UC Irvine
SSOE Research Symposium Dean's Awards

Title

Glove Band: Air Violin

Permalink

Authors

Zhu, Tangqin

Zhu, Canting

Zhuang, Zhengyang

et al.

Publication Date

2025-04-08

Copyright Information

Peer reviewed

Glove Band

Tangqin Zhu tangqin@uci.edu, Canting Zhu cantingz@uci.edu, Zhengyang Zhuang zzhuang13@uci.edu,
Thomas Yeung yeungks@uci.edu, Aarav Awasthy aawasthy@uci.edu
Professor Maxim Shcherbakov
University of California, Irvine

Abstract

The Glove Band is an innovative wearable musical instrument that emulates various instruments through finger gestures and hand movements. It bridges the gap between traditional playing techniques and modern digital synthesis, offering an intuitive and expressive way to create music. The glove is embedded with sensors that translate user movements into musical notes and dynamic controls, which are processed by a microcontroller and output through a speaker. By enhancing gesture-based interaction, the Glove Band provides a versatile musical experience and makes instrument emulation more accessible and interactive.

Objectives

1. Finalize a fully functional prototype with integrated gesture detection and real-time sound synthesis.
2. Enhance gesture recognition accuracy to improve responsiveness and musical expressiveness.
3. Optimize the hardware design for better ergonomics and seamless instrument emulation.
4. Develop and refine software for customizable gesture mapping, sound modulation, and instrument selection.
5. Prepare a polished demonstration for the Senior Design Review, ensuring smooth operation and user-friendly interaction.

Materials & Testings

Materials
1. Gloves
2. SoftPot Linear Potentiometers
3. Accelerometer (MPU-6050)
4. Function buttons (4x)
5. Arduino Leonardo

Testings
1. Gesture to Output latency: ≤ 20 ms
2. MIDI Note Detection Accuracy ≥ 95%
3. Accelerometer Sensitivity: 0.1 - 20 m/s²
4. Sliding Potentiometer Resolution: ≤ 0.5 mm
5. Finger Press Detection Accuracy: ≥ 98%

Diagrams and Prototype

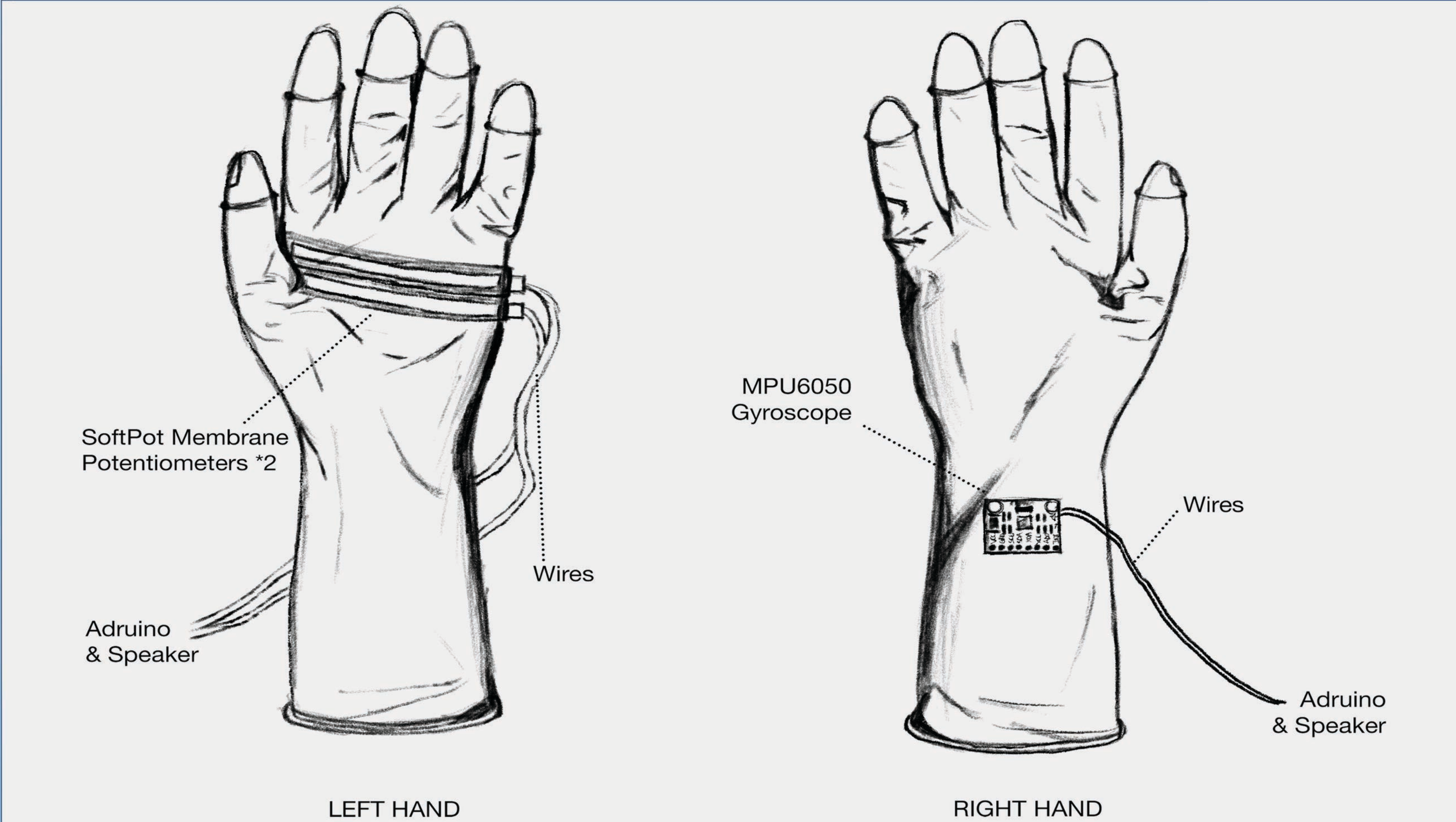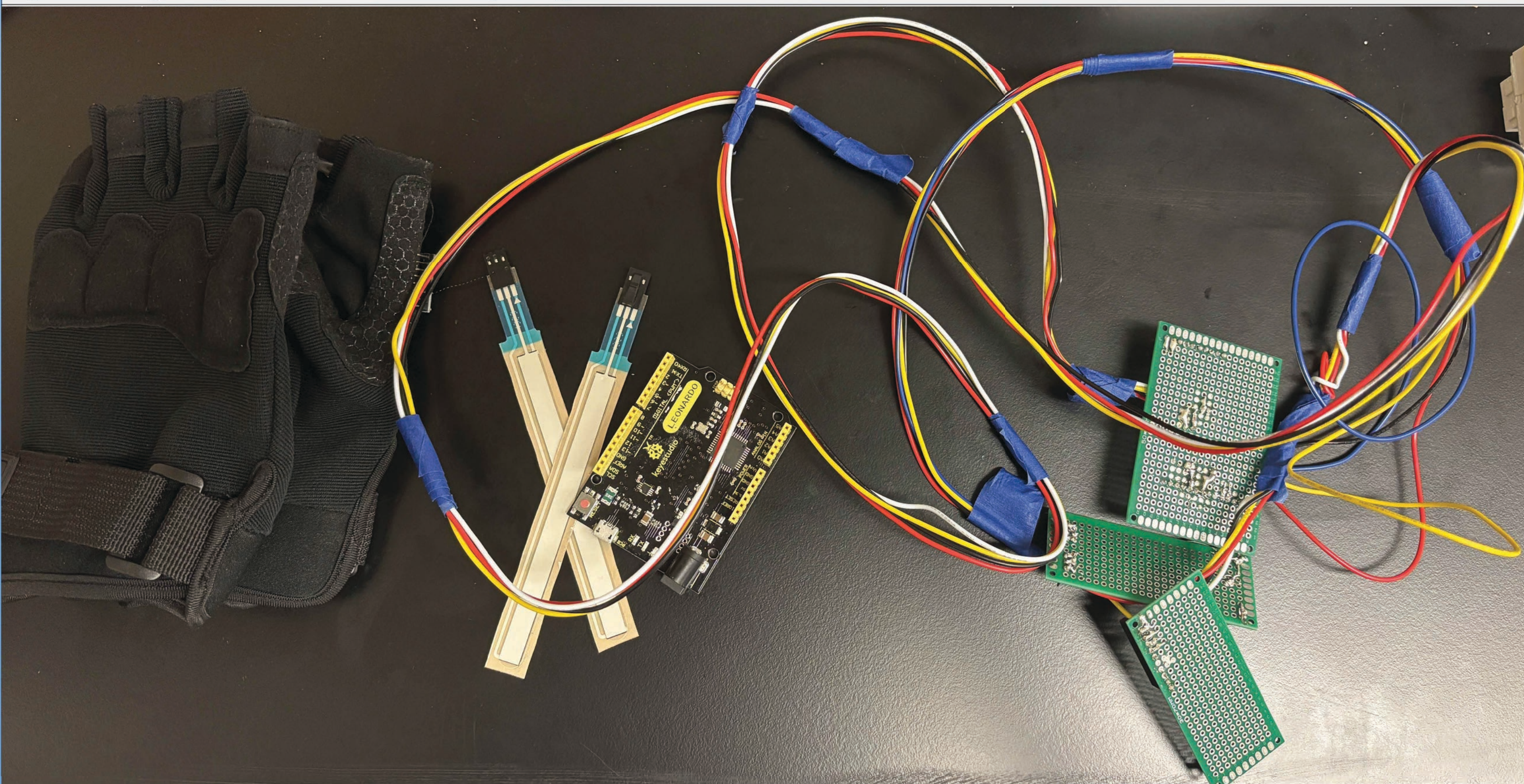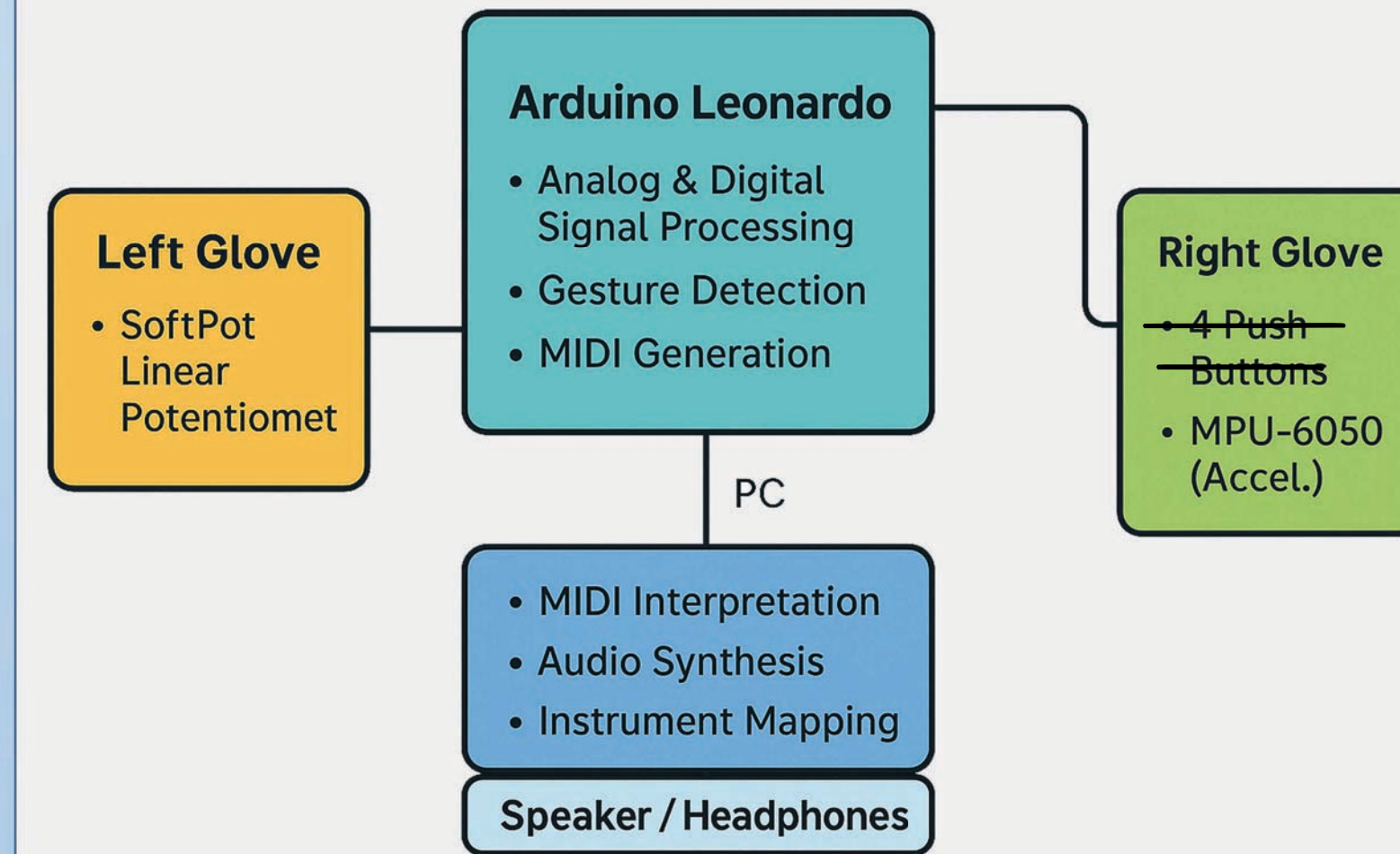Figure 1. Design diagrams of both hands of the prototype

LEFT HAND — SoftPot Membrane Potentiometers *2, Adruino & Speaker, Wires

RIGHT HAND — MPU6050 Gyroscope, Wires, Adruino & Speaker

Figure 2. Prototype of both hands with all sensors connected

Flowchart

Left Glove
• SoftPot Linear Potentiomet

Arduino Leonardo
• Analog & Digital Signal Processing
• Gesture Detection
• MIDI Generation

Right Glove
• 4 Push Buttons
• MPU-6050 (Accel.)

PC
• MIDI Interpretation
• Audio Synthesis
• Instrument Mapping

Speaker / Headphones

Figure 3. Flowchart of the prototype

Videos

Velocity measure:

Adding bend sound:

Adding potentiometer:

Final demo:

Key Standards Used

1. Hardware Safety: IEEE 1625 for Battery-powered wearable safety

2. PCB Design: IPC-2221, RoHS for PCB manufacturing & environmental safety

3. Microcontroller Communication: I2C, SPI, UART for Data exchange between sensors & microcontrollers

4. Musical Communication: MIDI for Digital music note transmission

5. Gesture Processing: IEEE 754 for Floating-point calculations for accurate gesture detection