Wireless Interactive Glove-Based Controller for Computer Games

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Overview

The focus of the project is to create a more intuitive, immersive, and interesting way to interact with existing computer games. Traditional games are controlled using a keyboard and mouse, but gamers are eager for new ways to interact with the virtual world. Our solution was to create a glove-based controller that translated the user's gestures into standard keyboard and mouse commands.

Glove Sensors

A variety of sensors are incorporated into the gloves to give users different ways to interact with their games. Resistive flex sensors (1) are placed along the knuckles detect when the user bends their fingers. A capacitive touch sensor (2) detects when the user touches their exposed thumb to the metal pads located on their fingertips. Lastly, an inertial measurement unit (3) detects when the user rotates their hand around an axis.

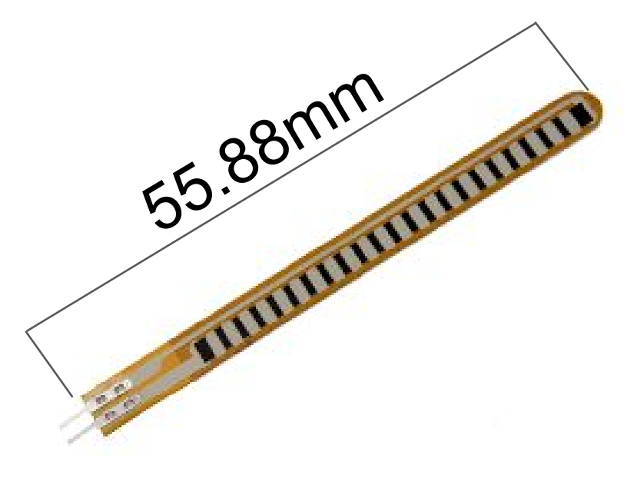


Figure 1. Flex Sensor

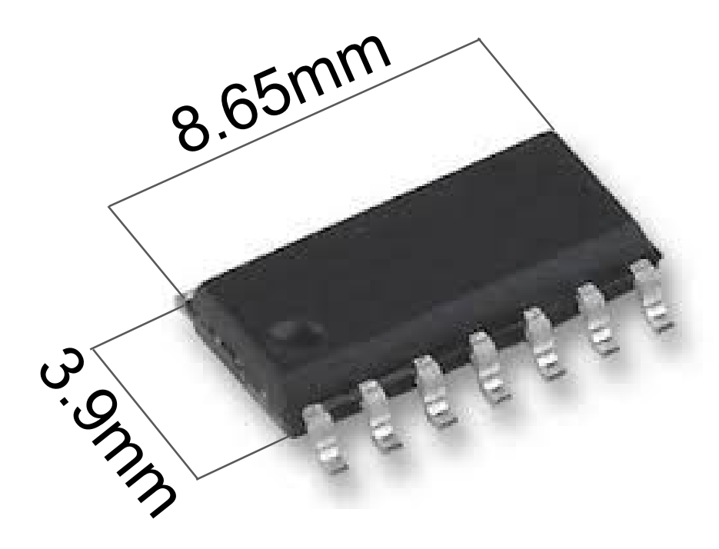


Figure 2. Capacitive Touch Sensor

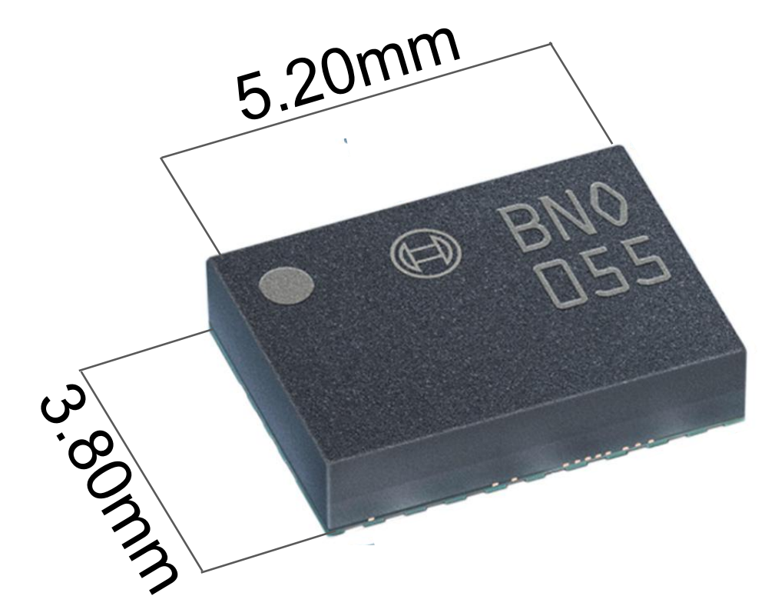


Figure 3. IMU

PCB Design

Each glove has an identical printed circuit board (PCB) which connects the processor to its sensors. The sensors communicate to the processor over I^2C and SPI protocols. The gloves can last up to 14 hours on a single charge. Status LEDs on the back of the hand communicate with the processor over SPI, and can indicate various programmable events. Once soldered, the circuit board is sewn into the glove to keep it secure.

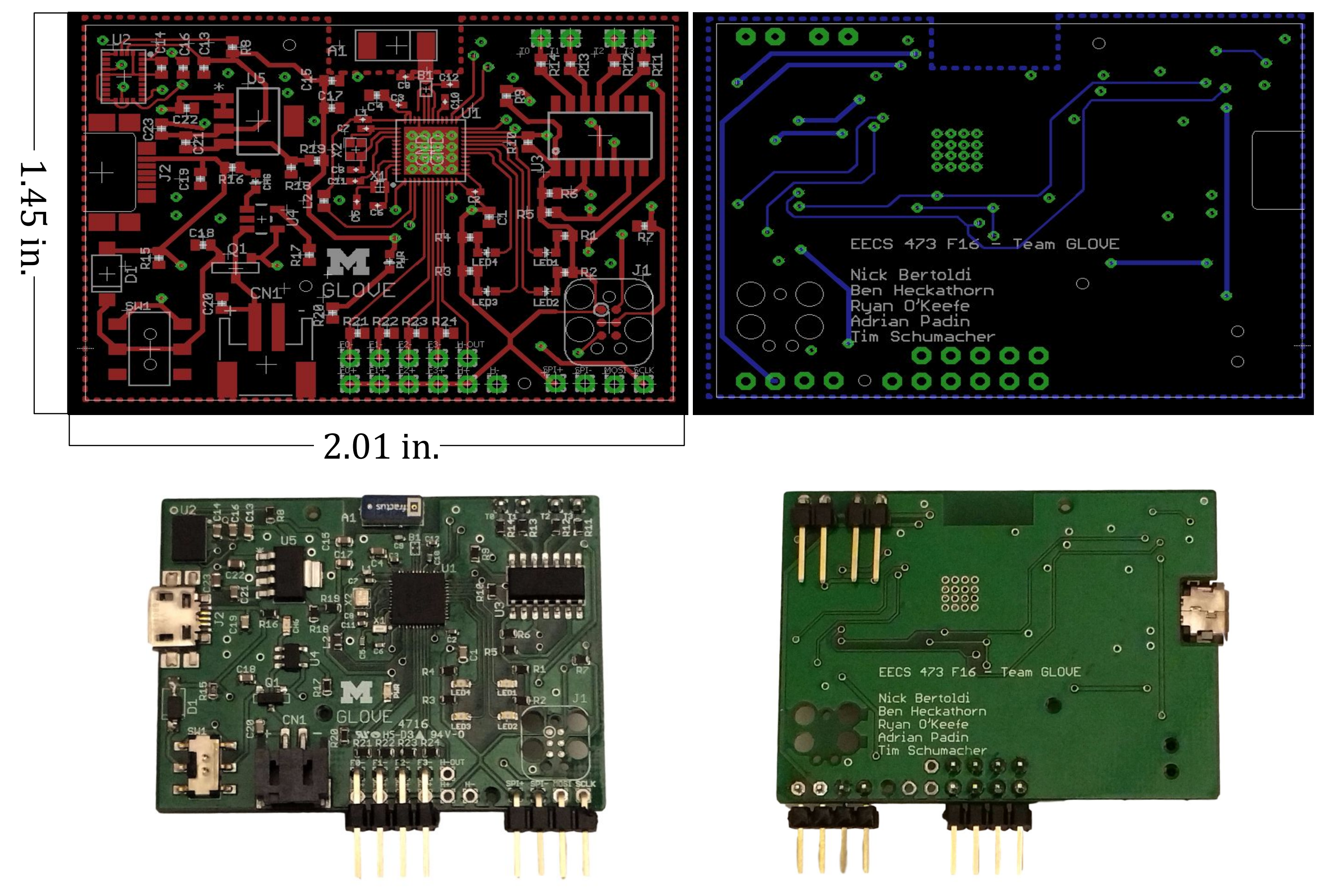


Figure 4. PCB Schematic (top) compared to the constructed PCB (bottom)

Prototyping

In order to test the software as it was being developed, a prototype glove needed to be created.The glove (5) incorporated each type of sensor used in the final glove, as well as a development kit to process the data and a mess of wires.

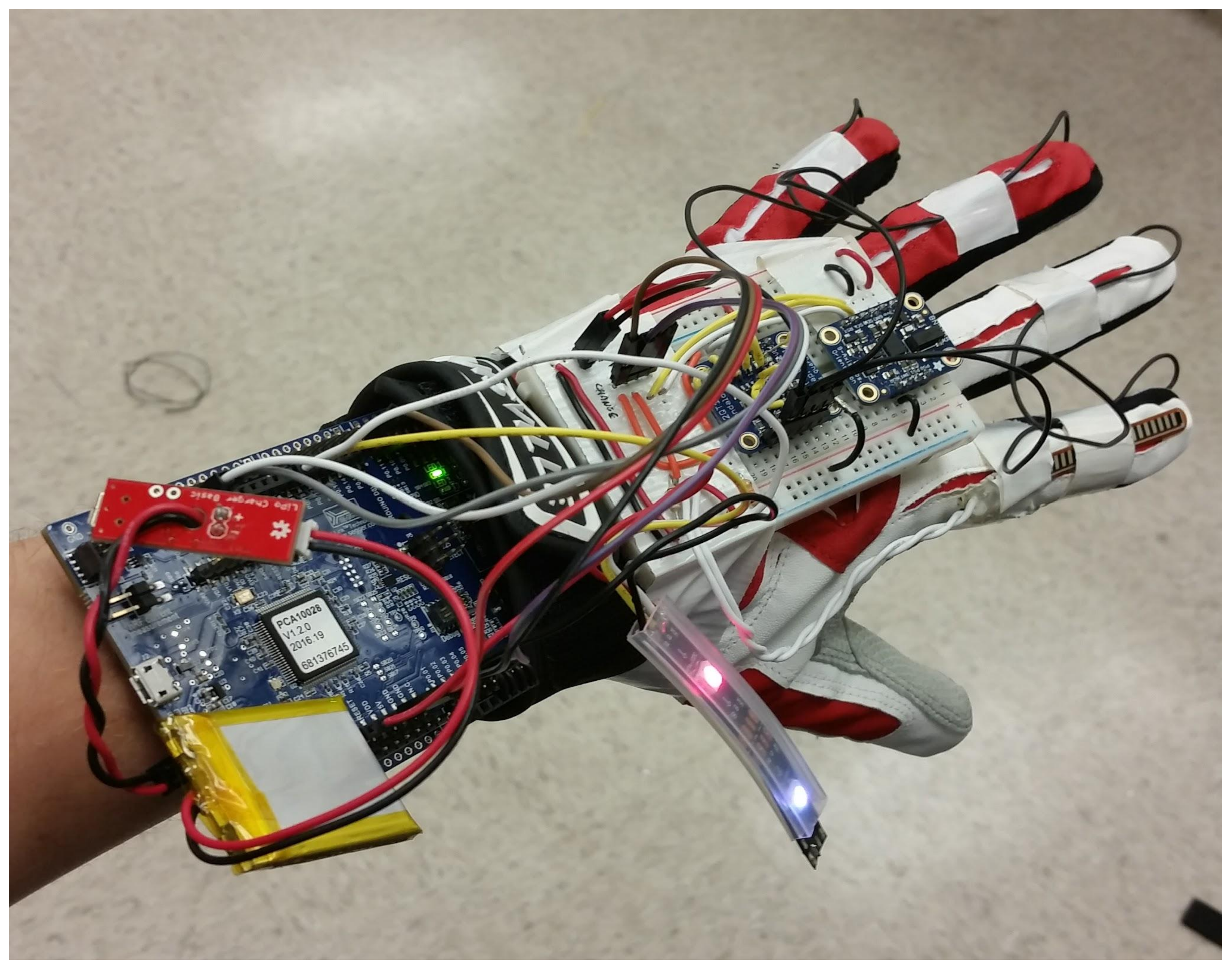


Figure 5. Prototype glove featuring the nRF51-DK, DotStar LEDs, touch sensors, flex sensors, and IMU

Final Construction

The final gloves are built on top of a bike glove base layer. The thumb is exposed to allow for touch sensor input. The flex and capacitive sensors are attached to the fingers, and the PCB and battery are attached to the back of the hand. Suede covers the internals of the glove to create a functional and complete wearable device as demonstrated below (6).

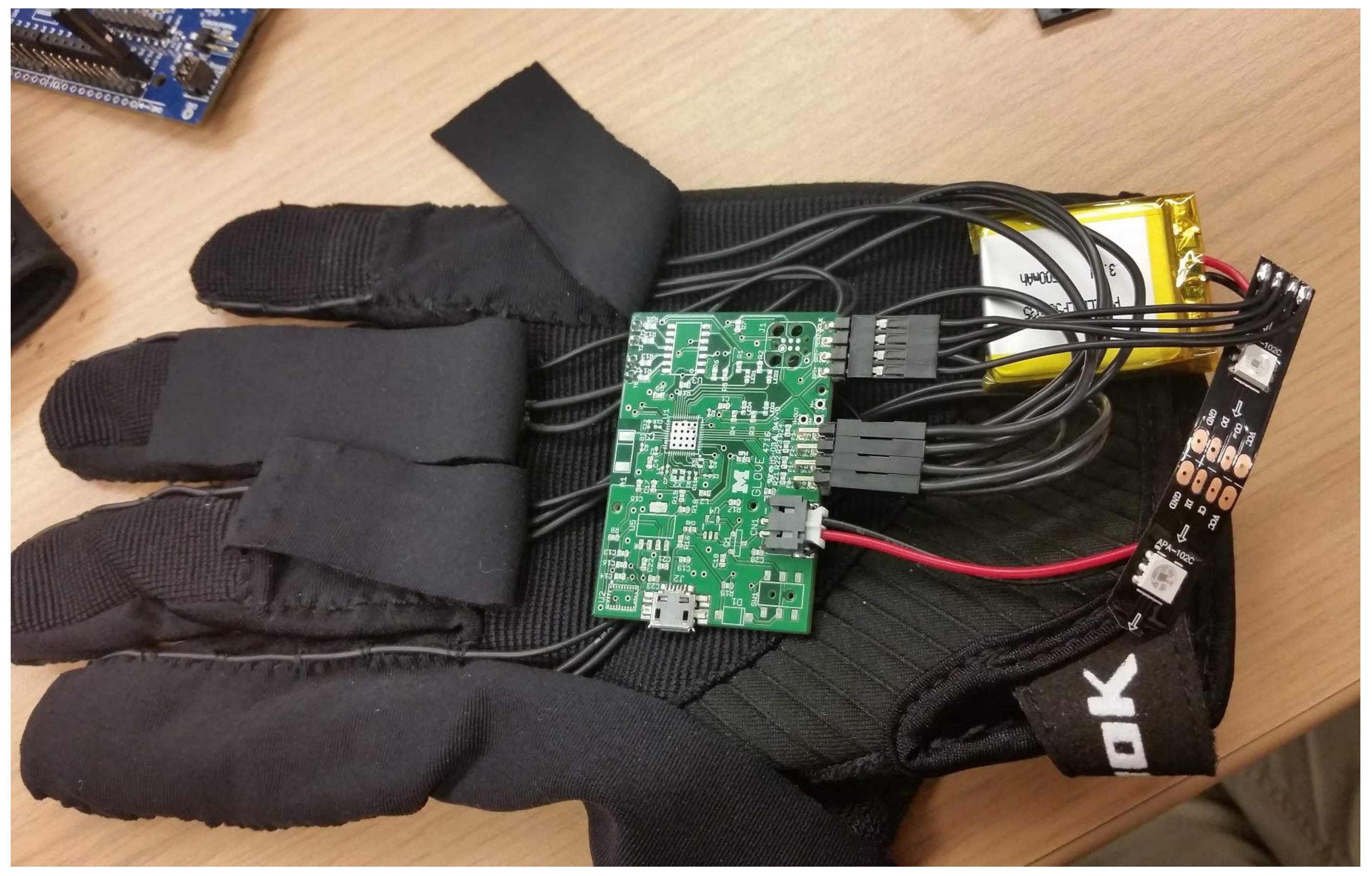


Figure 6. Final glove design with fabric pulled back to see the components and wiring

Using the Gloves

The setup consists of two gloves and a receiver board. Each glove continuously collects data from each finger's flex sensor, capacitive touch sensor, and the IMU for motion-sensing. The gloves then broadcast the sensor data over Bluetooth to the receiver board, which is plugged into the USB port of the computer. The receiver analyzes the data and maps it to standard keyboard and mouse input to send to the computer.

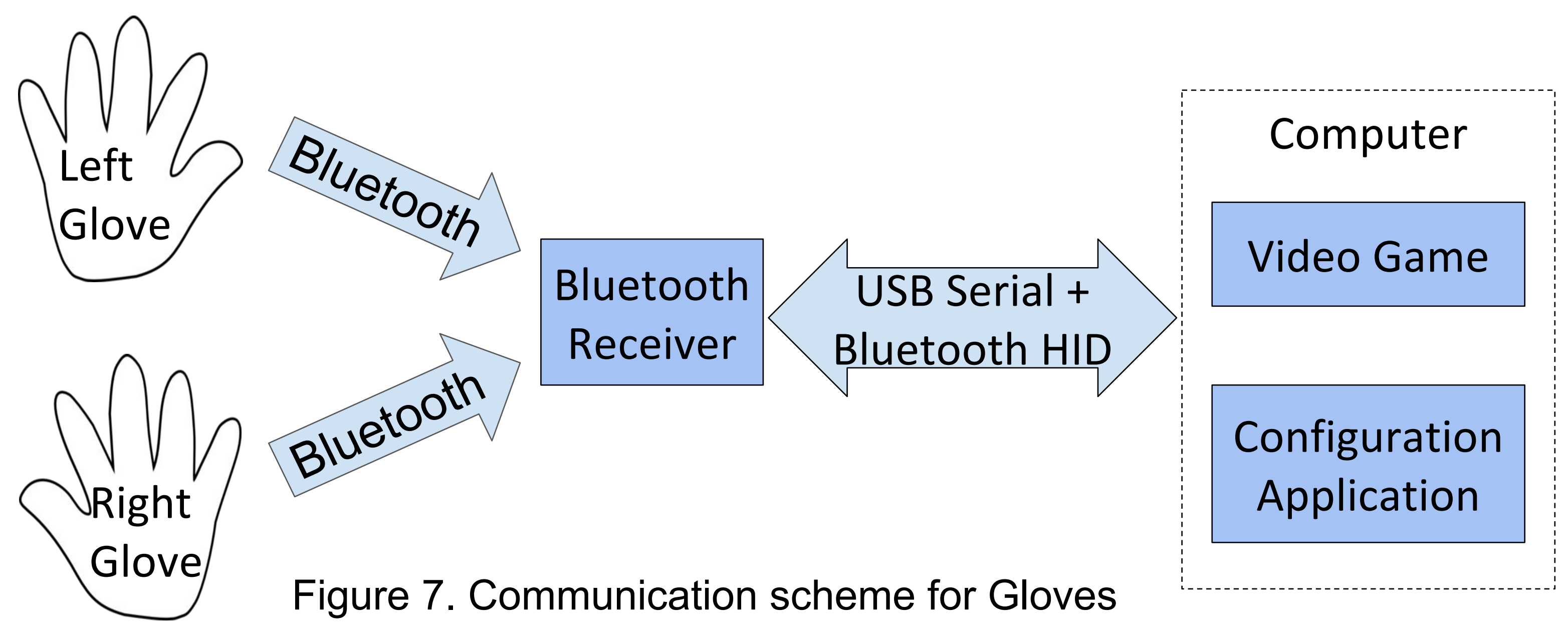


Figure 7. Communication scheme for Gloves

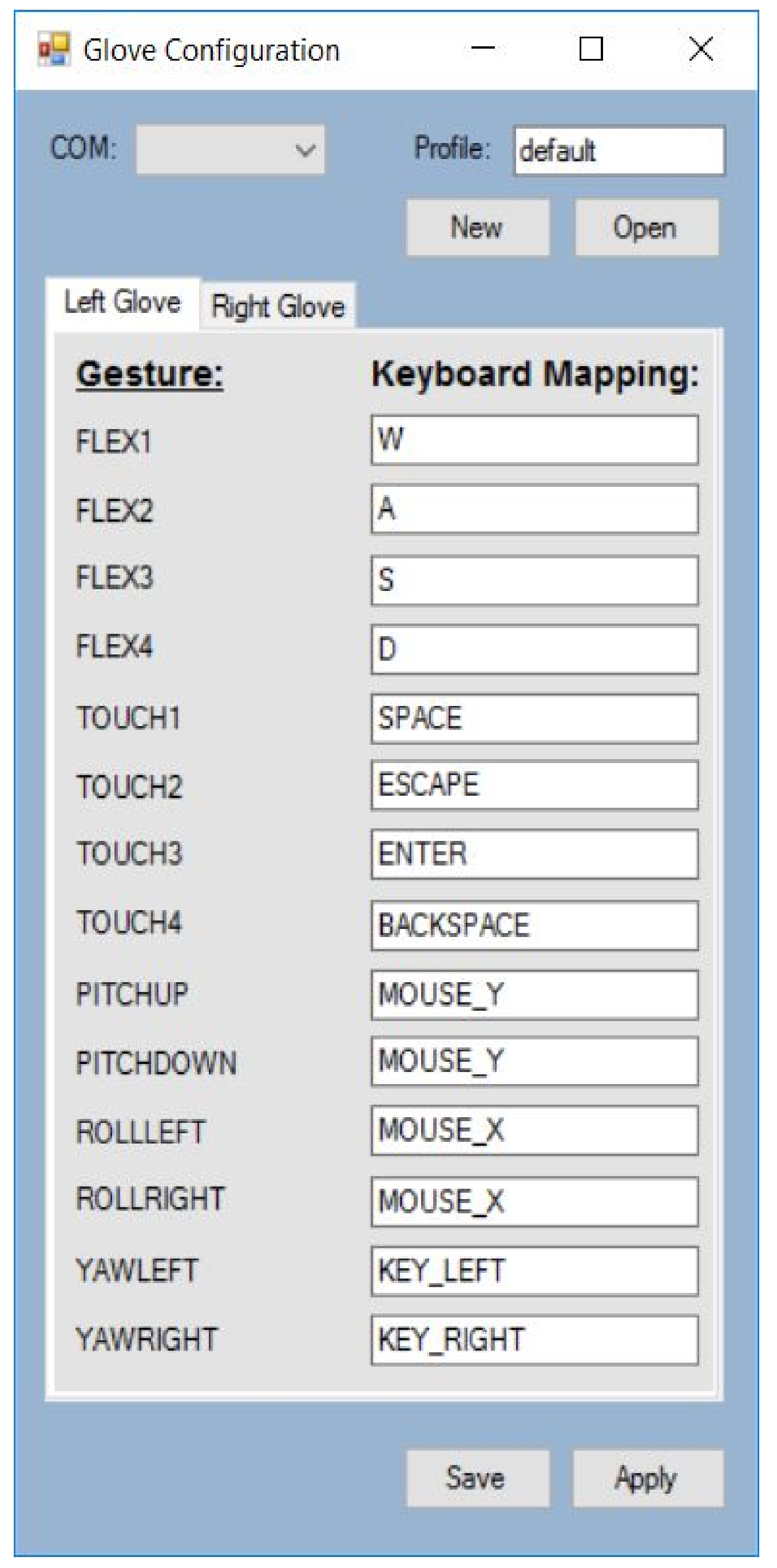
The HID Protocol

The Human Interface Device protocol (HID) is a standardized communication schemel used to send data to the computer from common input devices. This is what allows you to buy any keyboard off the shelf, plug it into your computer, and have it work instantly without need to install a new driver.

We chose HID for this project because it allows the glove to connect to any computer disguised as a keyboard and mouse, thus making it easy to use with existing computer games. Any game that can be controlled with a keyboard and/or mouse can be controlled with the gloves.

Configuration App

The Configuration App allows the user to change the command that each sensor controls. For instance, in the default settings shown right (8), bending the index finger of the left glove sends a "W" command to the computer, and rotating the left wrist moves the mouse cursor left and right. The ability to change the configuration allows the user to map the inputs to fit their preferences.



Glove Configuration

COM: Profile: default

Gesture:	Keyboard Mapping:
FLEX1	W
FLEX2	A
FLEX3	S
FLEX4	D
TOUCH1	SPACE
TOUCH2	ESCAPE
TOUCH3	ENTER
TOUCH4	BACKSPACE
PITCHUP	MOUSE_Y
PITCHDOWN	MOUSE_Y
ROLLLEFT	MOUSE_X
ROLLRIGHT	MOUSE_X
YAWLEFT	KEY_LEFT
YAWRIGHT	KEY_RIGHT

Figure 8. Interface for the configuration app

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