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3D Gaming Environment for Arm Assessment
Product Requirements

MAD SABINO

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PRODUCT SPECIFICATION

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Document History

Rev Number	Date	Modified By	Reason
0	21Sep2021	Dawson Hill, Alex Peña, Miguel Villanueva	Initial Release

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1 Objective

The objective of this document is to document the requirements for building a 3D virtual gaming environment that can utilize the BLUE SABINO to consistently assess patients in repeatable tasks such as reach and grasp movements.

2 Scope

The scope of this document is to define the requirements and vision for how the 3D gaming environment for the BLUE SABINO will be designed and implemented. These requirements will allow the gaming environment to perform smoothly and present patients with clear, measurable, and repeatable tasks that are easily configurable.

3 References

3.1 Cited Documents

This is place to cite any relevant standards, regulations, etc. relevant to the requirements…

3.2 Acronyms

BLUE SABINO - BiLateral Upper-limb Exoskeleton for Simultaneous Assessment of Biomechanics and Neuromuscular Output

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4 Functional Requirements

4.1 What it should do

The gaming environment should be able to assess patients while giving them visual instructions for repeatable tasks that can be modified within the software.

5 Mechanical Requirements

Not Applicable

6 Electrical Requirements

6.1 Hardware

Needs a computer to be able to run and execute the gaming environment. Also needs a monitor to view the software. The other electrical requirements have already been determined.

7 Software Requirements

7.1 Functionality

The software should be a virtual environment displayed on a monitor that contains an arm and hand viewed in a 3rd person view from behind the subject. The 3rd person view allows visibility of both left and right arms as the BLUE SABINO expands from a 1-arm to a 2- arm (bilateral) device. Transparency may be needed to avoid blocking location and orientation of the hand and target locations as is done in other games. The end goal is to have 5 degrees of motion within the armature implemented within the software. Using the virtual arm driven by angle outputs from the robot, the environment should be configurable to allow a variety of tasks to be displayed such as:

1. Point to point reach (only start and end locations matter)

2. Handgrip to handgrip reach (orientation of hand matters at start and end locations)

3. Trajectory following (movement along a prescribed path, orientation doesn't matter)

4. Trajectory following with hand orientation (position and orientation along the path matter)

5. Each of the above where the home (hand start/end), target (object start), and goal (object end) could be adapted so the home position and target are the same or different

The virtual human arm should allow modular use of any of the following joints to be controlled from robot outputs:
1. Shoulder elevation/depression (up and down translation of the joint center)

2. Shoulder protraction/retraction (fore-aft translation of the joint center)

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3. Shoulder abduction/adduction (lateral elevation of the arm about the shoulder)

4. Shoulder flexion/extension (forward elevation of the arm about the shoulder)

5. Shoulder internal/external rotation (rotation about the long axis of the upper arm segment)

6. Elbow flexion/extension

7. Forearm pronation/supination (rotation about the long axis of the forearm)

8. Wrist flexion/extension (direction of wrist motion for knocking, patting, or tapping)

9. Wrist radial/ulnar deviation (direction of wrist motion for waving or hammering)

10. Thumb abduction/adduction

11. Thumb flexion/extension

12. Index finger flexion/extension

13. Combined middle/ring/pinky finger flexion/extension

The display should provide clear visualization of position and orientation of on-screen items through shading from light sources, shadows, and clear contract from the background. The background should be simple and minimize distraction from the task or confusion over task targets/cues.

Additionally, we will need to design a library/wrapper to translate the exoskeleton movements and outputs into our gaming environment.

7.2 User Interface

The patient should be able to see their movements translated to a virtual armature on a screen. The interface and translated movements need to be highly configurable to allow for customization to suit each patient's needs.

Commented [DH1]: Maybe move this to the User Interface section under the "Software Requirements"?

8 Environmental Requirements

8.1 Area

There should be enough room to house and operate the BLUE SABINO with all the necessary peripheral equipment.

9 Regulatory Requirements

Not Applicable

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10 Cost Requirements

10.1 Budget

The budget should not exceed $500.

11 Schedule Requirements

The following are the major Project Milestones:

-	Snapshot Day #1	Oct. 12, 2021
-	Concept Design Review	Nov. 12, 2021
-	Snapshot Day #2	Dec. 3, 2021
-	Engineering Release Review	Feb. 18, 2022
-	Snapshot Day #3	March, 29, 2022
-	UI Design EXPO	April 28, 2022
-	Design Report and Portfolio	May 6, 2022