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Leap Street, An App that Integrates Gesture Recognitions with Leap Motion and Google Map API

**Introduction:**

This paper will discuss the Leap Street project, its implementation, and functionality. The project is made up of the Leap Motion, Google Map & StreetView, and HTML + JavaScript code for connecting the two of them. The Leap Street project allows a user to navigate Google Street View with only hand motions inside a web browser.

**Inspiration:**

Learning about Ubiquitous Computing we had tried to find a project that could tie in the concepts discussed in class while using existing technology in a new way. As a group we decided to try and make a way to traverse a map easily and maybe supply a cool self learning aspect. The professor was able to provide us with devices he had. We looked at the Myo armband and the Leap Motion because we thought they were interesting ways to get input directly from the user’s motion. The Leap Motion proved to be more responsive with a supportive and descriptive API so that was our final choice.

**Project goal:**

The goal of this project was to integrate a keyboard and mouse free operation for google Street View using Leap Motion. This would allow users who are unable to use a keyboard and mouse to traverse areas on Google Street View with ease. We also want to make the gestures simple and intuitive for the users to use. Stretch goals that we were unable to meet were to allow users to be able to place pins on the map and be given directions on how to get from point A to point B. With the potential to hotkey certain locations to specific gestures. For instance, one tap creates a path to the nearest school.

**Project features:**

The features of the project are recognizing the existing and created gestures and integrating them to functions controlling the Google StreetView. The basic functionality is divided into the Leap Motion and Google StreetView components. The primary feature of this project is the control of Google StreetView with a user’s hand.

Functionality of Leap Motion Gestures:

* Swipes: Up, Down, Left, and Right will traverse links on the panorama in the specified direction.
* Circular: Clockwise & Counterclockwise (Implemented but commented out) rotate the screen by a certain amount
* Grab: Closing hand into fist and moving fist allows movement in the 3D panorama and if held forward will traverse through the links ahead
* Communicates Gestures to JavaScript Gesture Manager to Control Google Street View

Functionality of Google Street View:

* Moving Panorama along links
* Changing pitch and heading of the panorama
* Maintain heading of panorama when a link is traversed

**Project design**:



**Picture 1:** Design of Leap Street Control and Communication

**Design:**

* Leap Device - Leap Motion hardware to recognize gestures and transmit data.
* Leap API - Translation of leap signals and utilization of pre-existing libraries.
* Gesture Controller - JavaScript wrapper to receive gestures and translate into functions for Street View.
* StreetView API - API that controls the access to Google’s Street View and how to traverse it.
* User Screen - Web browser where the user can see the results and the updated Street View in real-time.

**File structure**:

* index.html - Contains all the visual contents for our project. It has the original Google

Street View rendering and Google Maps Rendering.

* logic.js - Contains all of the logic for pulling data from the Leap Motion and controlled

the updating code for the Google Street View

* index.css - Basic css for the index page

All group members have contributed to and written all files mentioned above.

**Insights learned:**

Sticking to model view controller methodology is good, but when prototyping, the simplest way to make it work is the best way. Sometimes hardware limits what we can achieve, other times it’s our lack of creativity. Assume users have absolutely no clue of what your project is about, even though explicit instructions were given. Constant iterative meeting and collaborative work coordinates with college time best. No API is perfect some customization may be required to make implementation work, having a solid foundation of knowledge helps with this.

**Demo:** [**https://www.youtube.com/watch?v=vLgCqBjbIak**](https://www.youtube.com/watch?v=vLgCqBjbIak)

References and Resources used:

<https://developers.google.com/maps/documentation/javascript/tutorial>

<https://developer.leapmotion.com/documentation/javascript/api/Leap_Classes.html>

<https://github.com/jaxzin/leap-map>

**For graduate students only**: Project evaluation: comparing your project with existing papers sharing similar goals, arguing why your approach is better or novel, and lessons and insights you have learned.

**Project Evaluation:**

The approach taken to our project was to explore and test the potential of combining the Leap Motion controls with the Google API. Our goal was to allow someone to maneuver the Google Street View intuitively with hand gestures. We researched other products like the Myo controller and Kinect to see how accurate they were, but ultimately decided on the Leap Motion.

The result of our project was a a intuitive gesture handler for user to send gestures into the Leap Motion and finely control Google’s Street View on a browser. We created multiple gestures to control moving in any direction and changing the user’s horizontal and vertical view in a panorama. For the Street View side we created a split screen with Street View and a view of the zoomed out map. On the map we had a pin that would update as the user traversed through the Street View, and vice versa if the user clicked on the map the Street View would update. The Leap Motion gesture detection for our project is not perfect though. Since it is looking for multiple gestures sometimes it will detect the wrong one and the user has to be very specific with their hand motion. In the future we would like to fine tune it a little more and add some more utilities for the Street View side like drawing a route between two points or finding the nearest school, fire station, gas station etc. to allow the user to better explore an area.

For other projects we were not able to find anything that focused on using Leap Motion for controlling Google Maps. Below we have analyzed other papers that have researched gesture detection and the Leap Motion. The focus was to see what other people thought of the Leap Motion and their research on its usability in other applications. We have reviewed four other papers and cited them below.

**Existing Paper Comparison:**

**“The Leap Motion controller: a view on sign language, Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration”:**

This paper focuses on using the Leap Motion Controller for sign language interpretation. This paper discusses the accuracy and usability of the leap motion for sign language as opposed to kinect and other devices that detect 3D objects. This paper is a little out of date but it accurately describes the pros and cons of the Leap Motion Controller. Some of the issues discussed like the reliability and accuracy of the finger detection has improved since 2013 with the second version, but the device still stumbles with turning hands so that it blocks view of fingers and when two fingers touch.

**“Free-hand interaction with leap motion controller for stroke rehabilitation”:**

This project used leap motion to rehabilitate patients with stroke. They modified the game of Fruit Ninja to use Leap Motion controller’s hand tracking data for stroke patients with arm and hand weakness to practice their finger individuation. In a pilot study, 14 patients with chronic stroke were recruited to play the game using natural interaction. Their Fruit Ninja (FN) scores show high correlation with the standard clinical assessment scores such as Fugl-Meyer (FMA) and Box-and-Blocks Test (BBT) scores. This finding suggests that the free hand Fruit Ninja’s score is a good indicator of the patient’s hand function and therefore will be informative if used in their rehabilitation.

**“Hand gesture Recognition with Leap Motion and Kinect Devices”:**

This group focuses on recognizing hand motions with kinect and Leap Motion. This paper proposes a scheme to improve the accuracy of detection for the Leap Motion. Using their scheme they tested the change in accuracy of the Leap Motion they showed a drastic improvement. Their goal is to have more steady recognition of fingers and hand turning.

**“Analysis of the Accuracy and Robustness of the Leap Motion Controller”:**

This study evaluated the industry standard of accuracy of the leap motion using 3D sensors. Aim to test the claim of “millimeter accuracy” of the Leap Motion. It discusses the performance of the API in registering motion in cartesian space.

**Overall Lessons and Insight:**

Most of these papers are researches and studies to find out and test the functionality and performance of the Leap Motion, which helped reinforce our choice to use it. Our paper focused more on the implementation and utilization of the Leap Motion in a practical aspect to help users interact with the Street View intuitively.

Working with Google Street View we have learned a lot about how google stores their images and network of maps. The multiple photos are used to create a panorama through stitching. There are traces detectable and sometimes the photos look spotty but overall it is great to look at things from an eye level view. Google creates links to streets that can be traversed to go to a panorama of the new street. Interestingly the angles of links are split between 0 to +-180 so it is not based on a 360 degree angle system and needed adjusting so that the angles of the links can be used mathematically (JavaScript did not like negative numbers) to detect what direction the user is trying to move in relative to the links.

For the Leap Motion we were able to learn a lot about its accuracy in detecting hands, fingers, and the joints of each finger. The diagnostic window can show the exact motion of hands above its camera. Like mentioned above, it is not good with anything overlapping, disappearing from view, or touching two fingers together. We also encountered an interesting phenomenon where the Leap Motion would detect a gesture multiple times for circular motions. However, it was very capable of fulfilling our goal as detecting gestures and motions of the hand. We were actually able to create a pseudo gestures by tracking the movement of hands and two fingers as you tilt and move your hand.

The Leap Motion has improved in its latest development and Google Street View has a very comprehensive map setup. Both are not perfect but they do their job well. We highly recommend playing around with the Leap Motion in future projects. Hopefully Leap Street will help inspire more people to utilize the Leap Motion for disability assistance.

**Graduate References:**

G. Marin, F. Dominio and P. Zanuttigh, "Hand gesture recognition with leap motion and kinect devices", *Image Processing (ICIP), 2014 IEEE International Conference on*, pp. 1565-1569

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[Maryam Khademi , Hossein Mousavi Hondori , Alison McKenzie , Lucy Dodakian , Cristina Videira Lopes , Steven C. Cramer, Free-hand interaction with leap motion controller for stroke rehabilitation, CHI '14 Extended Abstracts on Human Factors in Computing Systems, April 26-May 01, 2014, Toronto, Ontario, Canada](http://dl.acm.org/citation.cfm?id=2581203&CFID=609746364&CFTOKEN=63812194)

[http://dl.acm.org/citation.cfm?id=258120](http://dl.acm.org/citation.cfm?id=2581203)

[Leigh Ellen Potter , Jake Araullo , Lewis Carter, The Leap Motion controller: a view on sign language, Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration, November 25-29, 2013, Adelaide, Australia](http://dl.acm.org/citation.cfm?id=2541072&CFID=609436209&CFTOKEN=45868929)  [doi>[10.1145/2541016.2541072](http://doi.acm.org/10.1145/2541016.2541072)]

<http://dl.acm.org/citation.cfm?id=2541072>

Weichert, F.; Bachmann, D.; Rudak, B.; Fisseler, D. Analysis of the Accuracy and Robustness of the Leap Motion Controller. *Sensors* **2013**, *13*, 6380-6393.

<http://www.mdpi.com/1424-8220/13/5/6380/htm>

**Individual Work:**

**Table 1:** Evaluation of teammate contributions

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Members | Math | Street View | Gestures | Map | Controllers | Testing | Source Control |
| Mike | ✓ |  | ✓ |  | ✓ | ✓ |  |
| Nick | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |  |
| Long |  | ✓ | ✓ | ✓ |  | ✓ | ✓ |
| David | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ |

**Unanimous Evaluation in Addition to Individual Submission:**

We all worked together, communicated, and did our parts. Each person focused on different aspects and came together for critical components. We leveraged division of labor so no one had to worry about too much at once. All teammates were focused and driven to succeed.

**Rubric:** https://www.dropbox.com/s/04934xa7qtrodzs/Final%20Project%20Grading.docx?dl=0