Exploratory software for the Leap Motion

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# 1 Background

## 1.1 Introduction

Motion capture is a technology that has been around since the rotoscope was introduced by Max Fleischer in 1915. Rotoscoping was an animation technique that involved tracing over footage frame by frame, in order to achieve realistic animation. This method was used in many of Walt Disney’s animations, including Snow White and The Seven Dwarves. This technology, while primitive, would lead to modern motion capture.

Modern motion capture started being used more heavily in the film industry at the end of the 1990’s, with films such as The Mummy and The Phantom Menace using reference points on actors to create reference points. These reference points were then textured over to create the final image. This technology however was limited to the film industry due to the requirement of reference points.

Motion control is the idea of using motion capture to interact with software. Motion control started to appear as early as 2003 with Sony’s EyeToy. The EyeToy captured images and used gesture recognition to allow users to interact with Playstation2 games. This was limited however, as it only tacked movement in two dimensions and did not capture the whole body. In 2010 Microsoft released the Kinect, a device that tracks the whole body’s motion in three dimensions using infrared.

Released in 2013, the Leap Motion is a motion control device that tracks a hand and finger motions. This project will focus on the Leap Motion, and explore its uses in commercial software.

## Problem Space

Almost all current and past uses of motion capture have been for entertainment purposes, namely film and gaming. Motion capture has potential uses outside of these areas. There have been tests on recognizing American Sign Language using the leap motion (Potter et al, 2013), and for use during surgery, potentially reducing infections (Bizzotto et al, 2014).

Similar gesture control could be used for office and presentation software. The aim of this project is to produce a PDF reader which utilizes the Leap Motion for gesture control.

## 1.3 Technical Specifications

The hardware in the Leap Motion is relatively simple. It consists of two cameras and three infrared LEDS. These are used to track light with a wavelength of 850 nanometers, which is in the near infrared part of the electromagnetic spectrum. Near-infrared provides more detail and results in less motion blur in the captured images (Raytec Limited, 2015). Near-infrared is present in sunlight and is emitted by both incandescent and halogen light bulbs, which can result in interference in the video capture.

The images captured are adjusted by the device’s USB controller and then streamed via USB to the Leap Motion’s tracking software. The software does not generate a depth map, instead favoring algorithms

The leap motion was found to provide an overall average accuracy of 0.7mm (Weichert et al, 2013). One weakness that is noted in the Leap Motion is it does not track hands on their sides well, it also does not track curvature well. (Own experience?)

## 1.4 Comparison to other devices

The main competitor to the leap motion is Microsoft’s Kinect. Unlike the Leap Motion, the Kinect tracks the whole body and uses a depth sensor. The Kinect was found to track a point to an accuracy of lower than 1cm (Frati and Prattichizzo, 2011), which is not as accurate as the Leap Motion, however it does handle curvature well due to its sensor.

In a study for gesture recognition, it was found that the Leap Motion was 80.86% accurate when tracking fingertips distance, angle and elevation. Whereas the Kinect was 89.71% accurate for tracking curvature and correlation. (Marin et al, 2014). Although these are different features, it illustrates the Kinect’s strong point and the advantage it has over the Leap Motion, namely its depth perception.

One disadvantage of the Leap compared to the Kinect is its lower range. The Kinect has a usable range of 1.2m to 3.5m, whereas the Leap Motion has a range of 25 to 600mm. The shorter range could potentially hurt the Leap’s ability to perform well in presentation scenarios.

Another competitor for the Leap Motion is the Myo Armband, which was released in 2014, uses similar technology to modern prosthetic limbs. The device is placed on the forearm, just below the elbow, and uses electromyography to measure electrical activity in the users’ muscles (Myo, 2016). A 9-axis intertial measurement unit also sense motion, orientation and rotation of the users’ arm. This device is noted as being 75% accurate for non-amputees. (Abduo and Galster, 2015). As Myo uses Bluetooth, it has a range advantage on both the Leap and the Kinect. Although the Myo is battery powered, its batteries are designed to last a day of continuous use. Therefore charge should not be an issue (Myo, 2016).

Myo also has an app that integrates it with Microsoft PowerPoint. The app allows you to wave your hand left or right to move between slides. This showcases how our possible software could work, although one would desire more full integration.

Aside from decreased accuracy, the other disadvantages of the Myo are its intrusiveness and cost. Each armband is $199, and we may potentially need to use both arms to achieve all the gestures desired. Additionally the armbands may prove uncomfortable and clunky, similar to google glass.

# References

Colgan, A. (2014) *How does the leap motion controller work?* Available at: http://blog.leapmotion.com/hardware-to-software-how-does-the-leap-motion-controller-work/ (Accessed: 7 December 2016).

Marin et al (2014) Hand Gesture Recognition with Leap Motion and Kinect Devices. IEEE International Conference on Image Processing, 2014. Paris, France.

Raytec Limited (2015). 850 nm vs 940mn Infra-Red Lighting [Online Video]. Available from: <https://www.youtube.com/watch?v=5YkJMVG9-1Q> (Accessed: 6 December 2016)

<https://pdfs.semanticscholar.org/35d1/4e4dc1d95074d3d4ac06cdb0e933a64f83b7.pdf>

<http://www.mdpi.com/1424-8220/13/5/6380/htm>   
(Weichert et al, 2013)

<http://dl.acm.org/citation.cfm?id=2541072> (Potter et al, 2013)

<https://www.researchgate.net/profile/Dario_Regis/publication/261756248_Leap_Motion_Gesture_Control_With_OsiriX_in_the_Operating_Room_to_Control_Imaging/links/562e2e4e08ae518e34835133.pdf> (Bizotto et al, 2014)

MYO 2016? https://support.getmyo.com/hc/en-us/articles/202532376-How-does-the-Myo-armband-work-

MYO 2016 2?? https://support.getmyo.com/hc/en-us/articles/202641403-Battery-life-of-the-Myo-armband

(Abduo and Galster, 2015) https://www.cosc.canterbury.ac.nz/research/reports/HonsReps/2015/hons\_1502.pdf