Full-Stack Web Application to Visualize Brain Imaging Data in 3D

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Abstract

- Neuroimaging data from epilepsy patients, due to its implicit spatial component, is better represented in three-dimensional format.
- Bar charts or other common statistical tools for parsing such data often hinder spatial understanding and require additional visualization for complete representation.
- We thus present a full-stack web application that maps numerical neuroimaging data on brain atlases, hosting the final 3D Model on the local browser.

Technologies

React.JS, Node.JS, Express.JS, Python, Blender

Objectives

1. Expedite spatial representation of 2D numeric data
2. Facilitate communication of results and accessibility by serving 3D Model on web browser (both mobile and desktop)
3. Improve work productivity and flexibility
4. Ameliorate user experience by using a fast, adaptive front-end language such as React.JS
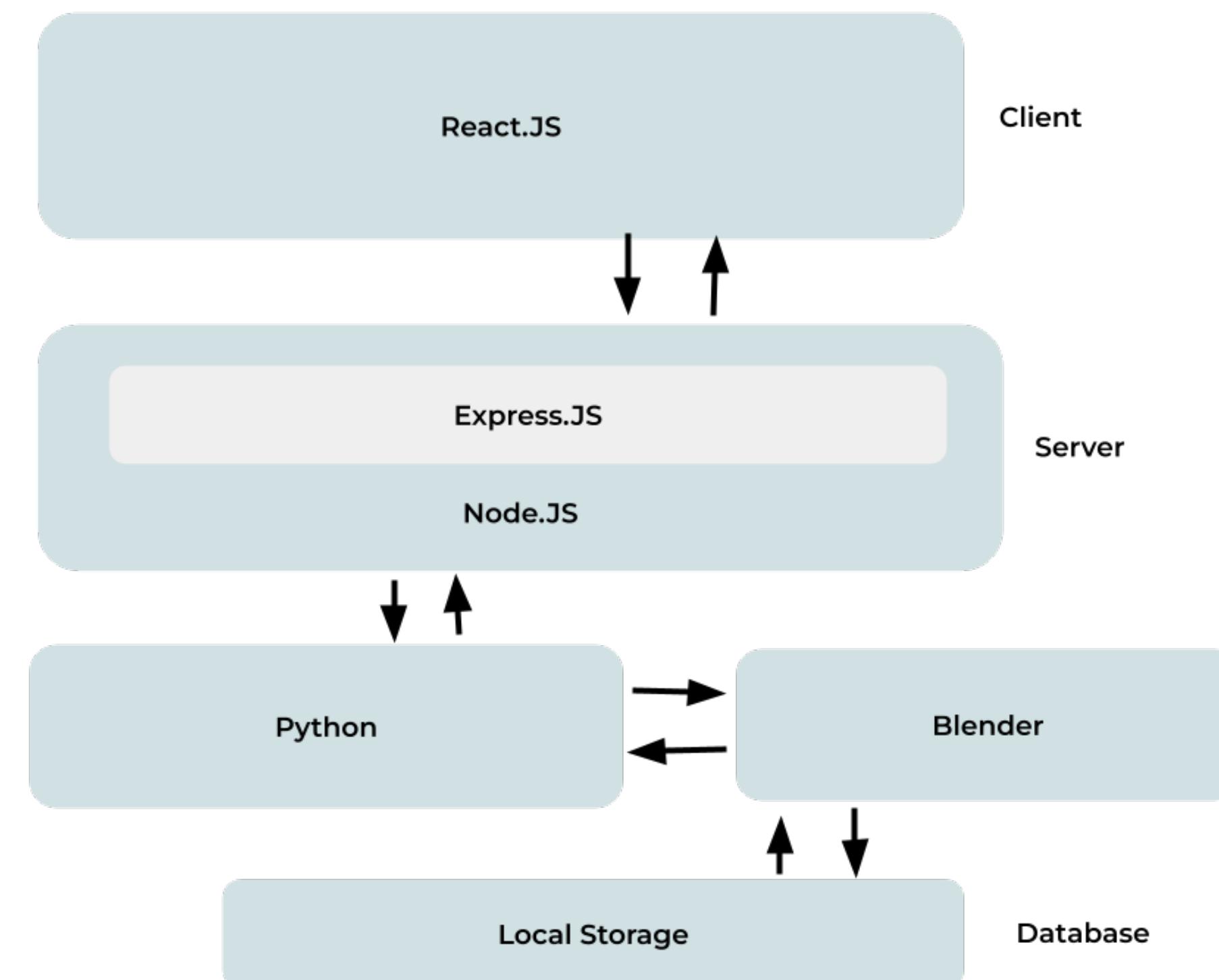
Methods

Figure 1: Framework of the Web Application as a Diagram

- The front-end of the web application was developed using React.JS. Initially, the user would input a comma-separated values (CSV) file of numerical brain data, the desired atlas, and the color.
- Consequently, Axios (a library in React) would send a HTTP request to Express.JS within the Node.JS server, for each submit button in the front end.
- Specifically, for the Atlas Selector and the Color Picker submit buttons, Node.JS would write the latest user's choice in a txt file after receiving the HTTP request.
- Finally, upon submission of the python button, Node.JS would run the main python script synchronously.
- The Python script runs Blender in the background, reading the txt files to update the 3D model based on the user's latest choices, and finally exports the generated 3D Model to the local storage.
- Upon termination of the Python script, the virtual React DOM re-renders itself, updating the 3D viewer such that the latest 3D Model in the local storage is rendered on the page.
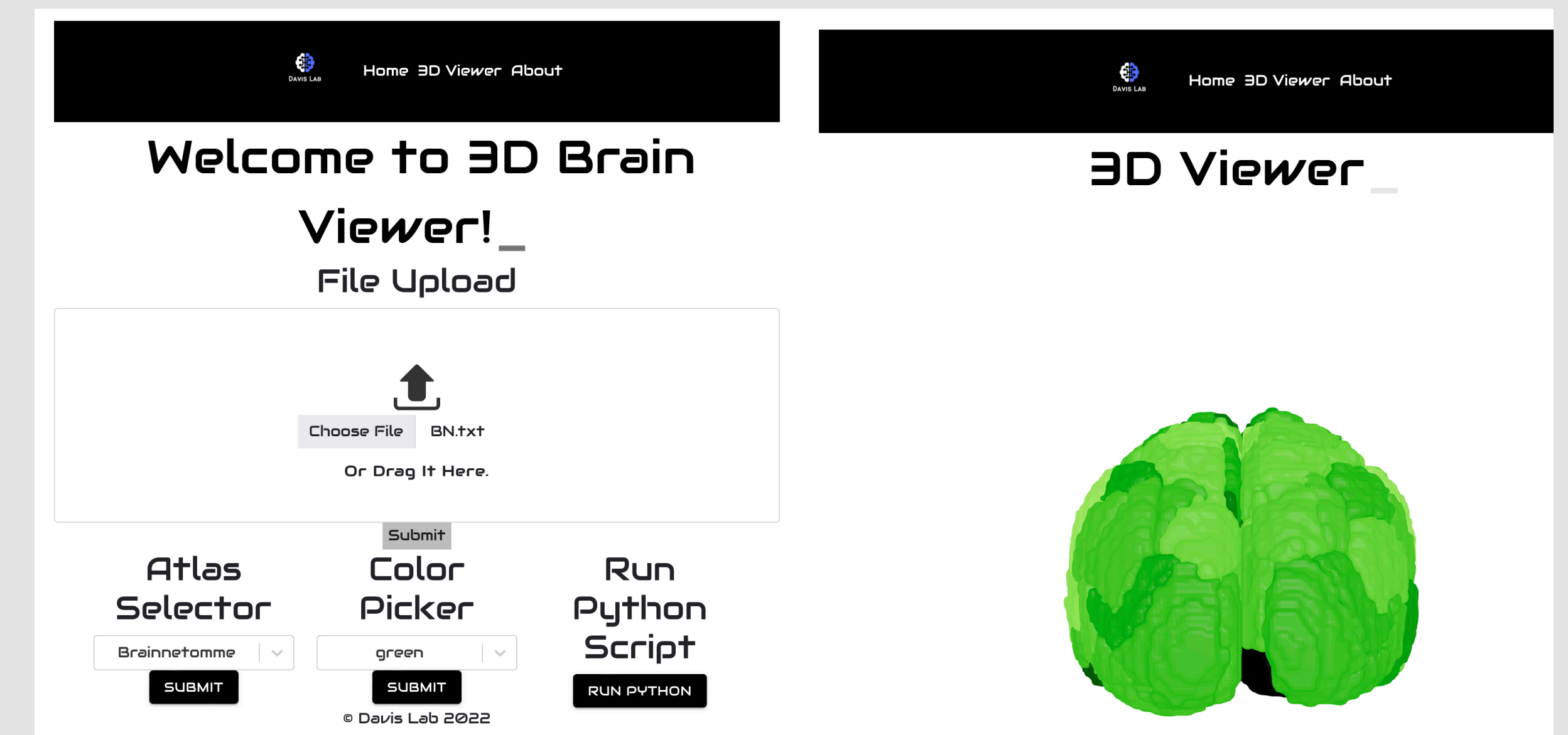
Results

Figure 2: Screenshots of the Final Web Application (Front-End view)

- The web application has two main pages: Home and 3D Viewer.
- The Home Page contains the user's inputs: file upload (CSV), the atlas selector, color picker, and the run python command.
- The 3D Viewer Page has the final 3D Brain Model with Orbit Control features. To clarify, by dragging the mouse, the user can interact with the generated 3D Brain Model and see all sides of the brain object.
- Darker regions of the brain represent higher numeric values for that brain region in the inputted CSV file, and vice versa.

Lab / Research Links

https://github.com/michellechang02/blender3d-app
https://davislab.med.upenn.edu
https://michellechang.netlify.app

Acknowledgements