

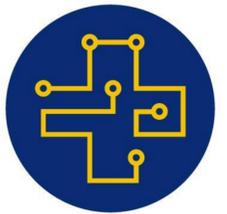


A Cognitive Training Quiz Application

Computer Integrated Surgery II

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Ran Liu and Nick Uebele, under the mentorship of Gorkem Sevinc, Michael Cohen, and Dr. Yuri Agrawal



Introduction

- We created a web application for the assessment of visuospatial cognitive deficits based on existing pen-and-paper exercises.
- This web application increases the accessibility of the exercises, by allowing patients to take the exercises from any device with an internet connection, and increases the amount of data which can be collected.
- Conversion of assessments of cognitive visuospatial ability to electronic format has been done in the past, is supported by efficacy research.

Problem

- Current method of assessing visuospatial deficit involves a pencil-and-paper test and must be administered by a clinician.
- Patients cannot do these exercises at home or track their own performance.

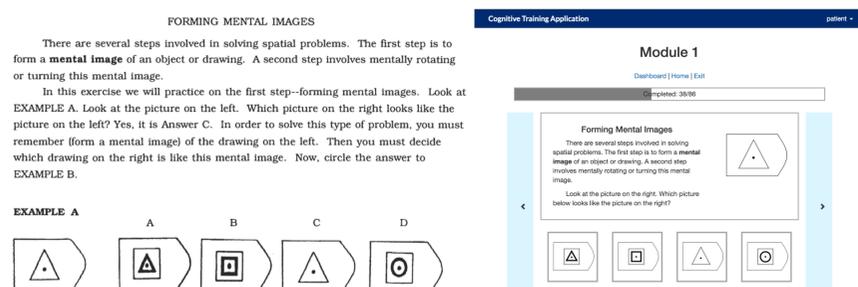
Solution

- We built a platform-agnostic single-page Angular web application, using Bootstrap as a front-end framework for responsive design.
- This application is supported by a RESTful API back-end, served by a Ruby on Rails application.



The Stack

- Three types of users: patient, physician, administrator
 - Patients are able to take the exercises and view their own results.
 - Physicians are able to view their patients' results.
 - Administrators manage user accounts.

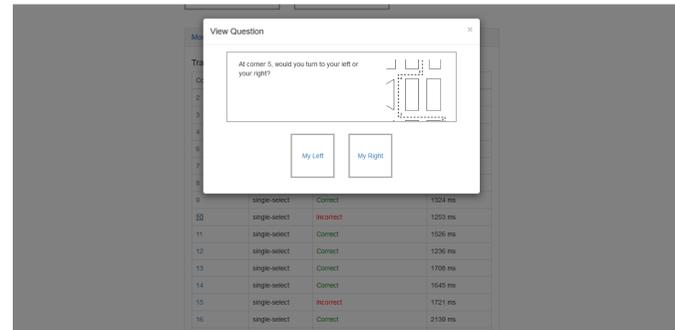


Side-by-side comparison of paper test and the web application

- Serialization of the paper exercises was done by classifying each exercise, creating a template that could be populated with the essential data of the question, and then digitizing the assets.
- Assets served by CDN (in practice, just an Apache instance)
 - Prompt images
 - Prompt text and layout

Results

- Complete transcription of modules, albeit without all images (dependency resolution still in progress).
- All core features built to completion: able to complete exercises, submit results, and view scores.
- Conducted UX/UI review, applied some insights to user interface design.



UI Insight: Modal windows for viewing questions in results view

Future Work

- Both team members graduating, Ran will bring the project to completion.
- Planned work:
 - Results digest, generate summaries of score report
 - Allow physicians to export patient data (excel, csv, etc.)
 - Additional UI Polish
 - Integration of artwork for modules 4, 5
- Current research surrounds the duration of benefits from cognitive training and the effects that training in a specific skill has on daily function.

Lessons Learned

- Ruby on Windows is a recipe for disaster. Development switched to Linux after two weeks of hitting our heads against the wall.
- Refactor early. You'll regret it if you don't, and you need to make a fundamental redesign or add a feature which you didn't plan for.
- You can stack Angular dependency resolution in order to create sequential asynchronous callback/resolve chains and avoid race conditions.

Credits

- Ran: Front-end development, back-end development, UI Design
- Nick: Front-end development, Module transcription, UI Design, UI Refinement

Publications

- Bigelow, RT, Agrawal, Y. "Vestibular involvement in cognition: Visuospatial ability, attention, executive function, and memory". *Journal of Vestibular Research* 25 (2015).
- Willis, Sherry L., et al. "Long-term effects of cognitive training on everyday functional outcomes in older adults". *Jama* 296.23 (2006).

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