

Smart Glove for VR by Magic Mitts

Team members: Rabiati Sadiq, Blake Novosad, John Navarro, Juan Casillas

### Design Package V2 – 10/31/2024

Description: This document contains the details of the software planning in the project, The software outline description of files, functions and variables, and modifications

Project Name: Smart Glove for VR.

Team Name: Magic Mitts

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### Description of files

These are the description of each software files:

1. Unity\_SerialManager.cs: This handles the com port connections and manages the command sending and data receiving
2. Full\_gloves.ino: This is the main ESP32 control scripts, it handles the flex sensor reading and serial communication, the haptics and brake system control, it has the constants for the pins and thresholds.
3. GrabDetector.cs: This integrated with oculus SDK HandGrabInteractable, it detects and processes grab type and manages the active grabbing fingers, with a real time GUI debug info display.
4. FullFingerTest.cs2: This file Processes the sensor data for all five fingers and maps the flex sensor values to finger rotations, this also allows for real time finger joint control
5. InteractionTest.cs: This file handles Collision detection and feedback
6. Output\_Buzz\_Test.cs: This file is to test sending output from unity - Without instance'

### Description of functions and variables

These are the description of each key functions and variables:

SerialManager Class:

- SendCommand(): Sends formatted string commands to ESP32 through serial port with error handling
- ReadFromPort(): Reads and returns incoming CSV data from ESP32 through serial port
- SerialPort: Main COM port handler that manages 9600 baud rate connection with ESP32

GrabDetector Class:

- HandleGrabStart(): Initiates grab detection process and activates appropriate finger brakes based on grab type
- UpdateGrabbingFingers(): Monitors and updates which fingers are actively grabbing, adjusting brakes accordingly
- HandleGrabEnd(): Releases all brakes and resets grab state when object is released
- ActivateFingersWithFeedback(): Activates haptic feedback and brakes for specific fingers during grab

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- `ReleaseFingersWithFeedback()`: Releases brakes and haptic feedback when fingers stop grabbing
- `GetActiveFingerNames()`: Returns a string list of currently active grabbing fingers for debugging
- `OnGUI()`: Displays real-time debugging information about grab states and active fingers

FullFingerTest Class:

- `ProcessSensorData()`: Parses incoming ESP32 sensor data and converts to finger angles
- `ApplyFingerRotations()`: Applies calculated rotations to virtual finger joints based on sensor data
- `Transform[] fingerJoints`: Array storing Unity transform references for each finger joint
- `float[] sensorValues`: Array storing current flex sensor values from ESP32

### Description of Modification:

- **Modification from Starter Code:**
  - The code expanded from a single-finger setup to handle five fingers, with sensor values adapted for flex sensors and smoothed for realistic joint movement. Integration with Oculus OVR rig and 3D hand models enabled lifelike virtual hand manipulation, and colliders ensure proper object interaction. Added collision detection and feedback, triggering signals like the buzzer when objects are touched. `SerialManager` was implemented for efficient serial communication, ensuring smooth data handling between hardware and Unity.

Note: Full code has been attached to the Design Package V3.