Team Project: Developing and testing a CES device simulator

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Table of Contents

Use Case 1: Alpha-Stim AID full functionality

Description: The user uses the alpha-stim AID for the treatment of anxiety.

Primary Actor: User

Preconditions: Battery indicator has more than one bar & device is off.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water.
2. User allows their skin to dry.
3. User plugs dual connector end of ear clip wires into the jack on the left side of the device.
4. User cleans and dries ear clips.
5. User attaches 4 new ear clip Electrode Pads.
6. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
7. User presses the power button.
8. User squeezes ear clips and applies one to each ear lobe.
9. User sets timer, sets current and timer countdown begins.
10. User presses the lock button twice to lock settings.
11. User lies down.
12. Timer completes and device power's off.
13. User removes and discards ear clip electrode pads.

Extensions:

1. A. User may also clean ear lobes with alcohol pads or antibacterial wipes.

1. B. Areas where skin oils, dirt have accumulated, where cosmetics or hair spray have been used must be thoroughly cleaned.

4. A. Old ear clip electrode pads are present; User removes and discards them.

7. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

9. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

10. A. User sets 20-minute timer if the current is set to at least 250 μA.

10. B. User sets 40-minutes to 1-hour timer if the current is at or below 200 μA.

10. C. User chooses one of the preloaded current controls. (0 – 500 microampere available).

11. A. User presses lock button twice again to unlock and change settings.

12. A. User sits quietly, reads, works or watches tv instead.

14. A. User skin burns following treatment. User discontinues use and applies skin cream.

14. B. Skin irritation may develop in light skin.

Postcondition: User completes treatment.

Use Case 2.0: Alpha-Stim AID power button functionality

Description: User turns on the alpha-stim AID device.

Primary Actor: User

Preconditions: Device is off.

Level: Summary

Main Success Scenario:

1. User presses on power button
2. Device turns on

Extensions:

2. A. Batteries are dead and device does not power on.
3. B. LCD screen lights up for 10 seconds if user is in a dark room.

Postcondition: Device is on and is ready to be used.

Use Case 2.1: Alpha-Stim AID power button functionality

Description: User turns off the alpha-stim AID device.

Primary Actor: User

Preconditions: Device is on.

Level: Summary

Main Success Scenario:

1. User presses power button
2. Device turns off.

Postcondition: Device is turned off.

Use Case 3: Alpha-Stim AID Cranial electrotherapy timer functionality

Primary Actor: User

Preconditions: Device is off.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User presses on timer button.
10. Device backlight turns on.
11. User sets timer to 20 minutes.
12. User sets current to 250 µA.
13. Countdown begins on display.

Extensions:

11. A. User sets 20-minute timer if the current is set to at least 250 µA.
11. B. User sets 40-minutes to 60-minutes timer if the current is at or below 200 µA.

Postcondition: Treatment is underway.

Use Case 4.0: Alpha-Stim AID Cranial electrotherapy lock on functionality

Description: User uses the alpha-stim AID for treatment of insomnia and locks settings.

Primary Actor: User

Preconditions: Battery indicator has more than one bar & device is off.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User sets timer to 20-minutes and sets current to 250 µA.
10. Device backlight turns on.
11. Device screen light's up and countdown begins.
12. User presses the lock button twice to lock settings.
13. Device backlight turns on.

Extensions:

9. A. User sets 20-minute timer if the current is set to at least 250 µA.
9. B. User sets 40-minutes to 1-hour timer if the current is at or below 200 µA.

Postcondition: Device is locked and treatment is underway.

Use Case 4.1: Alpha-Stim AID Cranial electrotherapy lock off functionality

Description: User uses the alpha-stim AID for treatment of insomnia and unlocks device to change settings.

Primary Actor: User

Preconditions: Battery indicator has more than one bar & device is off.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses the power button.
7. Device screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User sets timer to 20-minutes and sets current to 250 μA.
10. Device backlight turns on.
11. Device screen light's up and countdown begins.
12. User presses the lock button twice to lock settings.
13. Device backlight turns on.
14. User presses lock button and device unlocks.
15. Device backlight turns on.
16. User presses the timer button.
17. Device backlight turns on.
18. User changes the timer to 30-minutes.
19. User presses the lock button twice to lock settings

Extensions:

9. A. User sets 20-minute timer if the current is set to at least 250 μA.
9. B. User sets 40-minutes to 1-hour timer if the current is at or below 200 μA.

Postcondition: Device is locked and treatment is underway.

Use Case 5.0: Alpha-Stim AID Cranial electrotherapy increase current functionality

Description: User increases current of the alpha-stim AID during treatment of depression.

Primary Actor: User

Preconditions: Battery indicator has more than one bar & device is off.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User sets timer to 40-minutes and sets current to 250 μA.
10. Device backlight turns on.
11. Device screen light's up and countdown begins.
12. User presses the lock button twice to lock settings.
13. Device backlight turns on.
14. User presses lock button and device unlocks.
15. Device backlight turns on.
16. User presses the timer button.
17. Device backlight turns on.
18. User changes the timer to 20-minutes.
19. User presses the arrow up button twice, current increases to 250 μA.
20. Device backlight turns on.
21. User presses the lock button twice to lock settings.

Extensions:

9. A. User sets 20-minute timer if the current is set to at least 250 μA.
9. B. User sets 40-minutes to 1-hour timer if the current is at or below 200 μA.

Postcondition: Device is locked and treatment is underway.

Use Case 5.1: Alpha-Stim AID Cranial electrotherapy decrease current functionality

Description: User decreases current of the alpha-stim AID during treatment of anxiety.

Primary Actor: User

Preconditions: Battery indicator has more than one bar & device is off.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User sets timer to 20-minutes and sets current to 250 µA.
10. Device backlight turns on.
11. Device screen light's up and countdown begins.
12. User presses the lock button twice to lock settings.
13. Device backlight turns on.
14. User presses lock button and device unlocks.
15. Device backlight turns on.
16. User presses the timer button.
17. Device backlight turns on.
18. User changes the timer to 60-minutes.
19. User presses the arrow down button three time, current decreases to 175 µA.
20. Device backlight turns on.
21. User presses the lock button twice to lock settings.

Extensions:

9. A. User sets 20-minute timer if the current is set to at least 250 µA.
9. B. User sets 40-minutes to 1-hour timer if the current is at or below 200 µA.

Postcondition: Device is locked and treatment is underway.

Use Case 6: Alpha-Stim AID Cranial electrotherapy light sensor feature

Primary Actor: User

Preconditions: Device is off and user is in a dark room.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device LCD screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User presses on timer button.
10. Device backlight turns on and device LCD screen light's up.
11. User sets timer to 20 minutes.
12. User sets current to 250 µA.
13. Countdown begins on display.

Extensions:

7. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

9. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

11.A. User sets 20-minute timer if the current is set to at least 250 µA.

11.B. User sets 40-minutes to 60-minutes timer if the current is at or below 200 µA.

Postcondition: Treatment is underway.

Use Case 7: Alpha-Stim AID Cranial electrotherapy test circuit feature

Primary Actor: User

Preconditions: Device is off.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device LCD screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User presses on timer button.
10. User falls asleep.
11. Test Circuit symbol appears on screen.
12. Audio warning indicating device is not treating starts to play.
13. Device turns off.

Extensions:

7. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

9. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

13. Device turns off after 30 minutes of inactivity.

Postcondition: Device is off.

Use Case 8: Alpha-Stim AID Cranial electrotherapy low battery warning feature

Primary Actor: User

Preconditions: Device is off and only 1 bar of battery remains.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device LCD screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User presses on timer button.
10. Battery Charge indicator appears on screen.
11. Device plays low battery warning audio.

Extensions:

7. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

9. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

Use Case 9.0: Alpha-Stim AID Cranial electrotherapy mute on feature

Primary Actor: User

Preconditions: Device is off and only 1 bar of battery remains.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device LCD screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User presses on timer button.
10. Battery Charge indicator appears on screen.
11. Device plays low battery warning audio.
12. User presses lock button followed by the timer button followed by the lock button.
13. Mute symbol appears on screen.
14. Low battery warning is no longer being outputted.

Extensions:

7. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

9. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

Postcondition: Device is muted.

Use Case 9.1: Alpha-Stim AID Cranial electrotherapy mute off feature

Primary Actor: User

Preconditions: Device is off and only 1 bar of battery remains.

Level: Summary

Main Success Scenario:

1. User cleans ear lobes with mild soap and water and allows skin to dry.
2. User plugs dual connector end of ear clip wires into jack on left side of the device.
3. User cleans and dries ear clips.
4. User attaches 4 new ear clip Electrode Pads.
5. User saturates the 4 new ear clip Electrode Pads thoroughly with several drops of conducting solution.
6. User presses power button.
7. Device LCD screen light's up.
8. User squeezes ear clips and applies one to each ear lobe.
9. User presses on timer button.
10. Battery Charge indicator appears on screen.
11. Device plays low battery warning audio.
12. User presses lock button followed by the timer button followed by the lock button.
13. Mute symbol appears on screen.
14. Low battery warning is no longer being outputted.
15. User presses lock button followed by the timer button followed by the lock button.
16. Mute symbol disappears on screen.
17. Device plays low battery warning audio.

Extensions:

7. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

9. A. LCD screen lights up for 10 seconds if user is in a dark room when any button is pushed

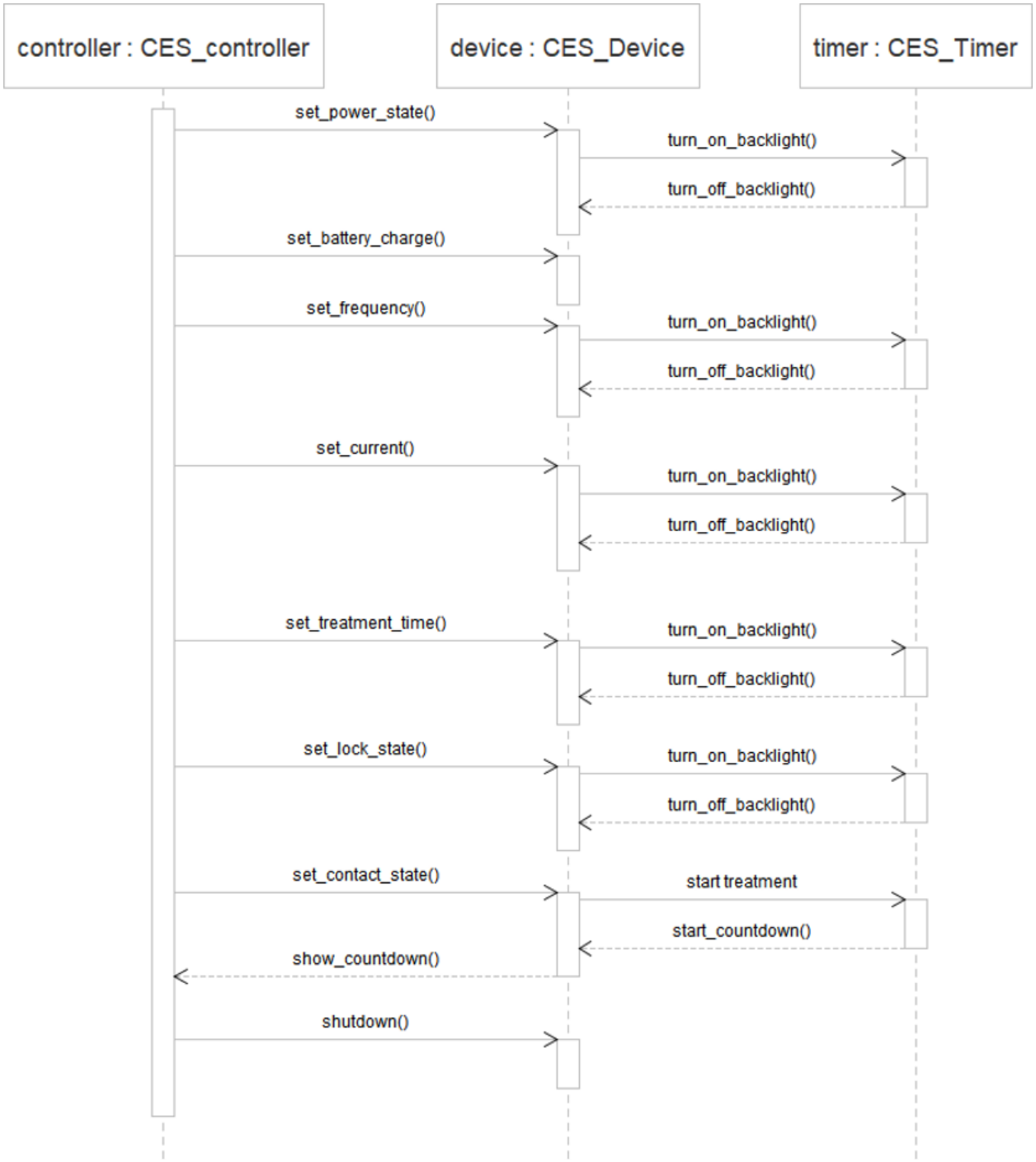
TRACEABILITY MATRIX

Id	Requirements / Use case	Design Element(s)	How to test
1	- On/off Switch	- **GUI**: Button that swaps between on/off as pressed. - **GUI**: Hide digital display when off. - **CES Control**: Receive on/off signals, boots up when turned on.	- Power button on/off
2	- Continuous circuit check	- **GUI**: Display circuit symbol. - **GUI**: Flash symbol if check has failed. - **CES Control**: Check loop that continues while the device is on(maybe sleep(1)?). - **CES Control**: If check fails, make GUI symbol flash, pause timer.	- Turn power on - Timer button to set time. - Checkbox “on Skin” (uncheck to pause)
3	- Two frequency options (0.5hz and 100hz)	- **CES Control**: Set to 0.5hz by default. - **GUI**: Button to swap between both frequencies. - **GUI**: Display frequency.	- Power on - Freq button (Frequency displayed bottom right)
4(maybe)	- Different wave frequencies.	- **GUI**: Button to cycle frequencies. - **CES Control**: Output various preset frequencies.	- Power on - Freq button (Frequency displayed bottom right)
5	- Time cycles. 20/40/60 minutes.	- **CES Control**: Update timer / pause timer. Loop to countdown timer. - **CES Control**: Time stored in seconds, -1	- Turn power on - Timer button to set time. - Checkbox “on Skin” (uncheck to pause) - Power off then back

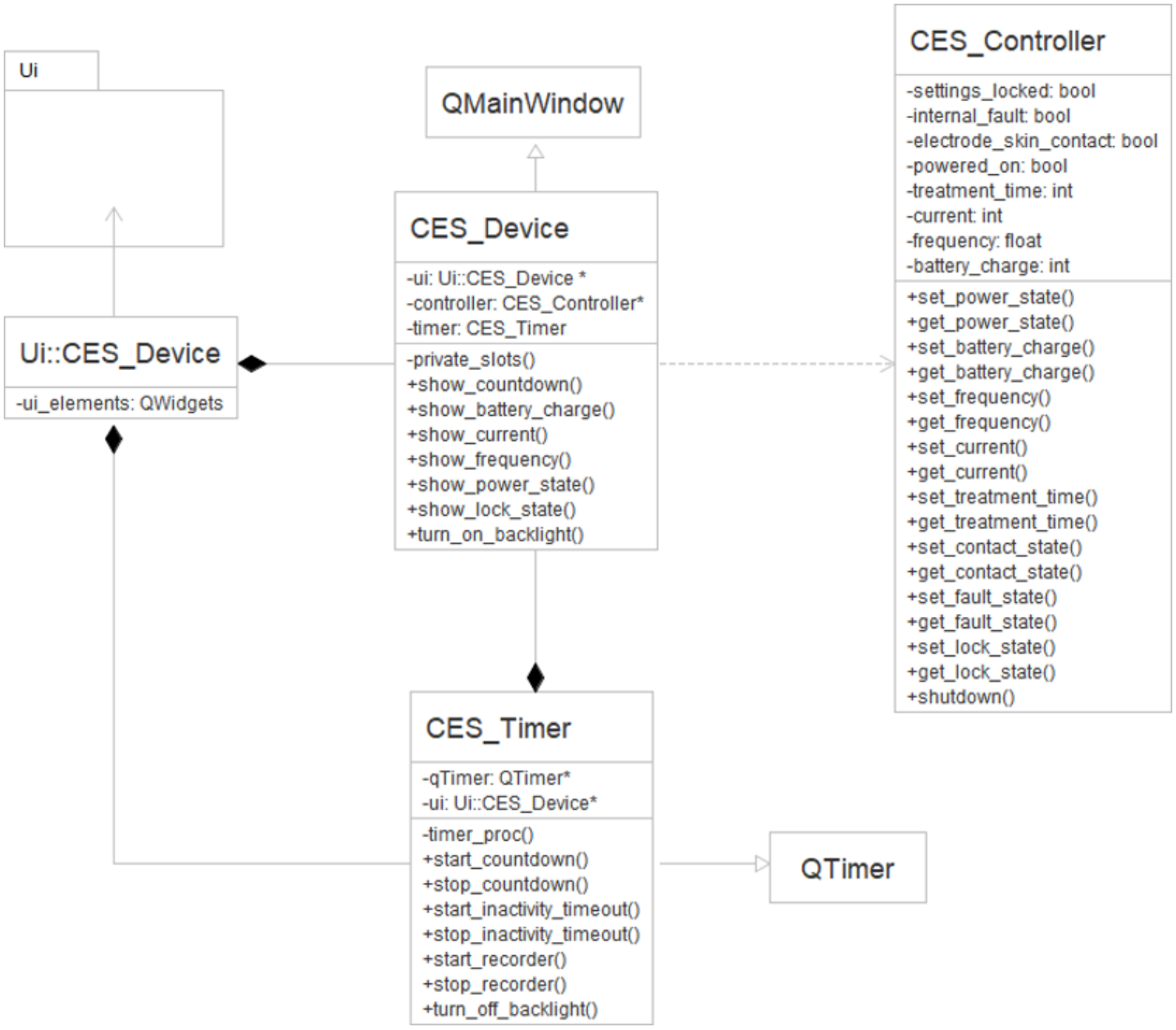
		every 1 second (QTimer) while electrodes in contact with the user. Start countdown when first contact is made. When time reaches 0, shutdown.	on, set a new time.
6	- Large timer Display	- **GUI**: Update displayed time / pauses from CES control.	- Power On - Timer Button - Checkbox on Skin
7	- Microampere current control	- **CES Control**: Start at 0. - **GUI**: Up / down increment control by 100 microampere.	- Power on - Up/down arrow control current.
8	- Auto off after 30 minutes of inactivity.	- **CES Control**: When device is on, and probes disconnect from user, begin a countdown for 30 minutes, resetting back to original value if probe connection is made. If the timer reaches 0, shutdown.	
9	- Battery charge indicator	- **CES Control**: Track battery with QTimer. - **GUI**: Display battery. - **Battery**: Track charge. - **CES Control**: Sends warning if battery reaches 5%. - **CES Control**: Sends warning and shutdown if battery reaches 2%.	- Power on - Battery loses %1 charge per minute of being on. - Battery indicator top right.
10	- Recording treatment	- **GUI**: Recording button - **CES Control**: Set recording flag to true. - **CES Control**: Log	- Recording output sent to build directory as session_recording.txt

		the following information. ● Start Time ● End Time (reason for ending -> battery, safety, device turned off, auto off) ● Frequency (log changes with time) ● Microampere (log changes with time)	
11	- Current safety	- **CES Control**: If current exceeds 700 uA, shutdown the device. System checks every 1 second. - **GUI**: Disable “On” button.	

UML Sequence Diagram



UML Class Diagram



Implementation Screenshot