Software Requirements Specification

for

<u>Connectome</u>

Version 3.0

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Revision History

Version	Date	Reason For Changes
Version 1	10/21/16	Original Copy
Version 2	1/23/17	Update 1
Version 3	4/13/17	Update 2
Version 4	5/21/17	Update 3

1. Introduction

1.1.   Purpose

This document describes the features, interface, underlying system, and constraints of Connectome. It also describes how to interact with and use the application. This document is applicable to both the developers and stakeholders of the system, and is used to outline the system.

1.2.   Overview

Amyotrophic Lateral Sclerosis (ALS) is a disease that attacks the nerve cells responsible for controlling voluntary muscle movement. As the disease progresses, the patient loses their ability to move on their own. In later stages of the disease, the user loses complete control of their muscles and may be unable to move. This project is designed specifically for use by people suffering from ALS, however, anyone with a mobility impairment could benefit from use.

Connectome is a hardware/software hybrid solution that allows patients with limited mobility to control social media using just their mind. The application interfaces with the Emotiv, a brain-computer interface, which senses changes in electrical signals in the brain, to operate the interfaces of the application. The API for the popular social media website, Twitter, is also used to fetch the user's data, which is displayed in the application. An accessible user interface has been developed to allow navigation using the Emotiv, along with algorithms and data structures to allow the Emotiv to be configurable to the strengths and weaknesses of each individual user.

Navigation of the application requires the user to reliably demonstrate two commands that are built into the Emotiv: a passive command and an active command. The passive command relies on the user to maintain a natural resting state while the active command depends on the generation of a distinct, neural signal that the Emotiv can recognize.

Therefore, when the active state is sensed, the application can adjust for this change and use it to trigger selection of various objects in the user interface. Using these binary states, a user navigates through Connectome's interface and thus communicates with friends and loved ones through social media.

1.3.   Product Scope

1.3.1. In Scope

The scope of this project is to create a hardware-software solution that works with the Emotiv to allow a person with ALS and limited body control to use social media websites. The application is responsible for interfacing with the Emotiv device, fetching data from the social media sites (only Twitter as of May 21, 2017) using their web APIs, adjusting the data received from the Emotiv to enhance the experience of the user and increase accuracy/reliability, and allow the user to navigate the data that is received from the social media websites using the mental commands received from the Emotiv. This project develops an easy to use interface that works efficiently with mental commands coming from the Emotiv. Using this software, the user can stay in touch with family and friends through social media.

A backup way to navigate the application is also required for testing when the Emotiv is not available to either the developers or other users who wish to test the application. Using an easy to use navigation panel, three actions will be used to simulate the emotiv: a button that selects an action, a button that triggers the next button to be highlighted, and a button that goes back to the previous screen. A second user interface will also be included to simulate a mental command, which allows a user to set the power and duration of a simulated command, and this command is sent to the application, and read as if it is coming from the Emotiv.

The application is also responsible for learning the type of user that a person is. The application will adjust to account for false positives and inability to hold a certain mental command power level for a sufficient duration.

1.3.2. Out of Scope

All social media outlets that are not initially specified social media outlets, as well as other platforms that are not social media related, are all outside the scope of this project. Also outside our scope is modifying the provided hardware-interfacing software given by the Emotiv manufacturer. Our system will remain a recreational application, any rehabilitative functionality is outside our scope. Our system will also only be compatible with the Emotiv Epoc+ Brain Computer Interface (BCI) device, other BCI hardware will not be supported within our scope of the project.

The application will not support the ability to create Emotiv accounts in order to save profiles to the cloud. In order to use the application, the account must be created before the application is used. Similarly, any social media accounts that will be used in the application will also need to be created prior to use of the application. Logging into Twitter using credentials is also not supported in the current version of the application. Users will need to navigate to a URL given by the application, authorize the application for use by Twitter, and copy the code that is received from the authentication back into the Connectome application. Mental commands can also not be used to log into either the Emotiv cloud or the social media sites. A mouse must be used to complete these steps.

1.4.   Definitions

Term	Definition
Brain Computer Interface (BCI)	A non-invasive device that collects neural signals which can be used to communicate or control a desired output
Amyotrophic Lateral Sclerosis (ALS)	A progressive neurodegenerative disease that weakens muscles and impacts physical function by causing the death of neurons that control voluntary muscles.
Active ("Push") Command	A distinct, user-trained neural signal that triggers a specific action (click, keyboard pop-up etc) in the Connectome interface.
Passive ("Neutral") Command	A resting state, baseline neural signal that does not elicit a specific action in the Connectome interface.
Electroencephalogram (EEG)	The measurement of electrical activity in different parts of the brain

Emotiv Epoc+	A 14-channel wireless brain computer interface designed for contextualized research.
Connectome	A comprehensive map of the neural connections in the brain. Also the name of the software detailed in this report.
User Profile	An account that is created per user that stores data trained within Emotiv's Xavier platform. This user profile can then be loaded into the Connectome software.
Unity Game Engine	A cross platform game engine developed by Unity Technologies. This is the platform used to design and develop the Connectome software.
Emotiv SDK	A set of software development tools that allowed for the development of Connectome.
Steady State Visually Evoked Potential (SSVEP)	Brain signals that are natural responses to a visual stimulus at specific frequencies. Within Connectome, a flashing light of black and white was used for training and navigating through the software.
Twitter	An online news and social networking service where users post and interact with messages, "tweets".
Emotiv Xavier	A control panel that comes with the Emotiv Epoc+ device to enable users to setup the device, create a profile, and train the device.

1.5.   Referencess

Emotiv Hardware Manual - https://www.Emotiv.com/files/Emotiv-**EPOC**-Product-Sheet-2014.pdf

For more information about the Emotiv hardware, please refer to the manual referenced above.

2. Overall Description

2.1.   Hardware Functions

Our hardware consists of the Emotiv Epoc +, which is a BCI device used for recreational uses. A user using the Emotiv must go through a training process to increase the strength of a mental command mapped to the Emotiv device. This training process is done using the Xavier software interface that must be installed on a computer prior to using the Emotiv. The use cases associated with Xavier, such as storing a training profile, are detailed in the product functions. A user must first train the Emotiv for their mental commands, and then upload that profile to the Emotive cloud (via the Xavier software) before they can use the Connectome software. The user manual for the Emotiv Epoch can be found [here](#).

2.2.   Product Functions

With the hardware-software solution created, users can use various social media websites through the use of mental commands. The application itself is a desktop application, and provides physically impaired individuals the ability to use social media through the use of a BCI, specifically the Emotiv Epoc+. Two commands are used for the navigation of the interface: a neutral state, where the user is not thinking of anything, which signals that no action should be performed, and an action state, which allows a user to trigger the selection of a menu item. The user provides input to the application through a mental "push" command. When they would like to select an option, they will imagine that they are "pushing" the button away from themselves, triggering the action.

The application will support the following use cases:

Class of Use Case	Use Case Name	Description of Use Cases
1) Use cases related to user	**1.1)** Click button	User triggers the selection of a button using either a mental command or through blinking. After the action

input		command is done for a sufficient amount of time, the action of the button is triggered.
	1.2) Keyboard Input	User types through an on-screen keyboard that is optimized for typing using a single mental command or through blinking. These keyboards can either be alphabetical keyboards that allow users to create custom messages, or keyboards that have previously created canned responses.
	1.3) Navigate screens	User navigates the user interface using a single mental command, or through blinking. Each button on the page is highlighted on a timed loop. Once the button that the user wishes to select is highlighted, the user can trigger the action of the button by performing the action command.
2) Use cases related to Social media	**2.1)** Log in to Twitter	User logs in to Twitter using the site's APIs. The application is unable to support logging in through the application by username and password, so the user will need to visit the Twitter website using a URL, and then enter a pin code in the Connectome application to connect. After the user has connected once, they can quit the application and relaunch it without requiring the user to re-authorize Twitter.
	2.2) Create a tweet	User creates a post using the onscreen keyboard to type a message, which is then post the tweet to Twitter.
	2.3) Respond to	User responds to a tweet that is created by another

	a tweet	user, by typing a message using the onscreen keyboard.
	2.4) Log out of Twitter	User logs out of their account once they are logged in to twitter.
	2.5) View direct messages	User is able to view the direct messages that they have received and sent to other users on Twitter.
	2.6) Send direct messages	User is able to send a direct message to another user of Twitter.
	2.7) View User's Profile	User is able to view their own profile, including the people they are following and tweets that they have created.
	2.8) View images in a Tweet	User is able to view all of the images that may be embedded in the body of a tweet.
3) Use cases related to training for Emotiv	**3.1)** Log in to the Emotiv cloud	The user can access their cloud account that is set up with the Emotiv.
	3.2) Load a user profile	User loads profile into Connectome's interface in order to access their individual training profile.
4) Use cases related to Settings	**4.1)** Adjust the input parameters	User adjusts the parameters related to duration and power executed for each command based on training level and comfort.

	4.2) Change the keyboard layout	User specifies the type of keyboard layout from a list of pre-selected formats.

2.3.   User Classes and Characteristics

The user should be familiar with Twitter and other social media websites that are integrated into the application. They should know the basics of how the social media websites work, and the different actions that can be made. The user should also already have accounts on these sites, with friends and followers already inputted into the respective systems.

While Connectome is catered mainly to ALS patients, it is useable by all patients with limited mobility. Most of these patients will not have the ability to use physical commands to interact with the system, due to impairments that are caused by the disease. The user relies on a "push"-based mental command to trigger any action with the application. Thus, the user can log in to various social media websites, and communicate with other people using the application and the Emotiv headset.

2.4.   Operating Environment

This application runs on Windows, Linux, and MAC OS. The user interface is developed using the Unity Game Engine, with a C# back-end developed using Microsoft Visual Studio. The machine that the application is running on must have access to Bluetooth or a usb port to connect to the Emotiv.

System Requirements

	Mac	**Windows**	**Linux**
Operating System	Mac OSX 10.8 and above	Windows XP SP2 and above	Ubuntu 12.04+, SteamOS+

Graphics Card	DX9 or DX11
RAM	2 GB RAM
Processor	3 GHz
Disk Space	500 MB Available
Ports	USB 2.0

2.5.   Design and Implementation Constraints

1.   There are limitations to what the social media APIs allow developers to do - specifically, due to privacy restrictions and anti-data mining concerns, many actions are unavailable. These restrictions limit the ways that users can communicate on each website.

2.   The application is constrained by the Emotiv and the SDK that is provided by the Emotiv team to interface with the device. Due to purchasing the newest headset, the development team is constrained to using only the desktop version of the SDK, since the web SDK does not support the newest version of the headset. Beyond this, the development team is constrained to a limited set of programming languages - including Java, C, C++, Python, C# and Matlab - since these are the languages supported by the SDK.

3.   Although the Emotiv can support up to three actions, the average person will most likely only be able to train one action efficiently and reliably due to the intensity and difficulty of the training procedure. This limitation of the commands the user can use limits the choices of the development team for user input, such as keyboards for communication and navigation.

4.   The application is constrained by the responsiveness of mental command input to the Emotiv. Due to only having two actions - the neutral state and "push" state - input can become tedious, often requiring many inputs to trigger a single action. The application requires the fastest method of input possible to maximize usability.

5.   The application needs to support various methods of input, including both facial expressions and mental commands. Depending on the stage of the disease, the user may or may not have the ability to perform each of these actions. This requires different input methods for the user based on their individual impairments.

2.6 User Documentation

Training Procedure Guide - a guide to teach new users how to use the Emotiv along with the application. This guide outlines the best practices for training a new user on how to use the Emotiv and produce the most effective commands.

2.7 Assumptions and Dependencies

One assumption is that the application is used on a computer with enough performance ability, and the use of an up-to-date internet browser. If the computer does not have enough performance to support the Emotiv's back-end (the input of mental commands from the hardware), then there may be scenarios where the application does not work as intended. This could cause performance and usability issues for the user. Another assumption is that the Emotiv training software, Xavier, is compatible and installed on the user machine, because the user must complete a training session with the Emotiv and upload their profile to their Emotiv account before being able to use the Connectome software. Finally, we are assuming that the user is able to run programs built with Unity on their machine.

Another assumption that we are making is that the Emotiv can be paired with a variety of different computers the same way. By using Unity, we plan to port our application to any system supported by Unity, which includes all major operating systems.

Facebook API - Originally planned to be a part of the initial release of connectome. Gaining access to the API through Facebook Inc. in a timely manner proved to be

impossible. Because of the company's strict policies to restrict access, it has become impossible to gain access early enough in the development cycle to implement.

Instagram API - The Instagram API is be in the same situation as the Facebook API. They are owned by the same company, and we are unable to gain access to their API in a timely fashion.

Emotiv Premium SDK - The Emotiv premium SDK is not freely available. Unfortunately, Emotiv Inc. wants to sell the premium SDK to businesses to make a profit. Out project does not have sufficient funding to gain access to the premium SDK.
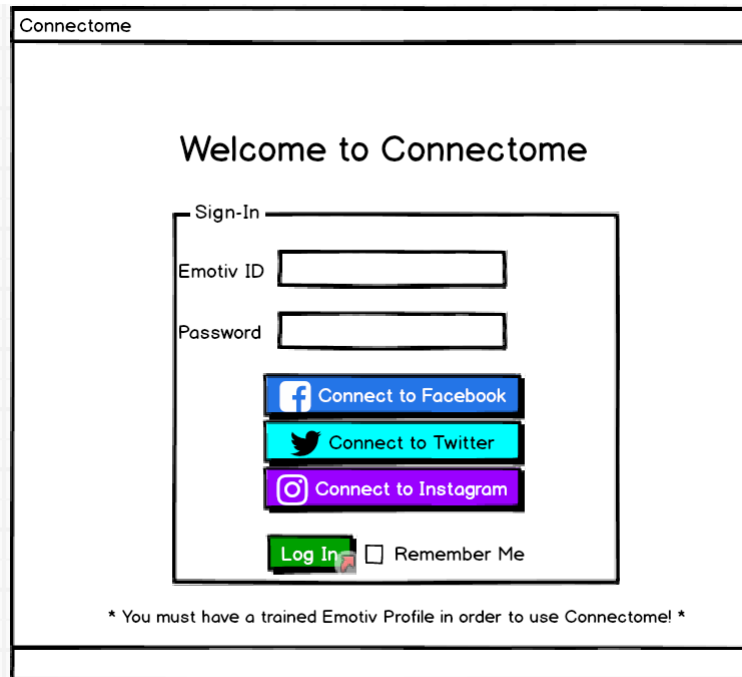
3 External Interface Requirements

3.1 User Interfaces

3.1.1 Emotiv Navigation
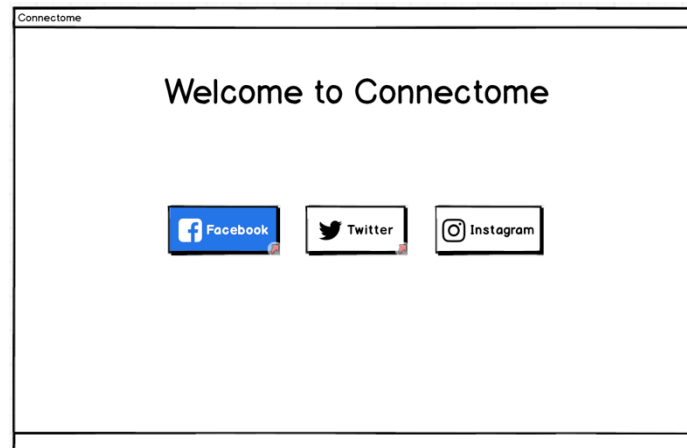
The buttons that are visible on the screen will be cycled through from left to right in the order the they are visible on the screen. For example, in a set interval, in the above user interface mock-up, the Facebook button will be selected, then the Twitter button, and then the Instagram button. Once all three are selected, it will rotate back to the Facebook button. After a specified amount of time that can be configured in the settings panel, the next button is highlighted, as long as no power from the Emotiv is detected. The Emotiv navigation will be based upon a SSVEP (Steady State Visually Evoked Potential) methodology. The button that is currently selected on the screen will flash between two colors rapidly, which has been studied and proven to help some users trigger the mental command.

3.1.2 Login Screen

1) Emotiv Cloud username text field

   i)   Input for the username to access the Emotiv profile.

2) Emotiv Cloud password text field

   i)   Input for the password to access the Emotiv profile.

   ii)   The password is hidden from the user typing. There is no password
   recovery implemented.

3) Connect to Facebook Button

   i)   Opens dialog to input Facebook credentials and link social media profile
   with application.

4) Connect to Twitter Button

   i)   Opens dialog to input twitter credentials and link social media profile with
   application.

5) Connect to Instagram Button

    i)   Opens dialog to input Instagram credentials and link social media profile with application.

6) Login Button

    i)   Verifies credentials and logs user into the application, showing the home screen below.

7) Remember Me Checkbox

    i)   Saves the user login credentials so that user is automatically logged in during their next session.

3.1.3 Logged in Menu
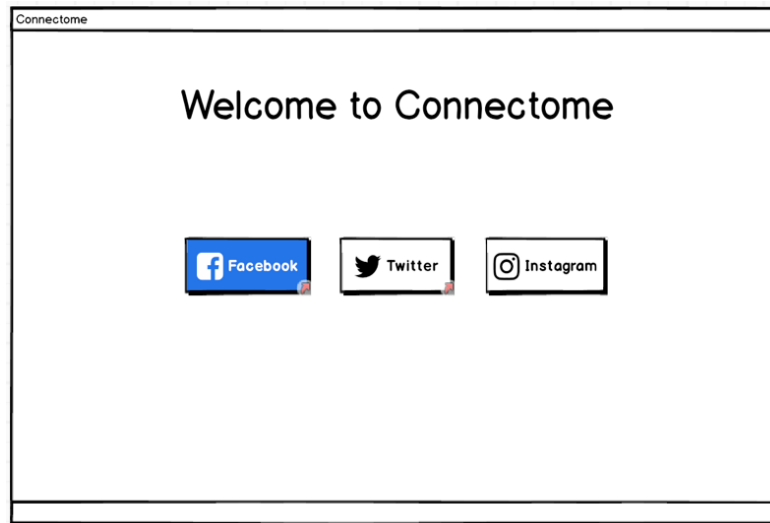
1) Facebook Button

    a)   Navigate to the Facebook home screen

2) Twitter Button

    a)   Navigate to the Twitter home screen

3) Instagram Button

    a)   Navigate to the Instagram home screen.

3.1.4 Twitter Home Menu
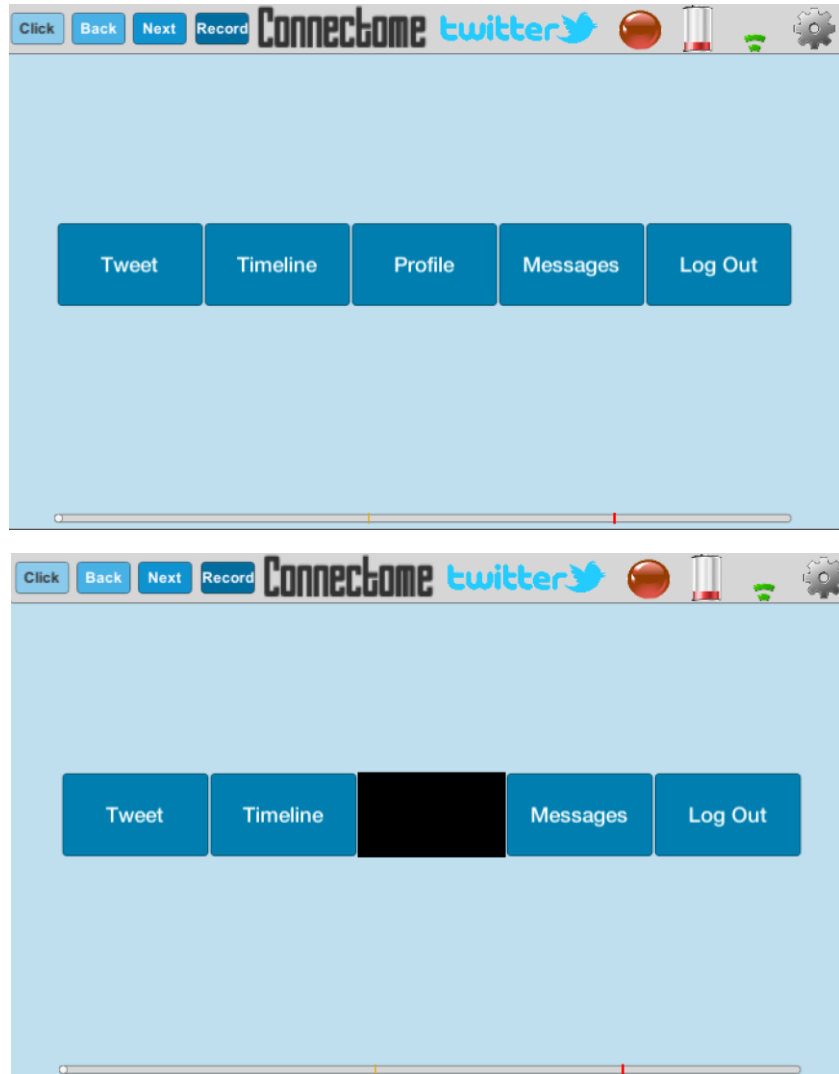
The two images above are pictures of the home menu without the flashing light highlighter on the buttons and with the flashing light on the button. All buttons in the Connectome interface will have the flashing light highlighter. Therefore, form the following user interface pictures do not show the highlighter as it is assumed to be there.

The specific portions of the home menu are explained below:

1) Tweet Button

    a)   Show the BCI keyboard and present options to type a tweet and submit it to user's twitter profile. For more information on the keyboard, see the keyboard

interface section.

2) Timeline Button

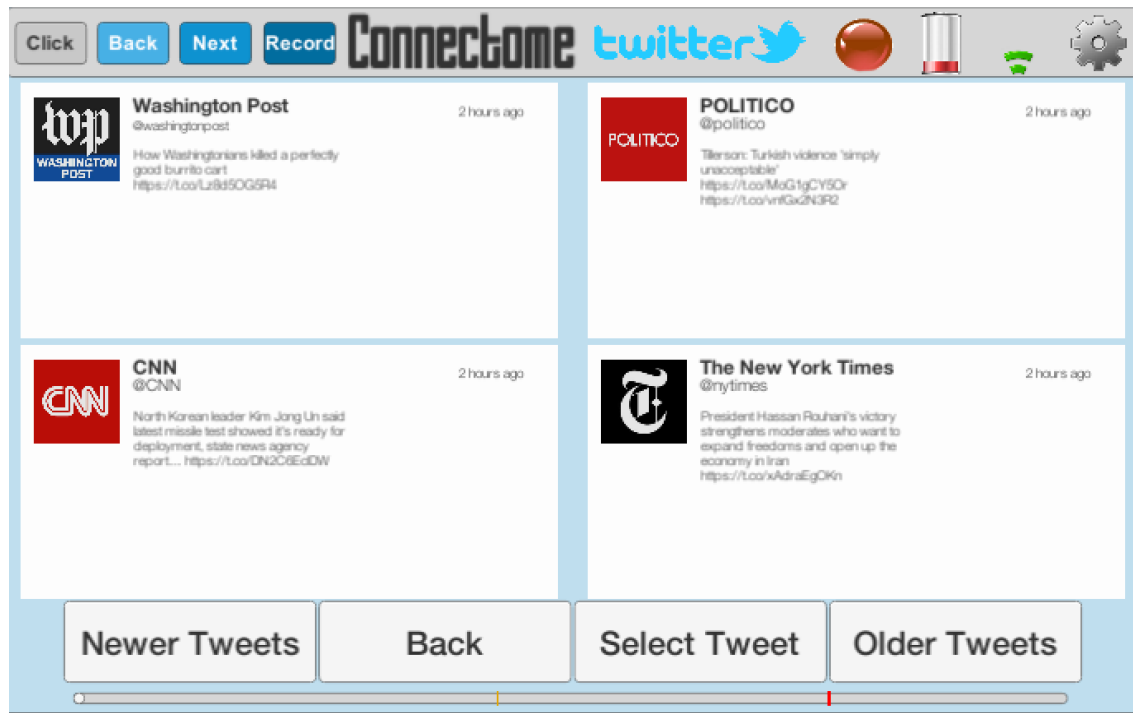a)   Navigate to the Twitter timeline and show the user various tweets and option to respond to them.

3) Profile Button

a)   Navigate to the Profile home menu options

4) Messages Button

a)   Navigate to the Twitter Direct Messages feature and show most recent active message

5) Mechanical Gear Button

a)   Change the color of the application background, or the flashing SSVEP lights.

6) Orb at top right

a)   The orb turns green if states are being read by the Emotive, ensuring a good connection.

7) Battery Indicator

a)   Displays the battery life remaining of the Emotiv

8) Signal indicator

a)   Displays the signal strength of the bluetooth connection with the Emotive

9) Manual Entry and Testing Input Buttons (Top left corner)

a)   These buttons are used for manually navigating the application in the event one needs to. Click simulates a button click on a button in order to select an element. Back goes back to the previous screen. Next, moves the selection highlighter to the right one element, and Record records all the states received from the Emotiv and exports it to a csv file.

3.1.5 Timeline Page

1) Newer Tweets

    a)   Navigates up the twitter timeline, to 4 newer tweets.

2) Older Tweets Button

    a)   Navigate down the twitter timeline towards older tweets. The number next to the text displays how many older tweets are there.

3) Four Tweet Elements

    a)   Displays a quick overview of four tweets on the timeline. Any pictures associated with the tweet is also shown.

4) Back Button

    a)   Navigate back to the home menu page.

5) Select Tweet

    a)   Move the selection highlighter to the current four tweets to select one of them and go to the Tweet Details Page below.

3.1.6 Tweet Details Page

1) Profile Picture

   a)   Shows the profile picture of the owner of the tweet the user is currently viewing

2) Twitter Name

   a)   Shows the name of the twitter account whose tweet is currently being viewed.

3) Twitter Handle

   a)   Shows the username associated with the twitter account.

4) Tweet Text

   a)   Shows the text of a tweet, including the links and references to other users.

5) Home button

   a)   Navigates back to the Twitter home menu.

6) Reply button

   a)   Compose a tweet using the keyboard addressed to the owner of the tweet user is currently viewing.

7) Message button

   a)   Compose and send a message using the keyboard to the owner of the tweet user is currently viewing.

8) Images button

   a)   Show attached images to this tweet. If there are more than one image, the user can cycle through them. If there are no images attached to the current tweet, the Images button is disabled and cannot be highlighted or selected.

3.1.7 Image Page

1) Image View

   a)   Displays the attached image related to the tweet currently being viewed by
   the user.

2) Last Image button

   a)   If there are more than one image, displays the previous image in the list.

3) Back button

   a)   Return to the timeline displaying the tweets to browse.

4) Reply button

   a)   Compose a tweet in reply to the tweet on which this image is attached.

5) Next button

   a)   If there are more than one image, displays the next image in the list.

3.1.8 Profile Home Menu
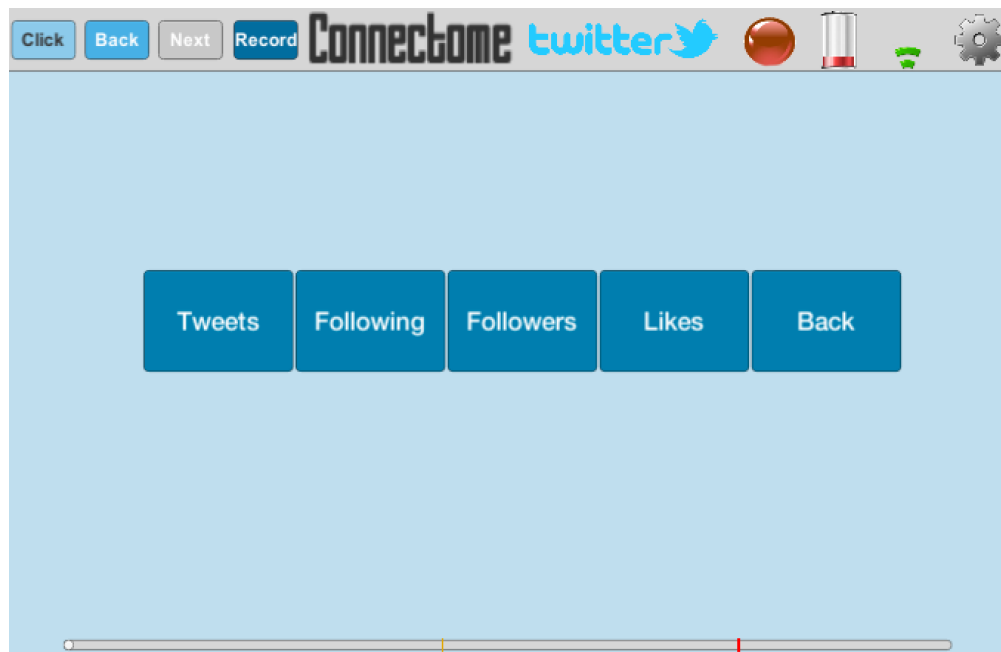
1) Tweets Button

   a)   Navigate to user tweets timeline which shows all of the tweets the user had composed to add to their timeline.

2) Following Button

   a)   Navigate to Browse following/followers screen, showing the twitter users the user is following.

3) Followers Button

   a)   Navigate to Browse following/followers screen, showing all of the twitter users following the user.

4) Likes Button

   a)   Allow user to browse all of the tweets the user has favorited.

5) Back Button

   a)   Return to the home menu.

3.1.9 User Tweets Timeline Page

1) Profile Picture

    a)   Shows the logged in user's profile picture

2) Twitter Name

    a)   Shows the logged in user's twitter account name.

3) Twitter Handle

    a)   Shows the logged in user's twitter username (twitter handle).

4) Twitter text body

    a)   Shows the text of the tweet, by the user.

5) < button

    a)   Navigate to a previous tweet on the logged in user's timeline

6) Home button

    a)   Navigate back to the profile home menu.

7) Reply button

    a)   Compose a tweet to the logged in user's own tweet.

8) Retweet button

    a)   Retweet a logged in user's own tweet.

9) Images button

a)   Navigate to the Image viewing screen and view images included with the tweet.

10) > button

a)   Navigate to the next tweet.

3.1.10 Browse Followers/Following Screen

1) Twitter Name

    a)   Shows the Twitter account name for the twitter account

2) Twitter handle

    a)   Shows the twitter account username

3) < button

    a)   Navigate to a previous twitter account on the list

4) Back button

    a)   Navigate back to the profile home menu

5) Mute button

    a)   Stop getting updates from this twitter account and stop having their tweets
    show up in the logged in user's home timeline.

6) Block button

a)   Stop this user from messaging, tweeting to, replying, or in any way communicating with the logged in user.

7) Unfollow button

a)   Remove this user from the list of people logged in user is receiving updates from. This option is only available when the user is navigating followers.

8) > button

a)   Navigate to the next twitter account on the list.

3.1.11 Direct Message Home Page
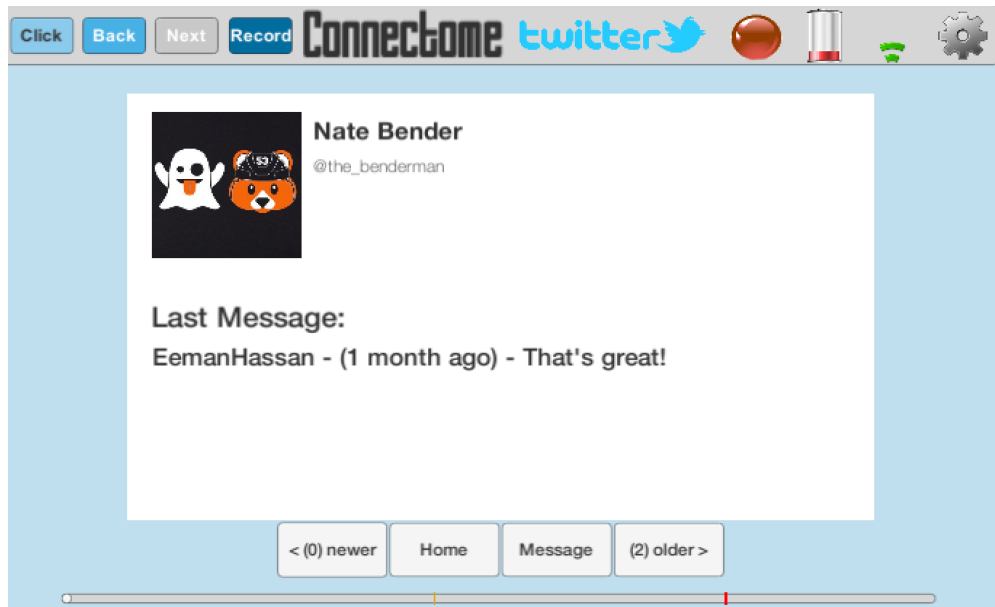
1) Twitter Name

   a)   Shows the twitter account name of the user that has messaged the logged in user.

2) Twitter Handle

   a)   Shows the twitter account username

3) Text Body

   a)   Shows the most recent message text for this user and also how long ago it was sent.

4) Newer button

   a)   Go to a more recent message thread from a different user.

5) Home button

   a)   Navigate back to the home menu.

6) Message button

   a)   Navigate to the browse message conversation page and see all of the

messages in the current thread

7) Older button

    a)   Navigate to an older message thread.

3.1.12 Browse Message Conversation Page
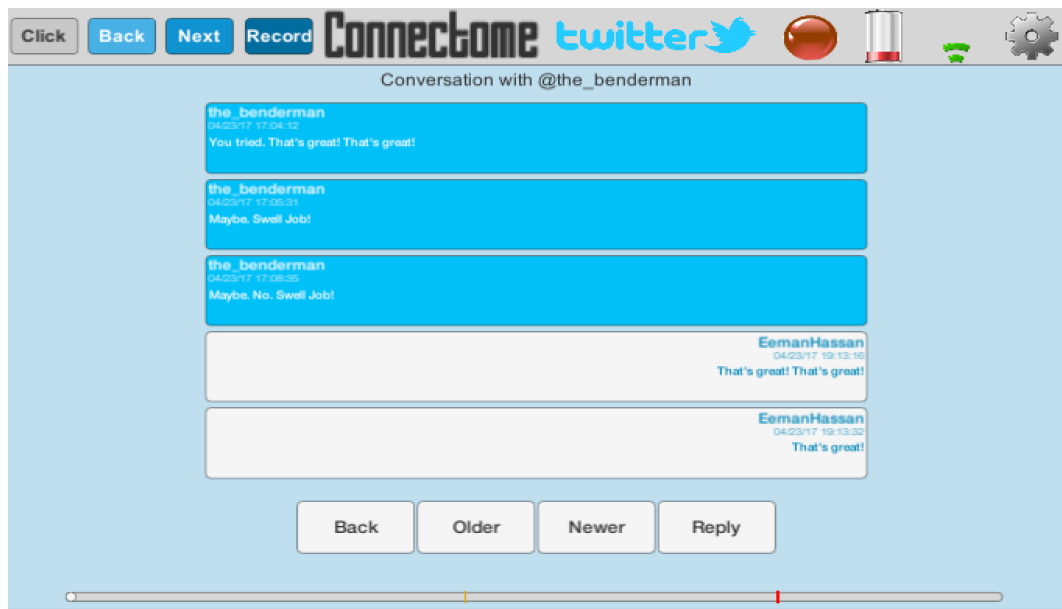
1) Blue text blocks

   a)   Shows the messages from the non-logged in user that is the target of messages from the logged in user.

2) White text blocks

   a)   Shows the messages sent in reply by the logged in user.

3) Back button

   a)   Navigate back to the Direct Message home menu.

4) Older button

   a)   Scroll up the message thread to older messages.

5) Newer button

   a)   Scroll down the message thread to newer messages.

6) Reply button

   a)   Compose a message to add to the message thread

3.1.13 Popup Keyboard

1) Enter text field

   a)   Shows the message the user is composing.

2) Exit button

   a)   Navigate back to the parent page and close the keyboard

3) Submit button

   a)   Submit the text of of the Enter text field and exit out of the keyboard.

4) Phrase/Letters buttons

   a)   Menu area navigated via the BCI. Each phrase/letter is selected by narrowing on the row/column of the desired letter.

3.2 Hardware Interfaces

The application will need to interface with the Emotiv hardware through the use of the developer SDK provided by the company. The Emotiv will require a connection to the user's computer using Bluetooth. The user will be required to train their mental commands to establish the ability to navigate the application.

3.3 Software Interfaces

C# and .NET

The application will run on version 6.0 of the C# language. This is the most recent version of the C# programming language. The C# programming language is used for all the backend programming for the application. Visual Studio 2015 is used to compile all the code that is developed in C#. Version 3.5 of the .NET framework is used for development in C# because of limitations imposed by the Unity game engine.

Unity

The application will use the Unity game engine for the user interface of the Connectome application. While the application will not contain any game components, the framework makes the interface with the Emotiv easy. A 32-bit personal version of the unity game engine is used for the project. None of the components of the professional version should be needed for the application. Unity version 5.5 is used for the development of the project.

3.4 Communications Interfaces

The external communication of our application involves connecting to social media outlets and the Emotiv account API, as well as performing actions once connected. Our interface for communicating with the Emotiv account API is handled within the provided Emotiv software, therefore the format is handled internally by the software.

The Emotiv will also need to externally interface with the social media APIs that are

provided by the companies. The Twitter API should be easily integrated into our application. There are many different 3rd party libraries that will allow our application to communicate with the social media website. Facebook components are heavily restricted, so the API will need to be further tested to determine if the site will house enough functionality to be feasible for our application.

4 System Features

4.1 Requirements Apportioning

Priority Level	Description
1	Priority 1 items have the highest level of importance and are necessary for the usability of the product. The items labeled Priority 1 are completed and verified prior to the release of the application.
2	Priority 2 items are not crucial to the usability of the application, but would enhance the user experience and are expected to be implemented in the next release of the application. Priority 2 items not completed prior to release do not inhibit functionality of the release version of the application.
3	Priority 3 items are not crucial to the usability of the application and are not within the current scope of the system. These items are expected to change with future development.

4.2 User Features

1. **Allow users to train the neutral mental state.**

Primary Actor	User
Description and Priority	User is able to train the neutral command. This is the state that the user is in when they are not trying to trigger any commands/are relaxed. **Priority 1**
Pre-Condition(s)	The user has the Emotiv software installed on their computer. The user has entered the Emotiv software. The user then places the Emotiv on their head and connects the Emotiv to their computer.
Main User Scenario	1. The user clicks on the training panel. 2. The user then clicks to trigger training of the neutral state. 3. The user then sits still, making sure that they do not get distracted or think about anything, for seven seconds. 4. The user can then accept the neutral state if it is sufficient, or can retrain it.
Alternate Scenario #1	N/A

2. Allow users to train a single mental "push" command.

Primary Actor	User
Description and Priority	Using the Emotive interface a user can assign one mental state as a neutral state and then assign another mental state as a command. **Priority 1**

Pre-Condition(s)	The user has entered the Emotiv control panel, connected the Emotiv to their computer, and trained the neutral mental state.
Main User Scenario	1. The user selects the "push" command from the list of mental commands that are available to be selected to train. 2. The user then focuses on pushing the cube away from them during the training time period. 3. Once the mental command has been read, the cube will then be animated while the push mental command is being triggered. 4. Once the training has been sufficiently completed, the training can be accepted or retrained.
Alternate Scenario #1	N/A

3. Allow users to log into the Emotiv cloud, to retrieve training profiles.

Primary Actor	User
Description and Priority	The user is able to log in to their Emotiv account, which contains an already saved training profile. **Priority 1**
Pre-Condition(s)	The user has trained the neutral and push commands in the Emotiv interface, and saved their training profile to their Emotiv cloud account. The user then opens the Connectome App to the setup screen.

Main User Scenario	1. The user enters their Emotiv cloud username, password, and training profile name into the Connectome app.
	2. The training profile is then loaded into the Connectome application, and can be used for future mental commands.
Alternate Scenario #1	N/A

4. Allow users to save a training profile, and reload in the future.

Primary Actor	User
Description and Priority	The user is able to save a trained profile to the cloud to be loaded for future use. **Priority 1**
Pre-Condition(s)	The user is logged into their Emotiv account, and has gone through the steps displayed on screen to train their emotic profile.
Main User Scenario	1. The user goes to the menu bar the the top of the Emotiv training software and selects 'Upload to Cloud'.
Alternate Scenario #1	N/A

5. Allow user to trigger the push of a button using a mental push command.

Primary Actor	User

Description and Priority	The user is able to select and trigger a button in the Connectome app using a single mental push command. This is the main way of navigating through the application. The buttons on the screen will cycle through the one that is currently highlighted/being focused on. After a period of sufficient mental command power, the button will be selected. **Priority 1**
Pre-Condition(s)	The user has opened the Connectome application, and loaded their Emotiv cloud profile into the application.
Main User Scenario	1. The user waits until the button that they wish to select is highlighted/being focused on. 2. The user imagines "pushing" the button away from themselves for a sufficient period of time. 3. The button selection is triggered, and the action that the button has is completed.
Alternate Scenario #1	N/A

6. Allow user to type through an on-screen keyboard using a single mental command.

Primary Actor	User
Description and	Using an on-screen keyboard, the user is able to fill in text using only

Priority	the single mental push command. **Priority 1**
Pre-Condition(s)	The user has opened the Connectome application, and loaded their Emotiv cloud profile into the application. The user has previously clicked on a text input element.
Main User Scenario	1. The keyboard appears on the screen, allowing for the user to input text. 2. The user waits until the column which the text element they want to input is highlighted. 3. The user imagines pushing an element away from themselves, triggering the push mental command, for a sufficient period of time. 4. In the row that the user selected, the columns are then cycled through, one button highlighted at a time. 5. The user then waits until the button they wish to trigger is highlighted. 6. The user imagines pushing an element away from themselves, triggering the push mental command, for a sufficient period of time. 7. The key the user wished to type is then printed to the screen.
Alternate Scenario #1	N/A

7.   Allow the suggestion for completion of user inputted text.

Primary Actor	User
Description and Priority	Using an on-screen keyboard, the user is able to fill in text, with completion suggestions being outputted to the screen when text is entered. **Priority 2**
Pre-Condition(s)	The user has opened the Connectome application, and loaded their Emotiv cloud profile into the application. The user has previously clicked on a text input element.
Main User Scenario	1.　The keyboard appears on the screen, allowing for the user to input text. 2.　The user waits until the column which the text element they want to input is highlighted. 3.　The user imagines pushing an element away from themselves, triggering the push mental command, for a sufficient period of time. 4.　In the row that the user selected, the columns are then cycled through, one button highlighted at a time. 5.　The user then waits until the button they wish to trigger is highlighted. 6.　The user imagines pushing an element away from themselves, triggering the push mental command, for a sufficient period of time. 7.　The key the user wished to type is then printed to the screen. 8.　Analyzing the current word that is printed to the screen, a list of suggestions is added to the keyboard, allowing the user to select one, completing the word.

8. Allow user to login to Connectome.

Primary Actor	User
Description and Priority	The user is able to login into their social media account through our application, and access all their information.
Pre-Condition(s)	The user has opened the application and is on the initial login page. **Priority 1**
Main User Scenario	1. The user selects the username box for Twitter and enters their username. 2. The user selects the password box for Twitter and enters their password. 3. The user selects the username box for Emotiv and enters their EmotivId. 4. The user selects the password box for Emotiv and enters their Emotiv password. 5. The user selects enter to log into their account. 6. The user is brought into the selection screen for all the different types of social media.
Alternate Scenario #1	N/A

9. Allow user to enter Twitter main screen

Primary Actor	User
Description and Priority	The user is able to enter the Twitter portion of the application. **Priority 1**
Pre-Condition(s)	The user has opened the Connectome application, and loaded their Emotiv cloud profile into the application as well as connected their Twitter account.
Main User Scenario	1.
Alternate Scenario #1	N/A

10. Allow user to post a tweet.

Primary Actor	User
Description and Priority	The user is able to post a tweet to Twitter. **Priority 1**
Pre-Condition(s)	The user has opened the Connectome application, and loaded their Emotiv cloud profile into the application as well as connected their Twitter account. The user has also selected Twitter as the social media application they wish to use.
Main User Scenario	1. The user is on the Twitter main screen and selects the 'Tweet' Button, and a keyboard appears on screen.

	2. Use Case: 4.2.6
	3. The user then selects the 'Enter' button to publish the tweet to Twitter.
Alternate Scenario #1	N/A

5 Other Nonfunctional Requirements

5.1 Performance Requirements

Our application is available for use when ran locally on a user's system until the user has completed use of the application. All social media connections and actions are executed or processed within 1 seconds of execution, as our interface requires precise timing from the user while performing actions. UI elements that do not involve outside connections to social media resources will respond to user input immediately with no noticeable lag.

5.2 Safety Requirements

This application accesses the user's social media sites. While using the application, the user should not provide any information that they do not want to be available to the public, since everything given is pushed to the user's linked social media account. Take the same precautions that would be used normally on any of these sites.

This application also requires that the user has access to an Emotiv Epoc+. While using the Emotiv to interact with the application, the Emotiv is attached to the user's head. The user should refrain from exposing the Emotiv to water or similar liquids. They should also protect it from falls, or rough treatment. Otherwise, the Emotiv is a passive device that only collects data from the user, and should not cause any harm while worn. The device might need to be re-adjusted periodically as the nodes can cause pain to areas of the head if worn for a long time, since they are applying a slight pressure.

5.3 Security Requirements

Our application involves two areas security of security which impose similar requirements: the Emotiv training accounts and profiles which are saved and loaded to the Emotiv Cloud, and all social media account information. Any stored user credentials are encrypted to secure their data and no plaintext account information is stored on our application. Account login is performed through social media and Emotiv's account API's following the specification given by the API documentation to maintain account

security. Our application will not monitor or collect data on user social media activity.

5.4 Software Quality Attributes

Our application is designed to interpret user actions as reliably as possible, ensuring that when the user invokes the "push" mental command, the application will respond correctly to select an item on the user interface. The threshold and interval for registering a command is adjustable by the user, providing flexibility for users with different learning curves. In addition, the application is usable by anyone who has created an Emotiv profile and has done sufficient training for the "neutral" and "push" states.

6 Known Issues

Using only a single action, keyboard input can be quite slow. Different keyboard layouts will need to be implemented and testing to make sure they do not restrict the abilities of the user.

7 Analysis Methodology

7.1 Feasibility Study

Due to the use of mental commands for the use of the application, the team is required to conduct feasibility studies and other analysis on the different input methods produced throughout the course of the project. Various measurements such as speed and reliability of input, simplicity of navigation, and intuitiveness will need to be measured and quantified in order to produce the most usable system possible.

7.2 Navigation

Various navigation methods are implemented and tested for functionality throughout the course of the project. The project team is responsible for determining which of these navigation methods provide the most usable experience for the user. Important attributes of the navigation of the application include speed of navigation (how the user can navigate between screens, posts, and perform actions on various social media websites),

reliability of mental commands for the pressing of buttons (how long and frequently can a mental command to trigger an action), and how intuitive the user interface is for use (a new user should be able to use the application without a relative amount of explanation).

7.3 Keyboard Input

Due to the use of binary mental commands - the neutral state, meaning do nothing, and the "push" state, meaning trigger an action - various keyboard implementations will need to be tested. Since the user cannot use a normal keyboard, the development team will need to create various on screen keyboards, and analyze them for ease of use and speed.