Haptic Feedback Glove

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EXECUTION AND VALIDATION PLAN

REVISION – 1
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EXECUTION AND VALIDATION PLAN
FOR
Haptic Feedback Glove

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Change Record

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0	9/20/2020	Nicholas Minton	NM BT	Rev 0
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1. Fall 2020 Execution Plans

1.1. Fall 2020 High Level Execution Schedule

Task	24-Aug	7-Sep	21-Sep	5-Oct	19-Oct	2-Nov	16-Nov
Research and Planning							
Write ConOps							
Identify Subsystem Modifications							
Write FSR							
Write ICD							
Midterm Presentation							
Order Project Parts							
Manufacture Glove Support and Braking System							
Develop Glove Sensor MCU							
Interface Glove Sensors with MCU							
Interface Braking System with HV Power Supply							
Develop Virtual Space							
Subsystem Troubleshooting							
Final Presentation							
Final Report							
Final Demo							

Table 1: Fall 2020 Execution Schedule

1.2. Subsystem Execution Schedule

Task	24-Aug	7-Sep	21-Sep	5-Oct	19-Oct	2-Nov	16-Nov
Develop Exoskeleton 3D Model							
Request Machining and 3D Printing							
Assemble Individual Finger							
Test Single Finger							
Assemble Remaining Fingers							
Validation							

Table 2 Glove Assembly Schedule

Task	24-Aug	7-Sep	21-Sep	5-Oct	19-Oct	2-Nov	16-Nov
Learn C# and Unity							
Develop Virtual Environment							
Develop Spatial Tracking							
Develop Force Feedback							
MCU Communication							
Validation							

Table 3: Virtual Environment Subsystem Schedule

Task	24-Aug	7-Sep	21-Sep	5-Oct	19-Oct	2-Nov	16-Nov
Download and Learn ALTIUM							
Design PCB							
Order MCU and IMU							
Program MCU							
Fabricate PCB							
Demonstrate Output with Flex Sensor and IMU							
Validation							

Table 4: MCU Subsystem Schedule

2. Validation Plans

2.1. Glove Assembly

Task #	Description	Relevant Requirement	Status
1	Index Finger brake module glides correctly	Movement is not inhibited by exoskeleton	✓
2	Middle Finger brake module glides correctly	Movement is not inhibited by exoskeleton	
3	Ring Finger brake module glides correctly	Movement is not inhibited by exoskeleton	
4	Pinky Finger brake module glides correctly	Movement is not inhibited by exoskeleton	
5	Thumb brake module glides correctly	Movement is not inhibited by exoskeleton	
6	Index Finger flex sensor is secured	Movement is not inhibited by exoskeleton	✓
7	Middle Finger flex sensor is secured	Movement is not inhibited by exoskeleton	
8	Ring Finger flex sensor is secured	Movement is not inhibited by exoskeleton	
9	Pinky Finger flex sensor is secured	Movement is not inhibited by exoskeleton	
10	Thumb flex sensor is secured	Movement is not inhibited by exoskeleton	
11	Hand stretching flex sensor on pinky is secured	Movement is not inhibited by exoskeleton	
12	Hand Stretching flex sensor on index finger is secured	Movement is not inhibited by exoskeleton	
13	Mounted Electrostatic brake can withstand 1300 V	No shorts occur during voltage applied for hard object	
14	Index finger mounts withstand 9 N Force	Glove is to retain shape when force is applied	
15	Middle Finger mounts withstand 9 N Force	Glove is to retain shape when force is applied	
16	Ring Finger mounts withstand 9 N Force	Glove is to retain shape when force is applied	
17	Pinky Finger mounts withstand 9 N Force	Glove is to retain shape when force is applied	
18	Thumb mounts withstand 9 N Force	Glove is to retain shape when force is applied	

Table 5: Glove Assembly Validation Plan

2.2. MCU and Hand Tracking

Task #	Description	Relevant Requirement	Status
1	Measure Flex Resistor values	The sensors should have a resistance between 20k and 120kΩ	✓
2	Pair and demo Integrator Circuit with flex resistor	Flex sensors will accuratley measure bending	✓
3	IMU X-axis rotation	Mapping should beaccurate to less than 2.5 degrees	✓
4	IMU Y-axis rotation	Mapping should beaccurate to less than 2.5 degrees	✓
5	IMU Z-axis rotation	Mapping should beaccurate to less than 2.5 degrees	✓
6	MCU I2C Protocol	MCU interfaces with IMU	✓
7	MCU Calibration Test	Calibrate maximum bend resistance data before use	✓
8	Send data to host	MCU establish communication with host	✓
9	Send resistance data to host	Must send accurate angle data based on bend in flex resistor	✓

Table 6: MCU Validation Plan

2.3. Graphical User Interface

Task #	Description	Relevant Requirement	Status
1	Verify Sensor MCU Communication	Virtual Environment Can Communicate with Glove Peripherals	Pass
2	Verify Power Supply MCU Communication	Virtual Environment Can Communicate with Glove Peripherals	Pass
3	Detects Thumb Rotation	Virtual Environment Can Interpret MCU Data	
4	Detects Index Rotation	Virtual Environment Can Interpret MCU Data	Pass
5	Detects Middle Rotation	Virtual Environment Can Interpret MCU Data	
6	Detects Ring Rotation	Virtual Environment Can Interpret MCU Data	
7	Detects Small Rotation	Virtual Environment Can Interpret MCU Data	
8	Detects Change in Hand Location/Orientation	Virtual Environment Can Interpret IMU Data	Pass
9	Detects Thumb Collision	Virtual Environment Provides Appropriate Feedback	Pass
10	Detects Index Collision	Virtual Environment Provides Appropriate Feedback	Pass
11	Detects Middle Collision	Virtual Environment Provides Appropriate Feedback	Pass
12	Detects Ring Collision	Virtual Environment Provides Appropriate Feedback	Pass
13	Detects Small Collision	Virtual Environment Provides Appropriate Feedback	Pass
14	Virtual Environment Can Recieve Improper Data	In the Event of Faulty Data the Virtual Environment Operated Properly	
15	Applies Appropriate Level of Force	Virtual Environment Provides Appropriate Feedback	

Table 7: GUI Validation Plan