EML4551-2

Design Review 4

Mixed Reality Wearable for Body Tracking

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Group Members

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Fall Semester Review

- Anthropometry is the measurement of the size and proportions of the human body

- Anthropometric scans typically output a 3D figure that can be used for body measurements and for Engineering design

Figure 1: 3D cad image of different hand views

Presented by: Matthew Bigerton

Fall Semester Review (cont.)

- Currently, scan participants are given verbal instructions on where and how to position and orient themselves for an anthropometric scan

- This process is tedious and time consuming for the scan technician

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Overall Project Objective

The objective of this project is to provide a user interface for participants in a 3D scan environment in order to reduce the amount of instructions given by the scan technician to position/orient the participant and to shorten the duration of this process.

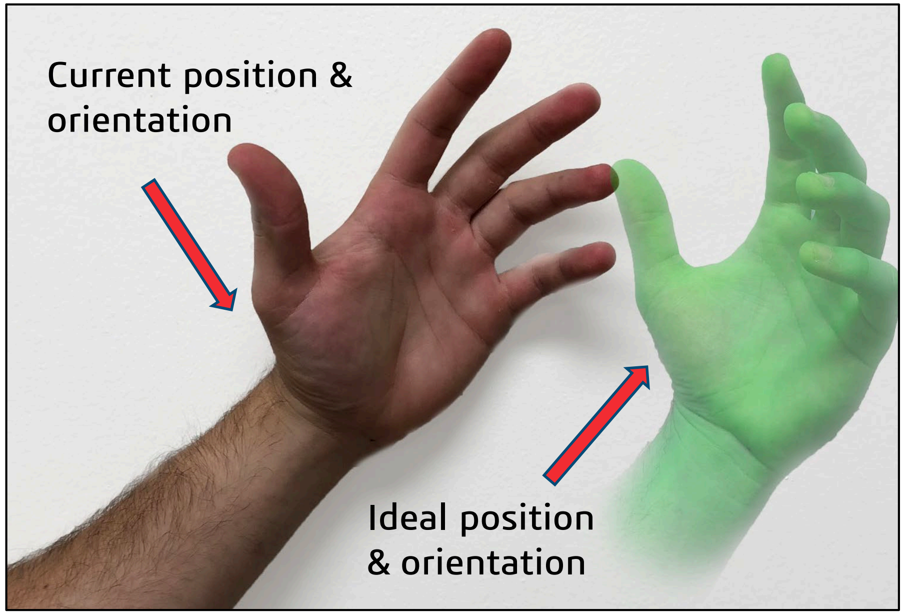

Figure 2: Physical representation of the project objective

Presented by: Matthew Bigerton

Customer Needs Review

Table 1: Customer needs table

#	CUSTOMER STATEMENTS	INTEPRETED NEED
1	**It would be beneficial if the device could indicate to the user when the "sweet spot" is filled**	**If possible, the device will be able to notify the user to hold the current orientation of the participant's head/hand**
2	**The device must not interfere with the scanner**	**The device must cease operating upon successful fulfillment of the ideal pose**
3	Project something into space for the participant to aim their head/hand	The device must indicate to the participant the ideal location and orientation for accurate scans
4	The device must be a stand-alone system	The device must complete its intended function without the assistance of other devices
5	The device must be able to be powered remotely	The device requires a method for power control
6	The device must not create any safety hazards	The device must minimally impact the participant

Presented by: Matthew Bigerton

Targets & Metrics Summary

- The device will:
  - be self-contained
  - not interfere with scanner
  - be safe for participant
  - indicate to the user to hold ideal pose when he/she is in the correct position and orientation

Table 2: Important targets & metrics

Mixed Reality Wearable For Body Tracking			
Main Functions	Sub-Functions	Metrics	Targets
Device	Self-Contained	Dimensions (in)	≤ 30 x 30 x 30
		Weight (lbs)	≤ 25
	Free of Interfernece	Distance From Scanner (m)	~ 1
Safety	Safe For Participant	Brightness Level (Lumens)	≤ 200
Visual Indication	Signals Participant to Hold Position	Time in designated location and Orientation (Seconds)	< 30

Presented by: Matthew Bigerton

Concept Selection: Overview

- House of Quality compares Customer Characteristics vs Engineering Characteristics
- Pair Wise Comparison evaluated the importance of each Customer Requirements
- Pugh Matrix was used to compare concepts
- AHP was used as a consistency check after selection

Table 3: Concept selection table

Concept Selection Process:
Pair Wise Comparison
House of Quality
Pugh Matrix
Analytical Hierarchy Process(AHP)

Presented by: Timothy Rubottom

8 Original Final Design Contenders

Table 4: List of 8 original final design concepts

Final Design Concepts
AR and Leap Motion
Mirage/Schlieren Imaging
BMW Holo-Touch
3D Image Live Feed Camera
Cast of Hand/Head
Adafruit with 3D Camera
Illumination Mirascope
Semi-Automatic Robot with 3D Camera

Presented by: Timothy Rubottom

Original Final Concept Selection: AHP

Concept Selection Process:
AHP

- The final concept was determined using multiple pair wise comparisons for each engineering characteristic
- The output is the weighted number ranking of the final 3 selections

Table 5: Analytical Hierarchy Process

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SELECTION:	Semi-Automatic Robot w/ 3D Camera	Adafruit w/ 3D Camera	3D Image Live Feed Camera
Design Volume	0.11	0.26	0.63
Weight	0.09	0.45	0.45
Distance from Scanner	0.23	0.32	0.45
Tolerance of Depth Measurement	0.57	0.29	0.14
Brightness Level/Intesity Level	0.60	0.20	0.20
Operationg Temperature:	0.60	0.20	0.20
Resolution	0.60	0.20	0.20
Operating Time	0.14	0.43	0.43
SUM	2.94	2.35	2.71

Table 6: Final Selection

FINAL CONCEPT WEIGHT	
Semi-Automatic Robot w/ 3D Camera	0.40
Adafruit w/ 3D Camera	0.28
3D Image Live Feed Camera	0.32

Presented by: Timothy Rubottom

End of Fall Semester Decision

- Upon further discussion with a Senior Design TA, Team Adviser and Sponsor, we determined that a better concept existed

- As a team, the decision was made to move away from our initial selected concept and moved towards a mixed reality design

Presented by: Timothy Rubottom

New Design: Mixed Reality Wearable

Design Components

- 3D dual lens camera
- Wearable device
- Processor
- Steady state monitor

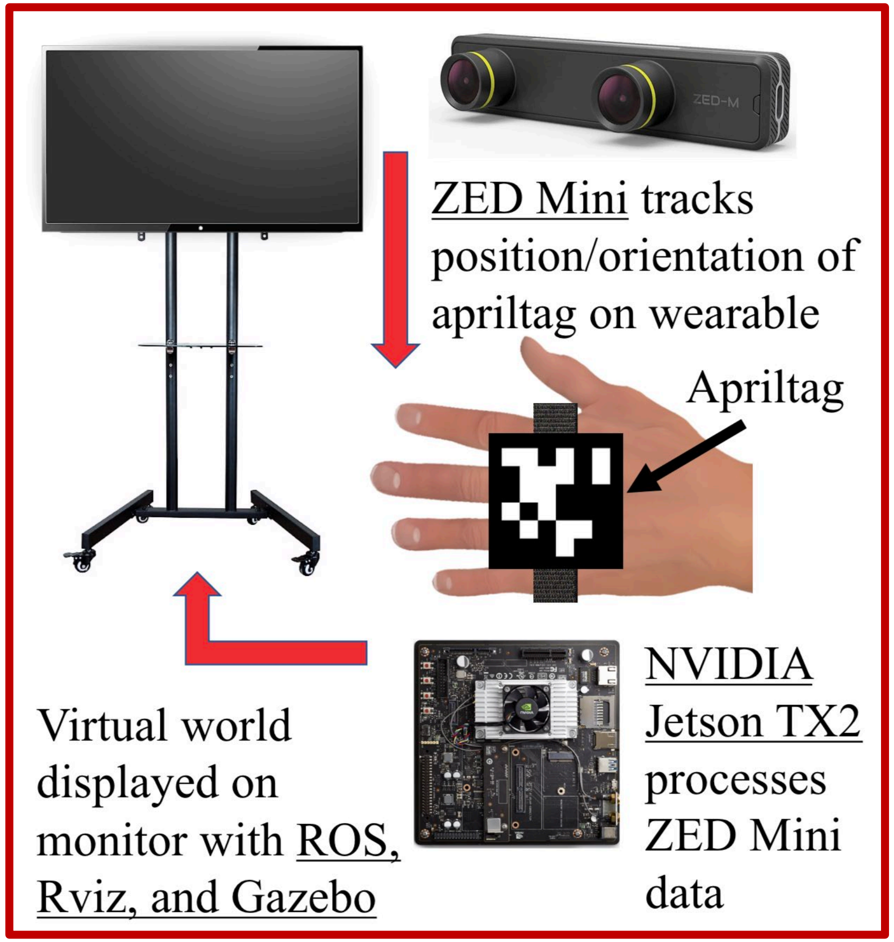

Figure 3: Chronological layout of new design

Presented by: Timothy Rubottom

Mixed Reality Wearable: Camera

<u>3D dual lens camera</u>

- ZED Mini stereoscopic camera ($449)
- Outputs 3D HD live feed video
- Will be utilized to track the pose of the AprilTag(s) in real-time

Figure 4: Picture of ZED Mini

Presented by: Caleb Pitts

Mixed Reality Wearable: Wearable Design

Wearable Device

- We will be designing a wearable device in house
- The design will incorporate AprilTag(s) to track the pose of the user

QR codes have a high pixel density

*Scan this QR code for an example of AprilTag tracking

AprilTags have a low pixel density

Figure 5: Comparison between QR codes and AprilTags

Presented by: Caleb Pitts

Mixed Reality Wearable: Computer

<u>Computer</u>

- ➢ NVIDIA Jetson TX2 ($299 with educational discount)
- ➢ Optimized for processing ZED Mini point cloud data (dense 3D data)

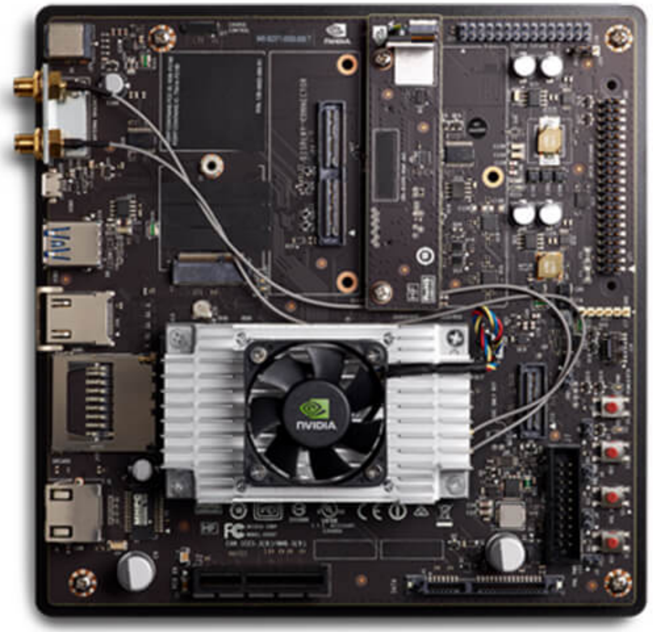

Figure 6: Picture of NVIDIA Jetson TX2

Presented by: Caleb Pitts

Mixed Reality Wearable: Monitor and Computing

Steady State Monitor

- ➢ TV or Computer monitor
- ➢ Used to output the processed visual data

Computing Software

- ➢ ROS – Robot Operating System
- ➢ RVIZ – used to visualize the exports of the ROS code
- ➢ Gazebo – efficiently simulates code from ROS

Presented by: Caleb Pitts

Spring Semester

- ➢ Ordering was accomplished over winter break
- ➢ NVIDIA Jetston TX2 and ZED Mini arrived on January 11, 2019
- ➢ We have acquired a used monitor, computer mouse, and keyboard for use with the NVIDIA Jetson TX2 and the ZED Mini

January 2019

Nº	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1			1	2	3	4	5
2	6	7	8	9	10	11	12
3	13	14	15	16	17	18	19
4	20	21	22	23	24	25	26
5	27	28	29	30	31		

Presented by: Caleb Pitts

Future Work

- Fabricate an AprilTag wearable & a protective covering for the NVIDIA Jetson TX2
- Represent the AprilTag's pose as a 3D image of a hand in a virtual world (Rviz/Gazebo)
- Create a translucent 3D image of a hand in the ideal pose within a virtual world
- Develop the team's website
- Work on DR5

Presented by: Caleb Pitts

Questions?

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