HeartWave Design Documentation

Use Cases:

Use Case 1: Turn on Heartwave

Primary Actor: User

Scope: HeartWave System

Level: User Goal

Stakeholders and Interests:

Device User – User looking to measure coherence level.

Precondition: User has the heartwave device

Success guarantee: The device turns on and displays the menu to the user.

Main success scenario:

1. User presses the power button located on the heartwave device.
2. The display is opened to the main menu where the user can make selections.

Extensions:

1.
    a. If the battery level is too low when the power button is pressed the screen will not turn on. The user will have to charge the battery before usage. **Include battery level low use case.**

Use Case 2: New Session

Primary Actor: User

Scope: HeartWave System

Level: User Goal

Stakeholders and Interests:

Device User – User looking to start a new session and measure coherence level.

Precondition: the heart wave device is on and displaying the main menu screen

Success guarantee: The user starts and completes a new session that will be saved to the device.

Main success scenario:

1. The user pressed the selector on “New Session” button to start the new session.
2. The heartwave deice displays the HRV graph to the user with current coherence score, length of session and achievement.
3. The light on the device changes color to indicate the coherence level dependent on the selected challenge level.
4. The breath pacer will indicate on the session screen how the user may pace their breath. By default, this will be every 10 seconds.
5. Once the user is finished, they can press the selector again which will end the session.
6. Upon ending the session, the summary view will appear showing the following information: Challenge level, percentage of time in different coherence levels, average coherence, length of session, achievement score and the entire HRV graph.

Extensions:

2.

- **a.** If the battery level is too low when attempting to start a new session the Heartwave will indicate to the user that it must be charged to proceed. **Include battery level low use case.**
- **b.** if the sensor is interrupted and loses the signal the session is ended. **Include sensor off use case.**

3.

- **a.** a beep is sounded when a new coherence level is reached.

Use Case 3: Settings

Primary Actor: User

Scope: HeartWave System

Level: User Goal

Stakeholders and Interests:

Device User – User is looking to modify the settings before attempting a new session.

Precondition: user is on the main menu screen hovering over the settings tab.

Success guarantee: The user modifies and saves their custom settings.

Main success scenario:

1. The user pressed the selector on the settings tab.
2. the user has the option of 4 challenge levels for coherence from beginner to advanced.
3. the user has the option of 1-30 seconds for the interval between each breath.
4. once desired modifications have been made the user can press back to return to menu.
5. then changed settings will be saved and applied to the next session.

Extensions:

4. by default, this will be set to 10 seconds.

Use Case 4: Session Data

Primary Actor: User

Scope: HeartWave System

Level: User Goal

Stakeholders and Interests:

Device User – User wants to read previous session summary data.

Precondition: user is on the main menu screen hovering over session data tab.

Success guarantee: The user can see all previous session and delete those of which they do not want.

Main success scenario:

1. The user pressed the selector on session data tab.
2. The history of all sessions is displayed to the user indicating the date in which they were produced.
3. Upon selecting a session, the summary view will be displayed.
4. The user can delete the session from the save file if they so desire.

Extensions:

3.
    a. the summary view will include challenge level, percentage of time in different coherence levels, average coherence, length of session, achievement score and entire hrv graph of the session.
4.
    a. Deleted session will no longer be displayed in the session data screen.

Use Case 5: Battery level low.

Primary Actor: User

Scope: HeartWave System

Level: User Goal

Stakeholders and Interests:

Device User – User wants to start a new session or is currently in a session.

Precondition: user is starting a new session or currently in a session.

Success guarantee: The battery level is properly adjusted before proceeding with session.

Main success scenario:

1. When the user chooses to start a new session
2. The battery level is below functioning percentage and the Heartwave does not let the user proceed to start a new session.
3. The user will have to increase the battery level to proceed.

Extensions:

1.

a. Alternatively, the user could already be in a session.
b. If this is the case, step two can still occur when battery drops below functioning percent during the session.

Use Case 6: Sensor off

Primary Actor: User

Scope: HeartWave System

Level: User Goal

Stakeholders and Interests:

Device User – User is a session measuring HRV and coherence.

Precondition: User is currently in a session.

Success guarantee: The session is ended prematurely without any data saved.

Main success scenario:

1. The user has the sensor connected and is proceeding through the session.
2. The sensor is interrupted and is no longer receiving HRV signal.
3. The session will be ended, and the user will return to the menu page.

Extensions:

3.

a) any session data from the incomplete session will not be saved.

Use Case 1: Turn Off Heartwave

Primary Actor: User

Scope: HeartWave System

Level: User Goal

Stakeholders and Interests:

Device User – User finished using the device.

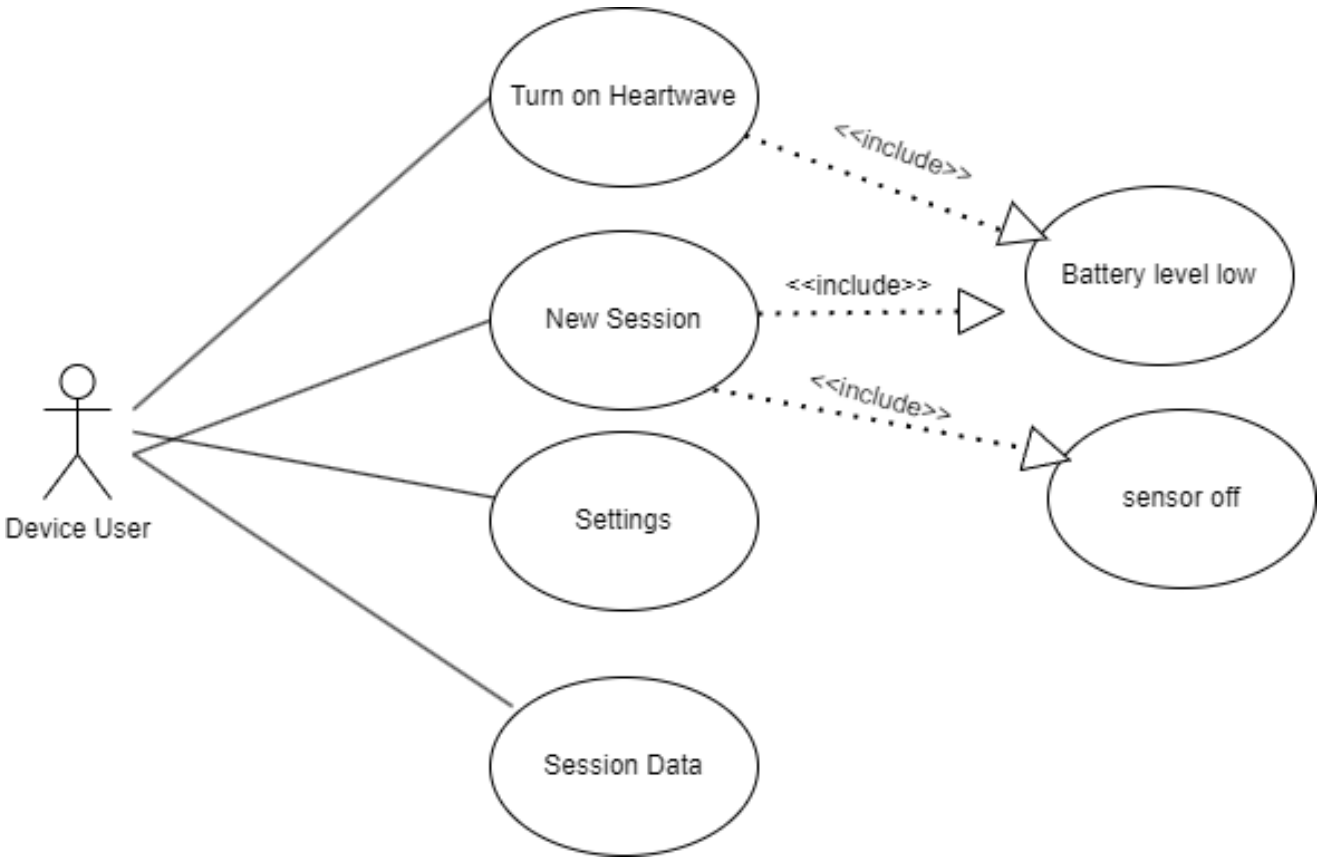
Precondition: Heartwave device is on after user session.

Success guarantee: The device turns off and display shuts down.

Main success scenario:

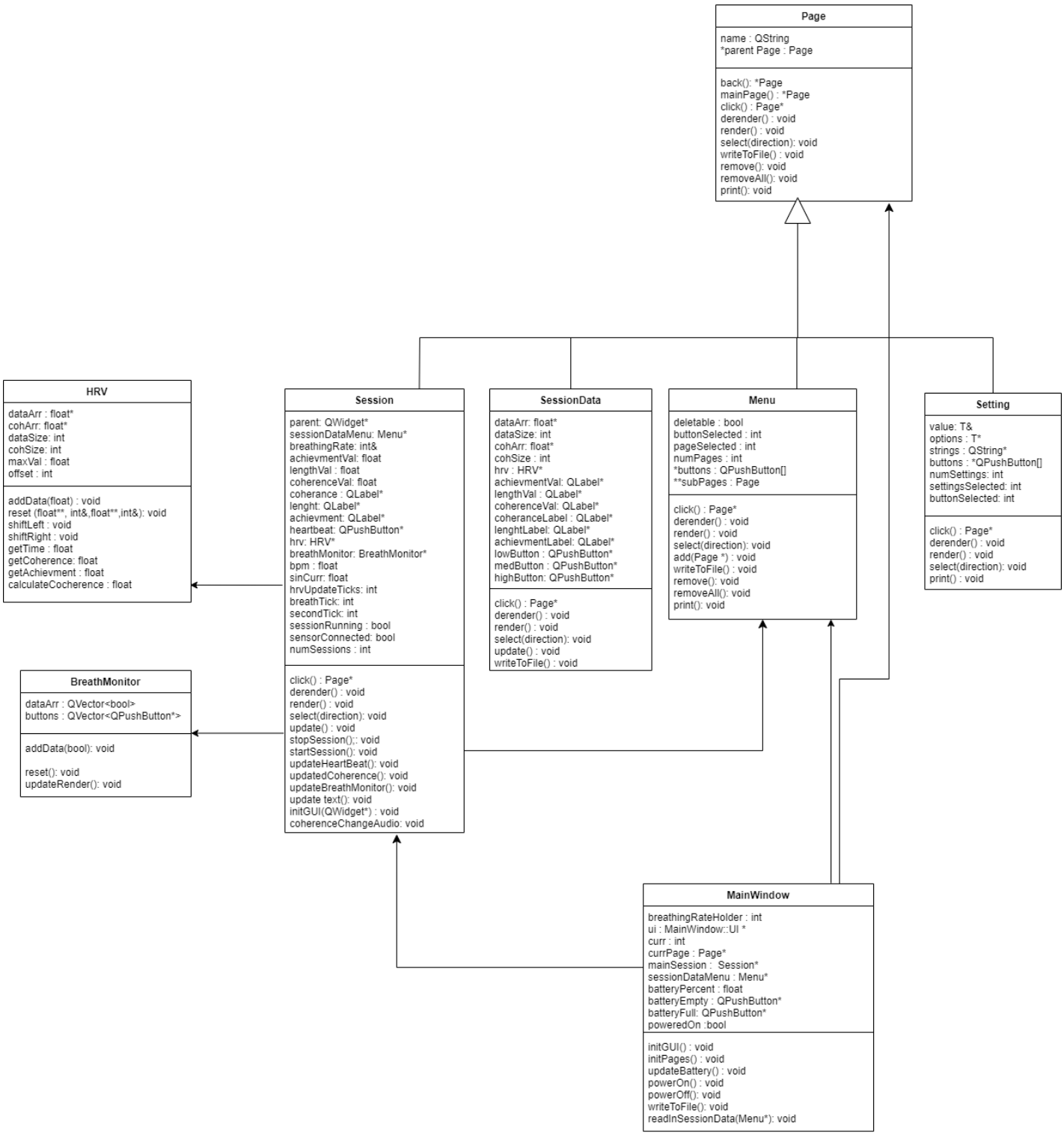
5. User presses the power button located on the heartwave device.
6. The display is shut down and all sessions are saved on the device.

Extensions:



Our design choice here was to split the use cases based on the requirements of the program. In this case we have 3 use cases for functionality of the heartWave in use cases 2,3,4 “New Session”, “settings” and “Session Data”. The remaining use cases are for error/program flow where “battery level low” and “sensor off” are for error handling and power on/power off are for program flow.

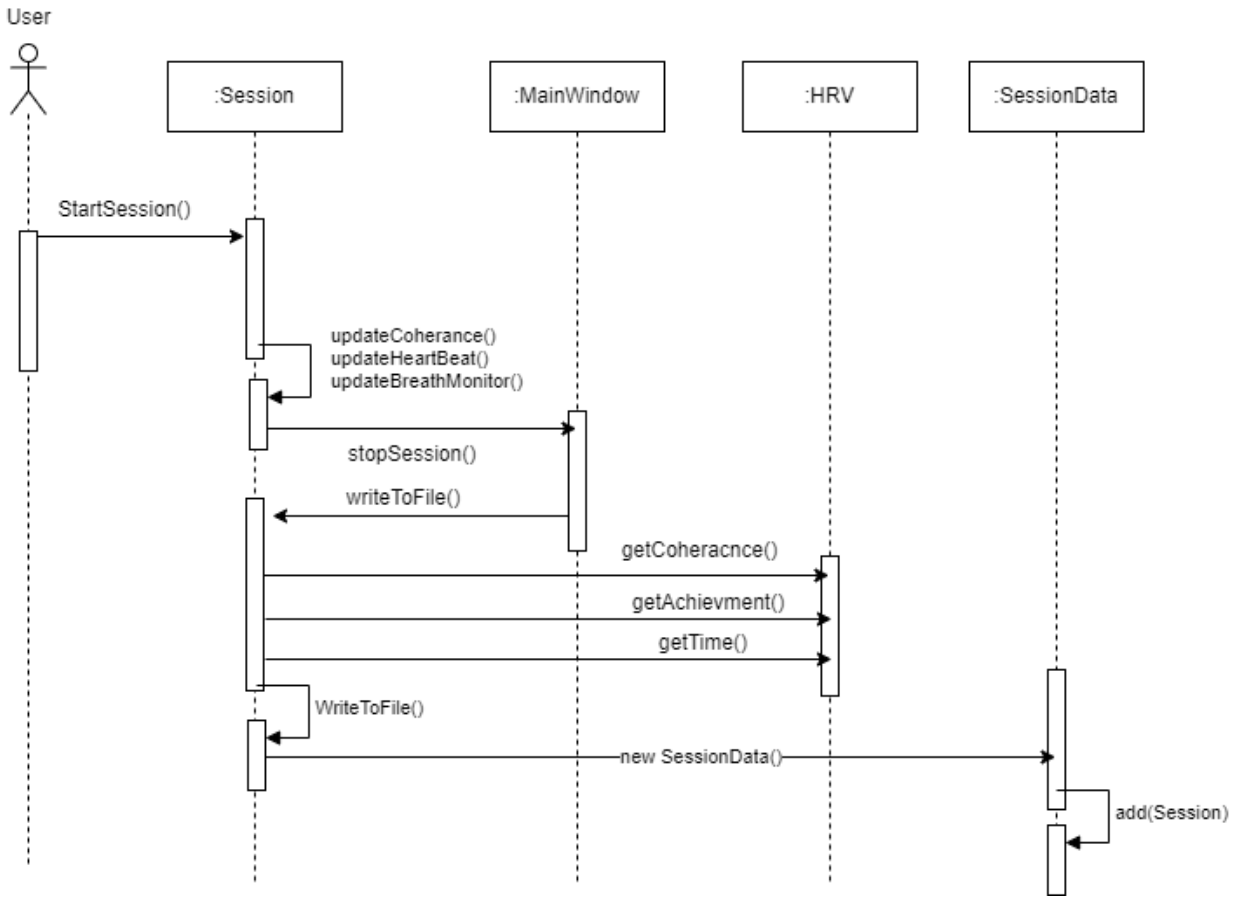
UML Class Diagram:



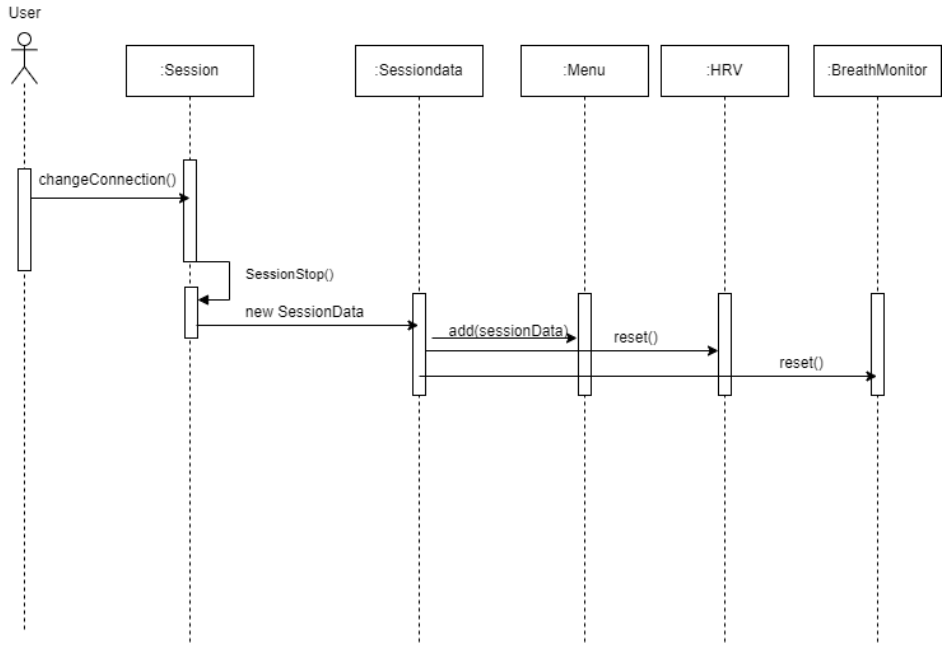
Above is the UML Class diagram for the heartwave program. Here Session, SessionData Menu and Setting all extend the page class and main window is the container for holding the Session,

Menu and Page functionality of the program. The session class is responsible for containing the HRV and BreathMonitor widgets represented on the screen.

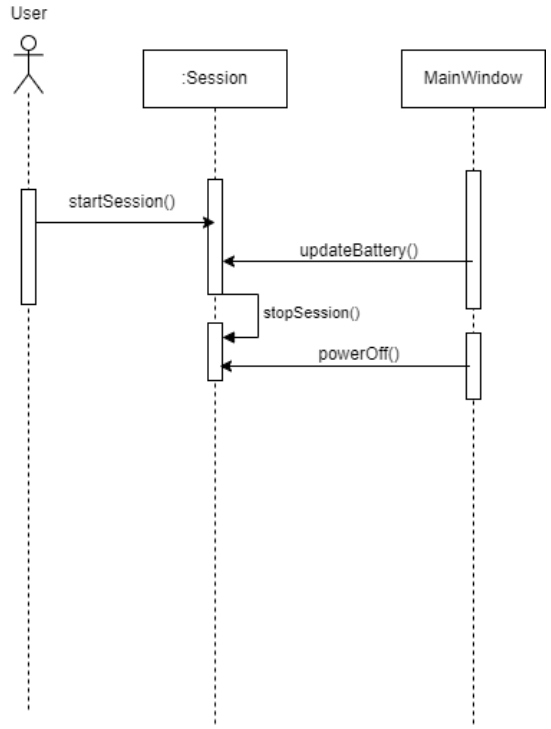
Sequence Diagrams:



The Above Sequence diagram represents the normal operation of starting a new session, using the program, and saving the data. The User starts the new session which begins the update loop for the data being displayed on the screen. Once the session is ended by the stop session function call the main window writes to the file which enables the session to get the data from the HRV widget and create a new sessionData object for holding this information. The previously mentioned data object is then added to the sessionData Menu object for storing.



Above is the sequence diagram representing the sensor off use case. In this case the changeConnection function will interrupt the heartbeat signal depicted by the heartbeat button in the mainWindow. The session will stop once the signal is interrupted and save the session data and add it to the database before resetting all aspects of the display (HRV, BreathMonitor).



In the above sequence diagram, we are depicting the battery level low use case. In this use case the user will start a new session, while the mainWindow calls update battery based on a Timer. If

the battery level is below 30 percent, then the session will call the StopSession function and the mainWindow.

Traceability Matrix:

Traceability Matrix

ID	Requirement	Related Use Case	Fulfilled By	Test	Description
1	A light on the machine and/or a symbol on the screen that indicates an active pulse reading.	New Session (UC2)	Session	Select 'Session' from main menu. Blue circle indicates no pulse, click blue circle followed by center button to start session. Flashing red circle now indicates pulse.	The active pulse reading is handled in the session class by function 'updateHeartBeat' where it is updated at regular intervals.
2	A suggested user interface consists of the following main components: A screen and buttons.	Turn on HeartWave (UC1)	MainWindow, Menu	Run the program in Qt to observe the menu and buttons.	Buttons are created in MainWindow on launch in the 'initGUI' function. MainWindow also creates Menu, Setting, and Page objects to populate the screen in 'initPages'.
3	The device has a led light that changes to red, blue or green to indicate coherence level.	New Session (UC2)	Session, HRV	Start a session, grey bar will become coloured to represent coherence. For different input values change 'HRV Mode' in settings.	Coherence indicator is handled by the session class in the 'updateCoherence' function.
4	Press selector to initiate and end a session. The menu	Turn on HeartWave (UC1),	MainWindow, Menu, Page, Setting, Session	Select 'Session' from main menu. Press blue	MainWindow creates all menu objects and handles input by passing it off to

	options are displayed as default on the session screen. There is an option at the top to start a new session. The menu could consist of the following options: start new session, settings, log/history.	Settings (UC3)		circle then center button to start session. All menu options should be visible when program is started.	relevant menu, page, or session object.
5	Session screen must display the main HRV graph (HR vs time) with key metrics.	New Session (UC2)	Session, HRV	Select 'Session' from main menu. Press blue circle then center button to start session. HRV graph will begin to generate. For different input values change 'HRV Mode' in settings.	HRV graph data is created in the hrv class and is based on the mode selected in settings. Session class displays the graph in the 'updateHrvGraph' function.
6	The light that changes to red, blue or green indicating low, medium or high coherence, depends on the challenge level.	New Session (UC2)	Setting, MainWindow, Session	To set challenge mode navigate to settings->challenge mode and choose option (1-4). Start session from main menu to see affect on coherence indicator.	The light colour is determined by the 'updateCoherence' function in the session class and is based on the challenge level chosen in settings.
7	The metrics on the screen include the current	New Session (UC2)	Session, HRV	All metrics will be displayed once	All metrics are updated and calculated in the session class in the 'updateText' function

	coherence score (numerical value), length (duration of session), achievement (total sum of coherence scores sampled every 5 seconds).			a session is started.	using data from the hrv class.
8	A breath pacer in the form of a strip of lights on the machine itself, or a ball going back and forth on the session screen, default set at one breath every 10 seconds, adjustable in settings.	New Session (UC2)	Session, BreathMonitor	Breath pacer is visible below HRV graph on session screen. To change value, navigate to settings->breath pacer setting and choose option (1-30).	Session class displays breath pacer using BreathMonitor class data in the 'updateBreathMonitor; function.
9	The settings tab includes challenge level and breath pacer settings.	Settings (UC3)	Setting, Menu, MainWindow	Navigate to settings to see challenge level, breath pacer, and HRV mode options. Select option to make changes.	Setting objects are created by main window and populate the settings menu.
10	There are 4 challenge levels for coherence, from beginner to advanced, for the user to choose.	Settings (UC3)	Setting, Session	Challenge level can be set at settings->challenge level.	Challenge levels are stored in a setting object and are used by the session class.
11	The breath pacer, 1-30 seconds,	Settings (UC3)	Setting, Session,	To change value, navigate to settings-	Breath pacer interval is stored in a setting object and is used by

	increases time interval between each breath, default at 10 seconds.		Menu, BreathMonitor	>breath pacer setting and choose option (1-30). Change can be observed in session.	the session and breathMonior classes.
12	The menu contains a log or history tab of all sessions, with dates, when selected show the summary view, as well as the ability to delete a session.	Session Data (UC4), Turn Off HeartWave (UC7)	Menu, SessionData, MainWindow	Device has a ‘delete’ and ‘delete all’ button. Navigate to Log/History from main menu to see past sessions, use delete buttons to delete sessions.	All past sessions are stored in data.txt and are read on program startup. Data can be viewed from the Log/History menu. Data is saved on machine power off.
13	An option to reset, wipe all data and restore the device to the initial install condition.	Settings (UC3)	MainWindow, SessionData	The ‘delete all’ button will remove all session data. All other setting changes will be reset on machine shut off.	The delete buttons are created by the main window and use the sessiondata class to manage the deletion of past sessions.
14	There is a battery charge indicator on the session screen.	Battery Level Low (UC5), Turn on HeartWave (UC1)	MainWindow	Battery indicator is visible on startup in the top left corner. Battery level slowly drains and will be refiled on clicking the battery indicator.	All battery operations are controlled in MainWindow.
15	An alert goes off when a new coherence level is reached.	New Session (UC2)	Session	While in a running session return to menu and change HRV	Alert is made by session class by checking for changes to coherence value.

				mode setting. Quickly return to session, a text alert above coherence light will notify of changed coherence.	