Mobile Navigation Control for Planetary Web Portals

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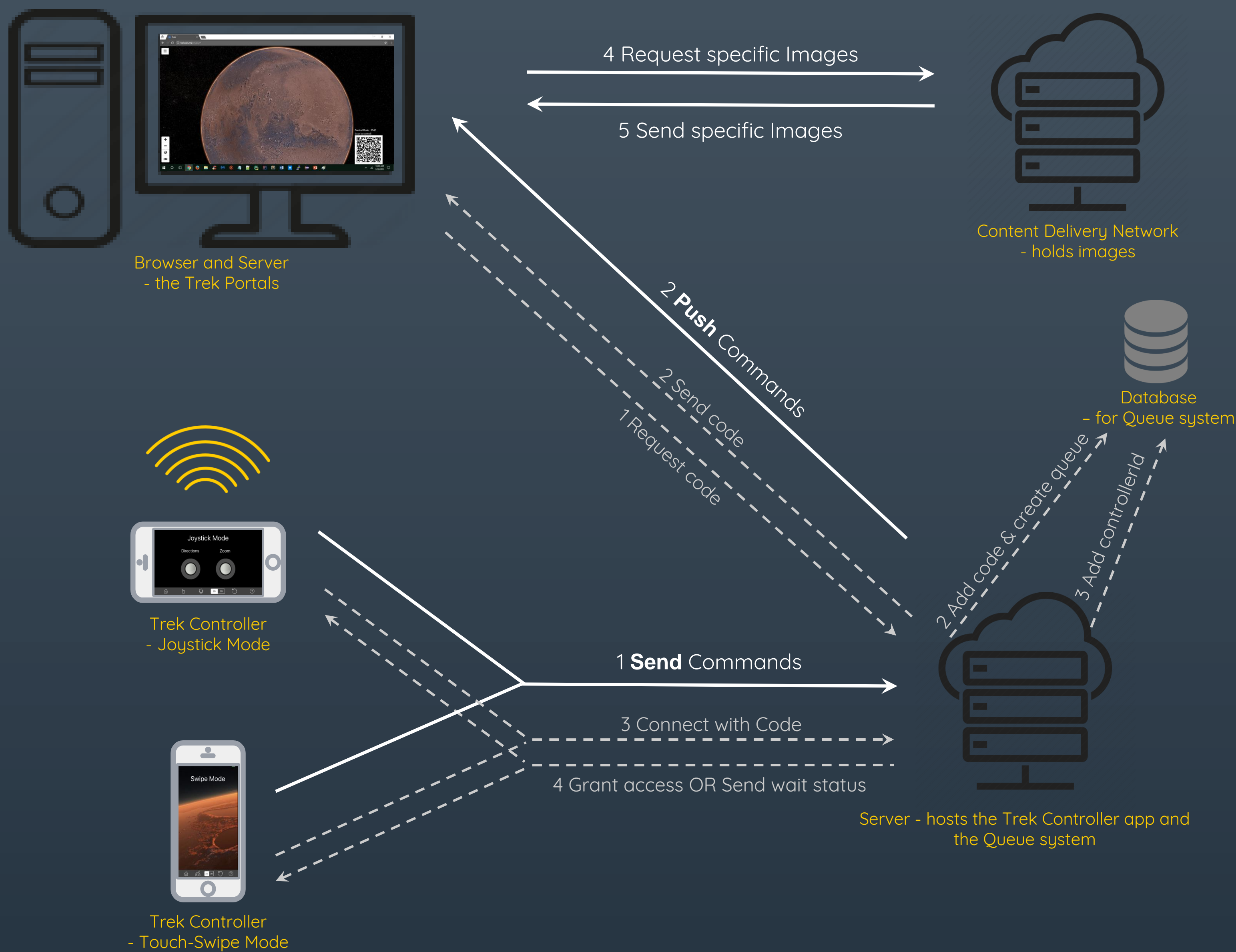California State University, Los Angeles

Background & Objective

JPL's Trek Portals offer virtual mappings of Mars, Vesta, and the Moon; it allows a user to explore the surface via a mouse or keyboard.

The objective of the project was to create Trek Controller, a mobile app that allows a user to remotely control a Trek Portal without the use of a mouse or keyboard.

Implementation

- Agile Development: frequent testing periods allows for constant refining of design, features, and functionality
- Multi-Platform support: iOS for Apple devices and Web App for all mobile devices
- Custom Queueing system to handle multiple users with position status feedback
- Asynchronous Javascript and XML (AJAX): client-side script to send the user's move commands from the Web App Trek Controller to the Command Server
- HTTP Requests: native HTTP communication protocols to send commands from iOS devices to the Command Server
- Server Sent Events (SSE): uni-directional communication protocol that uses HTTP to push the user's move commands from the Command Server to Trek Portal in real time

How It Works

Browser and Server - the Trek Portals

4 Request specific Images
5 Send specific Images

Content Delivery Network - holds images

2 **Push** Commands
2 Send code
1 Request code

Database – for Queue system

Trek Controller - Joystick Mode

1 **Send** Commands
3 Connect with Code
4 Grant access OR Send wait status

Trek Controller - Touch-Swipe Mode

2 Add code & create queue
3 Add controllerId

Server - hosts the Trek Controller app and the Queue system

Controller Initialization

To connect Trek Controller to Mars Trek Portal, first locate the lower right corner of the browser displaying Mars Trek Portal; there is a QR-code and a Control Code.

1. Scan the QR-code
2. Start controlling in Touch-Swipe Mode

- OR -

1. Open TrekCon.me on your smartphone's browser (Cookies must be allowed)
2. Click 'Control Trek Portal' or the mobile phone icon
3. Click 'Press to Control Me'
4. Enter the Control Code
5. Start controlling in Touch-Swipe Mode

Users can control the scene of the surface of Mars with three controller modes: Touch-Swipe, Joystick, and Motion. Swipes on the surface of the mobile device, pulling the left-hand joystick off-center, or moving the mobile device about its axes will move the camera in the desired direction. Pinching in and out, or moving the right-hand joystick in and out will zoom the camera in and out respectively. Users can toggle the 2D and 3D view of Mars or reset the view to its default center of the page with the use of buttons on the menu bar on bottom of the page. Multiple users are handled by a custom queueing system and informed of approximate wait times.

Interaction Performance

- Latency: average time to send a user's move command from Trek Controller to the server is on average less than 20 milliseconds over WiFi
- Disconnects: no extraneous disconnects reported; with usual cases, SSE automatically attempts to reconnect after an administrator-defined time

Conclusion

We've designed the entire communication architecture of Trek Controller and integrated it into the prototype of JPL's Trek Portal. For the back-end, we created our own control variables to read and issue move commands by piggybacking on the existing camera movement API to control what is seen on Trek Portal. The front-end work resulted in a user-friendly mobile controller that supports 8-way movement and zoom. The Queueing system was designed using a mySQL database to keep track of users and Trek Portal instances.

Additional features we would have liked to implement are the ability to bookmark locations and save screenshots to the mobile device of what is seen on Trek Portal.