Chirality: A Smart Glove Solution

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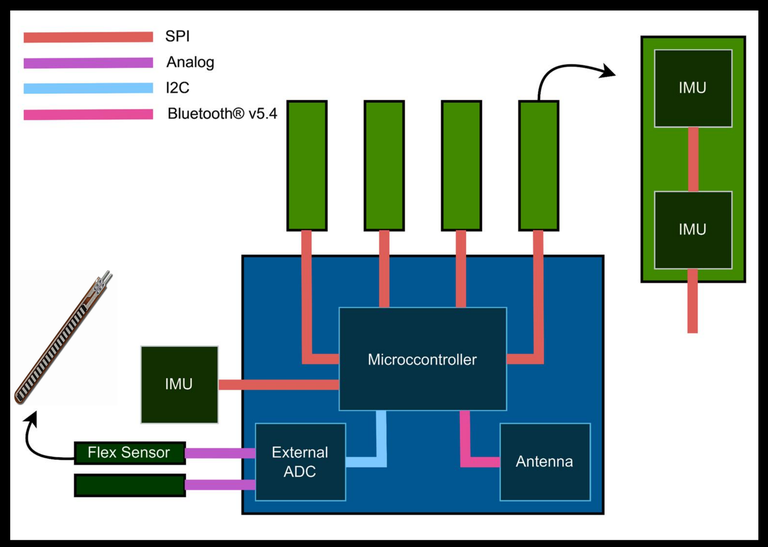
Abstract

Smart gloves are available in various forms, but they often lack accuracy or are overly specialized. Hand gestures and motions offer an intuitive form of control, yet there isn't a reliable interface that fully captures them. We developed a smart glove that precisely tracks hand movements, and can connect to any application via Bluetooth.

Overview

The glove will utilize individual modules for each finger, with IMUs tracking finger data and a flex sensor monitoring thumb web flexion and palm flexion. An additional IMU on the main unit captures holistic hand movements, while a built-in Bluetooth module transmits the data.

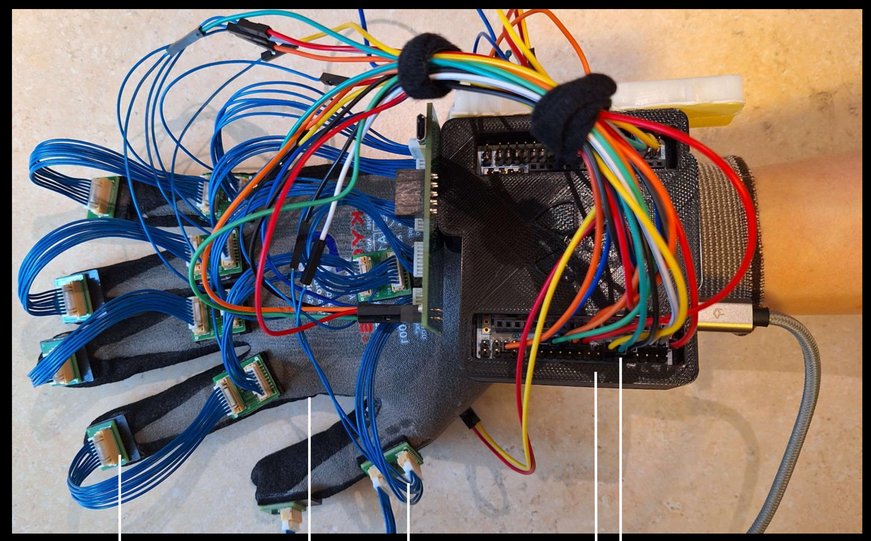
Block Diagram



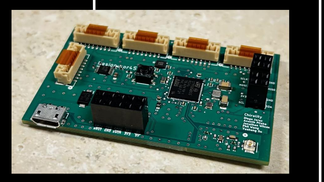
IMU Tip PCB: Equipped with a BMI323 IMU and a JST connector for detecting fingertip motion

IMU Base PCB: Equipped with a BMI323 IMU and a JST connector for detecting finger base motion

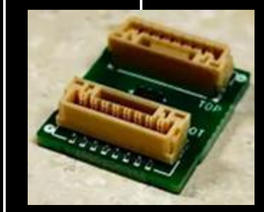
Product



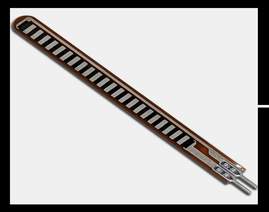
IMU Tip PCB



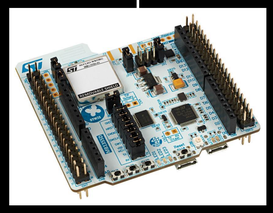
PCB Adapter



IMU Base PCB



ADS1115 Flex Sensor



STM32WB55RG Microcontroller

ADS1115 Flex Sensor: Located on the palm side used to detect the curvature of the hand

PCB Adapter: Connector for the JST ports to the main microcontroller

STM32WB55RG Microcontroller: The controller for processing IMU data and sending values through bluetooth to the 3D model

Software Development

Internal Representation:

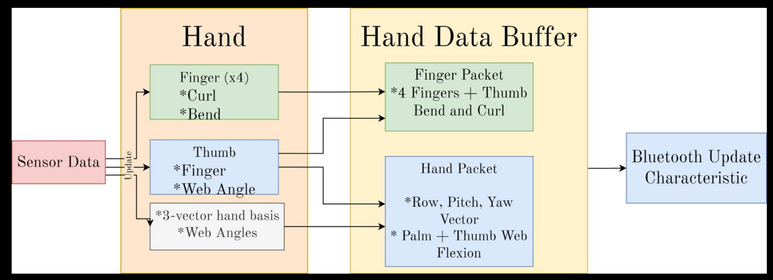
- Represent fingers with two angles: the curl of the finger itself, and the bend of the finger relative to the palm
- Represent the palm bend via **base thumb knuckle rotation** around the center of the palm

Sensor Fusion:

- Derive **rotation data** from the IMU
- Combine rotational data and **dynamically weighted average**

Virtual Model:

- Rendered using **real-time positional data** from the smart glove
- Each joint in the model uses **relative rotational data** from the nearest IMU and a **reference position** on the palm



Software Flowchart

Virtual Model

Three.js framework:
Real-time finger movements, palm and fingers in 3D space

Custom hand/finger data type:
Relative positioning of each segment, dynamic joints for geometric continuity

Real-time updates:
IMU data via Bluetooth, Chrome Web Bluetooth API, custom Bluetooth packet for system

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