George Li - 101107279
Eric Pham - 101104095
Soumen Nath - 101106968
Zakariya Legnain - 101117898

COMP 3004A
Apr 14, 2021

Final Project Submission

Use Case Model

Use Case Diagram: available in **useCaseDiagram.pdf**

UC1: Power ON/OFF
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to power on MCT device
Denas company - wants [customer satisfaction of their product]
Precondition: User owns mct device. Device has sufficient battery level.
Postcondition: Device is powered on and is ready for use.
Main success scenario:

1. User presses the power button.
2. The control system receives signal, and powers on/off the mct device.
    a. If powering off, the screen is wiped
    b. If powering on, the main menu is loaded on the display

Extensions:

2a. Battery level is 0
2a1. Device won't turn on.

UC2: User selects program
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to select program
Denas company - wants control system to display program options.
Precondition: User is in the main menu.
Postcondition: program is selected.
Main success scenario:

1. User enters the program menu

2. User selects a program
3. Device control system receives a signal, and include *Start the program/treatment*

UC3: User selects frequency
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to use frequency feature of device
Denas company - wants control system to display frequency options.
Precondition: User is in the main menu.
Postcondition: Frequency program is ready to be run.
Main success scenario:

1. User enters the frequency menu, selects a frequency option.
2. Device control system sets the frequency to the frequency selected by the user.
3. Include *Start the program/treatment* for the selected frequency (generic treatment program)

UC4: Start the program/treatment
Actors: User, device control system, electrodes
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to begin treatment.
Denas company - wants customer satisfaction of their product
Precondition: User has selected type of therapy
Postcondition: Therapy is completed.
Main success scenario:

1. Device control system receives the signal for the therapy selected
2. The display shows the diagram in which to apply the device for the selected therapy
3. The control system receives the therapy's frequency mode and duration (only if it is a program), and begins the therapy
4. The user puts the skin on their area of treatment onto the electrodes of the device, and the duration counts down for program and up for frequency mode as the user is treated
5. When the duration counts down to 0 for a program, the electrodes stop and power level is brought down to 10
6. The program has ended, either time runs out for a program, the user presses the back button, or the user presses the home button
7. The therapy occurrence is recorded in the device's history of treatment if the user selects "Yes" when prompted

Extensions:

3a. User presses left/right arrow buttons
    3a1. Include *User increases/decreases Power Level*
4a. User removes skin from the electrodes

4a1. The duration count is paused until the user puts their skin back on the electrodes

UC5: User increases/decreases power level
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to change power level
Denas company - wants customer satisfaction of their product
Precondition: User is using a program.
Postcondition: The power level is changed
Main success scenario:

1. User presses the left/right arrow buttons to decrease/increase the power level.
2. If user presses left arrow button, a “decrease power” signal is sent to the control system for it to decrease the power level by 10 units
    a. If power level is already at 10, the control system does not decrease it further
3. If user presses right arrow button, a “increase power” signal is sent to the control system for it to increase the power level by 10 units
    a. If power level is already at 100, the control system does not increase it further

UC6: User selects MED
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to use MED feature of device
Denas company - wants customer satisfaction of their product
Precondition: User is in the main menu.
Postcondition: MED program is ready to be run.
Main success scenario:

1. User selects MED option
2. The display shows a message: “this option is not available”

UC7: User selects Screen
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to use screen feature of device
Denas company - wants customer satisfaction of their product
Precondition: User is in the main menu.
Postcondition: Screen program is ready to be run.
Main success scenario:

1. User selects Screen option
2. The display shows a message: “this option is not available”

UC8: User selects Children
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to use children feature of device
Denas company - wants customer satisfaction of their product
Precondition: User is in the main menu.
Postcondition: Children program is ready to be run.
Main success scenario:

1. User selects children option
2. The display shows a message: “this option is not available”

UC9: User selects Settings
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to select settings
Denas company - wants customer satisfaction of their product
Precondition: User is in the main menu.
Postcondition: List of setting options is displayed to the user.
Main success scenario:

1. User selects the settings menu
2. User selects one of the settings:
    a. User selects a setting that isn't supported. The display shows a message: “this option is not available”
    b. User selects colour settings, and can modify the color preset of the display by selecting from the presets available

UC10: User presses home button
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to return to the main menu from anywhere
Denas company - wants control system to display main menu options.
Precondition: User has the device turned on.
Postcondition: Main menu is displayed to the user.
Main success scenario:
Note: This use case can interrupt any of the previous use cases.

1. User presses home button
2. Any current function (program or frequency treatment) is stopped
3. Main display arrives back at the main menu

UC11: User navigates menu
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to navigate the device.
Denas company - wants control system to change the selected menu option
Precondition: User is in a menu.
Postcondition: User successfully navigates to desired location.
Main success scenario:
Note: This use case can interrupt any of the other use cases where the user is in a menu (programs menu, frequency menu, settings menu, history menu, colour menu).

1. User presses UP/DOWN buttons.
3. Device control system receives a signal and moves in the direction of UP/DOWN.

UC12: User views therapy recording history
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to view recorded therapies.
Denas company - wants control system to display recorded therapies
Precondition: User is in the main menu.
Postcondition: User can view recorded therapies.
Main success scenario:

1. User navigates to History menu
2. User selects View History Option.
3. Control system displays all recorded therapies in pages.
4. User presses left/right arrows to view the different pages.

Extensions:

3a There are no recorded therapies
3a1. Display “No History”

UC13: User clears therapy recording history
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to clear the therapy recording history.
Denas company - wants control system to clear the therapy recording history

Precondition: User is in the main menu.
Postcondition: User successfully clears the therapy recording history.
Main success scenario:

1. User navigates to History menu
2. User selects Clear History Option.
3. Control system clears all recorded therapies and displays “History cleared”.

UC14: User charges device
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to charge the device.
Denas company - wants the device to be operational
Precondition: User has the device.
Postcondition: Device starts charging.
Main success scenario:

1. User plugs in device.
2. Battery level increases in increments of 5%/second.

UC15: User presses back button
Actors: User, device control system
Scope: DENAS User Interface
Level: User Goal
Stakeholders and Interests:
User - wants to return to the previous menu
Denas company - wants control system to display the previous menu options.
Precondition: User has the device turned on.
Postcondition: Previous menu is displayed to the user.
Main success scenario:
Note: This use case can interrupt any of the previous use cases.

1. User presses back button
2. Any current function (program or frequency treatment) is stopped
3. Main display arrives at the previous menu (the previous menu of the main menu is main menu)

Extension: Out of power
Actors: device control system
Scope: DENAS User Interface
Level: User goal
Stakeholders and Interests:
User - wants to use the device
Denas company - wants user to use product properly
Precondition: User is using the device, and the device battery level is about to reach 0

Postcondition: Device powers off.
Main success scenario:
Note: This extension can interrupt any of the previous use cases.

1. Battery level reaches 0
2. Device powers off (by force)
3. Device will only have its battery level restored once the user recharges the device

OO Design Model

UML Class Diagram: available in **umlDiagram.pdf**

- Textual explanation:
  This diagram realizes all use cases. This design follows the mediator pattern, in that the ControlSystem controls all aspects of the MCT Device. So all signals from sensors/buttons go to the ControlSystem where it then reviews signals from the other classes, makes the appropriate decisions, and sends back instructions. The observer pattern is also present as the QT framework is used. The simulation follows the model, control and view design, where the models are the classes that the ControlSystem controls, the view is the Ui object, and the control is from the ControlSystem class.

  For all the Button objects, a UI element will be connected and when it is interacted with (through use of the UI element's signal and Button's slot), pressed() will be called, which will call sendSignal(), which will call the specific Button's signal, and behavior is handled from there when this reaches a slot at ControlSystem.

  Another integral part of this design is the main menu of the device. The menu object is responsible for displaying the various menus of the device. Among the menus, three of the options stand out. There are three separate classes to represent each of them. These classes are the Frequency class, Program class and the Settings class. Also, note that the Frequency and Therapy classes both inherit from the Therapy class. Executing the various therapies is the main purpose of this device simulator. In addition to the Therapy class, there is also a TherapyDisplay class to display the various therapies. There is also a TherapyRecording class that handles the recording of all the therapies that the user has used.

  The Battery class is another important aspect of this design. This class simulates a battery that powers the device. Accordingly, it displays the current battery level as well as the changes to this battery level based on power level. Using a higher power level during therapies reduces battery level faster.

Sequence Diagrams: 7 diagrams available in **sequenceDiagram.pdf**

- Zoom in for each diagram
- Menu navigation and helper functions are not shown in the sequence diagrams to keep them concise for their main intention.
- Textual explanation for diagrams:
  - Base Use Case
    - The base use case demonstrates the basic functionality of the MCT Denas simulator. It explains the sequence of events that occur when a user turns on the device, selects a therapy and begins treatment, ends treatment, and turns off the device.
    - The use cases that this diagram relates to include:

        - UC1: Power On/Off, UC2: User selects program, UC4: Start the program/treatment, UC11: User navigates menu, UC15:User presses back button.
- Select Frequency
    - The Select Frequency sequence diagram illustrates the chain of events that occur when the user powers on the device, selects the frequency option, chooses the frequency level, starts the treatment, exits with the back button and powers off.
    - The use cases that this diagram relates to include:
        - UC1: Power On/Off, UC3: User selects frequency, UC4: Start the program/treatment, UC11: User navigates menu, UC15:User presses back button.
- Home Button
    - The Home Button sequence diagram demonstrates the events that occur when a user presses on the home button and wants to return the main menu.
    - The use cases that this diagram relates to include:
        - UC10: User presses home button
- Back Button
    - The Back Button sequence diagram demonstrates the events that occur when a user presses on the back button to return to the previous menu.
    - The use cases that this diagram relates to include:
        - UC15: User presses back button
- Battery Died
    - The Battery Died sequence diagram demonstrates the events that occur up to when the battery reaches 0.
    - This Sequence diagram maps to the following use cases:
        - Extension: Out of power, UC14: User recharges battery.
- View Recorded Therapies
    - The View Recorded Therapies sequence diagram demonstrates the events that occur when a user selects the View History option in the History menu to view recorded therapies.
    - This Sequence diagram maps to the following use case:
        - UC12: User views therapy recording history.
- Clear Recorded Therapies
    - The Clear Recorded Therapies sequence diagram demonstrates the events that occur when a user selects the Clear History option in the History menu to clear recorded therapies.
    - This Sequence diagram maps to the following use case:
        - UC13: User clears therapy recording history.

<u>Activity or State Diagrams</u>:

- Not relevant. Diagrams would be quite linear and straightforward. (ex. State of battery going down, current menu is updated to the current menu, same for previous menu, etc...)

Implementation

View github repo at: https://github.com/ericphamEP/MCT-device-sim

Follow the instructions in README.md for running the code.

Source code is also attached in cuLearn, under folder name “MCT-device-sim”.

Traceability Matrix

Use cases to tests, requirements, and design elements

Note: Use cases to design diagrams are mapped in the diagram descriptions in the OO Design Model section.

Use Case	Test	Requirements	Design	Status
UC1: Power ON/OFF	Power on/power off using power button	Simulate interface (power buttons, display)	PowerButton: powerRequest(); ControlSystem: powerToggle(); power button in UI	✔
UC2: User selects program	Go to program menu, select any treatment;	Simulate interface (enter button, display, back button) and programs menu	ControlSystem: enterRequested(), arrowRequested(), program menu as Menu object; EnterButton; ArrowButton	✔
UC3: User selects frequency	Go to frequency menu, select any mode;	Simulate interface (enter button, display, back button) and frequencies menu	ControlSystem: enterRequest(), arrowRequest(), frequency menu as Menu object; EnterButton; ArrowButton	✔
UC4: Start the program/treatment	After selecting treatment, begin therapy. Skin can be turned on/off;	Simulate interface (enter button, display, back button), therapy, electrodes (skin on/off), time of therapy, therapy recording	ControlSystem: startTherapy(), endTherapy(), recordTherapy(); Therapy class; Program class; Frequency class; TherapyDisplay class; TherapyRecording class; therapyON	✔
UC5: User increases/decreases Power Level	During a therapy, change power level using arrow buttons	Simulate interface (left/right buttons, display), therapy, power level	ControlSystem: Therapy class; Program class; Frequency class; TherapyDisplay class	✔
UC6: User selects MED	From the main menu, select option. Option not supported	Simulate interface (display, messages, back button)	ControlSystem: main menu as Menu object, showMsg(msg); EnterButton; ArrowButton	✔

UC7: User selects Screen	From the main menu, select option. Option not supported	Simulate interface (display, messages, back button)	ControlSystem: main menu as Menu object, showMsg(msg); EnterButton; ArrowButton	✔
UC8: User selects Children	From the main menu, select option. Option not supported	Simulate interface (display, messages, back button)	ControlSystem: main menu as Menu object, showMsg(msg); EnterButton; ArrowButton	✔
UC9: User selects Settings	Go to settings menu and select color option to edit color presets	Simulate interface (display, messages, up/down buttons, menus, back button)	ControlSystem: main menu, settings menu, and color menu as Menu objects; EnterButton; ArrowButton; Settings: setColourPreset(int)	✔
UC10: User presses home button	At any time, press home button to go to main menu	Simulate interface (display, menus, home button)	ControlSystem: currMenu, prevMenu, homeRequested(); HomeButton	✔
UC11: User navigates menu	From any menu (main, programs, frequency, settings, colour), user selects up/down arrow buttons to navigate upwards/downwards	Simulate interface (display, menus, up/down buttons, back button)	ControlSystem: currMenu, prevMenu, arrowRequested(); Settings: setColourPreset(int), selectedStyle(), unselectedStyle()	✔
UC12: User Views Therapy Recording History	Go to the history menu then select the view option. Select right/left arrow buttons to go through pages. All therapies should be recorded since the start of the program or the last time the history was cleared.	Simulate interface (display, menus, arrow buttons, enter button, back button), therapy recordings	ControlSystem: displayTherapyRecordings(); TherapyRecording; EnterButton; ArrowButton	✔
UC13: User Clears Therapy Recording History	Go to the history menu then select the clear history option.	Simulate interface (display, menus, up/down buttons, enter button, back button), therapy recordings	ControlSystem: clearTherapyRecordings(); TherapyRecording; EnterButton	✔
UC14: User Charges Device	Check the Plugged In checkbox to recharge the device. The battery level should rise.	Simulate interface (charging), battery level	ControlSystem: pIn, powerLevel, increaseB, startTimer(QTimer); Battery: increaseBattery(); getBatteryLevel();	✔
UC15: User presses back button	At any time, press back button to go to previous menu	Simulate interface (display, menus, back button)	ControlSystem: currMenu, prevMenu, backRequested(); BackButton	✔

Extension: Out of power	Let the battery level decrease to 0. The device should power off.	Simulate battery level	ControlSystem: powerLevel, decreaseB, startTimer(QTimer) Battery: decreaseBattery(int); getBatteryLevel();	✔