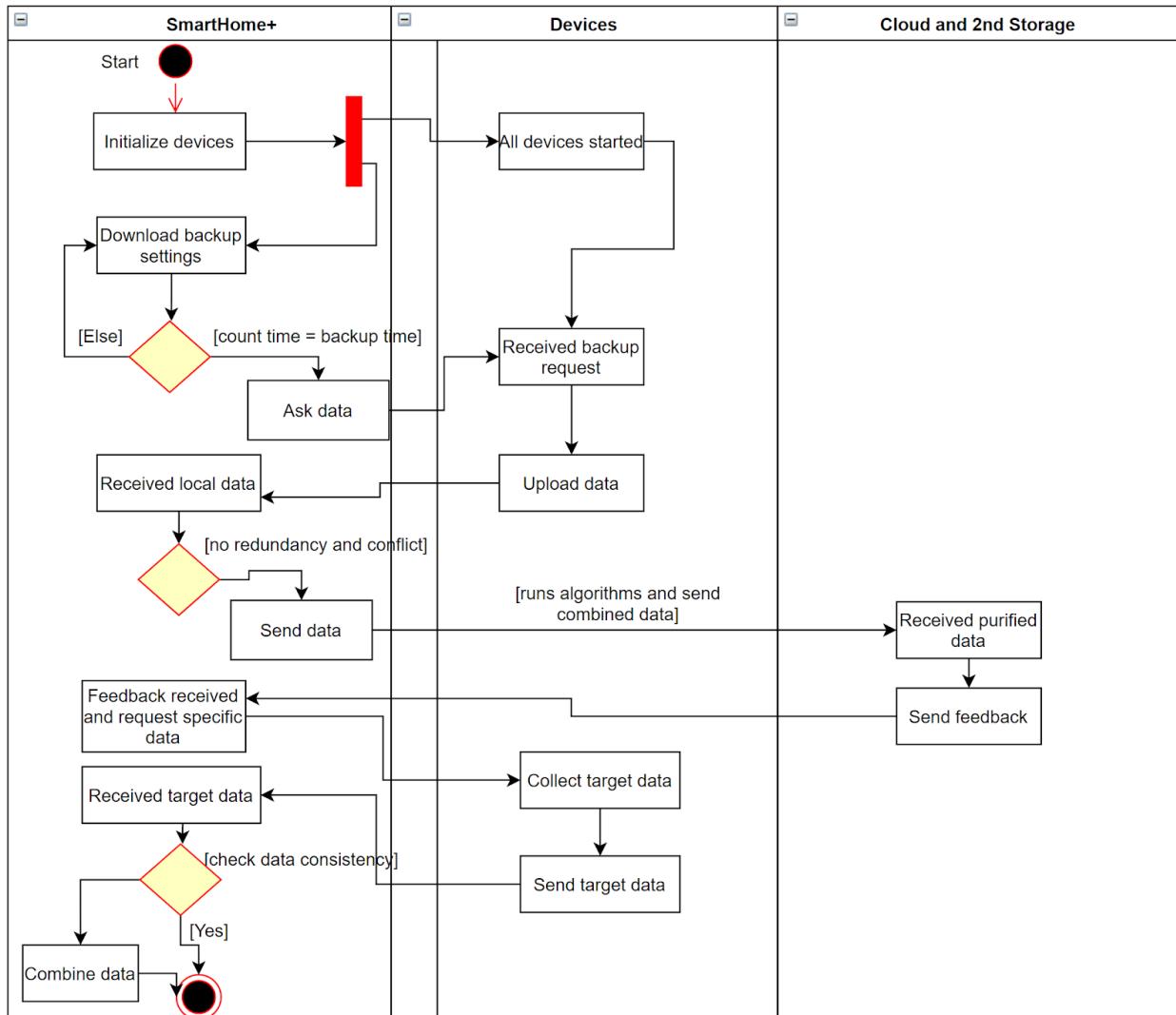


Figure.20 UC08 Activity Diagram

2.3.6 UC09 Activity Diagram

Based on the sequence diagram for UC09, the related activity diagram has been built.
The UC09 Activity diagram as shown below in Figure.21.

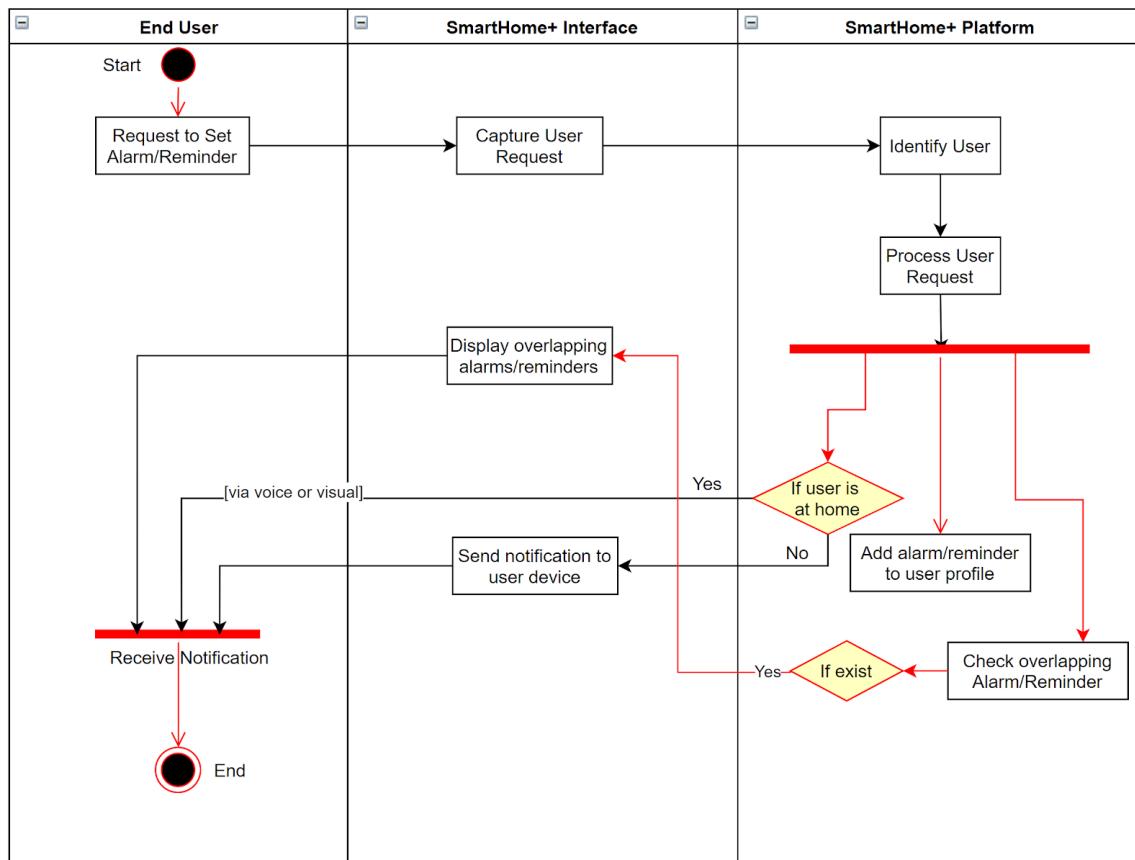


Figure.21 UC09 Activity Diagram

2.3.7 UC11 Activity diagram

Based on the sequence diagram for UC11, the related activity diagram has been built.
The UC11 Activity diagram as shown below in Figure.22.

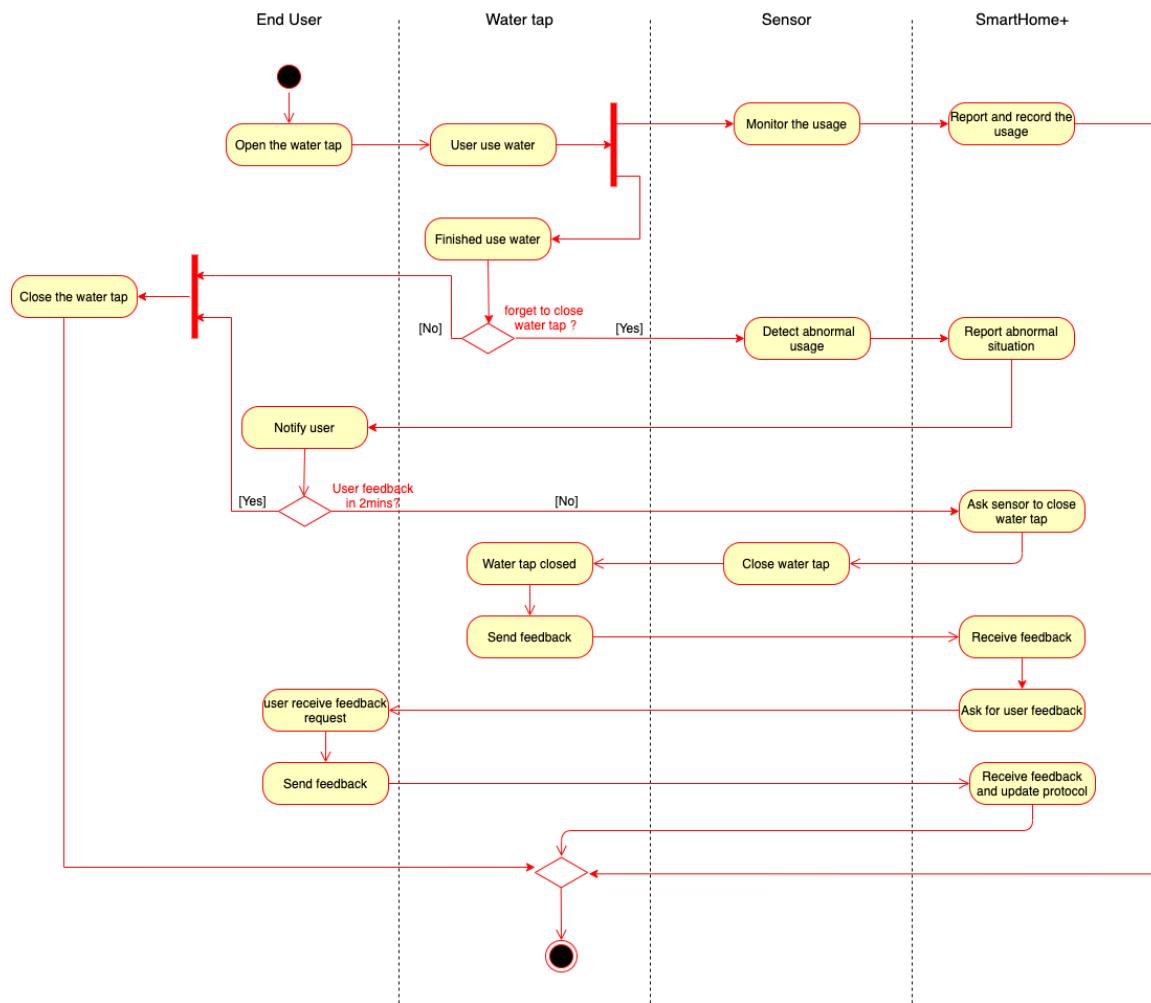


Figure.22 UC11 Activity Diagram

2.3.8 UC13 Activity diagram

Based on the sequence diagram for UC13, the related activity diagram has been built.
The UC13 Activity diagram as shown below in Figure.23.

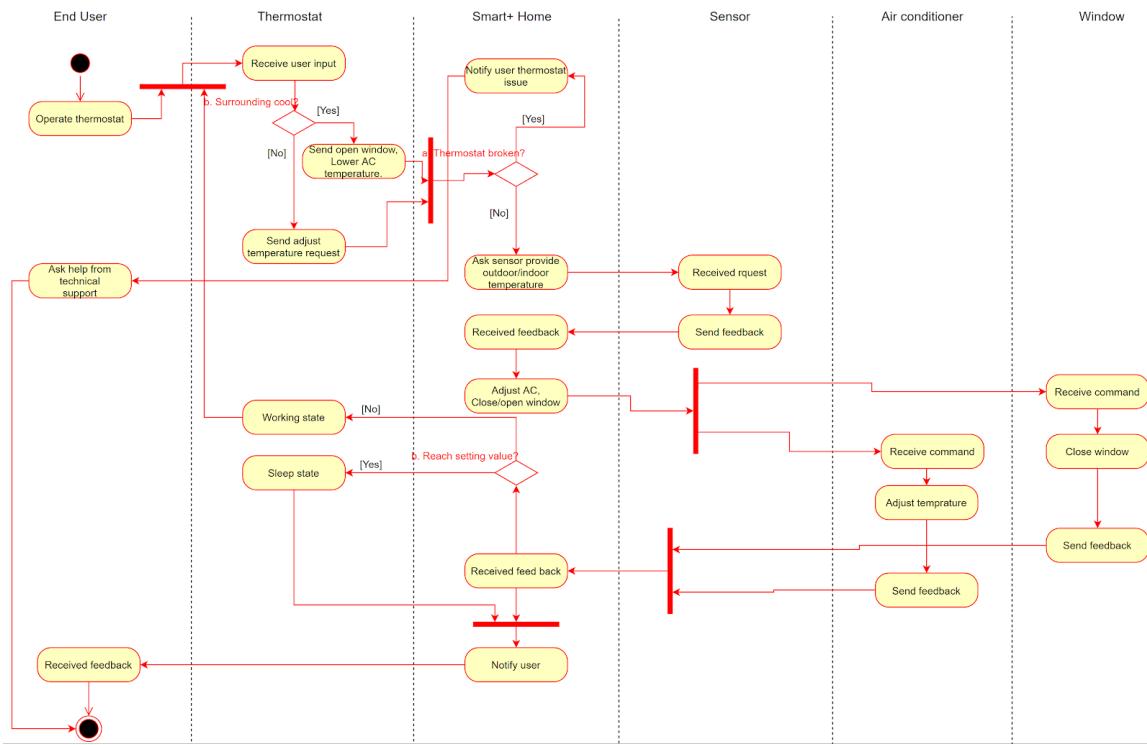


Figure.23 UC13 Activity Diagram

2.4 UML State Machine Diagram

2.4.1 UC02 State Machine Diagram

Based on the sequence diagram, activity diagram for UC02, the related state machine diagram has been built. The UC02 state machine diagram as shown below in Figure.24.

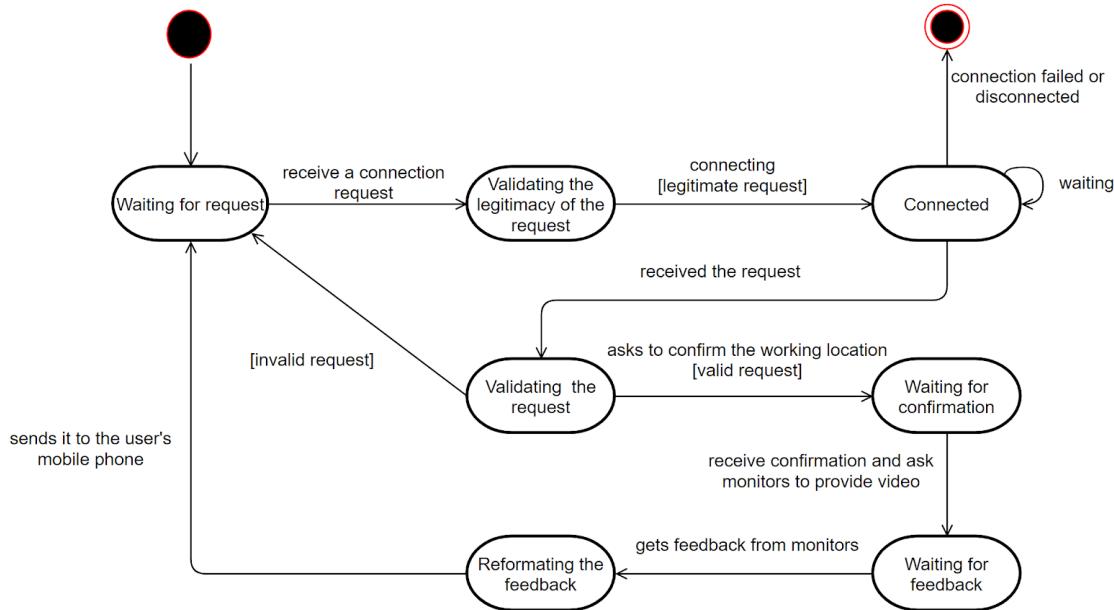


Figure.24 UC02 State Machine Diagram

2.4.2 UC03 State Machine Diagram

Similarly, based on the sequence diagram, activity diagram for UC03, the related state machine diagram has been built. The UC03 state machine diagram as shown below in Figure.25.

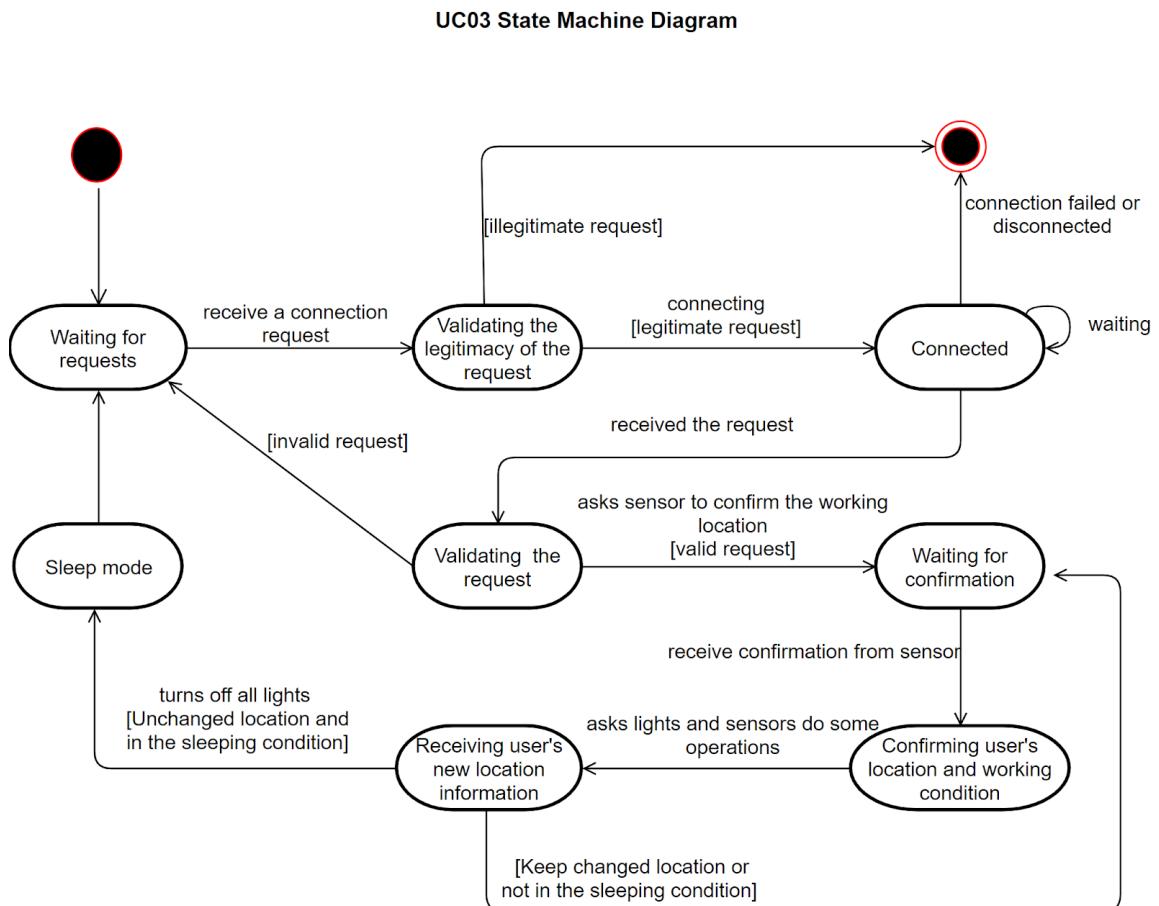


Figure.25 UC03 State Machine Diagram

2.4.3 UC04 State Machine Diagram

Similarly, based on the sequence diagram, activity diagram for UC04, the related state machine diagram has been built. The UC04 state machine diagram as shown below in Figure.26.

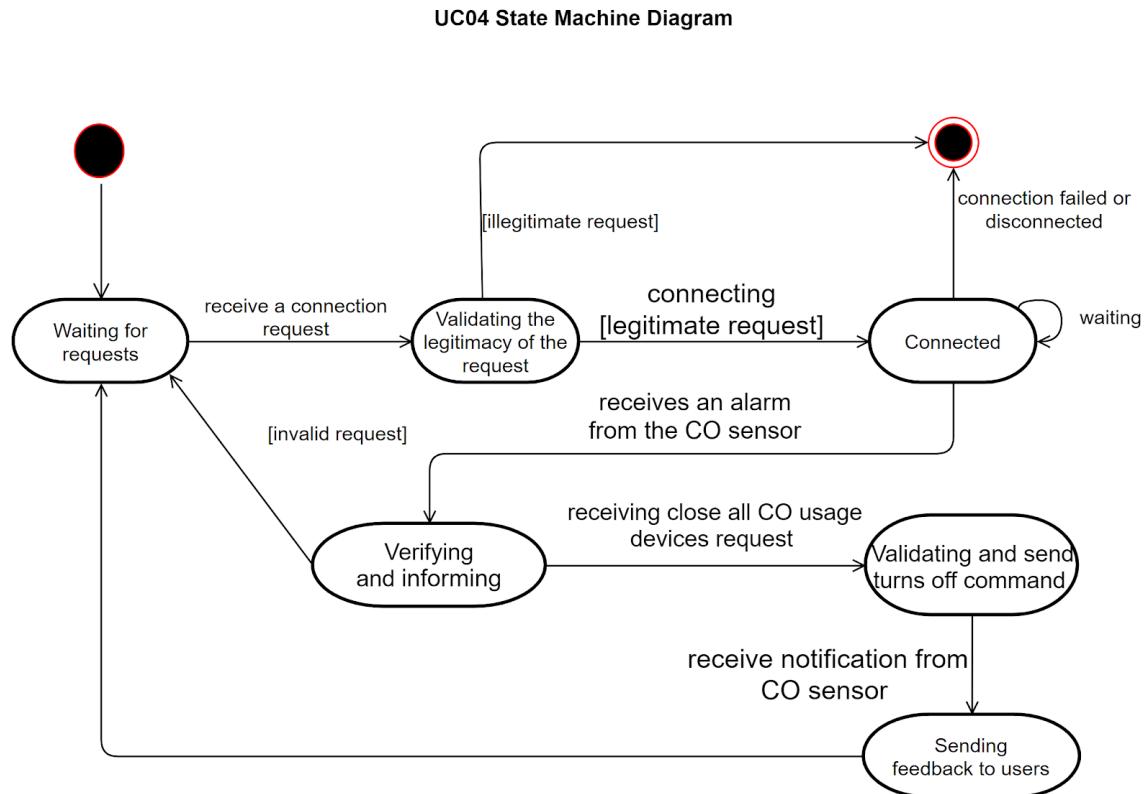


Figure.26 UC04 State Machine Diagram

2.4.4 UC05 State Machine Diagram

Based on the sequence diagram, activity diagram for UC05, the related state machine diagram has been built. The UC05 state machine diagram as shown below in Figure.27.

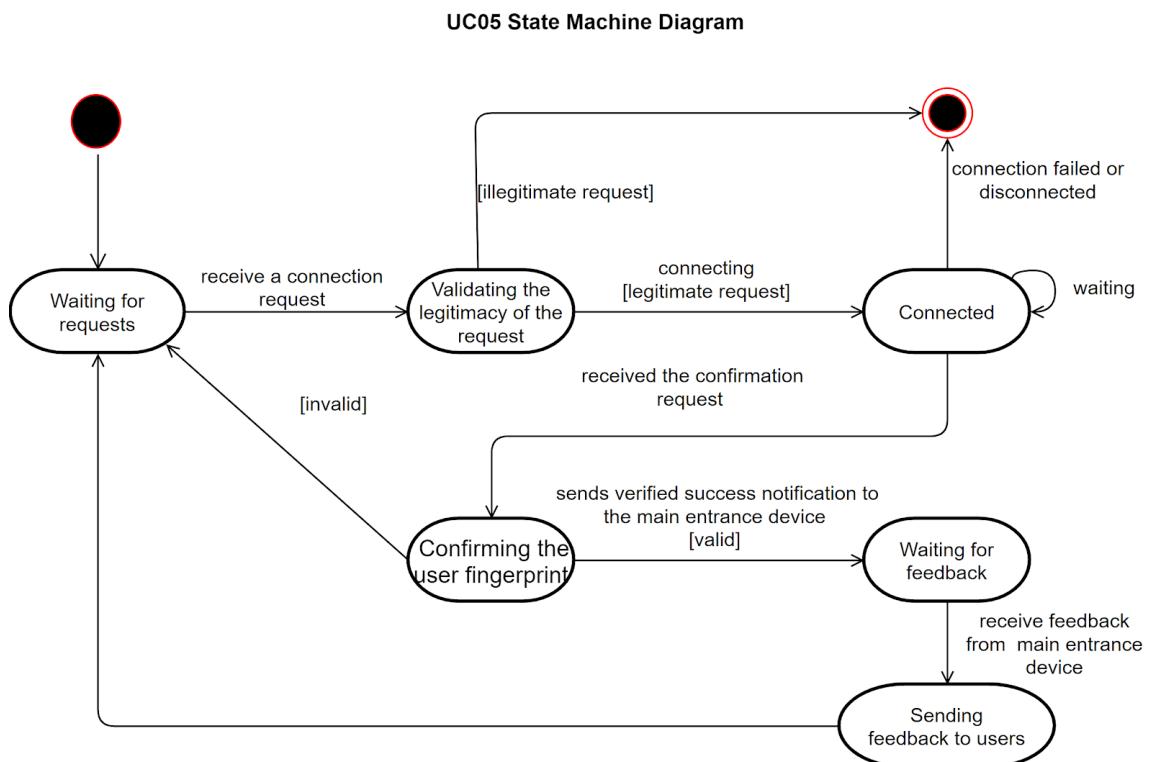


Figure.27 UC05 State Machine Diagram

2.4.5 UC08 State Machine Diagram

Based on the sequence diagram, activity diagram for UC08, the related state machine diagram has been built. The UC08 state machine diagram as shown below in Figure.28.

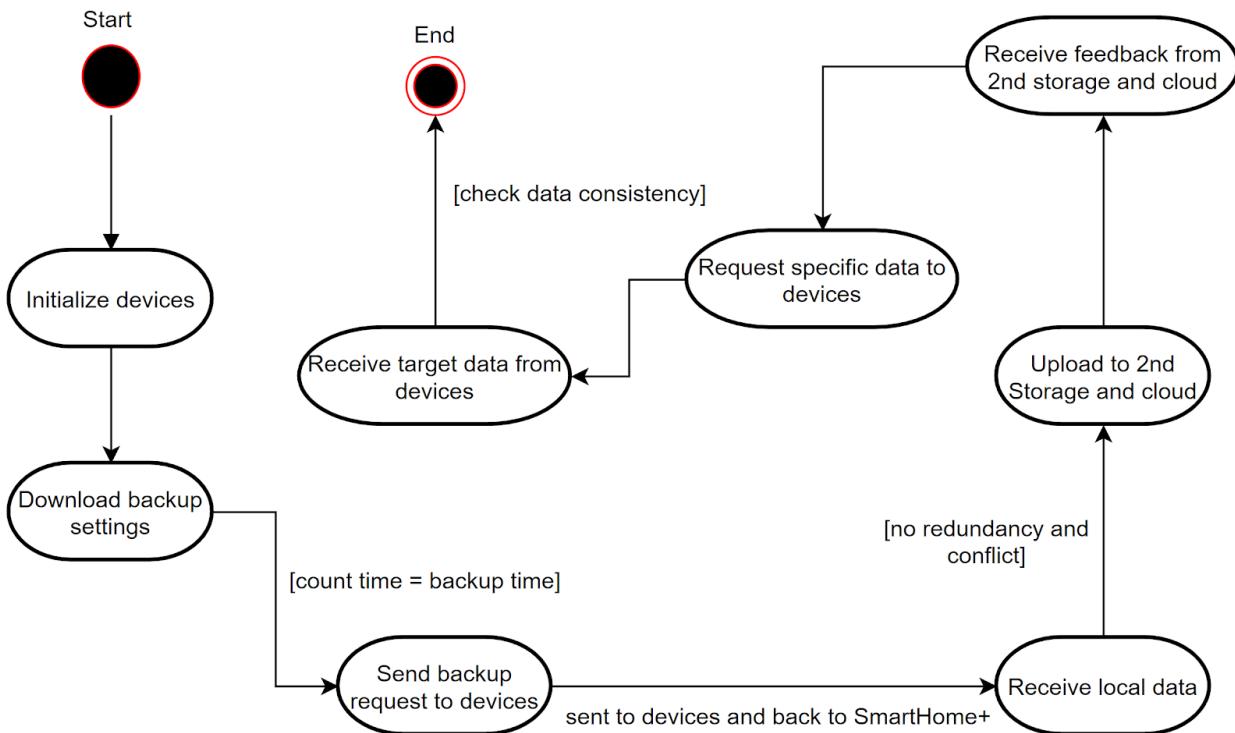


Figure.28 UC08 State Machine Diagram

2.4.6 UC09 State Machine Diagram

Based on the sequence diagram, activity diagram for UC09, the related state machine diagram has been built. The UC09 state machine diagram as shown below in Figure.29.

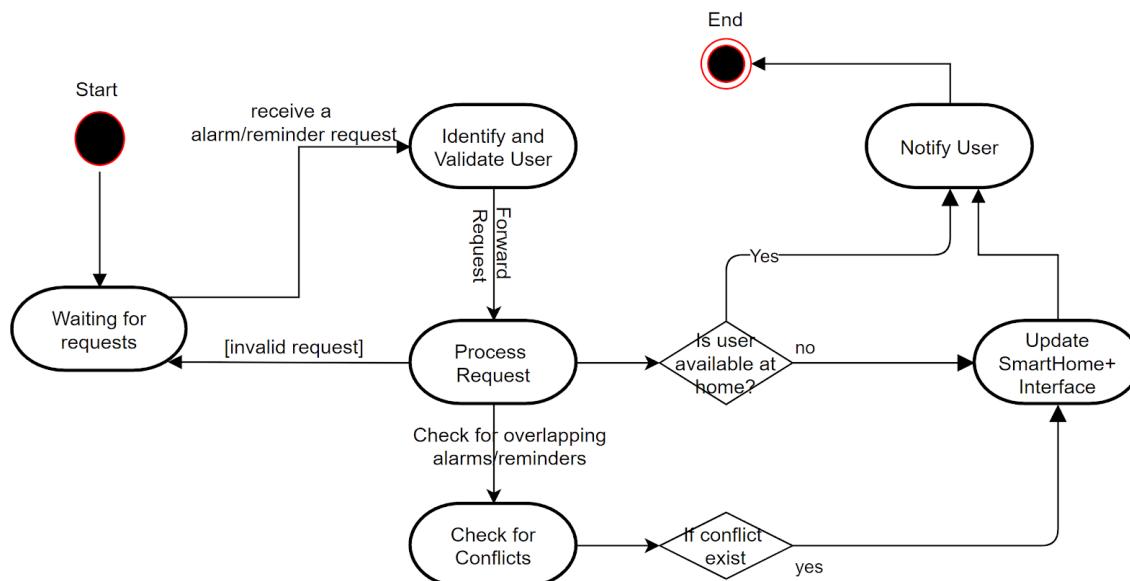


Figure.29 UC09 State Machine Diagram

2.4.7 UC11 State Machine Diagram

Based on the sequence diagram, activity diagram for UC11, the related state machine diagram has been built. The UC11 state machine diagram as shown below in Figure.30.

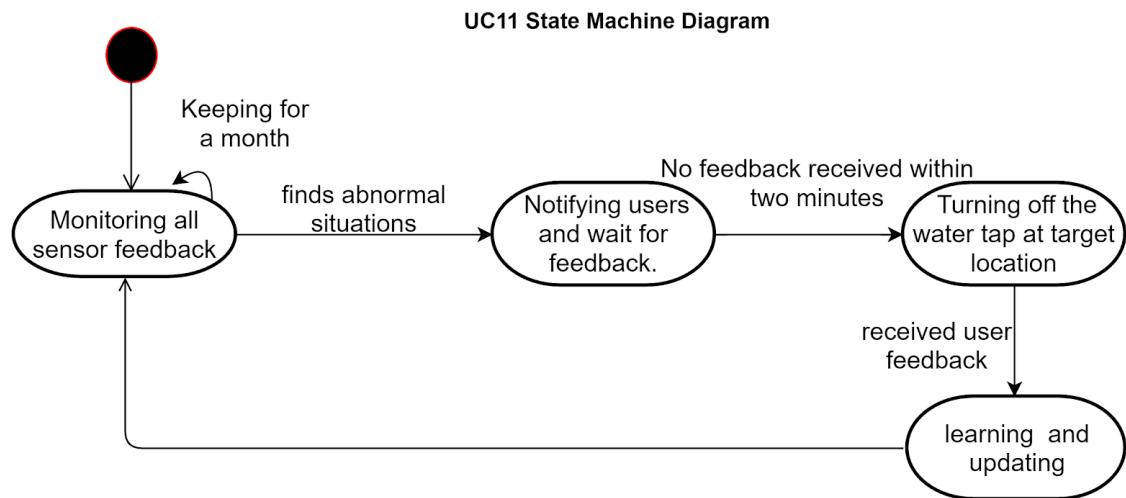


Figure.30 UC11 State Machine Diagram

2.4.8 UC13 State Machine Diagram

Based on the sequence diagram, activity diagram for UC13, the related state machine diagram has been built. The UC13 state machine diagram as shown below in Figure.31.

UC13 State Machine Diagram

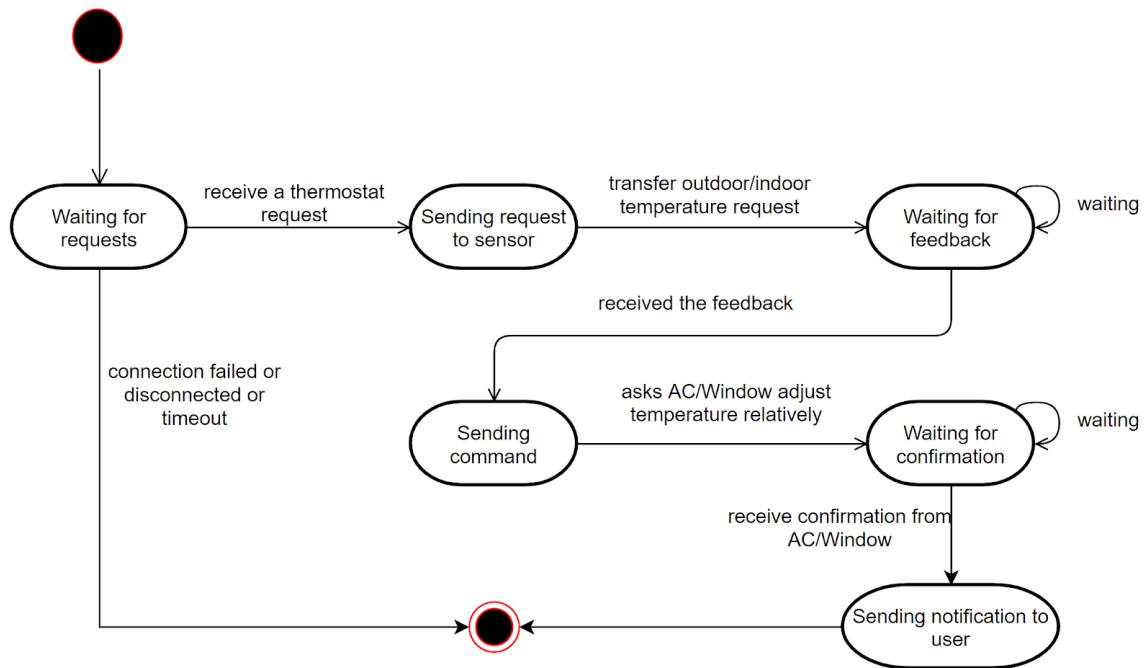


Figure.31 UC13 State Machine Diagram

3. Package: Main

In this section, the total 18 use cases classified to 6 categories have been provided as fully dressed format[15]. Other 9 related use cases are concluded in simple brief format[15]. Totally 27 use cases have been concluded.

3.1 Availability

Id: UC01

Use Case: Interacting with platform to play music[12]

Description: Users can interact with the SmartHome+ platform using a variety of input methods. Ex. Voice, Gesture, Touch etc. to play back online music.

Level: User-goal

Primary Actor: End Users

Supporting Actors: SmartHome+ Platform, Sensors, Smart phone, Microphone, Speaker.

Stakeholders and Interests:

- **End User:** Wants to perform tasks by sending requests to the system using preferred methods in different conditions and situations.
- **SmartHome+ System:** Receives accurate requests through the best possible input method for specific situations from the users to understand and process it correctly.
- **Interior Architect:** Wants to make sure that users can interact with the system from any corner of the house.
- **Technology provider:** wants to make sure that the streaming and video downsampling to mp3 file related algorithms provided are suitable for identity functions.
- **Construction worker:** wants to make sure the locational sensors, speaker and microphone are installed correctly.
- **Maintenance technician:** wants to ensure devices and platforms are running normally.
- **Requirement Manager:** wants to ensure services satisfy the end-user needs.
- **Project Manager:** wants to quickly perform override operations, and easily debug End-user problems.

- **Software Architect:** wants the platform to respond to users' music playing commands correctly.
- **Developer:** wants some fault tolerance to allow user misoperations.

Pre-Conditions: End-user is authorised to interact with the system, hardware works properly.

Post-Conditions:

Success end condition: Users play music requests received accurately. System is able to understand it correctly. Speaker plays back the music perfectly. System provided related information requested by the user.

Failure end condition: Users play music requests not received. System is unable to understand it correctly. Speaker not play back the music. System not provided related information requested by the user.

Minimal Guarantee: Platform will give feedback on the UI to notify users.

Main Success Scenario:

1. SmartHome+ platform is waiting to receive requests from user.
2. User starts the interface of SmartHome+ platform.
3. User sends a 'play music' request by using the mobile phone via voice/gesture/touch control.
4. Platform received the 'play music' request.
5. Platform tries to understand and process the 'play music' request.
6. Based on the time and sensor provided user location, the system provides an appropriate response to the user, sending a music stream to the target location speaker.
7. The target speaker received music stream data, start playback.
8. User is satisfied with the response.

System goes back to the state mentioned in step 1.

Extensions (or Alternative Flows):

- a. User provide 'play music' indirect input:
 - i. After receiving the response from the platform, the user validates the response through the dashboard.
 - ii. Platform asks for the feedback of the response.
 - iii. Re-execute the request in cases of unsatisfactory feedback from the user.
- b. At any time, user cancel the 'play music' request:
 - i. Platform received a request to cancel the previous request.
 - ii. Platform halt execution of the previous request and revert the platform state back to the original state
- 3a. User interrupt the 'play music' request, want to modify it:
 - i. Platform received a request while processing another request.
 - ii. Platform merges both the requests.
 - iii. Platform performs combined requests and provides consolidated response.

Special Requirements:

- Platform should process the 'play music' request within 8 second in 95% of the time.
- Platform should be accessible from any corner of the house.
- Platform should be able to interpret noisy requests.
- Platform should provide an interface in multiple languages.
- Users of any age should be able to understand and use the platform interface.

Id: UC02

Use Case: Access monitors of house [13]

Description: Users can access SmartHome+ platform to monitor his house from anywhere at any time.

Level: User-goal

Primary Actor: End Users

Supporting Actors: SmartHome+ Platform, Sensors, Smart Phone, Monitor.

Stakeholders and Interests:

- **End User:** Wants to monitor, access, control and modify the platform when not at home or before arriving at home.
- **SmartHome+ Platform:** Wants to perform some automatic task with user consent. Notify users for scheduled reminders, alerts and problems.
- **Internet Service Provider:** Wants to provide a communication channel between end-user and SmartHome+ system.
- **Technology provider:** wants to make sure that the monitors and video compression related algorithms provided are suitable for identity functions.
- **Construction worker:** wants to make sure the locational sensors, lights(for good video quality) and monitors are installed correctly.
- **Maintenance technician:** wants to ensure devices and platforms are running normally.
- **Requirement Manager:** wants to ensure services satisfy the end-user needs.
- **Project Manager:** wants to quickly perform override operations, and easily debug End-user problems.
- **Software Architect:** wants the platform to respond to users' monitoring commands correctly.
- **Developer:** wants some fault tolerance to allow user misoperations.

Pre-Conditions: Authenticate the user and establish a secure and reliable communication channel between end-user and platform, hardware works properly.

Post-Conditions:

- Success end condition:** User is connected to the platform. User request is received by system. Platform performed the requested task and sent an appropriate response.
- Failure end condition:** User is forbidden connected to the platform. User request is lost. Platform not response.

Minimal Guarantee: Platform will give feedback on the UI to notify users what happened.

Main Success Scenario:

1. SmartHome+ platform is waiting to receive requests from user.
2. The user using mobile phone connects to SmartHome+ platform through the internet.
3. The user using a mobile phone sends an access specified location of the monitors to the platform.
4. Platform received the request. Validates the request and asks for the sensor to confirm the working location.
5. Sensors give feedback to the platform. Platform confirms the monitor's location and working condition.
6. Platform asking monitors to provide video feedback.
7. Monitors send feedback to the platform via Wifi environment.
8. Platform gets feedback, reformats the video and sends it to the user's mobile phone.
9. The user received monitor video on the mobile phone.

Platform goes back to the state mentioned in step 1.

Extensions (or Alternative Flows):

- a. User request is intercepted and modified by unauthorised personal:
 - i. Platform should validate the legitimacy of the request.

1. Invalid requests should be discarded and notify users to reconnect with a new secure and reliable communication channel.
- b. Connection between platform and user is broken abruptly:
 - i. User's internet connection is unstable or not working
 1. Send notification to user with the status of request.
 2. User receives the response notification when reconnected to the internet.
 - ii. Platform is not able to connect to internet
 1. Perform the requested task in case it does not need internet connection.
 - a. Send notification to user when reconnected to the internet.
 2. Intimate user to re-request when reconnected to the internet.

Special Requirements:

- Users should be able to access SmartHome+ platform through different devices.
- Connection between user and platform should be secure and reliable.
- Platform should block/prevent unauthorised access of the platform.
- Platform should provide an easy and interactive interface to access platform.

ID: UC03

Use Case: Control smart lighting remotely [2]

Level: User-goal

Description: Smart Lighting works based on the inputs given by the user detection sensor, scheduled time, remote control via voice etc. The user will initially specify which lights need the user detection inputs because sometimes the user wants some lights to be manually controlled, especially lights outside the home. However, the user will get a warning if the energy consumption is too high.

Primary Actor: End Users

Supporting Actors: SmartHome+ Platform, Sensors, Smart Phone, Speaker.

Stakeholders and Interests:

- **End User:** Wants to monitor, access, control and modify the platform when not at home or before arriving at home.
- **SmartHome+ Platform:** Wants to perform some automatic task with user consent. Notify users for scheduled reminders, alerts and problems.
- **Technology provider:** wants to make sure that the smart lights provided are suitable for identity functions.
- **Construction worker:** wants to make sure the locational sensors and lights are installed correctly.
- **Internet service provider:** wants to perform as the client expected, not have the lag issue.
- **Maintenance technician:** wants to ensure devices and platforms are running normally.
- **Requirement Manager:** wants to ensure services satisfy the end-user needs.
- **Project Manager:** wants to quickly perform override operations, and easily debug End-user problems.

- **Software Architect:** wants the platform to respond to users' light commands correctly.
- **Developer:** wants some fault tolerance to allow user misoperations.

Pre-Conditions: Authenticate the user and establish a secure and reliable communication channel between end-user and platform, hardware works properly.

Post-Conditions:

Success end condition: User is connected to the platform. User request is received by the platform. Platform performed the requested task and sent an appropriate response to target light based on a locational sensor.

Failure end condition: User is forbidden connected to the platform. User request is lost. Platform not response. Light bulb connection lost. Sensor unresponsive.

Minimal Guarantee: Platform will give feedback on the UI to notify users what happened.

Main Success Scenario:

1. The SmartHome+ platform is waiting to receive requests from user.
2. The user just arrived home at midnight, at the doorway, he asked "turn on all lights near me!" to one of the speakers near the doorway or mobile phone mic.
3. The speaker's mic received human voice input, compressed it to digital data and sent it through Wifi to the SmartHome+ platform.
4. Platform received the user request. Validates the request and asks for the sensor to confirm the working location.
5. The doorway sensors give feedback to the platform. Platform confirms the user's location and working condition.
6. Platform asking lights at target user location turn on, and ask near areas sensors tracking the user location with higher frequency.
7. The lights and sensors received the platform commands, executed relatively.
8. The user is moving to his bedroom.
9. The sensors send new user location information to the platform with high frequency, and the platform repeats step 5-7.
10. The user stopped in his bedroom. Going to sleep now.
11. The locational sensors on the bed find the user in sleep condition, asking the platform to turn off all lights.
12. The platform turns off all lights. Execute sleep mode.

Platform goes back to the state mentioned in step 1.

Extensions (or Alternative Flows):

- c. User request is intercepted and modified by unauthorised personal:
 - i. Platform should validate the legitimacy of the request:
 1. Invalid requests should be discarded and notify users to reconnect with a new secure and reliable communication channel.
- d. Connection between platform and user is broken abruptly:
 - i. User's internet connection is unstable or not working
 1. Send notification to user with the status of request.
 2. User receives the response notification when reconnected to the internet.
 - ii. Platform is not able to connect to internet
 1. Perform the requested task in case it does not need internet connection.
 - a. Send notification to user when reconnected to the internet.
 2. Intimate user to re-request when reconnected to the internet.

2. The user request is not recorded by the speaker.
 - 2a. The speaker will notify the user "Did you say anything?"
 - 2b. The user reasking.
3. The user voice can't be transferred to a recognizable command.
 - 3a. The platform will ask the speaker to notify the user "I can't understand that, please retry."
 - 3b. The user retry. Back to step2.

Special Requirements:

- Users should be able to access SmartHome+ platform through different devices on all locations of the house, the lights are everywhere.
- Connection between user and platform should be secure and reliable.
- Platform should block/prevent unauthorised access of the platform.
- Platform should provide an easy and interactive interface to access platform.
- Platform should learn user habits of lights with the machine learning model updated.
- Platform should be based on user location and turn off unused lights to save energy.

3.2 Security

Id: UC04

Use Case: Notify residents CO(Carbon Monoxide) over limit

Level: User-goal

Description: The platform and sensors will coordinate and notify users if there is a limit cross of CO inside the home and will also suggest what action needs to be taken in order to reduce it.

Primary Actor: CO sensor

Supporting Actors: House resident(end user), CO Sensor, Smart Phone, Speaker, CO devices.

Stakeholders and Interests:

- **End User:** Wants to stay safe and live healthy in the home. Avoid risk of CO over limit.
- **SmartHome+ Platform:** Wants to keep track of CO statuses. Notify users for alerts and problems. Enter an emergency plan if needed.
- **Internet Service Provider:** Wants to provide a communication channel between end-user and SmartHome+ system.
- **Technology provider:** wants to make sure that the techniques provided are suitable for identity functions, which are accurate, fast, and no errors.
- **Construction worker:** wants to make sure the kitchen sensors and devices are installed correctly.
- **Maintenance technician:** wants to ensure devices and platforms are running normally.
- **Requirement Manager:** wants to ensure services satisfy the end-user needs.
- **Project Manager:** wants to quickly perform override operations, and easily debug End-user problems.

- **Software Architect:** wants the platform to validate users correctly and CO sensors report be well treated at platform as expected.
- **Developer:** wants some fault tolerance to allow user misoperations.

Pre-Conditions: Authenticate the user and establish a secure and reliable communication channel between end-user and platform, hardware works properly.

Post-Conditions:

Success end condition: Platform is connected to the CO sensor. CO sensor alert request is received by platform. Platform performed the alarm to all speakers and sent an appropriate response to stop CO usage and leak.

Failure end condition: User is forbidden connected to the platform. User request is lost. Platform not response.

Minimal Guarantee: Platform will give feedback on the UI to notify users what happened, fire alarm will be triggered.

Main Success Scenario:

1. SmartHome+ platform is waiting to receive requests from devices.
2. The CO sensor finds CO over limit value.
3. The CO sensor sends an alarm to the platform via the internet.

4. The platform receives an alarm request, verifies it then passes it to the user via speaker and mobile phone notification message, at same time informing the sensor.
5. The user gets the alarm, asks the platform to close all CO usage devices.
6. Platform received the user request. Validates the request and sends 'turns off' command to all CO devices.
7. The CO devices get the command from platform, shut down power and CO usage.
8. The CO sensor confirms CO value back to normal, and notify the platform.
9. The platform sends feedback to the end user.

Platform goes back to the state mentioned in step 1.

Extensions (or Alternative Flows):

- a. CO sensor request is intercepted:
 - I. Co sensor executes the emergency line via cable connection, alarm all house with speaker triggered.
 - II. After 1 mins none-response from the user, the CO sensor will directly call the fire alarm line.
- 4a. The platform receives an alarm request, can't verify it.
 1. Platform sends requests to users, asking users to verify CO values manually.
 2. Platform requires a CO sensor resend a report.
- 4b. The platform does not receive an alarm request.
 1. The CO sensor exceeds waiting time, resend alarm.
 2. The CO sensor directly triggers an emergency alarm.
 3. Platform gets an emergency alarm triggered, and notify users to manually check the alarm location.
- 6a. Platform didn't receive the user request.
 1. User resend request.
 2. User manually turn off CO usage devices
- 6b. Platform can't validate the request.
 1. Platform sends alarm to administrator, invalid user detected.
 2. Platform waiting administrator feedback.
 3. Waiting time over limit, automatically enter security mode.
- 8a. The CO sensor confirms CO value is still abnormal.
 1. Platform triggers the highest emergency mode, ask user to evacuate from the house.
 2. Platform automatically calling the fire alarm hotline.
- 8b. The CO sensor confirms CO value is normal, the feedback can't be sent to the platform.
 1. Platform over waiting time, notify user situations and ask the user to manually check sensor status.

Special Requirements:

- Users should be able to access SmartHome+ platform through different devices.
- Connection between user and platform should be secure and reliable.
- Platform should block/prevent unauthorised access of the platform.
- Platform should provide an easy and interactive interface to access platform.
- The CO sensor should work properly and have higher access than none-critical devices.

Id: UC05

Use Case: Verify gate access

Level: User-goal

Description: The platform will verify users using biometric authentication and admin approval to grant access to users to enter the house.

Primary Actor: End Users

Supporting Actors: SmartHome+ Platform, Biometric Sensors, Smartphone, Internet Service Provider.

Stakeholders and Interests:

- **Interior architect:** wants to receive confirmation from the platform.
- **Technology provider:** wants to make sure that the techniques provided are suitable for identity functions, which are accurate, fast, and no errors.
- **Construction worker:** wants to make sure the gates and doors sensors and fingerprint collectors are installed correctly.
- **Internet service provider:** wants to perform as the client expected, not have the lag issue.
- **Maintenance technician:** wants to ensure devices and platforms are running normally.
- **Requirement Manager:** wants to ensure services satisfy the end-user needs.
- **Project Manager:** wants to quickly perform override operations, and easily debug

End-user problems.

- **Software Architect:** wants the platform to validate users correctly and open/close doors as expected.
- **Developer:** wants some fault tolerance to allow user misoperations.

Pre-Conditions:

1. The biometric system should be running 24x7.
2. If the biometric system does not work, the doors will never be opened automatically.

Post-Conditions:

Success end condition: Platform is verified user identity. Approve the access authorize, Platform remote control the gates open/close automatically.

Failure end condition: User is forbidden access. User request is lost. Platform not response. Failure in opening/closing doors will be reported to the parent(Administrator) user. The biometrics system should check whether the user requires further validation, like authorization from the parent(Administrator) user.

Minimal Guarantee: Security and safety of the house is always ensured.

Main Success Scenario:

1. A User (Guest, friends, relatives, etc.) comes in front of the main entrance, wants to enter the house.
2. The user puts the finger to the fingerprint collector on the doorknob.
3. The biometric system gets the user fingerprint, validates the given print against a list of prints it has in its database.
4. SmartHome+ platform confirms the user fingerprint, sends verified success notification to the main entrance device.

5. The main entrance device receives the platform confirmation message, unlocks the doorknob.
(Success, use case: Verify User Identity finished)

Extensions (or Alternate Flows):

- a* At any time, the administrator user is not available to approve the incoming users:
- a1. The user is not granted access to enter the house.
 - a2. The platform asks the coming user to provide a password.

b* For certain users (less frequent incoming users), the administrator's approval is required even after successful biometric authentication, like opening the doors after checking the CCTV footage or any other methods.

1. A new user is coming for the first time.
 1. The user chooses the option to register for biometrics via the touch screen on the door ring panel.
 - 2a. The administrator user approved the new user register.
 - 2b. The administrator user denied the new user register.
2. The Biometric system has a problem (software or hardware).
 1. The user uses a call option via the touchscreen on the door ring panel.
 2. The administrator user received a call, deciding whether to allow the user or not.

Special requirements:

- The accuracy of biometric validation depends on how good the users have registered their initial prints and also how clear their prints are after subsequent validations.
 - The health report will notify the parent user if there is a hardware problem in validating users and the action that needs to be taken to rectify the problem.
-

Id: UC06

Use Case: Execute Emergency Protocols[14]

Description: In case of emergency, there are fixed sets of actions that will be performed in order to ensure and safety and security of all users inside the house. In emergency situations like fire, gas leak, excessive smoke etc platform helps users to rectify situations using pre-configured emergency protocols (Call 911). In situations where security of home is compromised, the platform helps users to secure home and inform homeland security.

Level: User-goal

Primary Actor: SmartHome+ Platform

Supporting Actors: End-User, Security Agencies, Medical Services.

Stakeholders and Interests:

- **SmartHome+ Platform:** Wants to provide required security and safety features so that users can feel safe inside home or away from home. Platform provides such features by continuously monitoring home for any safety or security concerns.
- **End-User:** Wants to get information about/prevent any unsafe situation to feel secure and safe while at home. Wants to make sure their home is secure while away from home.
- **Security Agencies:** Helps civilians by capturing nuisance of society (Thief, Burglar etc).
- **Medical Services:** Wants to provide medical help as soon as possible.
- **Interior Architect:** Wants to design home to make sure each and every corner of the home is safe and secure.
- **Construction Worker:** Install safety and security devices in designated places so users can access it easily when needed.

Pre-Conditions: All the required security and safety devices are working fine. Users had not covered sensors with any obstacles which prevent the platform from monitoring or detecting unwanted circumstances.

Post-Conditions:

Success end condition: The SmartHome+ Platform will inform users about security breach. Platform starts water sprinklers and informs the fire department to prevent the spreading of fire in the home. Platform opens windows if too much smoke is detected.

Failure end condition: Platform failed to detect unsafe situations. Smoke detectors are not working. Sprinkler system is not working. Platform is not able to inform users or security officials about security breaches.

Minimal Guarantee:

Platform and devices will notify users about any concerning situations.

Main Success Scenario:

1. User was boiling milk.
2. User left the home in a hurry leaving boiling milk on the stove and the stove open.
3. After some time there is smoke in the kitchen.
4. Smoke detectors detect smoke.
5. Platform immediately opens windows to remove smoke from the home.
6. Platform detects the stove open and immediately stops it.
7. SmartHome+ platform sends notification to users about incidents.

Extensions (or Alternative Flows):

- a. Smoke detector is not working:
 - i. Platform will check air quality.
 - ii. Detect significant deviation from average air quality.
 - 1. Then open the window and start the air purifier to remove smoke.
- b. Fire in the house:
 - i. Detect fire through fire sensors.
 - ii. Start sprinklers for that area and open windows.
 - iii. Inform fire department and user.

Special Requirements:

- Platform should be able to monitor home 24x7.
 - Platform should be able to detect and prevent unwanted and concerning situations.
 - Platform should be able to request external agencies in case of serious situations.
 - Platform should be able to detect and handle situations in more than one way.
-

3.3 Automation

Id: UC07

Use Case: Generate devices health report

Level: User-goal

Description: The main goal is to perform health analysis on all SmartHome+ devices and will report users about any changes or repairs to these devices.

Primary Actor: End Users

Supporting Actors: SmartHome+ Platform, Sensors, Smart phone, Internet Service Provider.

Stakeholders and Interests:

- **Internet Service Provider:** wants to make sure that all devices report their health status to SmartHome+, in turn to the user.
- **Interior architect:** wants all devices to be installed properly, especially notifying users in case of emergency where there is no network.
- **Technology provider:** wants to provide ease of usability for the users about health reports statistics.
- **Construction worker:** wants to ensure all physical devices are established correctly, thus enabling to run health analysis on those devices.
- **Customer service representative:** wants the users to be able to connect to this team incase of any queries related to statistics, give suggestions to the users about failure cases, etc.
- **Maintenance technician:** wants to help the users fix the failed devices and get them back in working condition.
- **Requirement Manager:** ensures all requirements regarding building a secure and faster way of reporting health status are elicited correctly.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

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Pre-Conditions:

All the required devices are working fine. Users had not interrupted the platform. The health reporting should always be on the exact frequency set by the user.

Post-Conditions:

Success end condition: The user be notified when the SmartHome+ receives the report, as it covers important cases which require immediate attention.

Failure end condition: User request is lost. Platform not response. Failure in generating reports, notify user operation failure.

Minimal Guarantee:

Platform and devices will notify users about the health status of each device at any cost, especially during emergencies.

Main Success Scenario:

1. The user initially set a certain frequency to run health analysis for all SmartHome+ devices installed at home.
2. The timer starts and at that particular instance of time, health analysis will run on all the devices.
3. All devices are sent a detailed report to SmartHome+ platform and to the user mobile phone via notification.
4. The user checks the notification, will be redirected to the app where all stats are displayed.
5. The SmartHome+ platform will display Information like the number of healthy devices, devices which require attention (for repair or next action approval) or user intervention, devices which require hardware assistance, etc.
6. The user takes necessary action based on the statistics and set which notifications are important and which are not, set warnings, solutions for problems and best suggestions, etc.

Extensions (or Alternate Flows):

- a. Due to network issues, sometimes the health report sent to SmartHome+ will not be notified to the user, it will create a problem to the user if an important notification might not be known to the user. In such cases
 - a1. The device will wait for a certain time for user intervention, after which the device will ring an alarm.

Id: UC08

Use Case: Do the System Backup and Recovery automatically

Level: User-goal

Description: The SmartHome+ needs backup and recovery automatically, without end-user concern, provides robustness and stable performance.

Primary Actor: SmartHome+ Platform

Supporting Actors: End User, Smart devices, 2nd storage device, Cloud disk

Stakeholders and Interests:

- **Internet Service Provider:** wants to make sure that all devices report their health status to SmartHome+, in turn to the user.
- **Interior architect:** wants all devices to be installed properly, especially notifying users in case of emergency where there is no network.
- **Technology provider:** wants to provide ease of usability for the users about automatically backup and recovery. Also provided smooth cloud services solutions.
- **Customer service representative:** wants the users to be able to connect to this team incase of any queries related to statistics, give suggestions to the users about failure cases, etc.
- **Maintenance technician:** wants to save time on recovery of user data.
- **Requirement Manager:** ensures the platform backup and recovery needs and features described to meet end-user expectations.
- **Project Manager:** wants the team to work in developing the platform and makes sure they report properly to the SmartHome+ app.

- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions:

All the required devices are working fine. Users had not interrupted the platform operation. The target devices are linked with the platform through local Wifi.

Post-Conditions:

Success end condition: The SmartHome+ receives the target devices data, backup them to 2nd storage. The SmartHome+ platform recovered based on 2nd storage data.

Failure end condition: Connections with smart home devices are lost. Platform not response. Failure in writing data to 2nd storage, notify user automatically operations failure.

Minimal Guarantee:

Platform and devices will run normally, the backup and recovery actions will not impact on running services.

Main Success Scenario:

1. The SmartHome+ platform with devices initialized at home, download the backup and recovery setting automatically.
2. The platform starts counting the time, when reach backup period time, backup request will be sent to all the devices.
3. All devices receive a request, transfer local data to SmartHome+ platform.
4. The SmartHome+ platform receives data, validated redundancy and conflict, purified data will be uploaded to both 2nd storage and cloud disk.
5. The 2nd storage and cloud disk send complete feedback to SmartHome+ platform.
6. The platform received feedback, sent requests to extract specific time recovery data to 2nd storage and cloud disk.
7. The cloud disk and storage send back target data to the platform.
8. The platform matching two data, check consistency.
9. The platform uses data recovery target time data to target smart devices.

Extensions (or Alternate Flows):

4. The platform doesn't receive some device data.
 - 4a. The platform asks users to manually check problem devices.
 - 4b. The user can't solve it, so they transfer to a maintenance technician.
8. The platform finds two data not matching.
 - 8a. The platform using algorithms combined two data.
 - 8b. The platform sends combined data to devices for recovery.

Special Requirements:

- Platform should have a 2nd storage device for backup.
- Platform should be able to backup itself with the local network.

ID: UC09

Use Case: Set Alarms and Reminder

Level: User-goal

Description: User can ask the platform to set a reminder or alarm. Platform will provide different ways to set reminders or alarms to users like voice or application. SmartHome+ will notify users based on their location. If the user is not at home, the platform will send a notification to the user's mobile phone. Platform maintains individual users' profiles for each member of the house and provides alarms/reminder notification in a personalized way.

Primary Actor: End User

Supporting Actors: SmartHome+ Platform, Sensors, Speaker, Smart phone

Stakeholders and Interests:

- **Internet service provider:** wants the communication to be reliable to send and receive important signals between SmartHome+ and kitchen devices.
- **Interior architect:** wants the sensors installed properly in order to report signals.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Construction worker:** wants the speaker and dashboard devices to be installed correctly and work as expected.
- **Customer service representative:** wants to serve the users in case of any queries related to working of the speaker devices.
- **Maintenance technician:** wants to repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding smart speaker devices and reporting status to SmartHome+ app are elicited correctly.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions:

The locational sensors should work properly and should send and receive messages to SmartHome+ app. The time should be synchronized with all devices.

Post-Conditions:

Success end condition: Notification devices alarm and remind the end user automatically at user defined time.

Failure end condition: Notification devices not alarm and remind the end user. Time not synchronized properly, platform not receive message, sensor not detect end-user location.

Minimal Guarantee:

Platform or the devices will ensure send feedback about what happened after the user inputs the alarm and reminds time.

Main Success Scenario:

1. The user set a schedule to alarm and remind for important events via voice control of speaker and mobile phone calendar synchronization.

2. The SmartHome+ platform received the request, input the data to SQL database with conflict checking and validation.
3. The SmartHome+ platform goto waiting states, until the user setting time comes.
4. The SmartHome+ platform sends notification to the user mobile phone, and with voice alarm on the speaker at user defined time.
5. The user confirms the remind and alarm, asking SmartHome+ platform stop notification via the speaker mic.
6. The speaker received user voice input, transferring .wave data to platform.
7. The platform received user feedback, labeled the current alarm and remind event as completed.

Platform goes back to the state mentioned in step 1.

Extensions (or Alternate Flows):

2. The SmartHome+ platform finds conflicts when checking and validation.
 - 2a. Indicate where there is conflict, ask user reinput.
 - 2b. After receiving reinput, recheck the request.
 7. The platform received user feedback, but can't recognize what command is.
 - 7a. The platform sends feedback to the input speaker, asking the speaker to notify the user "What?"
 - 7b. The user resend command.
-

3.4 Energy Efficiency

Id: UC10

Use Case: Control kitchen devices state

Level: User-goal

Description: In order to reduce waste of energy, these devices are set up with a functionality that will automatically switch off when they are not used. This will depend on the timeout set and type of signals sent between the devices and SmartHome+ app.

Primary Actor: SmartHome+ Platform

Supporting Actors: End User, Sensors, Kitchen devices, Kitchen timer

Stakeholders and Interests:

- **Internet service provider:** wants the communication to be reliable to send and receive important signals between SmartHome+ and kitchen devices.
- **Interior architect:** wants the sensors installed properly in order to report signals.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Construction worker:** wants the kitchen devices to be installed correctly and work as expected.
- **Customer service representative:** wants to serve the users in case of any queries related to working of the kitchen devices.
- **Maintenance technician:** wants to repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding building secure and safe kitchen devices and reporting status to SmartHome+ app are elicited correctly.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions:

The timeout sensors should work properly and should send and receive messages to SmartHome+ app.

Post-Conditions:

Success end condition: Kitchen devices switch off automatically after a certain time (set by user or emergency case) to avoid further complications.

Failure end condition: Kitchen devices keep running, timer not work properly, platform not receive message, sensor not detect error.

Minimal Guarantee:

Platform or the devices will notify users of the status of each device at any cost.

Main Success Scenario:

1. The user will initially set a timeout after which the kitchen devices will switch off automatically.
2. The user wants to cook something, switches on and sets the timer of the kitchen devices such as the stove and places the range hood.
3. The timer starts relatively and keeps running until it reaches the timeout set by the user.
4. The timer reset the timeout once the sensor find pot is placed back on.
5. The timer sends a notification to the platform once the timeout is reached, to check whether to switch off or not.
6. The SmartHome+ platform checks the timeout registered against the device and sends a signal to the target kitchen devices to be switched off.
7. The kitchen devices are switched off and a message is sent to SmartHome+ platform regarding its status.

Extensions (or Alternate Flows):

- a. If the sensors which detect the placing and removing of vessels on the stove, does not work, then the device will consume a lot of energy. In such cases, SmartHome+ will wait till the timeout set by the user is reached and will automatically notify user about the failure of the sensor
- b. Due to network issues, if the device close signal is not sent from SmartHome+ application, then the device will continue to run forever, creating further complications. In such cases, the running device will turn off automatically by itself after a certain time (say 10-20 seconds).

Id: UC11

Use Case: Use water optimally [5]

Level: User-goal

Description: In order to reduce waste of water, the water usages will be recorded and learned by platform with a period. This will depend on the time, location and volume. After that an automatically expected usage per target source will be generated, once unexpected usages are funded, it will ask user opinion, if no response, the platform will turn off the target devices.

Primary Actor: End User

Supporting Actors: SmartHome+, Sensors, Water devices

Stakeholders and Interests:

- **Internet service provider:** wants the communication to be reliable to send and receive important signals between SmartHome+ and kitchen devices.
- **Interior architect:** wants the sensors installed properly in order to report signals.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Construction worker:** wants the water consumption devices to be installed correctly and work as expected.
- **Customer service representative:** wants to serve the users in case of any queries related to working of the water devices.
- **Maintenance technician:** wants to repair and fix devices which run into problems.

- **Requirement Manager:** ensures all requirements regarding building secure and energy efficient water devices and reporting status to SmartHome+ app are elicited correctly.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions:

The water sensors should work properly and should send and receive messages to SmartHome+ app. The water system needs work normally, non blocking.

Post-Conditions:

Success end condition: Water devices switch off automatically after violating energy efficient protocol in platform and user-defined requirements.

Failure end condition: Water devices keep running, not turn off properly, platform not receive message, sensor not detect errors.

Minimal Guarantee:

The water devices do not worsen water usages. Platform or the devices will notify users of the status of each device at any cost.

Main Success Scenario:

1. The SmartHome+ platform working 7x24, keeps monitoring all sensor feedback.
2. After a month, the platform learned end-user normal water usages.
3. The user forgot to turn off one of the water taps at the garden.
4. The sensor sends an unexpected value of usages for the garden water tap.
5. The platform finds abnormal situations, notify users and wait for feedback.
6. The user does not feedback on time within 2 mins.
7. The platform treats this action as violation of the energy efficiency protocol, automatically turning off the water tap at target location.
8. The user is back, finding the abnormal notification, marking the platform treatment as satisfied.
9. The platform received user feedback, learning this standard and updated on energy efficiency protocol.

The platform back to step 1.

Extensions (or Alternate Flows):

1. Water sensor not response.
 - 1a. The manually checking request will be notified to user.
 - 2b. Depending on the situation, the user needs to ask for help from a maintenance technician.
2. End-User not at home.
 - 2a. The locational sensor keeps sending 'none' value of person detection.
 - 2b. The SmartHome+ platform skipped this month, back to step1.
8. The user marked the treatment as unsatisfied.
 - 8a. The platform received user feedback, ask users to define treatment.

8b. The user defined expected action via client App.

Id: UC12

Use Case: Use electricity optimally[6]

Level: User-goal

Description: The platform will based on energy consumption data provided by sensors, build a model of user power usage as shown below[7]. It can be based on user normal consumption, reduce the electricity usage by automatically turning off devices, and send notification when abnormal situations happen.

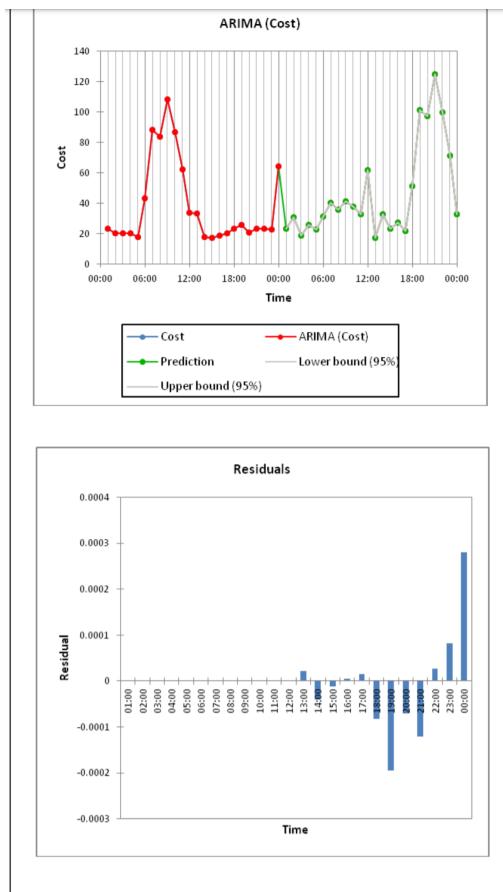


Figure 5.24 Cost of household 10 on April 28

Flow Chart:

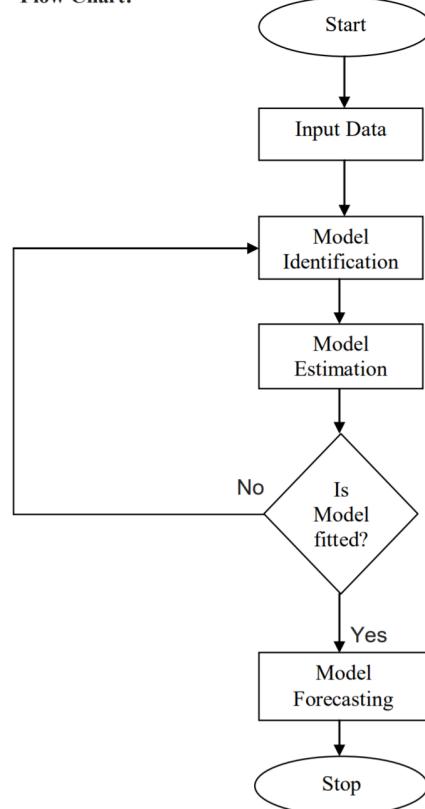


Figure 5.16 Flow chart of ARIMA Modeling

Primary Actor: End user

Supporting Actors: SmartHome+, Sensors, Electricity devices

Level: User-goal

Stakeholders and Interests:

- **Internet service provider:** wants the communication to be reliable to send and receive important signals between SmartHome+ and kitchen devices.
- **Interior architect:** wants the sensors installed properly in order to report signals.

- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Construction worker:** wants the electricity consumption devices to be installed correctly and work as expected.
- **Customer service representative:** wants to serve the users in case of any queries related to working of the electricity devices.
- **Maintenance technician:** wants to repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding building secure and energy efficient electricity devices and reporting status to SmartHome+ app are elicited correctly.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions:

The electricity sensors should work properly and should send and receive messages to SmartHome+ platform. The electricity system needs work normally.

Post-Conditions:

Success end condition: Electricity devices switch off automatically after violating energy efficient protocol in platform and user-defined requirements.

Failure end condition: Electricity devices keep running, not turn off properly, platform not receive message, sensor not detect errors.

Minimal Guarantee:

The electricity devices do not worsen electricity usages. Platform or the devices will notify users of the status of each device at any cost.

Main Success Scenario:

1. The SmartHome+ platform keeps monitoring all sensor feedback.
2. After a month, the platform learned end-user normal electricity usages.
3. The user forgot to turn off the TV at the dining room.
4. The sensor sends an unexpected value of usages for the TV at the dining room.
5. The platform finds abnormal situations, notify users and wait for feedback.
6. The user does not feedback on time within 2 mins.
7. The platform treats this action as violation of the energy efficiency protocol, automatically turning off the TV at target location.
8. The user is back, finding the abnormal notification, marking the platform treatment as satisfied.
9. The platform received user feedback, learning this standard and updated on energy efficiency protocol.

The platform back to step 1.

Extensions (or Alternate Flows):

1. Electricity sensor not response.
 - 1a. The manually checking request will be notified to the user.
 - 2b. Depending on the situation, the user needs to ask for help from a maintenance technician.
 2. End-User not at home.
 - 2a. The locational sensor keeps sending 'none' value of person detection.
 - 2b. The SmartHome+ platform skipped this month, back to step1.
 8. The user marked the treatment as unsatisfied.
 - 8a. The platform received user feedback, ask users to define treatment.
 - 8b. The user defined expected action via client App.
-

3.5 Environmental Considerations

Id: UC13

Use Case: Control home temperature

Description: Users can set preference to adjust temperature of the house in different climates. Platform will adapt user behavior and change temperature accordingly. Users can control temperature through SmartHome+ application from anywhere at any time.

Level: User-goal

Primary Actor: End User

Supporting Actors: SmartHome+ Platform, Thermostat, Sensors, Air Conditioner, Window

Stakeholder and Interests:

- **End User:** Wants to have a pleasant home environment. Home environment is relaxing and refreshing when coming back home from work or outings.
- **SmartHome+ Platform:** Wants to make the home environment relaxing, pleasant and refreshing by considering user preference and adapting to user behavior.
- **Interior Architect:** Wants to make sure the user gets the same feeling when roaming in the home. Want to make sure the design and placement of the thermostat is optimal and cover each and every corner of home.
- **Construction Worker:** Wants to make sure that thermostats are installed as suggested by interior architects.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Maintenance technician:** wants to easily repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding temperature control are smart and energy efficiency.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions: Thermostat is receiving user requests correctly.

Post-Conditions:

Success End Condition: Users temperature change request received successfully. Platform understands and processes requests accurately. Home temperature is set as requested by the user.

Failure End Condition: Platform did not receive users temperature change request because of network issue or packet loss. Platform misunderstands and processes requests wrongly. Home temperature is not set as requested by the user. Thermostat is not working at all.

Minimal Guarantee: Platform will give feedback on the UI to notify users.

Main Success Scenario:

1. User open thermostat control panel to change temperature. User issue temperature change request.
2. Thermostat receives a temperature change request from the user.
3. Thermostat sends the temperature changing request to the platform.
4. The platform ask sensor provides outdoor/indoor temperature data.
5. The sensor sends feedback data to the platform.
6. The platform commands home windows close, and adjust the air conditioner.
7. Air conditioner adjusts the temperature as requested by the user, and the windows executes close action. Notify the platform complete.
8. The platform notifies the user about modified temperature settings.

Extensions (or Alternative Flows):

- a. Thermostat is misbehaving:
 - a1.Thermostat is performing the opposite operation then requested by the user.
 - a2. Platform recognise and notify users about thermostat malfunction.
 - a3. Users immediately request a technical assistant.
- b. When home temperature reaches set temperature:
 - b1.Platform puts the temperature control unit to sleep state to prevent overutilization of resources.
 - b2. Platform automatically wakes up the temperature control unit when home temperature deviates from set temperature.
- c. User wants to make surrounding cool:
 - i. Outside temperature is lower than inside temperature
 1. Platform opens the window and door.
 - ii. Platform start an air-conditioning unit.

Special Requirements:

- Platform should be able to control home temperature in an energy efficient way
 - Platform should be able to predict user behavior in uncertain situations.
-

Id: UC14

Use Case: Control air purity level

Description: Users can set preference to adjust air purity level as shown below[10] of the house in different climates and times. Platform will adapt user behavior and change air purity level accordingly. Users can control air purity level through SmartHome+ platform from anywhere at any time.

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Level: User-goal

Primary Actor: End User

Supporting Actors: SmartHome+ Platform, Air purifier, Sensor, Window, Smart phone

Stakeholder and Interests:

- **End User:** Wants to have a pleasant air purity level. Home environment is relaxing and refreshing when coming back home from work or outings.
- **SmartHome+ Platform:** Wants to make the home air purity level relaxing, pleasant and refreshing by considering user preference and adapting to user behavior.
- **Interior Architect:** Wants to make sure the user gets the same feeling when roaming in the home. Want to make sure the design and placement of the thermostat is optimal and cover each and every corner of home.
- **Construction Worker:** Wants to make sure that air purity devices and sensors are installed as suggested by interior architects.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Maintenance technician:** wants to easily repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding air purity control are smart and energy efficiency.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions: All air purity level related devices work normally. The platform can receive user requests correctly.

Post-Conditions:

Success End Condition: Users air purity change request received successfully. Platform understands and processes requests accurately. Home air purity is set as requested by the user.

Failure End Condition: Platform did not receive users air purity change request because of network issue or packet loss. Platform misunderstands and processes requests wrongly. Home temperature is not set as requested by the user. Air purity sensor is not working at all.

Minimal Guarantee: Platform will give feedback on the UI to notify users.

Main Success Scenario:

1. The User adjusts target purity level 40-50 via smartphone.
2. The platform received a target purity level request, asking the sensor to provide information.
3. The sensor indoor and outdoor send feedback of purity level to the platform.
4. The platform makes a judgement, finds outer purity higher than inner, temperature also lower than inner(summer), asks all windows open and turns on the air purifier.
5. The window receives a message, asking the sensor to provide obstacle detection results. The air purifier receives a message at same time, turns on itself.
6. The sensor sends feedback to the platform, indicating 1 window has block.
7. The platform confirms all windows open actions, sends it to the rest of windows.
8. Windows executes open action.
9. Air purifier and window send a report to the platform.
10. The platform informs the user of the result. Suggest the user manually check the obstacles window.
11. Sensors send value when they reach target purity level.
12. Platform received value, close window, turn off air purifier

Extensions (or Alternative Flows):

4. Platform finds reverse values.
 - 4a. Invers actions, turn off purifier, close windows
 - 4b. Notify users.
9. Platform not receive reports of devices.
 - 4a. inform the target window and air purifier resend report.
 - 4b. Notify users.

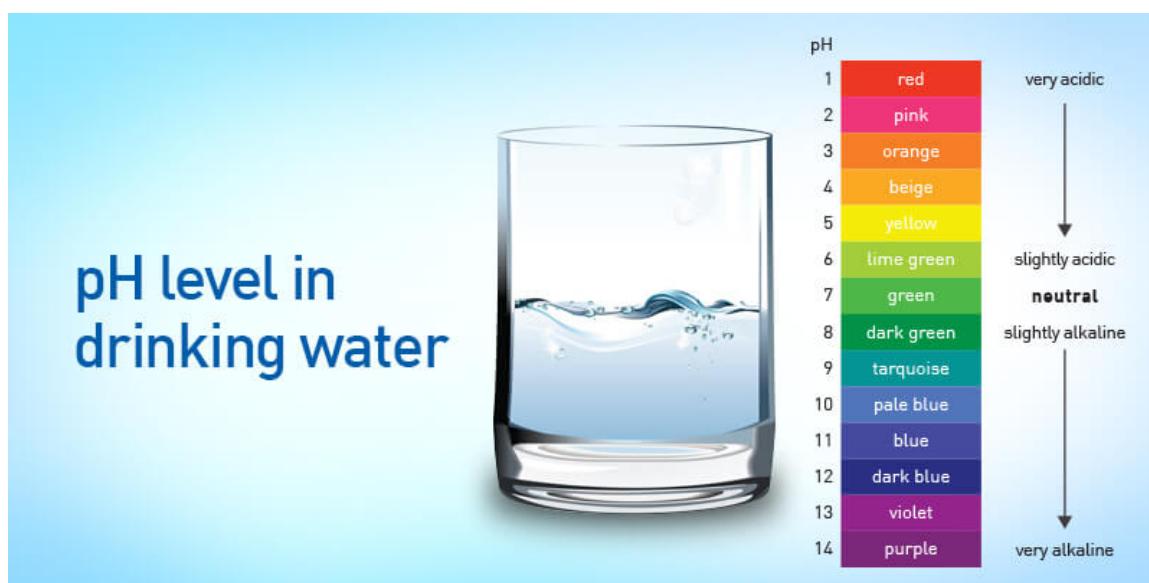
Special Requirements:

- Platform should be able to control home air purity level in an energy efficient way
- Platform should be able to predict user behavior in uncertain situations.

Id: UC15

Use Case: Control water pH level

Description: Users can set pH level from recommended values 6.5 - 8.5[8], to adjust pH level of the house. Platform will adapt water source pH level behavior and change to target pH level accordingly as shown below[9]:



Level: User-goal

Primary Actor: End User

Supporting Actors: SmartHome+ Platform, Water purifier, Sensor, Smart phone

Stakeholder and Interests:

- **End User:** Wants to have a pleasant water pH level. Home water is healthy and refreshing when coming back home from work or outings.
- **SmartHome+ Platform:** Wants to make the home water pH level healthy, pleasant and refreshing by considering user preference and adapting to user behavior.
- **Interior Architect:** Wants to make sure the user gets the same feeling when roaming in the home. Want to make sure the design and placement of the thermostat is optimal and cover each and every corner of home.
- **Construction Worker:** Wants to make sure that water pH devices and sensors are installed as suggested by interior architects.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Maintenance technician:** wants to easily repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding air purity control are smart and energy efficiency.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions: All water pH related devices work normally. The platform can receive user requests correctly.

Post-Conditions:

Success End Condition: Users water pH change request received successfully. Platform understands and processes requests accurately. Home temperature is set as requested by the user.

Failure End Condition: Platform did not receive users temperature change request because of network issue or packet loss. Platform misunderstands and processes requests wrongly. Home temperature is not set as requested by the user. Thermostat is not working at all.

Minimal Guarantee: Platform will give feedback on the UI to notify users.

Main Success Scenario:

1. The User adjusts target pH level range 6.5-7.5 via smartphone.
2. The platform received a target pH level range request, asking the water sensor to provide information.
3. The sensor indoor and outdoor send feedback of pH level to the platform.
4. The platform makes a judgement, sets important water taps as drinkable level 7, others for shower and wash machine to level 6.5 and 7.5.
5. The water purifier gets command from the platform, generate target pH level based on output tubes.
6. The sensor confirms all tubes pH level changes, sends it to the platform.
7. The platform confirms new pH level, update to user smarthome.

Extensions (or Alternative Flows):

4. Platform finds unreachable values.
 - 4a. Warning to user, ask user to modify pH value.
 - 4b. Users reset the pH value range.
6. Platform not receive target pH value of sensors.
 - 4a. inform the target water purifier retry.
 - 4b. Notify users.

Special Requirements:

- Platform should be able to control home water purity and pH level in an energy efficient way
- Platform should be able to predict user behavior in uncertain situations.

3.6 Media and Entertainment

Id: UC16

Use Case: Watch Movie/Series/News/Webs

Description: Platform will provide online information for entertainment and web browsers. Users can connect to any resources by their interests. The resources will be demonstrated as video or audio.

Level: User-goal

Primary Actor: End User

Supporting Actors: SmartHome+ Platform, Speaker, Smart phone, Sensor, Play devices, Internet Service Provider

Stakeholder and Interests:

- **End User:** Wants to get personalized information about their personal interests. Through video or audio playback. Want to know about updated news and get recommendations about what to play with.
- **SmartHome+ Platform:** Wants to provide useful information and entertainments. Identify different users and provide personalized experience.
- **Internet Service Provider:** Wants to provide reliable and secure communication channels.
- **Interior Architect:** Make communication and interaction devices aesthetically pleasant.
- **Construction Worker:** Wants to make sure that play devices and sensors are installed as suggested by interior architects.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Maintenance technician:** wants to easily repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding entertainments are smart and energy efficiency.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions: Platform has access to the world wide web. Bandwidth of the internet could meet the 4k video streaming request. Platform has information to identify each user distinctly.

Post-Conditions:

Success End Condition: Platform identifies users correctly and provides satisfactory personalized entertainments actions. Users get all the resources about their interest.

Failure End Condition: Platform unable to identify users correctly resulting in unsatisfactory service. Users did not get any information or get updates.

Minimal Guarantee: Platform will notify users about the state of their request with the most reliable, efficient and fast way.

Main Success Scenario:

1. The user that voice controls turns on TV(play device).
2. This smart speaker records the request, sends requests to the platform.
3. The platform transfers voice to command, understanding that it is turned on TV. Send TV on request to the target location.
4. The TV turns on, asking the sensor to detect user identity.
5. The sensor detects the user, and sends it to platform that user 1 is using TV.
6. The platform searched for the newest entertainment context related to user 1 interests.
7. The platform streams recommended context to TV, waiting for user further command.
8. The TV received streaming context, start playback.

Extensions (or Alternate Scenarios):

- a. Sensors find unauthorized people who want to use TV.
 - a1. Sensors send warnings to the platform.
 - a2. Platform using the monitor system rechecks the situation.
 - a3. Platform confirms the unauthorized person, and asks if the administrator approves.
- b. Searching for entertainment context failure.
 - b1. Platform provides old context on the local disk first.
 - b2. Platform automatically retries for alternative resources.
 - b3. Platform sends a notification to the user.

Special Requirements:

- Platform should be able to identify users in multiple ways like by voice, face or fingerprint.
- Platform should be able to recognize the user presence correctly and then read out the notification.

Id: UC17

Use Case: Communicate via social media updates

Description: Platform will provide information about different events and updates about users' social circle personalized to each of the family members by any medium (voice or display). Users can connect to anybody from their circle by video or audio.

Level: User-goal

Primary Actor: End User

Supporting Actors: SmartHome+ Platform, Speaker, Smart phone, Sensor

Stakeholder and Interests:

- **End User:** Wants to get personalized information about what is happening in their social circle. Want to talk to friends, family members or colleagues through video or audio calls. Want to know about upcoming events and get suggestions about future events.
- **SmartHome+ Platform:** Wants to provide useful information and updates interactively. Identify different users and provide personalized experience.
- **Internet Service Provider:** Wants to provide reliable and secure communication channels.
- **Interior Architect:** Make communication and interaction devices aesthetically pleasant.

Pre-Conditions: Platform has access to users' social media accounts and friends, family members and colleagues contact details. Platform has information to identify each user distinctly.

Post-Conditions:

Success End Condition: Platform identifies users correctly and provides satisfactory personalized updates. Users get all the updates about their social circle. End-user is able to connect with others via reliable and secure communication channels.

Failure End Condition: Platform unable to identify users correctly resulting in unsatisfactory service. Users did not get any information or get updates about other family members' social circle. Users are not able to connect with their friends and relatives reliably.

Minimal Guarantee: Platform will notify users about the state of their request with the most reliable, efficient and fast way.

Main Success Scenario:

1. A sensor will recognize the user that has entered the room.
2. This sensor will send a notification to SmartHome+ about the availability of the user.
3. The SmartHome+ platform will in turn notify the device which will read out the social media updates and call related information using voice.
4. The device will first read out all the calls that the user couldn't answer or missed.
5. It will ask for the user to call any of those contacts.
6. The user will name the caller and this info will be sent from the device to SmartHome+.
7. SmartHome+ will make a connection to the users mobile phone and a call will be made.
8. After the call, the voice device will read out any important updates or posts.
9. Then the user can decide whether to take any action on those social media updates.

Extensions (or Alternate Scenarios):

- a. The sensor which detects user presence does not work properly, and the user might end up missing out on important information. In such cases, the user will receive notifications about all these through SmartHome+ app.
- b. If the voice control device does not read out the updates even after being signalled by the SmartHome+ app, then the app will notify the user about the problem faced by the voice control device.

Special Requirements:

- Platform should be able to identify users in multiple ways like by voice, face or fingerprint.
- Platform should be able to recognize the user presence correctly and then read out the updates.
- Platform should read out the missed call information and important social updates first and without fail.

Use Case: Play video game remotely

Description: Platform will provide ports for TV and Projector for video game platforms such as Stream, Nintendo Switch and Playstation etc[11]. Users can play games via Wifi environment anywhere with display devices in home.



Level: User-goal

Primary Actor: End User

Supporting Actors: SmartHome+ Platform, Speaker, Sensor, Play devices, Game console, Controller, HDMI to Wifi converters

Stakeholder and Interests:

- **End User:** Wants to have convenient game streaming without lagging.
- **SmartHome+ Platform:** Wants to provide useful game streaming features. Identify controller and HDMI Wifi converter.
- **Internet Service Provider:** Wants to provide reliable and secure communication channels for high speed game remote streaming with low lagging.
- **Interior Architect:** Make communication and interaction devices aesthetically pleasant.
- **Construction Worker:** Wants to make sure that play devices and sensors are installed as suggested by interior architects.
- **Technology provider:** wants to make sure that technology with which it's developed is safe and reliable.
- **Maintenance technician:** wants to easily repair and fix devices which run into problems.
- **Requirement Manager:** ensures all requirements regarding entertainments are smart and energy efficiency.
- **Project Manager:** wants the team to work in developing these devices and makes sure they report properly to the SmartHome+ app.
- **Developer:** ensures these devices are programmed and should be able report to the users in case of any failure at any cost.

Pre-Conditions: Platform has access to users' gaming consoles, controllers and HDMI to Wifi converters.

Post-Conditions:

Success End Condition: Platform identifies users correctly and provides satisfactory stream video and audio.

Failure End Condition: Platform unable to identify users correctly resulting in unsatisfactory service. Users did not get any stream. Users are not able to connect with their devices.

Minimal Guarantee: Platform will notify users about the state of their request with the most reliable, efficient and fast way.

Main Success Scenario:

1. The user asks the speaker to start game console game streaming.
2. The speaker received the voice, and transferred command to the platform.
3. The platform detected user voice, authorized user detected. Start activates game console switcher to turn on condition.
4. The game console received command, turned on itself.
5. The graphic information and sound are transferred through the HDMI port to Wifi signal. Send to the platform.
6. The platform verified signal, transfer to speaker's location play devices.
7. The target play device projector received platform request, automatically turned on and started streaming Wifi signal.
8. The platform starts monitoring Wifi signals, ensuring it's stable and low lagging.
9. The play device projector asks the user to link the controller to the platform.
10. The user adds a controller through a smart speaker bluetooth environment.
11. The speaker port controller to the platform relatively.
12. The platform confirms the controller.

Extensions (or Alternate Scenarios):

- a. Sensors find unauthorized people who want to play games.
 - a1. Sensors send warnings to the platform.
 - a2. Platform using the monitor system rechecks the situation.
 - a3. Platform confirms the unauthorized person, and asks if the administrator approves.
- b. Start the game console failure.
 - b1. Platform sends a notification to the user.
 - b2. Users manually check the game console condition and the remote switcher condition.
8. The platform detected lagging over 100ms.
 - 8a. The platform drops the monitoring mode, bridge Wifi signal to target projector directly.
 - 8a. The platform asks users to provide feedback, confirm the lagging is solved.

Special Requirements:

- Platform should be able to identify users in multiple ways like by voice, face or fingerprint.

- Platform should be able to recognize the user presence correctly and then read out the notification through the speaker.
 - Platform should bridge the multiple speakers with main playback devices, and support 7.1 sound stage for many games.
-

3.7 Brief Use Cases

Some use cases that are labeled as brief, are complement use cases for section 3.1-3.6 fully dressed main use cases. This part will cover the rest of needs and features from vision document[1].

ID: UC19

Use Case: Protect home from theft

Actor: SmartHome+ Platform, End User

Description: The SmartHome+ platform monitors home continuously. If any trespasser tries to open any window or door by breaking the security system or forcefully breaking it, the platform informs end-users about unauthorised access. In case unauthorised person manages to enter the home platform will inform legal authorities immediately and intimate users about the same.

ID: UC20

Use Case: Monitoring House

Actor: SmartHome+ Platform

Description: The SmartHome+ will engage all the devices which monitor the house like CCTV cameras, user presence detection sensors, air purity control, fire detection sensors, etc., to run 24x7 and notify the user in case of any problems or danger situations. The user will also give general instructions based on the problem at hand and suggest users to take that course of action.

ID: UC21

Use Case: Open/Close Doors and Windows automatically

Actor: End User, Sensors, SmartHome+ Platform

Description: The ease of opening and closing doors is at tips of the user, as they can control all windows and doors from almost anywhere in the world, provided the user needs to be connected to the internet.

ID: UC22

Use Case: Update News

Actor: End User, SmartHome+ Platform

Description: Platform ask users for their news preference like interested topic and preferred news sites. Users will provide subscription information to the platform. After collecting all the required information, the system will provide news updates using different interaction methods like mobile notification, display or read out news highlights, play news related video on TV etc. News Feeds are interactive so users can explore deeply in particular new or related news.

ID: UC23

Use Case: Update Daily Weather

Actor: End User, SmartHome+ Platform, Smart Phone, ISP

Description: Platform monitors user daily travel or work routine location wise. Users can ask weather update locations they are planning to travel. In case of bad weather, the platform notify users in advance. This will be based on UV/Temperature sensor, and GPS information.

ID: UC24

Use Case: Update Traffic

Actor: End user, SmartHome+ Platform, Map Services, Smart Phone, ISP

Description: Platform stores all the information related to frequently visited places by users like work location, children school or friends/relatives house with their consent. SmartHome+ platform will notify the user before he/she leaves for work with the traffic condition of the normal route that the user takes and suggests alternative paths.

ID: UC25

Use Case: Find my device

Actor: SmartHome+ Platform, Sensors

Description: This feature enables the user to find their mobile devices or tablets either by the SmartHome+ app, which will automatically ring the searching device or by available sensors, which will detect the searching device is near to it or not, and the SmartHome+ app will notify the user about its location near that sensor, thus reducing the search area.

ID: UC26

Use Case: Set Parental Control

Actor: End User, SmartHome+ Platform

Description: This is one of the most important features as almost all the devices will ask for parental control at one point of time. This will enable additional security and safety, and the user will also know about the status of each device as the user intervenes.

ID: UC27

Use Case: Set Sleep Tracker

Actor: SmartHome+ Platform, Sensors

Description: The SmartHome+ will collect all information from users alarms, time on bed using user detection sensors and also from the information given directly by the user themselves. Taking all the information into consideration, the SmartHome+ will run some analysis and notify the user about the sleep schedule, give suggestions if needed and so on.

4. Use Case Verification

From the above use cases, the EBP/Boss has been used to test them relatively. The verification result as shown below:

ID/Name	EBP Test		Boss Test	
UC01: Interacting with platform to play music	Pass	The user(one person) enters information to achieve interaction with the platform(one place) at one time. This process is a valuable business operation, and also generates measurable business value and leaves the data in a consistent state(such as user instructions, etc.)	Pass	The user inputs instruction information through the platform or other systems. The platform collects user information (actions, sounds, etc.) and converts the information into machine commands, and informs the hardware system (controllers, etc.), which delivers measurable value to user(The operation can produce valuable results)
UC02: Access monitors of house	Pass	Users can access and get services from the SmartHome+ platform from anywhere at any time. This process is a valuable business operation, and also generates measurable business value and leaves the data in a consistent state.	Pass	This use case delivers measurable value(access time, location) to the user, which makes the boss satisfied, so it passes the Boss Test.
UC03: Remote control of smart lighting	Pass	The SmartHome+ platform provides users remote control smart lighting devices, which generate measurable business value as benefits to users.	Pass	This use case delivers measurable value(Lighting illumination location and number) to the user, which makes the boss satisfied, so it passes the Boss Test.

UC04: Notify residents CO(Carbon Monoxide) over limit	Pass	The SmartHome+ platform notifies users of CO information, which generates measurable business value CO index related to risk and maintain price.	Pass	This use case delivers measurable value(Sensor data related to CO index) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC05: Verify gate access	Pass	When end users access gates or doors of the house, the platform identifies users by biometric authentication. This generates measurable business value and leaves the data in a consistent state(such as users' biometric information etc.)	Pass	This use case delivers measurable value(Verify times and gate location, process duration) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC06: Execute Emergency Protocols	Pass	This use case can reduce the loss, even save life. So it generates measurable business value.	Pass	This use case delivers measurable value(Execute emergency protocols times, location, process duration) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC07: Generate devices health report	Pass	Platform check itself and report to users regularly, which helps users to figure out problems,if any, as soon as possible. Furthermore, it helps to avoid system errors and failures. This generates measurable business value and leaves the data in a consistent state.	Pass	This use case delivers measurable value(Reports length, times, scope, process duration) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC08: Do the System Backup and Recovery automatically	Pass	The SmartHome+ platform backup and repair itself automatically, which helps to avoid system errors and failures. This generates	Pass	This use case delivers measurable value(Backup size(MB,GB), duration, scope,recovery speed) to the user, which makes the boss satisfied,so it passes

		measurable business value and leaves the data in a consistent state.		the Boss Test.
UC09: Set alarms and reminds	Pass	This use case improves the automation of user daily life, saving overhead on time scheduling. Thereby helping users save living costs	Pass	This use case delivers measurable value(Time, output schedule) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC10: Control kitchen devices state	Pass	This use case can save users' expenses on energy utilities in the kitchen, the fee of electricity, gas etc.	Pass	This use case delivers measurable value(Energy consumption value, running time, price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC11: Use water optimally	Pass	This use case can save users' expenses of water utilities, the fee of water purifying and water usages, etc.	Pass	This use case delivers measurable value(Water consumption value, running time, price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC12: Use electricity optimally	Pass	This use case can save users' expenses of electricity utilities, the fee of electricity etc.	Pass	This use case delivers measurable value(electricity consumption value, running time, price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC13: Control home temperature	Pass	This use case can improve users' comfortableness and health, which can make users interested about the platform and generate huge market value.	Pass	This use case delivers measurable value(Environmental satisfied degree, save cost on AC, running time, price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC14: Control air purity level	Pass	This use case can improve users'	Pass	This use case delivers measurable

		comfortableness and health, which can make users interested about the platform and generate huge market value.		value(Environmental satisfied degree, save cost on air purifier, running time, price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC15: Control water pH level	Pass	This use case can improve users' water quality and health, which can make users interested about the platform and generate huge market value.	Pass	This use case delivers measurable value(Environmental satisfied degree, save cost on water post processing, running time, price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC16: Watch Movie/Series/News /Webs	Pass	This use case can improve the quality of users' life, which can generate a lot of business value.	Pass	This use case delivers measurable value(Number of entertainments, save cost on search time, enjoyment from activities) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC17: Communicate via social media updates	Pass	This use case can make users' life much easier and helps to avoid missing important information, which generates measurable business value.	Pass	This use case delivers measurable value(Contact number, save cost on information aggregation, enjoyment from activities) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC18: Play video game remotely	Pass	This use case can improve users' experience, which can make users interested about the platform and generate huge market value.	Pass	This use case delivers measurable value(Playing time, saving time on streaming manually, running time, price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC19:	Pass	This use case can improve users' security	Pass	This use case delivers measurable value(Theft

Protect home from theft		level, which can make users benefits about the platform and generate huge market value.		cases number, protecting time, running time, human source price saved) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC20: Monitoring House	Pass	This use case can improve users' security level and automatically level(via monitoring system, platform could detect many things), which can make users benefits about the platform and generate huge market value.	Pass	This use case delivers measurable value(Video recorded, data size, event number) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC21: Open/Close Doors and Windows automatically	Pass	This use case can improve users' automatic level, which can make users benefits about the platform and generate huge market value.	Pass	This use case delivers measurable value(Access times, history tracing, price benefits) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC22: Update News	Pass	This use case can improve users' information aggregation level, which can make users benefits about the platform and generate huge market value.	Pass	This use case delivers measurable value(news pages, history tracing, price benefits) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC23: Update Daily Weather	Pass	This use case can improve users' information aggregation level, which can make users benefits about the platform and generate huge market value.	Pass	This use case delivers measurable value(UV index, weather tracing, price benefits) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC24: Update Traffic	Pass	This use case can improve users' information aggregation level, which can make users benefits about the	Pass	This use case delivers measurable value(Maps real time information, GPS tracing, save price for GPS) to the user,which

		platform and generate huge market value.		makes the boss satisfied,so it passes the Boss Test.
UC25: Find my device	Pass	This use case can improve users' convenience related to loss and find, which can make users benefits about the platform and generate huge market value.	Pass	This use case delivers measurable value(Locations, GPS tracing, save price for accidents) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC26: Set Parental Control	Pass	This use case can improve users' convenience related to control kids access, which can make users benefits about the platform and generate huge market value.	Pass	This use case delivers measurable value(Users number, authorized devices, save price for management) to the user,which makes the boss satisfied,so it passes the Boss Test.
UC27: Set Sleep Tracker	Pass	This use case can improve users' convenience and automation, improve health level for the human body, which can make users benefits about the platform and generate huge market value.	Pass	This use case delivers measurable value(Sleep time, snore, save price for health care) to the user,which makes the boss satisfied,so it passes the Boss Test.

Reference

1. Vision Document 2.0, 2020, Team30
2. Archana Tripathy, An evolutionary IOT application, 2017, International Journal of Engineering Science Invention
3. <https://www.visual-paradigm.com/guide/uml-unified-modeling-language/what-is-sequence-diagram/>
4. Week 6b. UML Sequence and activity diagrams, 2020, SOEN 6481
5. <https://www.androidcentral.com/best-smart-water-monitoring-system>
6. Rausser, Gordon & Strielkowski, Wadim & Streimikiene, Dalia. Smart meters and household electricity consumption: A case study in Ireland. Energy & Environment. 2017, 29. 0958305X1774138. 10.1177/0958305X17741385.
7. Praveen Vadda, Sreerama Murthy Seelam, Smart Metering for Smart Electricity Consumption, Master Thesis Electrical Engineering May 2013, School of Computing Blekinge Institute of Technology
8. <https://water-research.net/index.php/water-treatment/tools/the-ph-of-water#:~:text=The%20pH%20scale%20ranges%20from%200%20to%2014.&text=In%20general%2C%20a%20water%20with,groundwater%20systems%206%20to%208.5.>
9. <https://www.kent.co.in/blog/ph-level-in-drinking-water-why-do-you-need-to-concerned/>
10. <https://scijinks.gov/air-quality/>
11. https://techcrunch.com/2019/03/14/valve-lets-you-stream-steam-games-from-anywhere/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xILmNvbS8&guce_referrer_sig=AQAAABjZrJ6Gh7fGm8-6GMDW42KYJ7Y6yemJQZH3_JPjPxTxSJfV-Fc1NxzuX8_Vt0-apSBCjN3fpc8jEC07d2uS0ZtkGrA8f_7NjhY5IMwCTZ93fFcKIX9dxgABz5N3I00-IEaR5hMbJZT6ihGMcebVYIJwAvhne-hgl6kGIYR_Zni
12. <https://musically.com/wp-content/uploads/2018/03/SmartSpeakersFinal.pdf>
13. Vancea, A. & Orha, Ioan.. Smart home automation and monitoring system. 2018, Carpathian Journal of Electronic and Computer Engineering. 11. 40-43. 10.2478/cjece-2018-0007.
14. Li, K.F.. Smart home technology for telemedicine and emergency management. 2012, Journal of Ambient Intelligence and Humanized Computing. 4. 10.1007/s12652-012-0129-8.
15. https://www.craiglarman.com/wiki/downloads/applying_uml/larman-ch6-applying-evolutionary-use-cases.pdf

SmartHome+
Supplementary Specification and Glossary

Version <2.0>

Provided by:(Team-30)

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Table of Contents

1. Introduction	88
1.1 Purpose	89
1.2 Scope	89
1.3 Definitions, Acronyms and Abbreviations	89
1.4 References	90
1.5 Overview	91
2. Functionality	92
2.1 Logging	92
2.2 SmartHome+ Skill App Shop	92
2.3 User Defined Information Aggregation	92
2.4 Data Encryption	92
2.5 Auto Pet-Care	92
3. Usability	92
3.1 Usage	93
3.2 Training	93
3.3 Design for Ease-of-Use	93
3.4 OS Compliance	93
3.5 Online Help	93
3.6 Usability Standards	93
4. Reliability	94
4.1 Availability	94
4.2 Mean Time Between Failures	94
4.3 Mean Time To Repair	94
4.4 Accuracy	94
4.5 Bugs or Defect Rate	94
4.6 Backup Facility	94
4.7 Emergency Response	94
5. Performance	94
5.1 Response time for a transaction	94
5.2 Throughput	95
5.3 Capacity	95
5.4 Degradation modes	95
5.5 Resource utilization	95
5.6 Concurrent User	95
5.7 Database	95
5.8 Expandability	95
6. Supportability	95
6.1 Coding Standards	95
6.2 Naming Conventions	95
6.3 Class Libraries	96

6.4 Maintenance Access	96
6.5 Maintenance Utilities	96
6.6 Automatic Updater	96
7. Design Constraints	96
7.1 Developmental Tools	96
7.2 Software Languages	96
7.3 Software Process Requirements	96
7.4 Using Smart Home Library	97
7.5 Architectural Design Constraints	97
8. Online User Documentation and Help System Requirements	97
9. Purchased Components	97
10. Interfaces	97
10.1 User Interfaces	97
10.2 Hardware Interfaces	97
10.3 Software Interfaces	98
10.4 Communications Interfaces	98
11. Licensing Requirements	98
12. Legal, Copyright and Other Notices	98
13. Applicable Standards	98
14. Glossary	100

Supplementary Specification

1. Introduction

1.1. Purpose

This supplementary specification document is focused on specifying the non-functional requirements with a small part of functional requirements, constraints and system requirements for the SmartHome+ platform. It also specifies the terms and acronyms definitions that are frequently used in the requirements document. In general, this document helps better understanding and elaborate use case document via supplementary requirements.

1.2. Scope

The scope of this supplementary specification is targeted to all non-functional requirements and 20% functional requirements. It is mainly focused on the system's requirements for the SmartHome+ platform.

1.3. Definitions, Acronyms and Abbreviations

Item	Definition
AES	Advanced encryption standard
Android	Android mobile operating system
App	Application software
CO	Carbon monoxide
DES	Data encryption standard
FIFO	First in first out
ISO	International organization for standardization
ISP	Internet service provider
IOS	iPhone operating system
I/O	Input / Output
IFTTT	If This Then That
OS	Operating system

PC	Personal computer
PM	Project management
PH	Hydrogen ion exponent
RM	Requirement management
RSA	Rivest–Shamir–Adleman
STASH	SmartTV Alliance Smart Home
TV	Television
UV	Ultraviolet
UI	User interface

1.4. References

1. Vision Document, 2020, Team 30
2. Design and Fabrication of Smart Home with Internet of Things Enabled Automation System. 2019, IEEE Access. PP. 1-1.
10.1109/ACCESS.2019.2942846.
3. iOS Human Interface Guidelines, 2011, Apple Inc
4. Android UI Design, 2014, Exelixis Media Ltd.
5. ISO 9241-210:2010 Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems, 2010, ISO
6. ISO/IEC 25062:2006 Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability test reports, 2006, ISO
7. ISO/TS 20282-2:2013 Usability of consumer products and products for public use — Part 2: Summative test method, 2013, ISO
8. ISO/IEC 25010:2011 Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — System and software quality models, 2011, ISO
9. The RAID Reliability Anthology – Part 1 – The Primer, 2010,
www.servethehome.com
10. Voice Recognition Still Has Significant Race and Gender Biases, 2019, Harvard Business Review
11. Six-Sigma-A-Complete-Step-by-Step-Guide, 2018, Council for Six Sigma Certification
12. Six Sigma, 2020, Wikipedia

13. Production Defects Are Not Inevitable, 2017, DevOps
14. ISO/IEC 27000 Information Security Management, 2018, ISO
15. ISO 22320:2018 Security and resilience — Emergency management — Guidelines for incident management, 2018, ISO
16. Is there a time limit on Alexa response, 2019, Amazon Developer
17. How much bandwidth does the Echo consume, 2016, Reddit
18. ISO/IEC AWI 9075-1 Information technology — Database languages — SQL — Part 1: Framework (SQL/Framework), ISO
19. The Ultimate IFTTT Guide: Use the Web's Most Powerful Tool Like a Pro, 2017, MakeUseOf
20. OCF SPECIFICATION 2.2.0, 2020, Open Connectivity Foundation
21. Official Android Coding Style Conventions, 2012, Marty Hall
22. Swift Style Guide, 2020, Google
23. Google Assistant Library, 2020, Google
24. Utilities to Maintain Optim Objects, 2020, IBM
25. Smart Home Library Manual, 2016, Smart TV Alliance
26. Local Home SDK Reference, 2020, Google
27. ISO/IEC TR 25060:2010, Systems and software engineering — Systems and software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability: General framework for usability-related information, 2010, ISO
28. ISO/IEC 26514:2008, Systems and software engineering — Requirements for designers and developers of user documentation, 2008, ISO
29. ISO/IEC 90003:2004, Software engineering — Guidelines for the application of ISO 9001:2000 to computer software, 2004, ISO
30. ISO 9000:2000, Quality management systems — Fundamentals and vocabulary, 2000, ISO
31. ISO 9241-210:2010, Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems, 2010, ISO
32. Galitz, Wilbert O. The essential guide to user interface design: an introduction to GUI design principles and techniques. 2007, John Wiley & Sons
33. BSD_licFIPS 197
34. FIPS 197, Advanced Encryption Standard (AES)enses, 2001, National Institute of Standards and Technology
35. ISO/IEC 18033-3:2010, Information technology — Security techniques — Encryption algorithms — Part 3: Block ciphers, 2010, ISO

1.5. Overview

The rest supplementary document contains:

- Functional requirements.
- Non-functional requirements: usability, reliability, performance, supportability, design constraints, system requirements, Interfaces, licensing.
- Other notices, standards and glossary.

The rest supplementary document is organized as:

- In section 2, describes the functional requirements.
- In sections 3 to 11, includes the non-functional requirements.
- In sections 12 and 14, describes the other notices, standards and glossary.

2. Functionality

Based on 80/20 rules, In this section will provide extra several functionalities that may need a more detailed analysis regarding their usage and may be not covered entirely in use cases.

2.1. Logging

Logging function is the platform-level function, which should provide an accurate log file be used for report generating and history tracing. This function is generally used by all smart devices.

Feature sets: All features.

2.2. SmartHome+ Skill App Shop

The SmartHome+ platform will provide an App shop in order to provide advanced skills and new features, end users could choose it as their needs.

Feature sets: Compatibility, Initialization, Smart divides support, Automation setting.

2.3. User Defined Information Aggregation

End users can self define performance information resources, the SmartHome+ platform will provide an automatic information aggregation then update it frequently.

Feature sets: Notification, Dashboard display, Daily routine, Web surfing.

2.4. Data Encryption

The data exchange in SmartHome+ platform needs to be encrypted. Encode methods: Triple DES, RSA, Blowfish, AES been used here.

Feature sets: User privacy, Database management, I/O, Self-diagnosis and repair.

2.5. Auto Pet-Care

The SmartHome+ platform could automatically feed pets via an additional smart pet feeder device. It can monitor pet health situations and send alarms to the end user.

Feature sets: Health monitoring,Notification, Dashboard display, Daily routine.

3. Usability

This section includes all of the SmartHome+ usability requirements. The system needs easy to use and maintenance properties.

3.1. Usage

The SmartHome+ platform shall be available all time and ensure reliability after the client finishes the first time setup[1]. It needs to keep daily performance and connection with smart devices stable.

3.2. Training

The SmartHome+ platform end-users should be able to use the system without formal training, the guide of how to use applications will be shown when they first use SmartHome+. One short initialization training is needed to establish a connection network with smart devices to the SmartHome+ platform. There is no need to do that face by face, it will be 2 mins short demo video included in the App.

3.3. Design for Ease-of-Use

The overall UI and design logic of the SmartHome+ platform shall be designed for ease-of-use and shall be appropriate for a non-technology user community.

3.4. OS Compliance

The SmartHome+ platform shall be running at Android 4.0 to 10.0, and iOS 9 to 14. Also, it shall be compliant with BlueStacks Android emulator running at the PC environment, which are Windows OS xp/7/8/10, and Mac OS 10.0 to 14.2.

3.5. Online Help

All features of the SmartHome+ platform shall have a built-in online help port for the end-user. Online Help document shall include user-friendly step by step instructions on how to use the platform. It also needs a fully detailed demonstration with some examples for deep understanding if needed. The document shall include demo videos, figures, diagrams, and definitions for terms and acronyms.

On the other hand, the online help professional documents will also provide for a maintenance technician with the platform automatically generated diagrammatical reports.

3.6. Usability Standards

The SmartHome+ platform user interface shall be compliant to standard mobile devices UI accessibility features via the App[2]. It needs to be designed to support user-friendly. It also shall follow the iOS Human Interface Guidelines[3] and the Android UI design guide[4].

The ISO standards for SmartHome+ platform usability shall be used are:

1. ISO 9241-210:2010[5]
2. ISO/IEC 25062:2006[6]
3. ISO/TS 20282-2:2013[7]
4. ISO/IEC 25010:2011[8]

4. Reliability

4.1. Availability

The SmartHome+ platform shall be available 24 hours a day, 7 days a week. Which shall be available over 99.05% time after initialization. It shall be no more than 0.95% down time.

The maintenance access is needed for maintenance technicians, the system saves config mode and administrator access also needs to be provided. For degraded mode operations will be designed for unexpected situations that need to sustain basic essential services, drop other unimportant services.

4.2. Mean Time Between Failures

The SmartHome+ platform server running at RAID server disk[9] with high performance, the Mean Time Between Failures shall exceed 3 years.

4.3. Mean Time To Repair

The SmartHome+ platform should be designed to have remote support access functions for technicians and software developers, the Mean Time To Repair shall not exceed 3 hours.

4.4. Accuracy

The SmartHome+ platform should be designed to have over 95.00% accuracy[10] for voice control recognition, for other UI inputs, it needs to reach 99.99% accuracy.

4.5. Bugs or Defect Rate

The SmartHome+ platform should be developed following Six Sigma[11] management protocol, to have less than 0.00034% defect rate[12]. For bugs rate, needs reach less than 5 / 1000 lines of code[13].

4.6. Backup Facility

The SmartHome+ platform should be designed to have backup power. Also needs auto-backup functions following ISO/IEC 27001[14], includes all platform configurations and data.

4.7. Emergency Response

The SmartHome+ platform shall provide multiple emergency response strategies. The strategies include automatic call hotline, asking help, sending alerts to both server and end-user, emergency security mode and self-protection mode. These strategies need following ISO 22320:2018[15].

5. Performance

5.1. Response time for a transaction

The platform must be able to invoke for on request within 1s, complete that request of all transactions within 8s[16] in 95% of the time.

5.2. Throughput

The platform transactions throughput should be less than 20 kbit/s[17], avoiding high throughput for daily transactions will let system benefits without internet delay. For exchange data with the world wide web, should not exceed ISP 90% maximum throughput.

5.3. Capacity

For one house, the platform must be able to accommodate at least 20 end-users.

5.4. Degradation modes

The SmartHome+ degradation modes shall forbid user edit authorization, running all essential serves on config read-only mode. It will keep working but skip the performance boost feature.

5.5. Resource utilization

The SmartHome+ platform application shall take less than 200MB of RAM from user devices, the size of the platform needs not to exceed 5GB. For user data, it needs at least 2TB free storage to keep temp data.

5.6. Concurrent User

The SmartHome+ platform shall support concurrent users for only none conflicts functions when conflicts happen, it will follow requests on FIFO order.

5.7. Database

The SmartHome+ platform shall support ISO/IEC AWI 9075-1[18] standard, using SQL based database.

5.8. Expandability

The SmartHome+ platform shall support IFTTT[19] platform, and support OCF 2.2 certification[20] devices. Also, it needs to support previous old smart home devices for Zigbee, Amazon, Google and Apple.

6. Supportability

This section defines any requirements that will enhance the supportability or maintainability of the system being built.

6.1. Coding Standards

All codes for the SmartHome+ platform need to be based on Official Android Coding Style Conventions[21] using Java 14 and Python. And for iOS needs coding on Swift and C, follow Swift Style Guide[22].

6.2. Naming Conventions

- All identifiers should begin with a letter.
- After the first character, identifiers can have any combination of characters.
- A keyword cannot be used as an identifier.
- Case sensitive.

6.3. Class Libraries

Java 14 Class Library, IFTTT Class Library 1.0.0, Google Assistant Library 1.0[23].

6.4. Maintenance Access

Provides access ports for firemen, policemen, maintenance technician and software developer separately. Need certificate verification before access.

6.5. Maintenance Utilities

For the SmartHome+ platform, IBM Batch Utility[24] has been used to generate the impact analysis report, health report, and it could fast identify problems.

6.6. Automatic Updater

SmartHome+ platform provides a secure, reliable web/local automatic updates feature. Which should include:

- Automatic usage of proxy
- Updates integrity checks using file size and MD5 signatures
- HTTP authentication for secure update access
- Optional server-side license check before downloading updates
- Install only digitally signed update packages signed with the same certificate as the Updater

7. Design Constraints

7.1. Developmental Tools

- Xcode 11.6,
- IDEA IntelliJ 2020.2
- Visual Studio 16.7
- Android Studio 4.2
- AppCode 2019.01

7.2. Software Languages

- C
- C++
- SQL
- Java
- Swift
- Python

7.3. Software Process Requirements

For SmartHome+ software development process, the following requirements must meet:

- Software specification
- Software design and implementation
- Software verification and validation
- Software evolution

7.4. Using Smart Home Library

- STASH JavaScript Library 1.0[\[25\]](#)
- Local Home SDK 1.1.1[\[26\]](#)

7.5. Architectural Design Constraints

The 1.0 alpha version should be completed in one year, the budget should not exceed 350,000 CAD\$. All important codes should be highlighted as red. The font for it should be set as Arial with size 10.

8. Online User Documentation and Help System Requirements

The SmartHome+ platform provides online documentation in order to familiarize users with the platform and properly use its full features. The user only needs to click the help button in the menu bar, a web page navigation should be opened, the help menu window contains a list of all the main topics in ascending alphabetical order.

9. Purchased Components

SmartHome+ platform cannot use independence, it must be used with sensors, smart devices and laptop/mobile/tablet.

- Sensors: Monitor the water Ph level, the CO concentration, the indoor temperature etc. Sensors collect the information and report it to the SmartHome+ platform.
- Smart devices: Smart speaker, smart TV, smart stove, smart microwave/oven, smart water tap, biometric lock and smart lights etc. Smart devices according to the requests sent by SmartHome+ platform to do different operations.
- Laptop/tablet/mobile: The machine which SmartHome+ platform installs.

10. Interfaces

10.1. User Interfaces

The UI of the SmartHome+ platform is interactive and user friendly. The GUI adopts eye-friendly colours and concise icons with text descriptions. And the unified menu bar is always on the left side of the application, the user can easily access any mode.

The design of UI for the SmartHome+ platform meets the Principles of quality, Principle of least astonishment, Principle of habit formation[\[32\]](#).

10.2. Hardware Interfaces

The SmartHome+ platform installed in tablet, mobile or laptop. It uses keyboard, mouse, touch screen, monitor, microphone and sensors as input devices. It also can connect with different smart devices through USB or Ethernet, those devices

operated with the support of device drivers and the proper API hook to the desired functionality.

10.3. Software Interfaces

A SQL version database management system will be used to store the information of each user so there will be a software interface between it and the SmartHome+ platform to enable the interaction.

10.4. Communications Interfaces

The communication interface enables communication between the SmartHome+ platform and other applications, it can receive messages sent by other applications(daily weather, traffic conditions, reminders etc.) and send a confirmation message.

Telecommunication between different machines (laptop, tablet and mobile) also achieved, the operation request sent by one machine can be seen in other machines, machines with higher user authorization can decline or accept this request.

11. Licensing Requirements

To support the sharing of this example project for educational purposes, and because the developers believe that open source software is important for improving the overall quality of software, the project will be licensed under an open-source license. We chose the BSD license[33] for this SmartHome+ platform.

12. Legal, Copyright and Other Notices

The SmartHome+ platform is copyright to their respective owners. All rights reserved. Permission to use all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation. Copyright content must be submitted to respective owners prior to commercial use.

The SmartHome+ platform is intended for academic study only. Researchers involved in this project are not liable for any losses or injuries caused by misuse of this platform or the results of this platform.

13. Applicable Standards

The SmartHome+ platform strictly follow and meet with all ISO/IEC/IEEE standards for Information Technology and Software Engineering, more specifically the following standards:

- ISO/IEC 25062:2006

Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability test reports[6]

- ISO/TS 20282-2:2013
Usability of consumer products and products for public use — Part 2: Summative test method[7]
- ISO/IEC 25010:2011
Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — System and software quality models[8]
- ISO/IEC 27000:2018
Information Security Management[14]
- ISO 22320:2018
Security and resilience — Emergency management — Guidelines for incident management[15]
- ISO/IEC AWI 9075-1
Information technology — Database languages — SQL — Part 1: Framework (SQL/Framework)[18]
- ISO/IEC AWI 9075-1
Information technology — Database languages — SQL — Part 1: Framework (SQL/Framework)[18]
- ISO/IEC TR 25060:2010
Systems and software engineering — Systems and software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability: General framework for usability-related information[27]
- ISO/IEC 26514:2008(en)
Systems and software engineering — Requirements for designers and developers of user documentation[28]
- ISO/IEC 90003:2004
Software engineering — Guidelines for the application of ISO 9001:2000 to computer software[29]
- ISO 9000:2000
Quality management systems — Fundamentals and vocabulary[30]
- ISO 9241-210:2010
Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems[31]

- FIPS PUB 197: 2011
Advanced Encryption Standard (AES)[\[34\]](#)
- ISO/IEC 18033-3: 2010
Information technology — Security techniques — Encryption algorithms — Part 3: Block ciphers[\[35\]](#)

14. Glossary

Term	Term definition
SmartHome+	The SmartHome+ platform.
End user	Any person, organization, or functional unit that uses the services of this SmartHome+ platform.
Android	A mobile operating system based on a modified version of the Linux kernel and other open source software.
iOS	A mobile operating system created and developed by Apple Inc.
Artificial intelligence	Any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals.
Machine learning	The study of computer algorithms that improve automatically through experience.
Deep learning	Part of a broader family of machine learning methods based on artificial neural networks with representation learning.
Robustness	The ability to tolerate perturbations that might affect the system's functional body.
Risk	Uncertain factor whose occurrence may result in a loss of satisfaction of a corresponding objective.
RSA	One of the first public-key cryptosystems and is widely used for secure data transmission.
AES	A specification for the encryption of electronic data
Six Sigma	A set of techniques and tools for process improvement.

IFTTT	If This Then That, it is a freeware web-based service that creates chains of simple conditional statements, called applets.
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Acronym	Acronym definition
OS	Operating system
IOT	Internet of things
DES	Data Encryption Standard
AES	Advanced Encryption Standard
CO	Carbon monoxide
UV	Ultraviolet
RE	Risk exposure
RRL	Risk reduction leverage
CPU	Central processing unit
UC	Use case
UI	User Interface
APP	Software application
RSA	Rivest–Shamir–Adleman
RAID	Redundant Array of Independent Disks
ISP	Internet service provider
FIFO	First in first out
AWI	Approved Work Item
OCF	Open Connectivity Foundation
HTTP	Hypertext Transfer Protocol
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission

IEEE	Institute of Electrical and Electronics Engineers
GUI	Graphical User Interface
USB	Universal Serial Bus
API	Application Programming Interface