Cognitive Training Quiz Application

Project Proposal

Group 07:

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Mentors:

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1. Introduction

Our project is "Cognitive Training Quiz Application", which aims to create a web application version of a widely used paper-and-pencil test used by physicians to assess and develop patients' spatial memory and cognitive skills. This web app test would allow many patients to practice and complete these exercises at home, without the help of the physician, as well as to track their performance on these tasks over time and monitor their improvement. The project will begin with production of the design documents outlining our technical approach and the development of the backend of the application (including an encrypted database for the storage of the users' results). From there, a barebones user interface will be created so that the quiz can be taken and feedback can be received from the project leaders about the performance of the quiz application. Lastly, the UI will be polished based on this feedback and performance history viewing will be added to allow both patients and physicians to track their progress over time. Stretch goals of this project include conducting pilot studies on real patients--pending IRB approval--in order to further tweak the design of the application to make it more user-friendly, as well as enabling data analytics and advanced queries on the stored data.

2. Project Relevance

Many elderly patients suffer from a decrease in spatial memory and navigational skills due to old age or trauma and report not remembering familiar environments or getting lost easily. Currently, the test used to assess and improve these cognitive skills exists solely in a pencil-and-paper format, which is inconvenient for both the patients and physicians and restricts the availability of the test. We hope that by digitizing this cognitive training quiz, we will allow a greater number of patients access to the test, as well as the ability to take it at home without the help of a physician or test administrator. This means that they will be able to work on improving their cognitive abilities much more frequently than with the current written test, and by tracking their performance over time, this application would allow them to see how much progress they have made and motivate them to keep using the application. Furthermore, we hope to enable some data analytics on the test results, so that a patient's performance on a certain type of test may be able to alert their physician to symptoms they may be experiencing or suggest a possible diagnosis for a patient based on their performance on this test.

3. Technical Summary

We propose to build a platform-agnostic (equally functional on desktop as on mobile devices, such as smartphone or tablet) web application. This will consist of two components: a back-end, which we will implement as a RESTful web service, and a browser-based user-facing client.

Back-end Architecture:

Our RESTful web service will be served by a Ruby on Rails application, interfacing with an embedded SQLite database. The API will primarily serve CRUD (create, read, update, delete) functionality to the front-end, allowing for the registration and authentication of users, the access of training/testing module data, and the submission of training/testing results.

Front-end Architecture:

Our front-end will consist of a responsive web application written in AngularJS. We will also use Bootstrap as a responsive design framework, which will help enable our application to be platform-agnostic. Users will access their testing histories, view training modules, and submit testing data through this application. So that the current paper assessments can be conducted through this application, we have categorized the questions on the current paper test such a View within an AngularJS single-page application (SPA) capable of displaying all questions of a category can be developed for each category.

Included here are a few figures to better illustrated our planned approach. First, the UML Class Diagram shows the various classes that will be written and used by our application, while the included UI sketches demonstrate various views that will be included in the application, such as the login screen, patient dashboard, and physician dashboard.
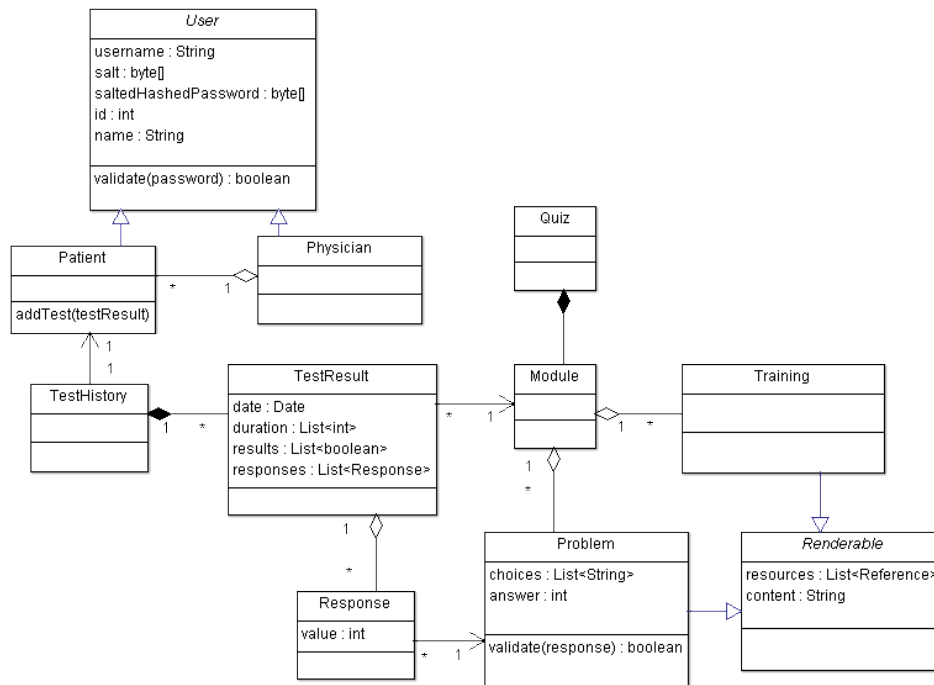

Figure 1: UML Class Diagram for the Quiz Application

Figure 2: Various UI Sketches for the Quiz Application

4. Project Milestones

For this project, we have set tangible milestones for our development in order to assess our progress as we work throughout the semester. The first major milestone in any software development project is the completion of our design documents and formal plan, which we have set to occur by today, 2/25. Our next major milestone is the completion of the back-end of our application, which we expect to occur by 3/3. On the front-end side of the project, we will begin to work on static mockups of our front-end design in parallel with development of the back-end; we expect these mockups to be completed by 3/10. Once this UI design milestone has been completed, the next major checkpoint is the completion of the first working version of the front-end, which is set for 3/31. Finally, our last major development milestone is to complete a polished version of our front-end user interface by 4/15.

After these milestones have been completed, we enter into our maximum deliverables. For these, the major milestone is the completion of our maximum deliverables, the end of our project, and the final poster presentation, which all occur on 5/6.

5. Project Deliverables

As this is a software development project, we essentially have two types of deliverables: documentation and code. Documentation entails our design documents, including data, architectural, interface, and procedural specifications, as well as UI mockups. Our code will be pushed to Stash, a private Git server, and ultimately will be deployed on a production server for consumption.

At minimum, we must have a fully functional backend, and a minimally functional front-end capable of serving the training and testing modules, along with full documentation. Our expected deliverables involve refinement of the UI, along with enhanced functionality with regard to visualizing and accessing testing histories. Our maximum deliverable is to deploy and conduct a pilot study with real patients in order to assess the usability of our application, and to provide an interface for making advanced queries on the data from the user-facing client.

6. Timeline

We have outlined our various milestones in the Milestones section above, but included below is a copy of our full project Gantt chart. Clearly marked across the top are the highest-level milestones, as well as an approximate date for our paper seminar presentation and final poster session. Each of our deliverable categories is broken down into various tasks, which can be seen listed below its respective deliverable. It is important to note that tasks related to logistics/design are colored a light grey, task related to the development of the backend are colored in blue, and the tasks related to the development of the frontend are colored in red. We have also included a much bigger version of this chart at the end of this document in order to increase its clarity and readability.
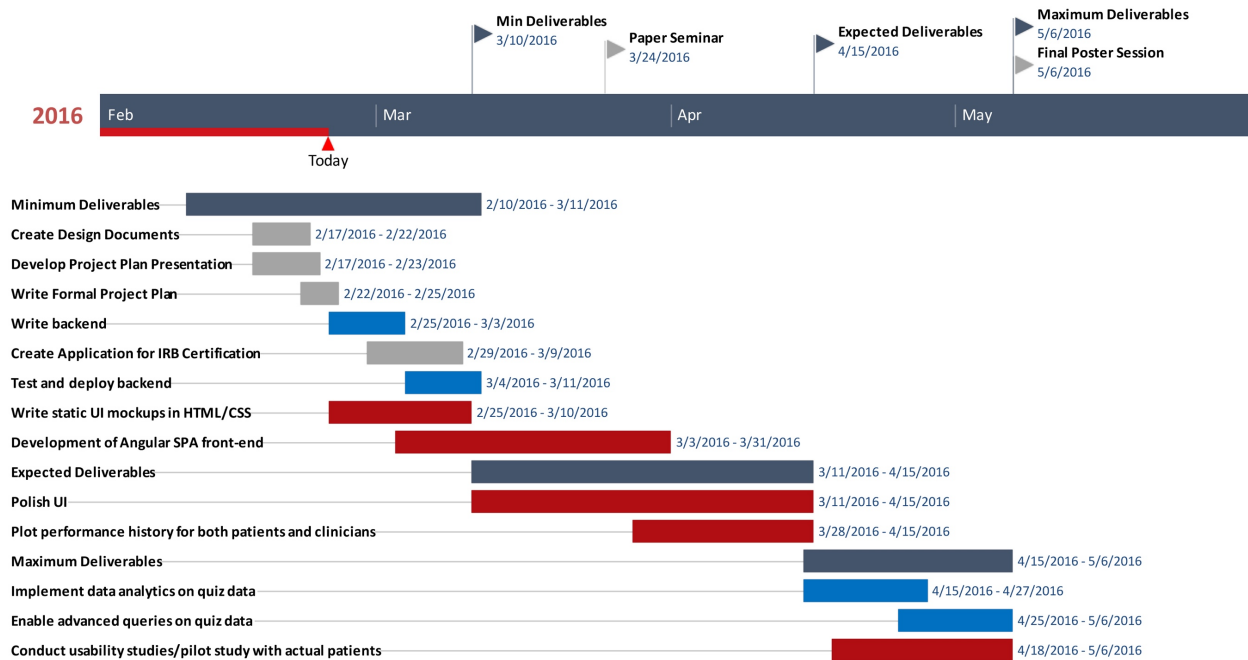

Figure 3: The Gantt Chart for Our Project

7. Dependencies

Because this is a software development project, we have many software dependencies on libraries and frameworks. We will be using npm (node.js package manager) and bower in order to manage these dependencies. We will also be using Stash, an enterprise Git service, for code versioning, and JIRA as an Agile project management tool. These dependencies have all been resolved. Furthermore, while these additional dependencies will not impact our development timeline for several months, we require illustrations from the Arts as Applied to Medicine Department. While we've contacted David Rini at the AAMD, we have yet to receive a reply regarding his timeline for producing the digital copies of the test illustrations. Furthermore, before any sort of pilot studies can be conducted, we also require IRB approval, as well as a server on which our backend can be deployed in order to service the application. This server will likely be provided by the TIC, though no arrangements have been made as of present. If necessary, a hosting solution could be rented fairly cheaply (on the order of 10 dollars). We will

consult our clinical mentor, Yuri Agrawal, regarding the attainment of IRB approval at our next meeting.

8. Management Plan

We've scheduled biweekly team meetings, including a weekly conference with our technical mentor. We will use JIRA to keep track of task assignments, progression, and project milestones, and Git for code versioning. Because the vast majority of the work for this project is on the front-end, both group members will have to contribute extensively to developing the web client. However, as a rough division of responsibilities, Ran will be responsible for back-end development in Rails, as well as data layer/data access code. Nick will be responsible for layout and front-end design, as well as organizing usability studies.

9. Reading List

Copeland, David B. *Rails, Angular, Postgres, and Bootstrap: Powerful,effective, and Efficient Full-stack Web... Development*. S.l.: O'Reilly Media, 2015. Print.

"Introduction to User-Centered Design." *Usability First*. N.p., n.d. Web. 25 Feb. 2016.

"Usability Testing." *Usability First*. N.p., n.d. Web. 25 Feb. 2016.

"Web Application Design." *Usability First*. N.p., n.d. Web. 25 Feb. 2016.

"AngularJS Tutorials." *AngularJS*. N.p., n.d. Web. 25 Feb. 2016.

"AngularJS Developer Guide." *AngularJS.* N.p., n.d. Web. 25 Feb. 2016.

"Ruby on Rails Guides." *Ruby on Rails*. N.p., n.d. Web. 25 Feb. 2016.

2016

Feb | Mar | Apr | May

Today

Min Deliverables
3/10/2016

Paper Seminar
3/24/2016

Expected Deliverables
4/15/2016

Maximum Deliverables
5/6/2016

Final Poster Session
5/6/2016

Task	Dates
Minimum Deliverables	2/10/2016 - 3/11/2016
Create Design Documents	2/17/2016 - 2/22/2016
Develop Project Plan Presentation	2/17/2016 - 2/23/2016
Write Formal Project Plan	2/22/2016 - 2/25/2016
Write backend	2/25/2016 - 3/3/2016
Create Application for IRB Certification	2/29/2016 - 3/9/2016
Test and deploy backend	3/4/2016 - 3/11/2016
Write static UI mockups in HTML/CSS	2/25/2016 - 3/10/2016
Development of Angular SPA front-end	3/3/2016 - 3/31/2016
Expected Deliverables	3/11/2016 - 4/15/2016
Polish UI	3/11/2016 - 4/15/2016
Plot performance history for both patients and clinicians	3/28/2016 - 4/15/2016
Maximum Deliverables	4/15/2016 - 5/6/2016
Implement data analytics on quiz data	4/15/2016 - 4/27/2016
Enable advanced queries on quiz data	4/25/2016 - 5/6/2016
Conduct usability studies/pilot study with actual patients	4/18/2016 - 5/6/2016