Creating Interfaces for Deep Space Network Operation

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I. Introduction

The Deep Space Network (DSN) is NASA's international array of giant radio antennas that supports interplanetary spacecraft missions, plus a few that orbit Earth. The DSN also provides radar and radio astronomy observations that improve our understanding of the solar system and the larger universe. It consists of three main sites spaced equal distance from each other. These sites are at Goldstone, near Barstow, California; near Madrid, Spain; and near Canberra, Australia.

The operator stations of the DSN are currently manned 24/7 at all three sites. but an upcoming change, Follow the Sun (FTS), will change this to 8 hours a day and have the following implications:

- Operation will compose of one facility remotely controlling the other two during operation time
- Operators will remotely handoff their control over to an operator of another facility

The Human Interfaces Group at JPL is tasked with creating interfaces for the operators of the DSN to handle the new challenges of FTS.

II. Assignment

Operators of the DNS require a combined information interface, one that displays all the crucial information of a given support. Our task is to design, develop, and iterate a prototype solution to this problem, namely, the Mason All-In-One Display. The requirements of this prototype include the following:

1. An iterated design created with feedback from users and veteran designers
2. A CSS framework for quick iterations and for future use for other displays and for other developers to use
3. A Node.js application comprising of the display itself
4. A false-data pipeline for simulating real world scenarios with the display

I will be leading development with another intern under me, Nate Fortner, and I am tasked with assessing his development skills and delegating appropriate tasks to him.

III. Approach

Participatory design is our method of choice for designing displays for the FTS DSN. In participatory design the end users, in our case the Link Control Operators (LCOs), are engaged in the process of solving design problems. We will be consulting with LCOs when brainstorming, designing, and reviewing our displays. On July 7th we will take a trip to the Goldstone Deep Space Communications Complex to meet with LCOs and involve them in the designing of the displays through participatory design.

The mode of development for creating the display will include the agile development framework called Scrum. Scrum promotes rapid prototyping, short feedback loops, and iterative development by accepting the volatile nature of software development and systematically allows for flexible design and development. Scrum is characterized by two week programming sprints, daily time locked meetings called scrums, constant feedback, and reviews. Scrum utilizes user stories as a means of communicating software features. User stories are a description of a feature using a story of what a user does or needs to do as part of his or her job function.

The second day of my internship will be a day of planning, with a programming sprint the two weeks following. This pattern of planning, review, sprint will continue a total of 5 times throughout my internship and I will have completed 5 iterations of my project during those sprints.

IV. Possible Challenges

Some foreseeable problems with the project are as

follows:

1. When making applications using large sets of data the need to avoid methods that block javascript operation is exacerbated

Node.js is an asynchronous event driven JavaScript runtime, designed to build scalable network applications. Node was chosen because it contains non-blocking asynchronous I/O methods which will allow for use with large sets of data.

The solution to (1) gives way to another problem:

2. I will have to quickly learn Node.js and ensure the intern under me is prepared enough with Node to take on the tasks that I assign to him

Node.js is well supported with intricate documentation that includes many example projects. Additionally, Node is used amongst the veteran programmers of my group and getting help from them is an option for me to utilize during my project. I am confident that Node will be an invaluable tool for this project, one that will be quick to pick up for me and the intern under me.

3. Creating a CSS framework can be complex and hard to maintain

My solution to this problem is using the CSS preprocessor Sass. Sass lets you use features that don't exist in CSS yet like variables, nesting, functions, and inheritance. This allows for writing and maintaining large CSS frameworks. I am already familiar and confident with using Sass.

V. Project Schedule

- Weeks 1-2: The First Sprint
  - Ramp up
  - Start CSS framework
  - Get Nate set up
- Weeks 3-4: The Second Sprint
  - Get feedback on the CSS framework, iterate
  - Start Node.js project
  - Take trip to Goldstone Facility
- Weeks 5-6: The Third Sprint
  - Get feedback on the Node.js project
  - Iterate on the Node.js project
- Weeks 7-8: The Fourth Sprint
  - Get more feedback on the Node.js project
  - Start the false-data pipeline
- Weeks 9-10: The Final Sprint
  - Finish the false-data pipeline
  - Do the final iteration of the Node.js project

References

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