VR Hand Simulator

Team 67 - Alex Brannick and Daryl Drake (brannic2, dadrake3)
ECE 445 Project Proposal Spring 2019
TA: Dongwei Shi

1 Introduction

1.1 Objective

In the past decade, we have seen a new type of technology reach customers worldwide, and that technology is Virtual Reality. After the acquisition of Oculus VR for $2 billion by Facebook [1] larger companies began focusing their attention on developing their own VR technology. Shortly after companies such as HTC and Sony began making their own VR technology, bringing their own VR headsets to the market.[2] In particular, these VR headsets have been largely involved in the game industry. By making the headsets available to the typical consumer, it caught the attention of game companies and this brought out new games for these platforms. While the quantity and quality of these VR games has been increasing, the platforms that they are played on have stayed relatively the same. These types of games strive to create a more immersive experience for the player, and VR headsets have lacked to keep up with this increased creativity. In an article posted by the LA Times, there has been a significant decline in the amount of investment towards the VR industry recently. In 2018 alone, funding for VR startups fell 46% from 2017 [3]. Many of the investors' concerns were focused on the fact that the VR market had not reached a large enough mass of consumers.

Our goal is to help revive the VR industry by creating a more immersive environment for all VR headsets. We plan on doing this by creating an attachment for all headsets called the "VR Hand Simulator". With this attachment, it will allow for users to perform complex interactions within their virtual environment using their hands as the controllers. Our device will also be a plug in for the Unity game engine, allowing any indie developer or large company to create games for these headsets using our device.

1.2 Background

In 2018, the VR industry saw a large decline in investment and a decline in adoption of VR platforms. While the quantity and quality of VR games has risen, the demand for these games has not reached as high of a level as was expected. With our product, we would combat this decline in sales by making virtual reality more immersive than ever before. Adding hand simulation to our product provides a new avenue for developers to make games. This could be anything from playing a virtual piano to building a castle out of blocks. Furthermore, by making our product into a plug-in for Unity, we give small indie developers and large companies a chance to develop their game to use our product.
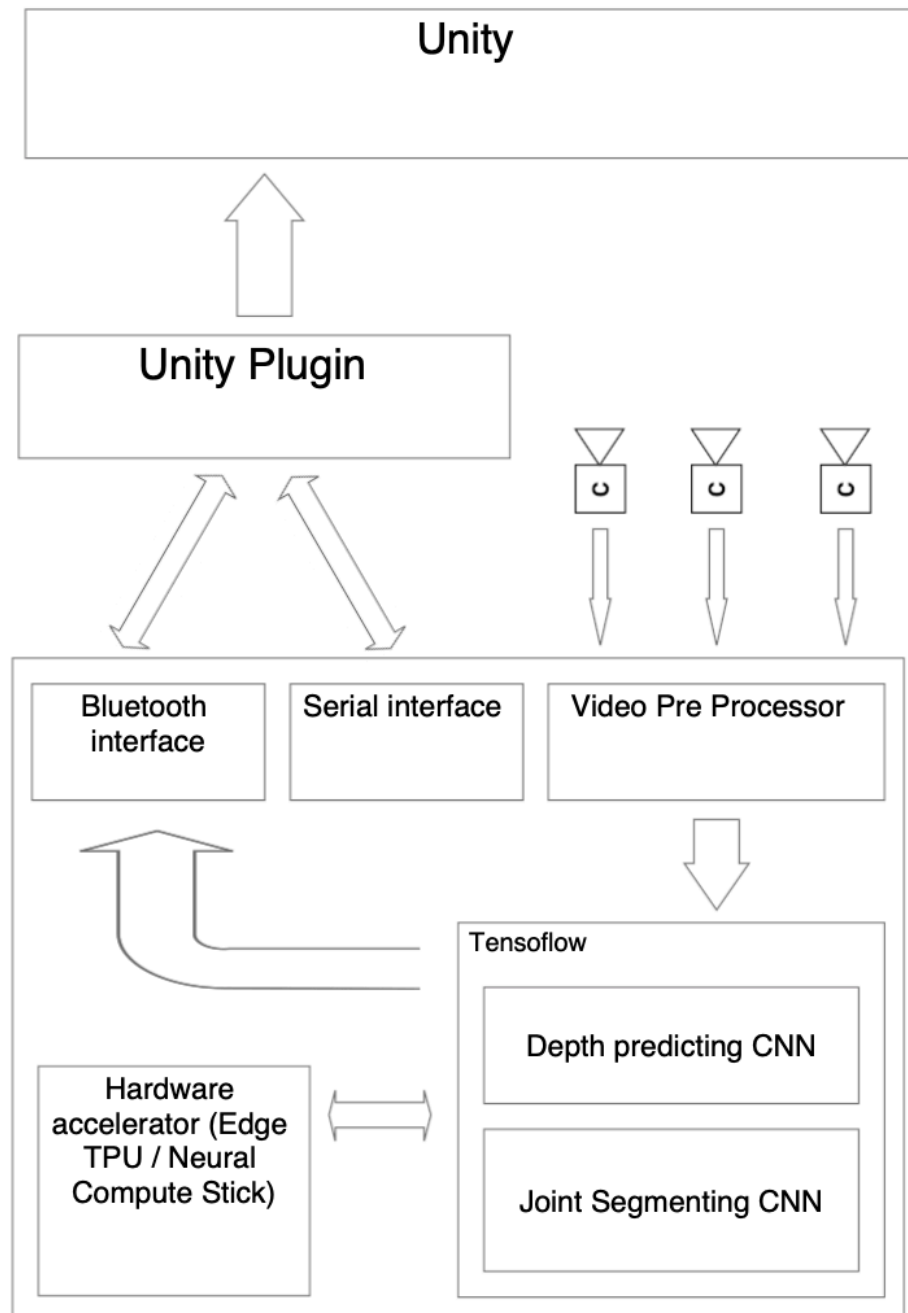
1.3 High-Level Requirements

- The device must be able to accurately capture and simulate the movement of our hands in Virtual Reality.
- The device needs to have a plug-in for the Unity game engine, allowing a large number of developers to create games with it.
- The device has to be easily useable with any VR headset

2 Design

The VR hand simulator will require a few main components to work properly. The device will consist of a headset with a three-camera array. All of the image data captured from the cameras will then be fed to a raspberry pi. The raspberry pi to interpret the images quickly sends the data to the Neural Net Computing stick, a hardware accelerator. After the hands have been located and segmented, the data is passed to the transmitter where it is sent to the computer. We will create a Unity plug-in to interpret this data so that developers can then make VR games in Unity that use our product. Finally, we will need some sort of power supply in the form of a battery to power our headset.

Block Design

Power Supply

To power the headset, our device will need some type of battery to keep it running wirelessly. This will be some type of Lithium - Ion battery that can be used in a lightweight, low profile design. We also need to keep in mind that the battery we use will have to be able to provide extended battery life for a very processing intensive program.

Neural Net Compute Stick

The Neural Net Compute stick is a hardware accelerator made by Intel. We decided to use it in our design because it will drastically speed up the hand location and segmentation of the image data from the cameras. The compute stick can be attached through the PCB and needs to be connected to the raspberry pi.

Raspberry Pi Processor

The Raspberry Pi is the main processor of our headset. It will be responsible for interpreting the image data from the headset and passing it to the Neural Net Compute Stick for computation. Besides passing this data around, it needs to prepare the data to send. This formatted data is passed to the bluetooth transmitter to be used in Unity.

RGB Camera Array

Our design will locate and segment our hands by using an array of three cameras. These cameras would be laid over any VR headset, with one camera on top and a single camera on each side of the visor. The output from these cameras will then be fed to the camera for hand location and segmentation. One issue we might encounter with this portion of our circuit would be that the raspberry pi only has only one camera input. We will need to design some type of hardware to interface our camera input with the GPIO pins of the raspberry pi.

Voltage Transformers

In order for us to be able to power the camera array, each camera will most likely need a voltage transformer. These transformers will be part of our PCB design and will lead to the ports that connect to our camera array.

Bluetooth/Serial Transmitter

To get the camera data to the computer, we will need some type of transmitter to send data. This could be in the form of a bluetooth transmitter or a wired serial connection. In order for our transmitter to work with Unity, we will have to define a type of data protocol for sending the packets from our headset to the computer.

Unity Game Engine

The final part of our project will require us to interface our headset with the Unity Game Engine. We will need to transmit the data of our hand location and positioning to the game, where this data will allow a user to control the game. In order to test our device we will also need to create some type of demo, or obstacle course to check how we handle basic hand movements. By completing these steps, it will allow developers to use our plug-in for their VR games on any platform.

3 Safety and Ethics

With our proposed project, there are a few safety hazards that should be identified before advancing. In our block diagram, we believe that we will need some sort of lithium-ion battery to charge the device while it is running. Lithium-ion batteries have been known to occasionally fail, and this includes catching on fire or even exploding. Many of these failures come from the battery being exposed to a lot of heat at a full charge. [4] In our PCB design we will work on keeping the battery adequately cooled and add components to our circuit to prevent any unsafe discharge of power.

Our device is also meant to be an attachment to other VR headsets, so it will be in close proximity to a users head. If our device becomes to hot it can possibly harm the individual if it were to burn the user or overheat the circuit. We plan on preventing this by adequately cooling our circuit through adding heat sinks to warm areas and possibly adding a fan. There can also be a sensor to measure the heat of the device, which could act as a kill switch if it exceeds a certain temperature.

In the IEEE code of ethics, rule 9 states that we should "avoid injuring others, their property, reputation, or employment by false or malicious action". [5] Since our device is considered an add-on or attachment for VR headsets, we would be forced to address this rule. While we would not be working directly for any of these VR companies, we are creating a product that could be affiliated with their brand and has a chance of causing injury to their reputation. We would work to address this issue by explicitly stating on our packaging or device that we are not in any way affiliated with the VR companies. Furthermore, if the product were to gain traction it would be necessary to contact the VR headset companies to work with them in creating an attachment to their platform that they agree with.

References

[1]   Virtual reality. (2019, February 06). Retrieved from https://en.wikipedia.org/wiki/Virtual_reality

[2]   Thier, D. (2014, March 21). Sony Announces 'Project Morpheus:' Virtual Reality Headset For PS4. Retrieved from https://www.forbes.com/sites/davidthier/2014/03/18/sony-announces-virtual-reality-headset-for-ps4/#73aab31d1639

[3]   VR gets reality check with significant decline in investment. (2019, January 13). Retrieved from https://www.latimes.com/business/hollywood/la-fi-ct-virtual-reality-investment20190113-story.html

[4]   BU-304a: Safety Concerns with Li-ion. (n.d.). Retrieved from https://batteryuniversity.com/learn/article/safety_concerns_with_li_ion

[5]   IEEE Code of Ethics. (n.d.). Retrieved from https://www.ieee.org/about/corporate/governance/p7-8.html