House in Your Head

Team G1-FrigidWaters

Launch Report

Cycle # 2

Date: 01/09/2015

Team Members:

Name: Samuel Bever

Name: Michael Conway

Name: Joseph Muoio

Name: Kyle Patron

Name: Kevin Zakszewski

The System/Product

System/Product Name

House in Your Head

Introduction

Amyotrophic lateral sclerosis (ALS) (also called "Lou Gehrig's Disease") is a neurodegenerative disease affecting the brain and spinal cord. The motor neurons progressively degenerate and die off, leading to the loss of muscle control and death. Affected indivuals suffer a spectrum of symptoms culminating in total lock-in. In this state, the patient is aware but cannot move their body in any way. They cannot breathe on their own or even blink their eyes. Because of this, late-stage ALS patients are unable to interface with conventional assistive technologies. [1]

The goal of the project is to build a system which people afflicted with ALS can use to interact with their houses through Home Automation Systems (HAS). This includes controlling the thermostat, lights, stereo, and television as well as interfacing with social media. By having a Brain Computer Interface (BCI) to their automated house, individuals with ALS can still interact with their environment despite full paralysis.

This project builds off a previous senior design project. The old project had a few limitations in the design of the interface. It was a scrolling list that did not work very well. It clunky and hard to use. The interface was also too flashy which can break the concentration of the user. In addition to limitations in the interface and usability, calibration was a time consuming process and the results were not able to be saved. To overcome these problems, a new method to read the brainwaves will be used and a new interface will be tested.

Highlighted Features

- Calibration for individual users
- Intuitive interface with simple selections
- Allow users with ALS to perform basic household tasks, such as
  - Turning lights on and off
  - Adjusting the thermostat
  - Controlling the television

Sponsor or Proxy User

Our outside stakeholder is **Sara Feldman**, PT, DPT, ATP, MDA/ALS Center of Hope, Drexel University College of Medicine. We will be meeting with Dr. Feldman on an ongoing basis to continually reevaluate the progress and project goals to ensure that this product will be useful to ALS patients.

Issues

Brains are complicated, and so expecting them to perform a task in a deterministic way is not necessarily realistic. This means that we will have to have a sophisticated signal processing system in place. There is no one correct way to do this, and since the current method is not robust enough for general use, we predict that this will occupy a significant portion of the project development cycle.

To get an idea of the complexities involved, consider the current best-performing text-entry interface using the Emotiv device, which requires the user to focus on the chosen letter on the screen and observes the involuntary recognition response when this letter flashes. Even this method takes a long time to reliably select the correct letter, resulting in a speed of only about 1 letter every 30 seconds. It is also mentally taxing for the user. [3]

Our proposed method will build off of the work done in the video cited above, but our own symbols for lights, television, and thermostat will be used in place of letters and numbers. This will allow the user to select the appropriate action simply by concentrating on it. The method used has already been proven to be effective and can be expanded to include any number of options. The primary advantage to specializing our system this way is that there will be fewer options available, which means that choices can be accurately made much more quickly. In addition, each option is more expressive than a single letter, allowing ideas to be communicated much more quickly.

Gathering project requirements will present difficulties because we cannot easily identify with the daily experiences of ALS patients and communicating directly with late-stage ALS patients is challenging. To circumvent this, we will have to depend heavily on our contacts at Drexel Medicine, who work with ALS patients.

Project Costs

The Emotiv device[2] costs between $300 and $500. This cost is being covered by the Drexel College of Engineering and College of Medicine. Before being able to be used, the device will have to be trained, costing the user time. The software will be fully open source, so it will be free for users to download and use as long as they have an Emotiv device.

Benefits

The biggest benefit will be the quality of life improvement for patients who are suffering from ALS, specifically, those that are totally paralyzed and cannot even move their eyes. The device we are developing software for is much cheaper than the alternatives, which can cost upwards of $17,000. Since this project is open source, there is a large potential for our project to grow and be used in future work.

The Team

Team Name

G1-FrigidWaters

Team Members and Their Specialties

Samuel Bever enjoys working in algorithms, artificial intelligence, and graphics. Role: Tester.

Michael Conway has experience and interests in the areas of algorithms, programming languages and computer security. Role: Technical Lead.

Joseph Muoio has experience and interests in the areas of AI, mobile app development and software development. Role: Team Leader.

Kyle Patron is interested in mathematics, particularly as it relates to signal processing and machine control. Role: Tools lead.

Kevin Zakszewski has experience in UI/UX design and front end implementation. Role: Lead Designer.

Team Communication

Our team will be meeting at least once a week on Wednesdays at 5pm to discuss our progress, outline our tasks for that week, and address any other issues. If necessary, more meetings will be scheduled for the remainder of that week. Most group communication outside of these meetings will be done via email. For source code management, we will be using a GitHub [4] repository, which comes with an issue tracker and a project wiki. We will also be using Review Board in order to organize and distribute code reviews to the team.

Team Issues

We are all busy and have many other school and work commitments. Finding time to meet on a regular basis will be important but possibly difficult.

There are some differences of opinion when it comes to technical aspects of this project. We are still debating which language we should use.

The Plan

Objectives

Our goals for this cycle are to

- Revise our requirements and design specifications based on information from the previous cycle
- Develop a test plan
- Develop the Emotiv-based UI, which is the core of the project
- Refine and extend the HAS interface begun in the previous cycle
- Integrate these two components into a single package that provides the basic functionality of the end product

Schedule

Week	Person	Contribution
1	Everyone	Revise and update launch report for C2
1-3	Joe Muoio	Revise requirements
2-5	Sam Bever	Develop test plan
3-6	Joe Muoio	Revise system design
1-3	Kyle Patron	Experiment with Emotiv functionality
3-6	Kyle Patron, Kevin Zakszewski	Develop Emotiv-based UI
3-6	Michael Conway	Refine and extend HAS interface
7-8	Sam Bever	Integrate and test C2 implementation
7-9	Everyone	Revise and update launch report for C3
8-11	Joe Muoio, Sam Bever	Prepare presentation

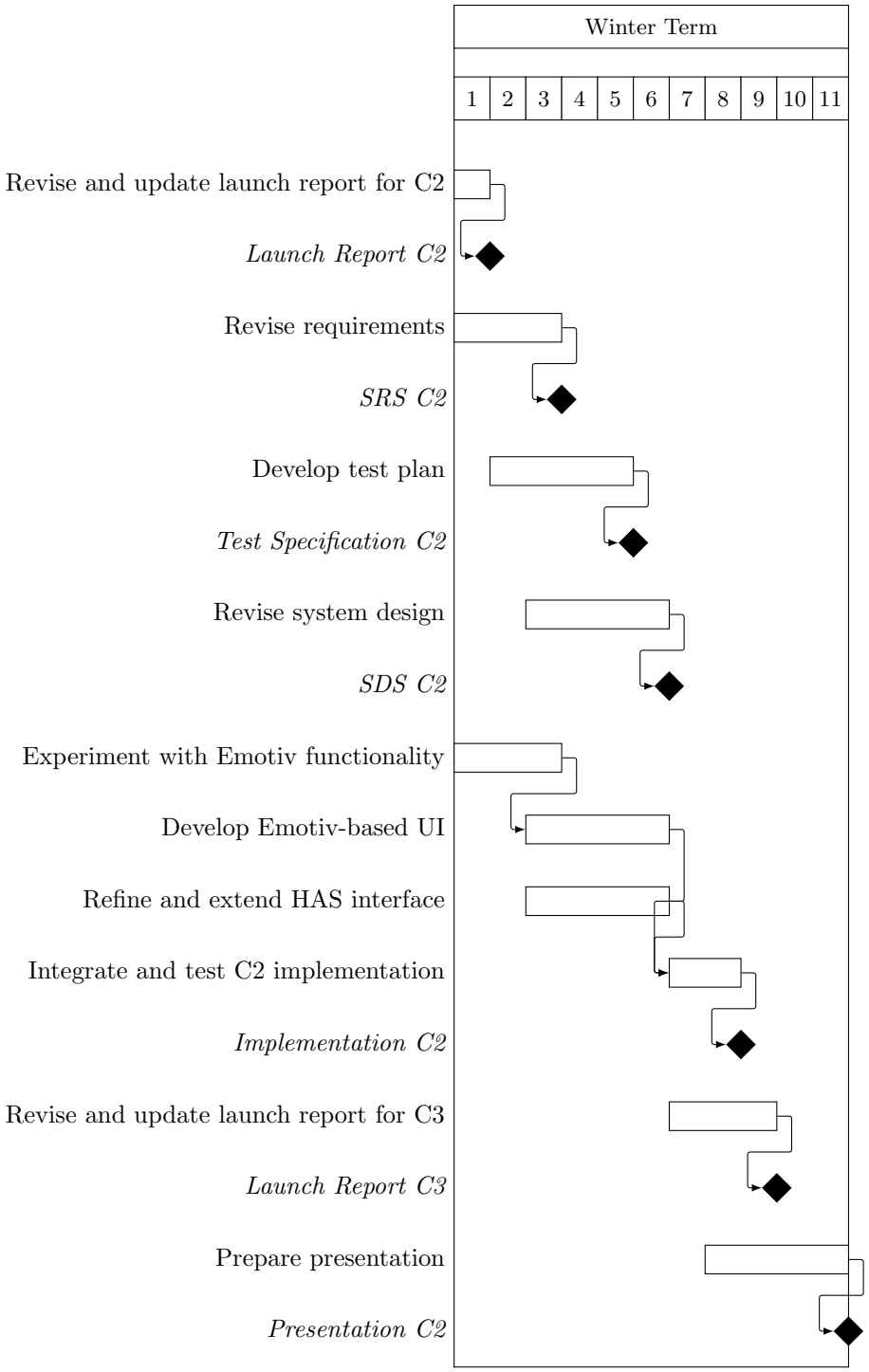
Winter Term
1
2
3
4
5
6
7
8
9
10
11
Revise and update launch report for C2
Launch Report C2
Revise requirements
SRS C2
Develop test plan
Test Specification C2
Revise system design
SDS C2
Experiment with Emotiv functionality
Develop Emotiv-based UI
Refine and extend HAS interface
Integrate and test C2 implementation
Implementation C2
Revise and update launch report for C3
Launch Report C3
Prepare presentation
Presentation C2

Table of Contributions

	Section	Writing	Editing
1	Project	Joe Muoio	Mike Conway
2	Team	Everyone	Sam Bever
3	Plan	Kyle Patron	Kevin Zakszewski

Bibliography

[1] The ALS Association. (2014, October, 5). *What is ALS?* [Online]. Available: `http://www.alsa.org/about-als/what-is-als.html`

[2] Emotiv, Inc. (2014, October, 6). *Emotiv—EEG System* [Online]. Available: `http://emotiv.com/`

[3] http://youtu.be/08GNE6OdNcs

[4] GitHub (2015, February, 7). *GitHub* [Online]. Available: `https://github.com/about`

I certify that:

- This paper/project/exam is entirely my own work.
- I have not quoted the words of any other person from a printed source or a website without indicating what has been quoted and providing an appropriate citation.
- I have not submitted this paper / project to satisfy the requirements of any other course.

Signature: Samuel Bever Date: 01/09/2015

Signature: Michael Conway Date: 01/09/2015

Signature: Joe Muoio Date: 01/09/2015

Signature: Kyle Patron Date: 01/09/2015

Signature: Kevin Zakszewski Date: 01/09/2015

Grading

The grade is given on the basis of quality, clarity, presentation, completeness, and writing of each section in the report. This is the grade of the group. Individual grades will be assigned at the end of the term when peer reviews are collected.