CSE 485 Semester Report
Team 1, Friday 10:30am

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Project sponsors: Dr. Judd Bowman and Dr. Danny Jacobs

Project description: A virtual observatory for the Murchison Widefield Array radio telescope.

Contents

1 Executive Summary

The Murchison Widefield Array (MWA) is an enormous radio telescope in Australia used by scientists to monitor hydrogen radiation. This telescope assists scientists interested in learning about the formation of the universe. EoRLive, a website which allows scientists to communicate regarding the MWA data, is in need of additional functionality. This project was formed to address the deficits with the current EoRLive website and to allow the scientists to more efficiently engage with their data.

2 Introduction

a Project description

This semester, we produced a website which functions as a data browser for the MWA telescope's observations. It allows a user to log in with their account and select a date range using selectors at the top of the page and see a list of telescope observations that happened in that range (or scheduled observations that will happen, if the range extends into the future). Specifically, the user can see the observation ID (the unique identifier for the observation in the system), the observation name, and who scheduled the observation. Additionally, the user can see a graph that shows the status of the telescope's data pipeline over that date range. This graph shows the total observation hours scheduled for the telescope versus how many hours have actually been observed, and how many hours' worth of observation data have been transferred from the telescope to databases at MIT.

b Purpose of project

The motivation for this project was to make improvements upon the existing site, which lacked some key features the MWA researchers really wanted. They wanted a site that would allow them to monitor the status of the telescope in real time, annotate and share data sets, create discussions about the data through forum-style discussions, and write custom queries that allow them to see the data they want, all on an intuitive Web platform. Ultimately, the goal for this project was to build a more dynamic, collaborative, and customizable site. This

will allow the scientists to focus more on their research and less on the tools which connect them to their data.

3 Scope

a Original Definition

The original plan was to develop a website with the layout which was provided in the document given to us by our project sponsors. The document specified a visual view of the telescope array, user account support, and user interaction functionality. However, the original document did not go into much detail as to the specifics of functionality or implementation. After meeting with our project sponsors, we decided that there will be three different layers that our team will work on.

b Change of scope and reason for change

The main change to our project was to divide it into three distinct "layers." The lowest layer is the actual telescope data itself. As said by our project sponsors, the main component of the website itself will be displaying the data - our goal for this layer is to pull the telescope data out of the databases in a meaningful way.

The middle layer is the logic layer, which will be the layer in-between the user interface and data layers. There is not a well-defined API for extracting the data from the databases - our team will have to develop an API - with demos/documents/plots, and more - so that someone else may want to extend functionality later. Also, the databases are extremely complex, so we need to develop an ORM for modeling the data.

The third layer is the user interface. There are several features that needed to be added - one was user accounts. Users need to be able to register and/or login to the website. Another important feature was comments - we need to have a comments feature on each and any data point, allowing for conversations between users. There will also be a forum that

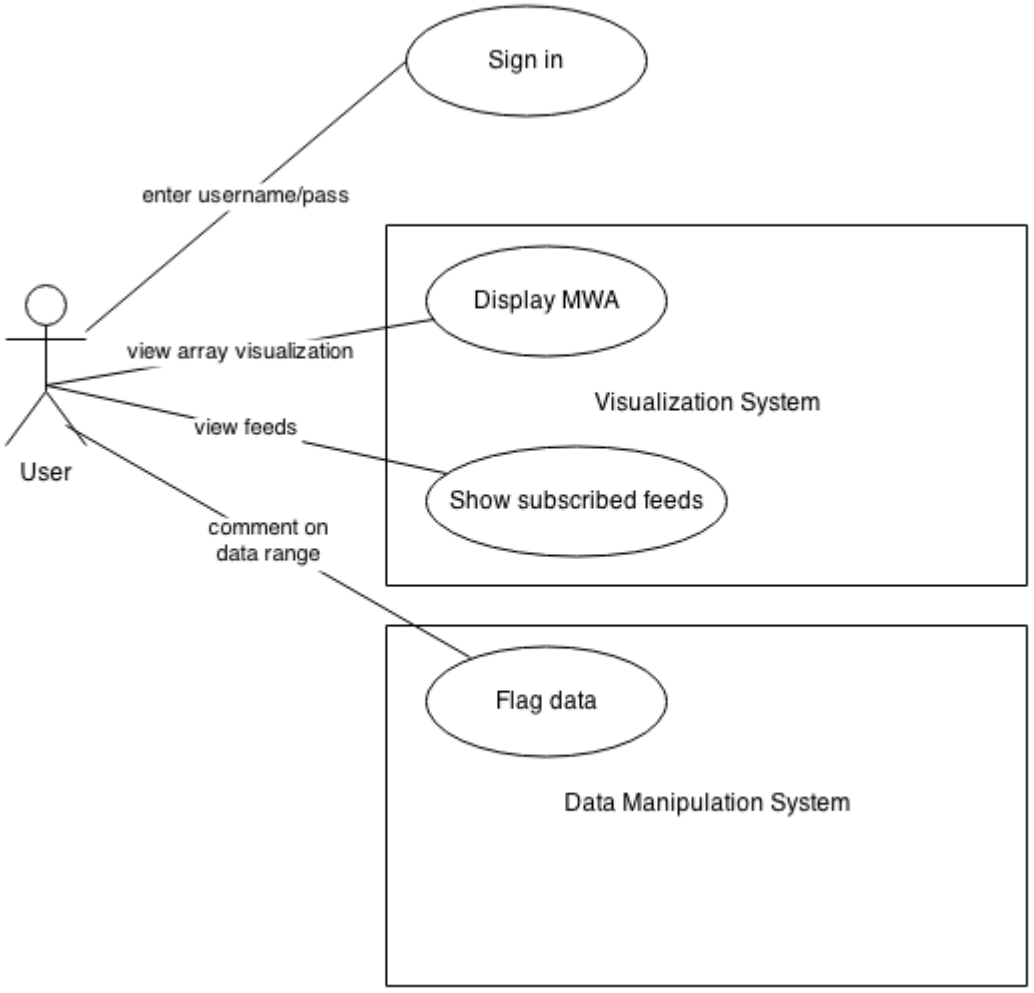
will allow direct communication to various UI elements on the website. The project sponsors also wanted more interactivity in the website, such as manually flagging data streams, seeing which other users are also online (possibly to start a conversation), having a photo of the array itself and having it be interactive, and more.

4 User Overview

The intended users of this website are astrophysicists involved in research which focuses on monitoring hydrogen radiation throughout the universe. The users are already familiar with the Murchison Widefield Array and the science associated with it. Some of the scientists may be familiar with software development (for example, experience with scripting languages like Python), but it is assumed that none of the users have a deep understanding of software development.

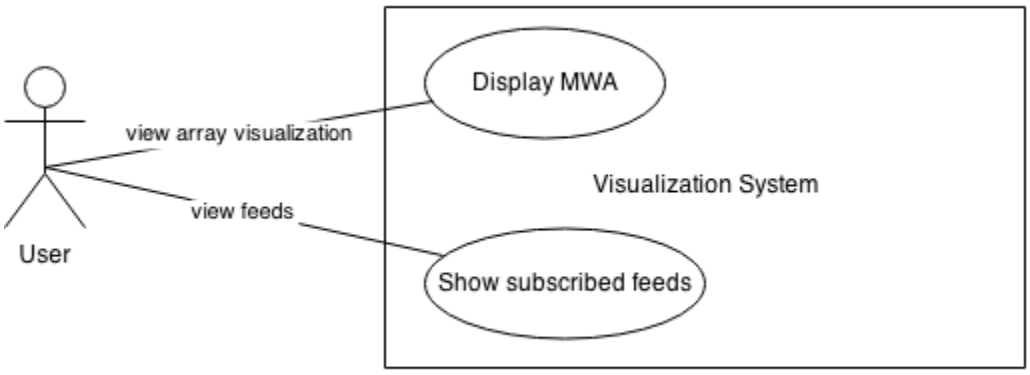
a Use case diagram

i Figure 1: User with account



Users who are not logged in are not permitted to edit the data:

ii Figure 2: User without account



b Description of actors

In the figures above, the actors are viewers of the EoRLive website. The users in Figure 1 are all scientists, and must have been approved by a site admin in order to view the website. The actor in Figure 2 encompasses any user, regardless of affiliation with a specific scientific organization.

c User stories

1. User views website
    - As a user who is not signed in, I want to see a graphical representation of the Murchison Widefield Array so I can tell whether any of the telescope's nodes are malfunctioning.
    - Given that the data stream is valid, when the user loads the page, the page should show a graphic that shows the state of the array.
2. User signs in
    - As as user with an account, I want to sign in with my account on the site so I can view the site with my custom settings enabled.

- Given that the user's credentials are valid, the website should allow the user to sign in and should load their personal settings before rendering the page.
- Given that the user's credentials are invalid, the website should refuse to allow the user to sign in but should still show the status of the array.

3. User modifies settings

   - As a signed-in user, I want to modify my subscription settings so I can choose which data streams I will be shown.
   - Given that the user is signed in, the user should be permitted to modify subscription settings.
   - Given that the user is not signed in, the user should not be permitted to see or modify subscription settings.

4. User flags data

   - As a signed-in user, I want to leave comments on data streams so I can collaborate with other users and generate discussions about the data.
   - Given that the user is signed in, and that the data stream is valid, the user should be permitted to leave comments on a data stream.
   - Given that the user is not signed in or that the data stream is not valid, the user should not be permitted to leave comments on that data stream.

5 Project Plan

a First semester

b Second Semester

6 Development Approach

7 Design Overview and Decisions

8 Technology and Tools

a Programming Languages

The development for this website uses many of the standard web-development languages. Front-end design is accomplished using HTML and CSS. Some client-side code is run with JavaScript, though this is minimal. The primary server-side language used is Python, in conjunction with a framework called Flask.

b Other Tools

The development environment used by the team is managed by Vagrant. Vagrant is a tool which allows teams to create specific virtual machines, allowing everyone to develop on their own machine but in environments with identical configurations. This allows the team to focus on the code and not on solving issues related to their specific configuration, which can be an issue with web development when users must simulate web servers on their workstations.

The version control tool chosen to manage our codebase is Git, with GitHub as a host and collaborative tool. Comments and issues on GitHub allow the team to communicate directly on the code. Slack, a team communication tool, was used to keep the development team connected. Standard email communication was used in conjunction with meetings to communicate with the sponsors.

9 Preliminary results

Our primary deliverable for this semester is a small Web site that allows the user to browse data based on date ranges. It includes support for user accounts, which are added via the command line on the server. The user logs in with their username and password and is taken to the main screen that contains "Start" and "End" datetime selectors that are filled in with reasonable default values (the end time is the current UTC time and the start time is 24 hours prior). Clicking the "Get observations" button loads a table below that displays a list of observations that occurred in that range. Specifically, each entry in the table includes the observation's ID, name, and who scheduled the observation. Below this table is a graph that displays the status of the telescope's data pipeline during that range. This graph is a line graph that shows the total observation hours scheduled for the telescope versus how many hours have actually been observed, and how many hours' worth of observation data have been transferred from the telescope to databases at MIT. The graph is interactive; the user can toggle the data sets in the legend to choose which ones are shown in the graph.
TODO: Add screenshots of the login page & the main page.

10 Problems and risks

11 Summary of Tasks

a Connor Alfheim

i Team Presentation

ii Report

iii Product

iv Initialization Document

v Team Management

b Ryan Dougherty

i Team Presentation

Ryan created the shareable Google Drive link for the presentation. Also, in addition to filling out my slides for the section in which he presented, Ryan also gave some feedback to the rest of the team on their slides. Also, when the entire team met to test how much time our presentation took in total, Ryan took account of time for each individual, such as who needed to talk more, who needed to talk less, and other suggestions.

ii Report

Ryan created the initial document that was shared among our group. He also contributed some ideas among the group as to what to include in the final report, such as how much detail was needed to include in sections of the report. Also, he helped review some of the sections that were written by the other group members, by fixing grammar errors, including more details, and fixing flow between paragraphs and separate sections. In addition, Ryan also wrote Sections #9 and #10.

iii Product

Ryan was mainly the "tester" of the group. As soon as a commit was made to the code repository, Ryan would pull the changes down from it and start up the virtual machine. If there were any problems with regard to features/usability that was seen in that pull, Ryan would create an issue/feature request on our repository on Github. After that, Ryan would then communicate with the rest of the team as to specifics of the issue/feature.

iv Initialization Document

Ryan, like in the team presentation, gave feedback on each other's work in the initialization document.

v Team Management

Ryan helped team management by being helpful to the team in terms of being able to understand what is needed to move forward in the project, particularly in testing each version of (and commit to) the shared code repository.

c David Ganey

i Team Presentation

David contributed to the team presentation by completing the relevant slides. Additionally, he contributed to discussion in a team meeting before the presentation date. David was able to present his material succinctly within the unexpected time constraint at the end of the presentation, while maintaining clarity and making our goals for the next semester clear.

ii Report

David contributed much of the content to the final report. He set up the LaTeX skeleton (including the sections and table of contents) before beginning to write the executive summary, user stories, and use-case sections. He was also the primary contributor to the lessons learned and future work components.

iii Product

David contributed to the development of the product in several ways. By taking detailed notes and asking questions at meetings with sponsors, he was able to identify a list of defined requirements to be implemented. He also assisted with troubleshooting the initial setup of the development environment. David also made a significant effort to review all code pushed, and to monitor the status of the repository to prevent issues with the version control.

iv Initialization Document

David contributed significantly to the initialization document. He created and added the use-case diagrams to the LaTeX document. He also edited the introduction, description, and milestones sections. He rewrote the user stories for resubmission of the document. Additionally, David promoted the feature-branch workflow by setting up a git branch for the initialization document. He made other miscellaneous fixes to tables and formatting as necessary.

v Team Management

David helped manage the team by being a point of contact between the team and the project sponsors. He frequently sent emails to the entire group to set up meetings and keep track of progress. As mentioned above, David also assisted with source code management by defining the git workflow.

d Dylan Lusi

i Team Presentation

ii Report

iii Product

iv Initialization Document

v Team Management

e Joseph North

i Team Presentation

ii Report

iii Product

iv Initialization Document

v Team Management

f Ben Roos

i Team Presentation

ii Report

iii Product

iv Initialization Document

v Team Management

12 Conclusions

a Success So Far

b Lessons Learned

c Future Work