MotionSculpt: A Gestural-Based 3D Content Authoring Tool

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ABSTRACT

The prevalence of 3D media in both the entertainment, games and web industries have generated a considerable amount of interest in the creation of 3D content. Yet the tools for 3D content creation have not caught up with this trend and continue to be relatively difficult to learn to use quickly, with a steep learning curve.

The development of a new workflow using hand gestural input would greatly simplify the learning process, as well as present a more intuitive means of creating and editing 3D content. To fulfill the increasing interest for rich 3D content in web pages, this new workflow creates allows for the creation of 3D content on the web using WebGL. Amateur and/or aspiring 3D artists would benefit greatly from such an interface redesign and simplification.

Project Blog: http://motionsculpt.tumblr.com/

1. INTRODUCTION

General interest in 3D-modeling software has been steadily on the rise in recent years, with the growing prevalence of special effects and CGI films in the movie industry and 3D content on the web. Yet, learning to use such complex modeling software has always posed a challenge to newcomers, with its complex interface and often-unintuitive controls. This issue is exacerbated for people who have not had extensive experience with working with computers and have difficulty with even the more basic ways of interaction with a computer such as the mouse and keyboard. This problem poses to be one of the primary barriers that separate a lot of creative minds from the capabilities of today's 3D modeling software.

Today, many developers are searching for ways to utilize computer vision and motion detection in creating more fluid and intuitive ways for people to interact with the virtual world. Hence, we propose the creation of an application that redesigns the way artists create 3D content for the web with simple hand motions.

This project makes the following contributions:

- Valuable user experience/interface research that offers greater insight into how people can interact with computer interfaces in a more instinctive manner.
- Enable more artists access to creating online 3D content through a relatively easy to learn interface.

1.1 Design Goals

The application would target traditional artists not familiar with creating digital and web content. Other consequential users include young children, and older people who also do not have the familiarity with using the conventional computer interface. These users will be able to more easily create 3D graphics and save time and effort attempting to learn the complex tools available today in order to get started.

1.2 Proposed Features and Functionality

Features and functionality that would be included in the application include:

- Researched and redesigned user interaction with 3D content creation and motion capture.
- 3D camera control and navigation using gestural input.
- Creation of custom 3D primitives through hand motions.
- Basic sculpting and geometrical transformations of 3D objects by gestural input.

2. RELATED WORK

2.1 Prior Research on Gestural User Interfaces

Although gesture based user interfaces are still relatively new, the development of 3D motion sensing devices is spurring a revolution of gesture based applications trying to replace their tradition counterparts. The book *Brave NUI World: Designing Natural User interfaces for Touch and Gesture* describes methods for designing effective user interfaces. The book describes multiple considerations that UI designers and developers must face in order to create an effective motion-based user interface [WW11]. The development and design of MotionSculpt will take into consideration the challenges described in the book.

There has been much research in the area of creating a motion-based user interfaces for applications such as game controls and the process at which one should go about creating an effective design. Gestural user interfaces are particularly interesting in the way that test-subject related research is conducted. Aker describes in his paper -

Observation-Based Design Methods for Gestural User Interfaces – two methods of developing and improving motion-based interface designs from test-subject data: gesture brainstorming and gesture log analysis, both of which were extensively tested with a couple of already existing gesture-based graphical interfaces [Ake07]. Primarily observation-based methods, Aker's research sheds light upon the gathering of useful data for the design of effective gestural interfaces.

Additionally, the recent rise in the development of advanced motion detection devices that allow for human gestural input in casual gaming environments have also spurred the development of SDK's and drivers for the interpretation of that data to allow for interesting real-life motion based applications. In the area of games and home game consoles such as the Wii and the Kinect, navigating maps and playing games with gestural user input have been found to be much more satisfying and intuitive than with a mouse and keyboard [FPT12]. Additionally, These results serve to demonstrate the immense possibilities and influence that gestural motion input will have upon the future and consequently, supports the idea that a redefined motion-based interface could greatly benefit the workflow of creating 3D graphics.

Furthermore, despite the fact that currently most development in movement-based controls are based in video games and simulators where the motion is usually very similar to the task the user wishes to accomplish, there have been further investigations pushing into the realm of everyday gesture interfaces. A general set of guidelines for creating an effective gestural user interface for everyday use rather than unique simulations have been developed from findings in these investigations. These guidelines are: simplicity, adaptivity, ubiquity and unobtrusiveness [PHP08]. This general prototype can be expanded upon with further user experience research conducted for the development of a gestural 3D content authoring tool.

Additional studies show that humans modify their gesutral motions to be looser and less stiff when interacting with machines rather than other people. This study is useful when conducting research for the design of a new user interface for MotionSculpt [Gra13].

2.2 Previous Work with the Leap Motion Controller

The recent release of the Leap Motion Controller has been met with much enthusiasm and attempts to harness the power of motion detection into user interfaces. Developers at Sutton Studios & Gallery have created an air painting application with Corel Painter. This application emulates the actual experience of painting that drawing with tablets and mice cannot replace [Sut13]. The app demonstrates the promise that devices such as the Leap Motion Controller can offer to the field of gestural user interfaces. MotionsSculpt will push even further from 2D graphics into 3D graphics.

3. PROJECT PROPOSAL

For the senior design project, I will design and implement a gesture based web application - tentatively named MotionSculpt – that allows users to create and rich 3D web content with the Leap Motion gesture detecting device and SDK. The WebGL JavaScript API will provide the main 3D (and even 2D) backbone for the application. Observational-based research will be used to design a gestural user interface that redefines how 3D content is traditionally created on the computer.

3.1 Anticipated Approach

To build MotionSculpt, first it would be necessary to collect some information from test subjects. The ideal test subject would have minimal to no knowledge of how to use modern 3D and 2D graphics software. Younger test subjects are also ideal (ages 3-5) since their small learned knowledge of current user interfaces would ensure simplicity while preserving basic intuition.

An example would be to ask a child to imagine he or she could summon a cube out of thin air with a gesture. Then ask them to repeat for a sphere, and other primitives. Gathering data from a few subjects can give valuable information about how gestures can define the difference between a cube and a sphere or translational and rotational camera controls.

Experiments would also be carried out to test the full capability of the Leap Motion device. The next step after having finished the research and design of the gesture library would be to implement detection of those gestures with the Leap Motion SDK and feed the data to WebGL.

After communication between the WebGL API and Leap Motion 3D motion data is established, we can proceed to implement camera movement and control, primitive creation, and simple sculptural deformations.

3.2 Target Platforms

The application will primarily utilize the Leap Motion device and WebGL. The Leap Motion comes with an SDK for developers to handle input from the device. The primary 3D development will be done in WebGL for the generation of 3D web content and interactive graphics.

3.3 Evaluation Criteria

A successfully executed implementation of MotionSculpt should challenge current conventions 3D and 2D graphics while still maintaining an easy-to-learn and intuitive interface for the user. The interface should also exhibit the four qualities of an effective gesture interface as stated earlier: simplicity, adaptivity, ubiquity and unobtrusiveness [PHP08].

Additionally, the success of the application should also be measured not just in terms of the number of features implemented in the application, but the quality of execution of these features. Many shoddily implemented features should not take precedence over a few well thought out and well executed features.

Lastly, the application should prove to be useful in creating and modeling simple 3D graphics.

4. RESEARCH TIMELINE

Project Milestone Report (Alpha Version)

- Conducted appropriate studies and research with test subjects exploring the most intuitive motions used to simulate the creation, transformation and deformation of virtual objects.
- Designed appropriate library of gestures to represent a set number of functions I would like to implement for the tool by the end of the semester.
- Explored the Leap Motion SDK as well as WebGL with some rudimentary experimental demos to showcase what I've learned.

Project Milestone Report (Beta Version)

- Be able to process and recognize most, if not all gestures in the user interface from the Leap Motion device.
- Have a few of the recognized motions mapped to functionality in the 3D user interface.
- Explored the Leap Motion SDK as well as WebGL with some rudimentary experimental demos to showcase what I've learned.

Project Final Deliverables

At the end of the semester, I would like to have completed the following:

- Web application that can create, transform and sculpt 3D web content (via WebGL) through a gesture user interface. Some specific features include:
    - Creation of a few basic primitive shapes.
    - Rotation and translation of camera and object.
    - Basic sculpting and deformation capabilities.
- A live demo of the application in action.
- Documentation

Project Future Tasks

Future tasks would primarily include designing and implementing more robust and sculptural features into the application that are relatively commonplace and useful for 3D sculpture.

5. Method

6. RESULTS

7. CONCLUSIONS and FUTURE WORK

APPENDIX

A. Optional Appendix

References

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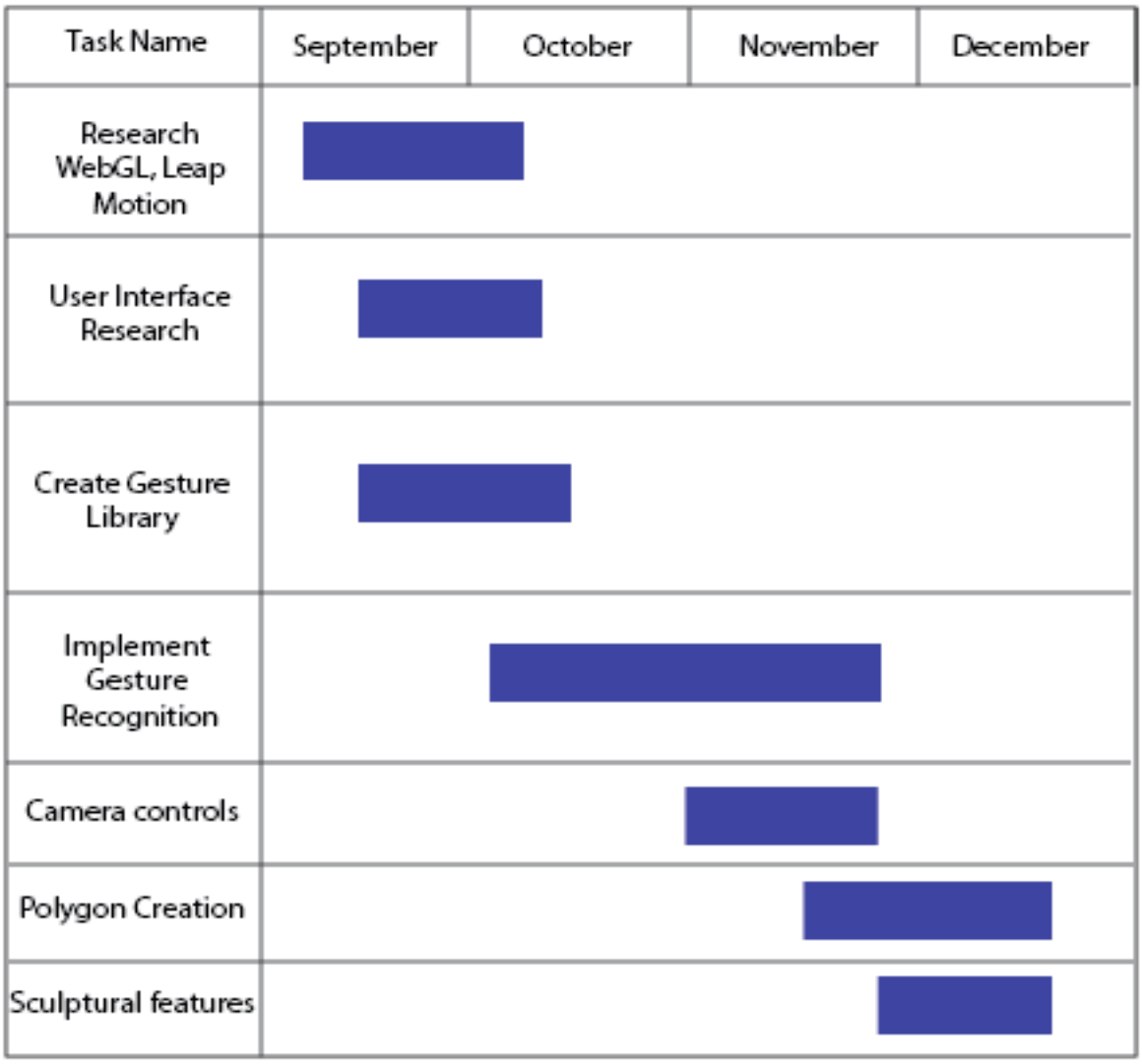

Figure 1: *The proposed timeline for the development of MotionSculpt.*