Traceability Matrix for Neureset

ID	Requirement	Related Use Case	Fulfilled By	Test	Description
1	User presses the power button and the device turns on/off. Enabling/disabling functionality respectively	New Session (UC1)	MainWindow	Press the power button to turn the device on, observe the device turning on as the menu displays. Can press menu buttons to confirm functionality. Turn device off, observe device screen turns off, no menu buttons present, also observe pause, resume, stop no longer work.	The power button is connected to the MainWindow such that it sets a boolean notifying that the device is on or off. The power button is in control of displaying the menu on power on, and disabling it on power off. Moreover all other buttons on the device are reliant on the boolean saying that the device is on to allow their respective functionality.
2	User presses menu button and it displays menu	New Session (UC1)	MainWindow	Turn device on, press date and time, press menu button, observe that the main menu is brought back	The device when power is turned on defaults to the main menu. So to test that it works must go to another tab then click back. The main menu button is connected to MainWindow such that it sets the stacked device frames index to that of the main menu.
3	User presses new session button and it displays timer and progress bar	New Session (UC1)	MainWindow, Session	Turn the device on, when on menu screen click the new session button. Observe that a timer progress bar are present	The Session has 2 QTimers, 1 of which is a progress timer that helps keep track of the time that has gone by. MainWindow will switch the devices frames index to the session index when the new session button is clicked which has a text for timer and progress bar on it.
4	Timer begins when contact is initiated indicated by blue light	New Session (UC1)	MainWindow, MainWindow.ui, Session, Electrode	Do test 3 and observe that all electrodes have been connected and which is depicted by them switch from red to green in the UI. also observe that timer starts and progress bar progressing along with blue light on once all electrode light up green	MainWindow has 21 Electrode objects. They are resembled by QPushButtons in the UI that portray them in a headset. For testing purposes the mainwindow initiates contact with all of them for us instead of the user individually clicking,

					when the new session button is clicked. The reason for this is to shave off testing time as connecting all of the electrodes manually requires clicking each of them individually from red to green and vice versa to disconnect fully.On full conection MainWindow will toggle on the blue light thats on the device UI. Once all connected the timer begins as there is QTimer within Session that is instantiated and started by MainWindow.
5	There is a timer that shows approx. time remaining and session progress bar indicated by percentage	New Session (UC1)	MainWindow MainWindow.ui, Session	Begin a session, and observe the timer ticking down along with the progress bar increasing. Observe that once the bar hits 100 and the timer hits 00:00. The console says that therapy is complete	There are stacked device frames that include one for the session screen. This session screen in the ui has text for the timer and a progress bar with percentage. MainWindow grabs session length from Session, and ties that attribute to the text in session screen frame in the MainWindow.ui. Sessions QTimer for progress helps tick the timer down in increments of 1 second as its connected to MainWindows updateCountdown slot. The progress bar is also correlated with the session length and current countdown length to get the percentage.
6	Software calculates baseline/dominant freq. for each eeg site individually over approx. 1 min	New Session (UC1)	Session, Electrode	Begin the session and observe the console for any given round during the session. Observe in console that Electrodes emit a wave with 3 frequency values and 3 amplitude values respectively. Observe in console that dominate freq is being	Session has access to the list of 21 Electrodes object. The electrodes will emitSignal() and give Session the wave data in the form of a QVector of integers. Within the Session’s slot

				calculated and displayed for the given wave attributes. Using the the equation $fd = (f_1 \cdot A_b^2 + f_2 * A_2^2 + f_3 * A_3^2) / (A_1^2 + A_2^2 + A_3^2)$	calcBaseline thats responsible for observing and analyzing the waves it will calculate the dominant frequencies for each of the sites and display this process in the console.
7	Software applies effective treatment over duration of one second, indicated by green light, to each site concurrently, approx 1 sec.	New Session (UC1)	MainWindow, Session, Electrode	Begin a new session and observe console along side the device ui. Look in the console for when the treatment is about to start after the baselines have been calculated. Observe in console output that there are 16 pulses to all electrodes within 1 second with the correct dominant freq+offset for any given round. Observe that the green light is blinking during this 1 second of 1/16th of a second pulses. Observe on the following baseline calc round that the treatment has been effective, hinted by the dominant freq recordings increasing from the baseline calculation round prior to treatment.	Session has second QTimer, electrodeTimer, that is set to an interval of 1sec/16. When the state of Session is TREATING once the baseline calcs are complete this is started. This timer is connected to a slot in the MainWindow that controls the toggling of the green light. Moreover it is connected to a slot in Session that is responsible for sending treatment pulses. The treatment slot will apply the treatment affect to each Electrode at the end of the 16th pulse to simulate the treatments affect so an increase in dominant frequency can by seen.
8	The software successfully completes session cycle as per specs	New Session (UC1)	Session, Electrode	Begin a session and observe the console throughout the lifespan of the session. It will begin with a baseline calculation, followed by 4 rounds of treatment and recalculation of baseline/dominant frequency. All of these calculations and rounds are displayed in the console. Observe the console for when the treatment is over. Scroll through the console to ensure all steps are present.	Session has loops built around QTimer signals. The slots are reliant on Sessions attributes such as round, pulseCount, currentElectrode, baselinePhase, state. Such that the observing/anaylzing baselineCalc slot/phase knows when a single iteration is over and can change its state to TREATING. Moreover the treatment slot also knows when the treatment round is over based on pulse count. Switching state back to ANALYZING such that baselineCalc can start and

					treatment will end. This general loop structure is continued until the 5th round of baselineCalcs has been completed. Signaling the end of the session cycle.
9	The device logs the session data and it persists when device power off	New Session (UC1)	MainWindow, Session, SessionData	Start a session and wait for it to finish. Once finished go to the main menu and click on the history button to observe if the session has been logged. Once the session has been seen, turn the device off and back on, click on the history button on the device again to observe if the session persists.	MainWindow gets Session to generate SessionData. This is stored locally in MainWindow QVector that holds SessionData structs and acts as a log. When the power button is clicked, the storages don't get wiped in MainWindow. But rather a blank frame is shown and button functionality is halted. The history button simply changes the current index of the stacked device frame to that of the history frame. This is updated whenever a session ends, with the new sessions data.
10	Device will not turn on when 0 battery	New Session (UC1E2)	MainWindow	Turn device on, start and wait through sessions until not possible due to low battery at 10%, wait for last 10 percent to deplete. Once the device turns off due to 0% battery, click power button and observe that the device will not back on.	MainWindow has attributes to keep track of battery. Along with boolean signifying whether there is no battery or not. When power button is clicked the signal sent to MainWindow checks for if there is battery or not before turning device on. Moreover there is QTimer that specifically depletes battery and updates the current battery. This signal will turn off the device once at 0 battery.
11	When low battery detected notify user, if during session end and erase the session and return to menu	New Session (UC1E9B)	MainWindow	Do test 10 and observe that when the battery percentage reaches 10 a low battery warning is shown and it returns to main menu. If a session was in progress, observe both on the device UI and console that session has terminated and that the session is not recorded in the	MainWindow has QTimer that acts as the battery timer . This is connected to a slot that updates the current battery second. There are also attributes that act as the current battery and percentage. When the

				history tab..	slot see that percent is at low battery, 10%, it will show main menu. If at 10 % mid session, MainWindow terminates the session aswell.
12	User presses pause, the session will pause. If user not resume within 5 min, session end and device turn off	New Session (UC1E9A)	MainWindow, Session	Start session, click pause, observe that timer and progress bar pauses. press resume button within 5 seconds, observe that the timer and progress bar resume, press pause, and wait 5 seconds, observe that the session ends and device turns off.	MainWindow has a pause button. When clicked it sends a signal that is connected to a slot that pauses timers and the Session and initiates a single shot timer. This single shot timer goes off after 5 minutes and if it sees that the Session state is still paused, it will terminate the session and turn the device off. For the case of testing the single shot timers interval is set to 5 seconds instead of 5 minutes so testing is easier. The resume button sends a signal to a slot that resumes the Session if done so within in time limit and the Session state changes from PAUSED to whichever STATE it was prior. Continuing from where paused.
13	Contact loss mid session, red light flashes, blue light off, devices beeps, and session halts. If no contact within 5 min, session end and device turn off.	New Session (UC1E5)	MainWindow, Session, Electrode	Start session, click on a green(connected) electrode button to make it turn red(loss of contact). Observe that the timer and progress bar stops. Observe in consol that device beeps. Observe that the redlight flashes and the blue light turns off. Click the red electrode back to green(ensuring all electrodes are green) signaling contact reestablished between the electrodes and device within 5 seconds and observe in console that the device stops beeping. The redlight on the device turns off blue light turns on, and the timer and	MainWindow has Electrode buttons that when clicked simulate the loss or connection of contact between a particular Electrode, setting it to active or not active. When a Session is active. If the Electrode button is clicked while it is green(symoblic of it being in contact) it will turn red, and initiate beeping in console, and red light on and blue light off. It will also start the same interruption protocol as test

				progress bar resumes. Click on an electrode again to simulate loss of contact and let 5 seconds pass. Observe that the session ends and the device turns off.	12. Session will be paused and it initiates a single shot timer. This single shot timer goes off after 5 minutes and if it sees that the Session state is still paused, it will terminate the session and turn the device off. For the case of testing the single shot timers interval is set to 5 seconds instead of 5 minutes so testing is easier. Reclicking the red electrodes and establishing contact again within the time frame sends a signal that resumes the Session and the Session state changes from PAUSED to whichever STATE it was prior. Continuing from where paused. Beeping will stop, and blue light will turn back on instead of the red light.
14	Battery level remains the same when power is turned off and back on	N/A	MainWindow	Turn the device on and off and observe that the battery level remains the same.	MainWindow keeps track of battery attributes along the lifecycle of run time. So even if power is turned off the battery attributes persist at the same values. More over, turning the device off halts the battery update timer.
15	Data and time option allows user to changed current date and time	Input Date and Time UC 3	MainWindow	Click on the date and time option on the device, enter in desired date and time. Start and finish a session. Click on the history log to see that the date and time of the session. Observe that the date and time is the same as the date and time as the one entered.	MainWindow has QDateTime attribute that holds date and time. When the TimeandDate button is clicked. The mainwindow changes the stacked device frame to that of the date and time frame. At this frame the user can change the date to a desired one and click enter to update the date and time attribute.

16	Session history option on device allows user to view all past session with only time and date	Viewing Session Log History on Device UC 2	MainWindow, SessionData	Freshly build the simulation. Start and finish a session. Click on the session log button on the device. Observe that the session has been logged. Observe that only date and time is shown for each sesion.	MainWindow, when the session log button is clicked on the device changes the stacked device frame to that of the session Log page. This page is updated with the QVector that holds SessionData. This frame only shows the time an date of each session for this device button.
17	User can upload therapy session data from device to PC, PC view will show time date, before and after average dominant freq	View Session History on PC UC 4	MainWindow, MainWindow.ui , SessionData	After starting and finishing a session, click on the upload to pc button on the top of the device next to the power button. On the pc click on session log button. Observe that the sessions show up with time, date, before and after average dominant freq for all sites.	MainWindow's ui has a device frame group and a separate widget group for PC frames. When the upload to pc button is clicked, MainWindow appends the session log data to the frame on the PC widget incharge of displaying the session log. The session log button on the PC will change the current PC widget frame to that of the history log one.
18	When at low battery, session will not start	New Session (UC1E4)	MainWindow	Drain battery to 10% by running sessions and then try to run another one, observe that session will not start and page wont open.	Before allowing new session to be initialized, MainWindow ensures battery is greater than 10%
20	Interface has buttons, display, and electrodes	N/A	MainWindow.ui	Run the sim in QT and observe the ui.	There are interactable buttons and stacked frames in place for both the PC and device. Along with electrodes that are portrayed as push buttons. This is all dont usign the QT Creator.
21	Battery drains faster during session, allows 2-3 fully treatments fully depleting battery	N/A	MainWindow	Turn device on and observe battery. Start a session and observe that battery drains 3x as fast. Continue running sessions and observe that after 2-3 sessions, there is no longer enough batter to start another session.	Battery capacity in MainWindow is set such that it equals a little more than 3*sessionlength*3. This is because during sessions the battery timer interval is changed such that it fires 3x as fast to simulate the battery draining faster instead of every 1 second.

					Taking this into consideration the little more than 3*sessionlength*3 as battery capacity allows for 2-3 sessions to be completed.
22	Develop waveform generator to test Neurset and. Plot waveform 1 at a time based on selecting an electrode, the waveforms should differ.	N/A	MainWindow, MainWindow.ui, Electrode	Start a session and observe in console that Electrodes emit a "wave" in the form of wave attributes f1 f2 f3 a1 a2 a3. These are the frequencies and amplitudes of 3 sin curves that make up a waveform. Observe that they are randomly generated (ie values differ), in the UI click on the graph button on the PC. Observe that it should bring up an electrode selector. Observe that changing the electrode changes the plotted graph to the respective electrodes waveform and that only 1 graph is plot/displayed at a time. Observe that these waveforms are all slightly different from each other.	MainWindow'ss Electrode objects when instantiated randomly generate their own waveform attributes, f1 f2 f3 a1 a2 a3. It is ensured that the frequencies are from the 5 bands, alpha, beta, delta, theta, gamma. When the graph button on PC is clicked, the PC widget frame is swapped to that of the graph and electrode selector on MainWindow. Based on the selected electrode, the wave elements of the selected electrode are gathered and they are plotted using QChartView. The plot is 3 sin curves with the above frequencies back to back to portray a complete wave form.
23	21 electrodes	N/A	MainWindow, Session	Observe in the console during the session that there are 21 electrodes total being observed, analyzed, and treated.	Number of electrodes are handled in the back end and user is not able to change this. MainWindow creates Electrode 21 objects. Session loops works under the notion that there are 21 Electrodes.
25	Allow adjustability in therapy time for testing purposes	N/A	MainWindow, Session	Start the session and observe that treatment takes 29 seconds, instead of the longer required time.	Session object constructor takes in arguments for analyzing time and treatment time. This allows its QTimer interval increments to change along with when(at which elapsed second) each of the slots finish their task of either

					treating or calculating baseline. MainWindow initialize the session object with the a shorted time for calculating baseline so testing can be more efficient. Ie Baseline calculations take 5 sec instead of 1 min.