The Glove

ECE445 Senior Design

Project Proposal

Project contributors:

Chenhao Wu

Jiayi Wang

Lei Wang

TA: Luke Wendt

Febuarary 10th, 2016

Table of Contents

1. Introduction

1.1 Statement of Purpose

Motion tracking technology has been largely used in Virtual Reality Game to offer more engaging gaming experience. Most motion matching device enables people to move their hands in virtual world. Based on this, our team think that providing haptical feedback to the contacts with virtual objects enhances the interaction between real world and virtual world.

We plan to build a glove with haptic implementation to give feedback to the fingers/palm. We will incooperate Leap Motion with our glove wirelessly to simulate the signal. Conditions like touching or grabbing the virtual object will output a signal sending to a controller to activate the vibration motor/skeleton, giving a haptical feedback to the hand.

1.2 Objectives

- To provide more actual force feedback to the users in the journey of Virtual Reality.
- Besides the vibration feedback, mechanical skeleton will stop fingers from moving into the virtual object.
- Wireless glove with high portability
- Low power consumption

- Create a 4D environment with more interactive experience for leap motion games

2. Design

2.1 Block diagram

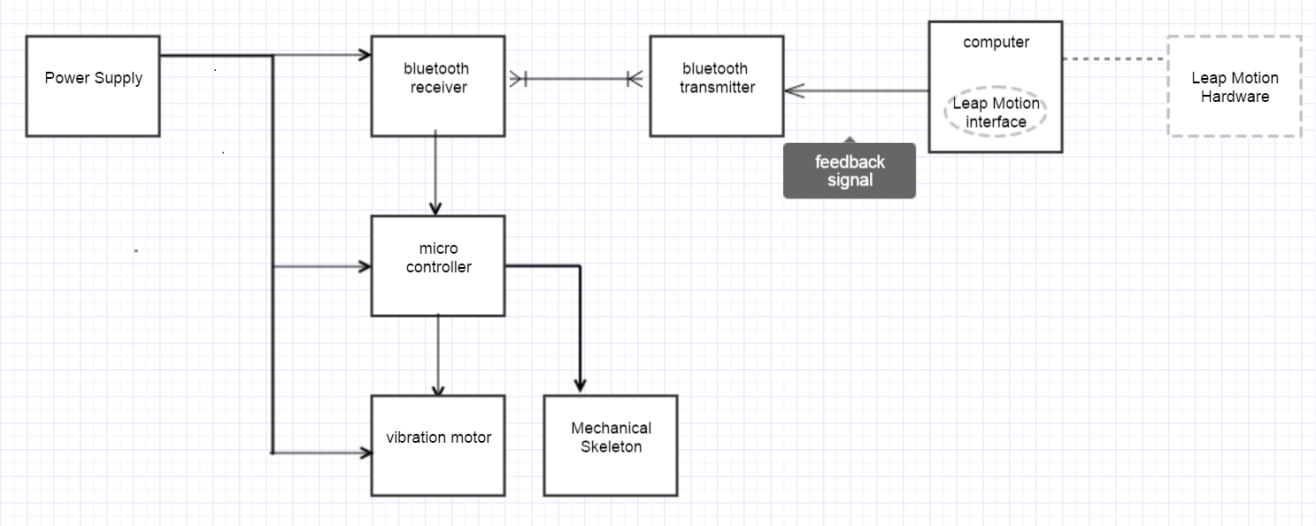

Figure 1: High Level Block Diagram of the Glove

2.2 Block Description

2.2.1 Leap Motion Hardware:

It refers to the latest leap motion controller. The leap motion controller can detect the movements of hands and fingers under a certain frame rate and then transmit the data of the movements to the computer(leap motion SDK unit).

2.2.2 Computer:

The computer will collect the data of hand movements coming from the leap motion controller and store the previous and current frame data. Then the computer will analyze the data to determine when to send the trigger signal using blue tooth to the microcontroller.(all done by leap motion SDK programming) So each time the virtual

hand touches the virtual object, a signal will be sent out to activate the vibration motor. Also, if the hand is trying to grab the object, software will generate signal that controls the mechanical skeleton to prevent the fingers from moving “into” the virtual object. Vibrators should vibrate only one time to each touch while mechanical skeleton continuously provides force feedback to fingers.

2.2.3 Bluetooth (transmittor and receiver): The bluetooth module will collect the control signal from computer and trasmit it wirelessly to a microcontroller on the glove. The glove will be wireless and mobile through this implementation.

2.2.4 Power Supply:

We will use battery to the power the bluetooth transmitter, the microcontroller and the motors. The bluetooth receiver will use USB cable and the microcontroller will use battery to power.

2.2.5 Microcontroller:

Microcontroller manages data generated in software and controls the vibration motors as well as motors for skeleton.

2.2.6 Vibration Motor

This block refers to the five mini vibratiors on every finger with each motor with seperate control. The vibration signals will be sent by the microcontroller whenever the hand or fingers touch a virtual object.

2.2.7 Mechanical Skeleton

The mechanical skeleton will pull the fingers to opposite directions whenever the finger touches the virtual object. So the fingers will fell and actual counterforce from the cirtual

objects. Similar to the vibration motors, the signal to the mechanical skeleton is sent by the microcontroller.

3. Block Level Requirements and Varification & Tolerance Analysis

3.1 Block Level Requirements and Varification

Requirements	Verification	Points
Bluetooth: **a)Connects to computer without lagging /frame-dropping(stable)** **b)Perform perfectly within 5 meters**	**a) Connect with computer stably during the demo** **b)Stand anywhere within 5 meters from the computer to the glove without disconnecting**	**20**
Vibration feedback: **Vibrate when the virtual hand touches objects**	**Vibrate successfully when the glove touches any objects in VR and activates according finger's vibrator**	**20**
Mechanical Skeleton: **a)The mechanical skeleton controls each finger's movement**	**a) Prevent fingers from moving forward when they are grabbing the virtual object.**	**5**
Leap motion: **a)Connection with computer leap motion SDK unit.**	**a) Test using the leap motion utilities within the SDK**	**20**
b)Display and outputting movement data of hands.	**b) Test using the motion visualizer within leap motion SDK (and pre-loaded demos)**	**10**
microcontroller: **a)The microcontroller should connect to mechanical skeleton**	**a)Test by running elementary commands to stimulate reaction**	**5**
b)The microcontroller should connect to vibration motor.	**b) Test that by running elementary high-low commands to check how the motor works.**	**20**

3.2 Tolerance Analysis

The microcontroller is the most important part since it not only controls the 5 vibrative motors and mechanical skeletons but also should it be responsible of receiving the data sent from the computer. We allow the microcontroller to control motors or mechanical skeletons seperately in case of conflicts. We will measure the signals seperately usng computers and then send it together to test whether they can work together.

4. Cost:

4.1Labor:

Name	Hourly Rate($)	Total Hour Invested(hrs)	Total($)
Lei Wang	25.00	225	5625.00
Jiayi Wang	25.00	225	5625.00
Chenhao Wu	25.00	225	5625.00
		675	16875

4.2 Parts:

Items	Quantity	Cost($)
Microcontroller	1	10
Battery	2	2
DC/DC converter	1	10
Leap motion	1	80
Bluetooth Module	1	10
vibration motor	5	10
Skeleton Component	unmeasurable	30
PCB		free

Total		**152**
Total with labor		**17,027**

5. Schedule:

WEEK	TASK	DUTY
Feburary 10th	**Finalize Proposal**	**All**
Feburary 18th	**Prepare Mock Design Review**	**Lei Wang**
Feburary 25th	**Research about Leap Motion interface, bluetooth transmission and skeleton control**	**All**
March 3rd	**Finalize Research and purchase parts**	**ALL**
March 10th	**Progam interface of leap motion**	**Chenhao Wu**
March 17th	**Program Connection Bluetooth with microcontroller**	**Lei Wang**
March 24th	**Program Microcontroller with the vibration motors, make skeleton mechanism**	**Jiayi Wang**
March 31th	**Program Microcontroller with mechanism skeleton**	**Chenhao Wu**
April 7th	**Finalize motion control**	**Jiayi Wang**
April 14th	**Preparing Mock demo**	**Lei Wang**
April 21st	**Finalize Demonstration**	**Chenhao Wu**
April 28th	**Finalize Presentation**	**Jiayi Wang**
May 5th	**Lab checkout & Finalize Paper**	**All**