DJ Spatial Tracking and Gesture Recognition for Audio Effects and Mixing

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I. Introduction

Overview

Gesture recognition is used to enable the disc jockey (DJ) to control audio effects with hand motions. Gesture and color scheme information are acquired by a Pixy camera. A Raspberry Pi will perform gesture recognition and send musical instrument device interface (MIDI) commands to execute audio effects.

Objective

Our objective is to create a glove system that allows DJs to control audio effects through gesticulation.

Motivation

In the music production world, there is a disconnect between the DJ and their software. DJ boards are unintuitive to the novice DJ due to a complex array of knobs, sliders, and switches.

Significance

The DJ glove aims to integrate gesture recognition into the DJ realm. The use of gestural control to execute audio effects adds a natural connection between the DJ and their performance.
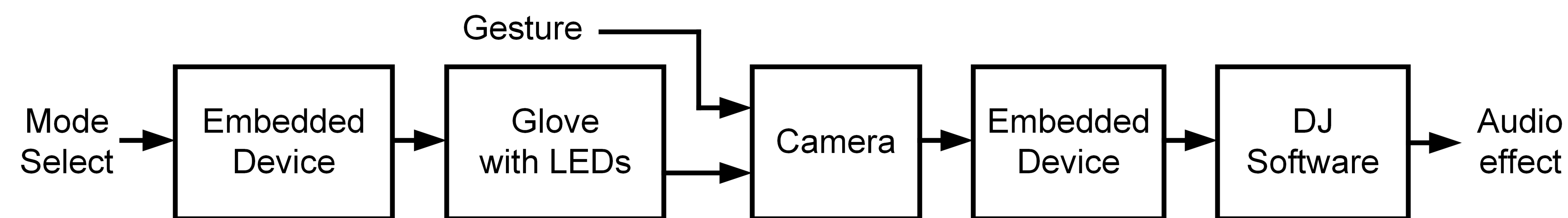

http://www.numark.com

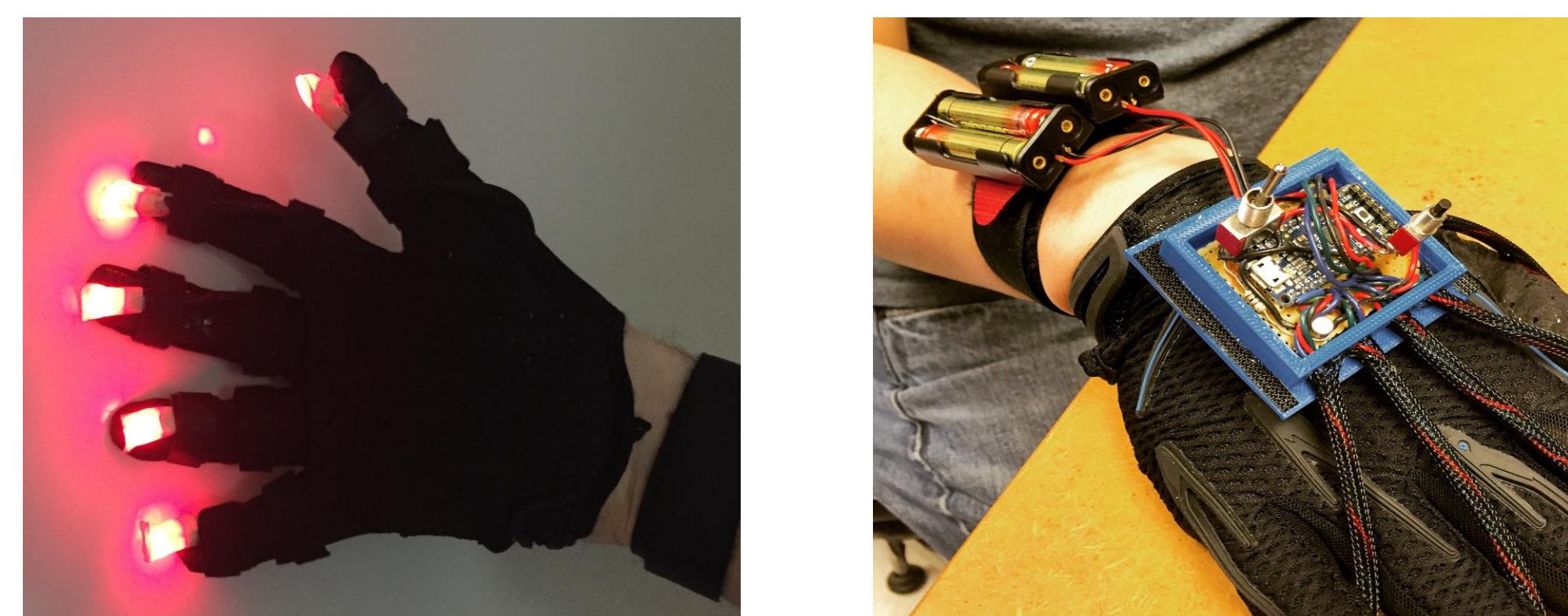### System Visual Diagram

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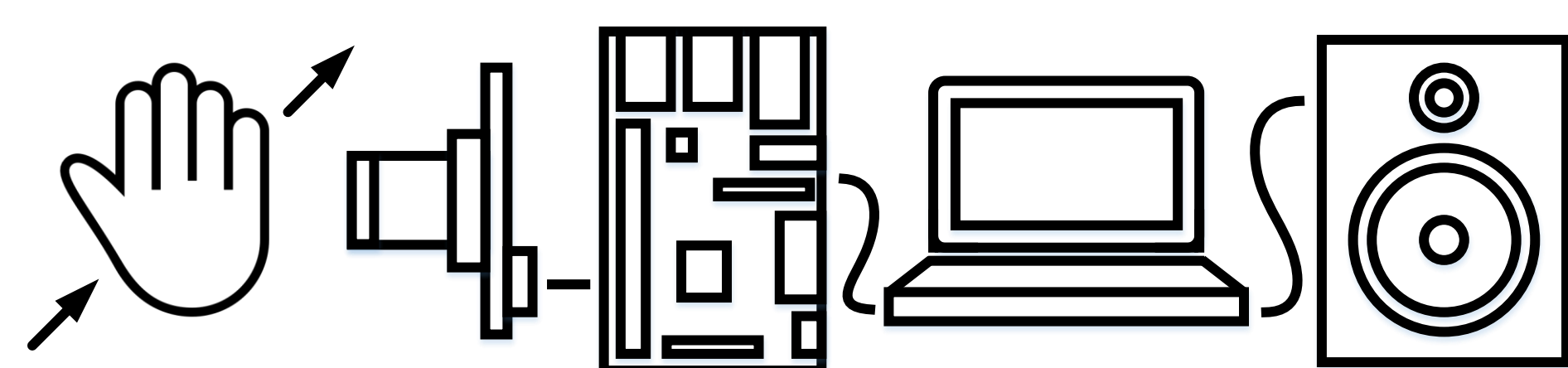
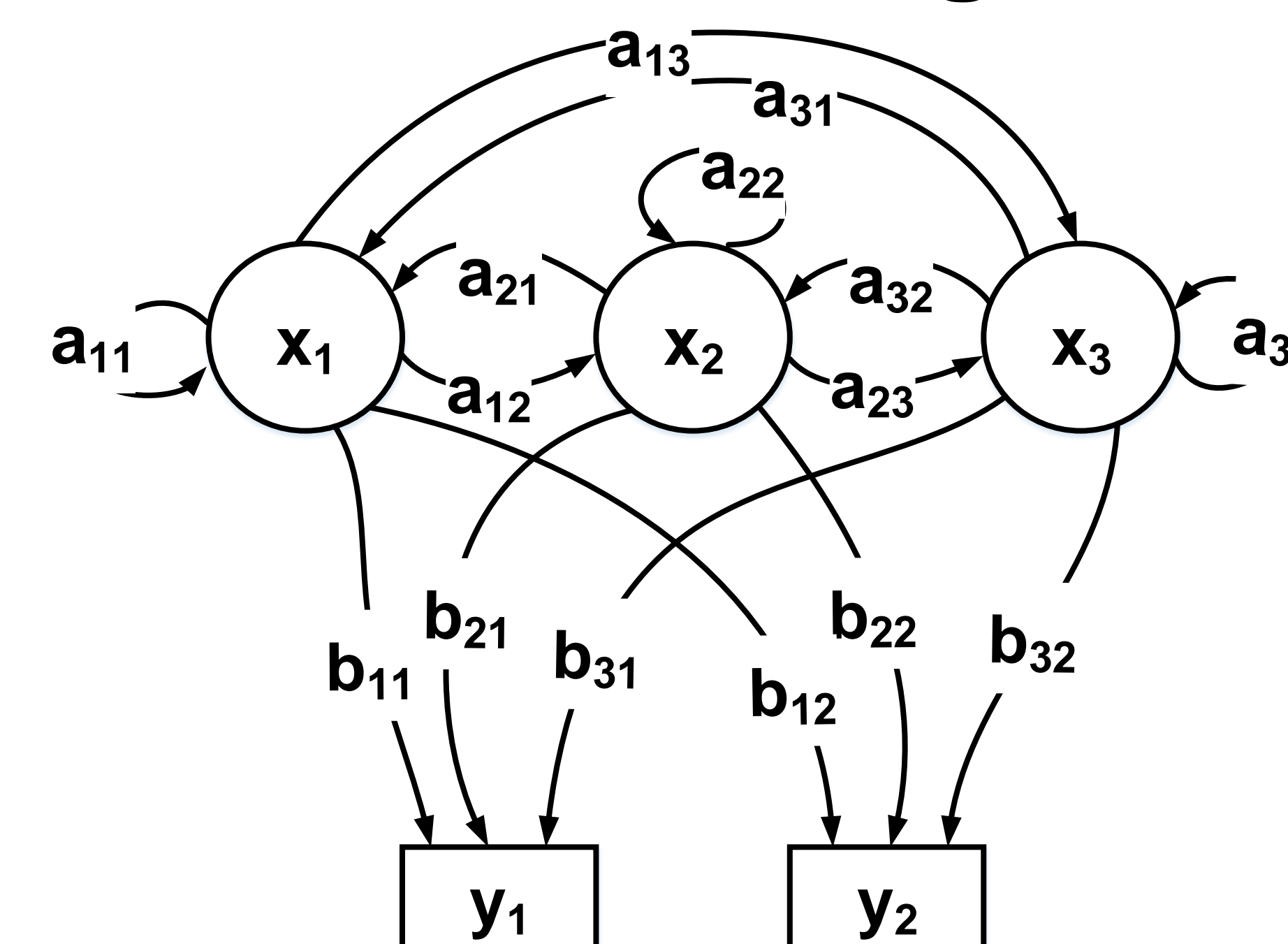## II. Methods

System Block Diagram

Glove System

The DJ glove allows the execution of multiple audio effects by combining a color scheme with a gesture. Tri-colored light-emitting diodes (LED), attached to the fingertips of the glove, emit red, blue, or green light based on the DJ's selection. A circuit case, secured onto the back of the glove, contains an embedded device and circuitry.

Gesture Acquisition

Pixy is trained to recognize the glove's LED color signature and track its motion. The center of the hand is used to determine the gesture trajectory. The angles between the glove's position in sequential frames are quantized.

Bin

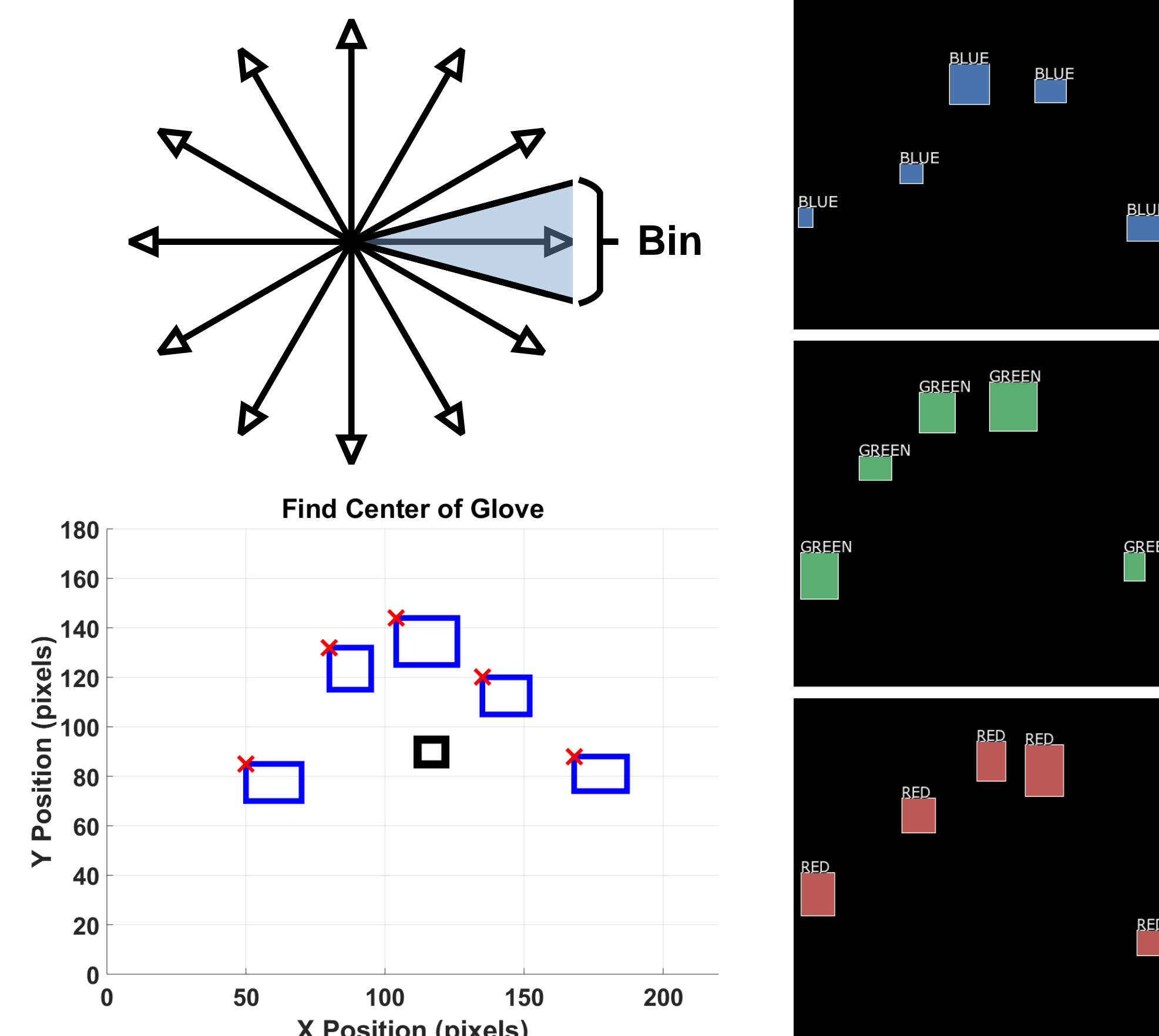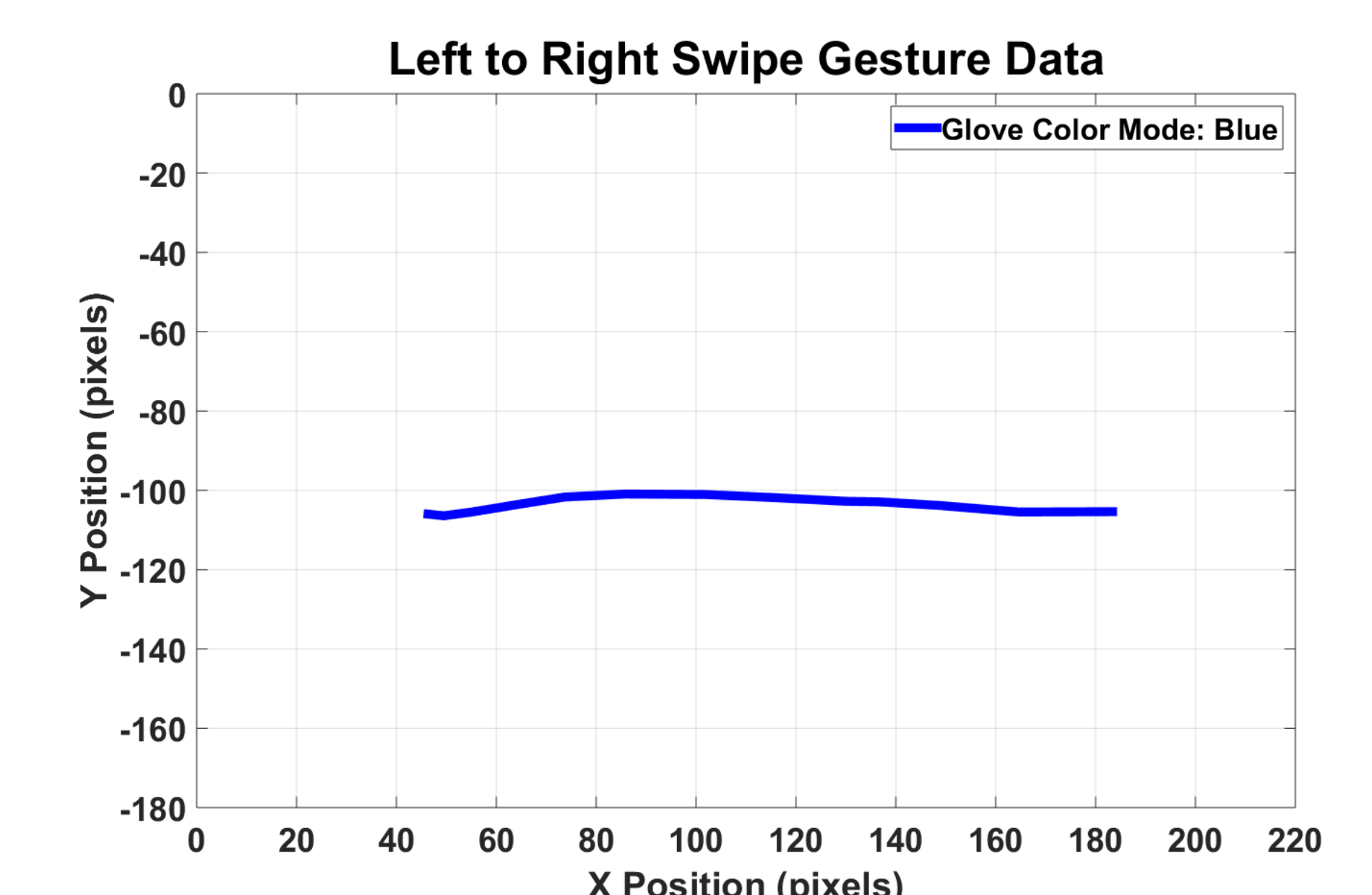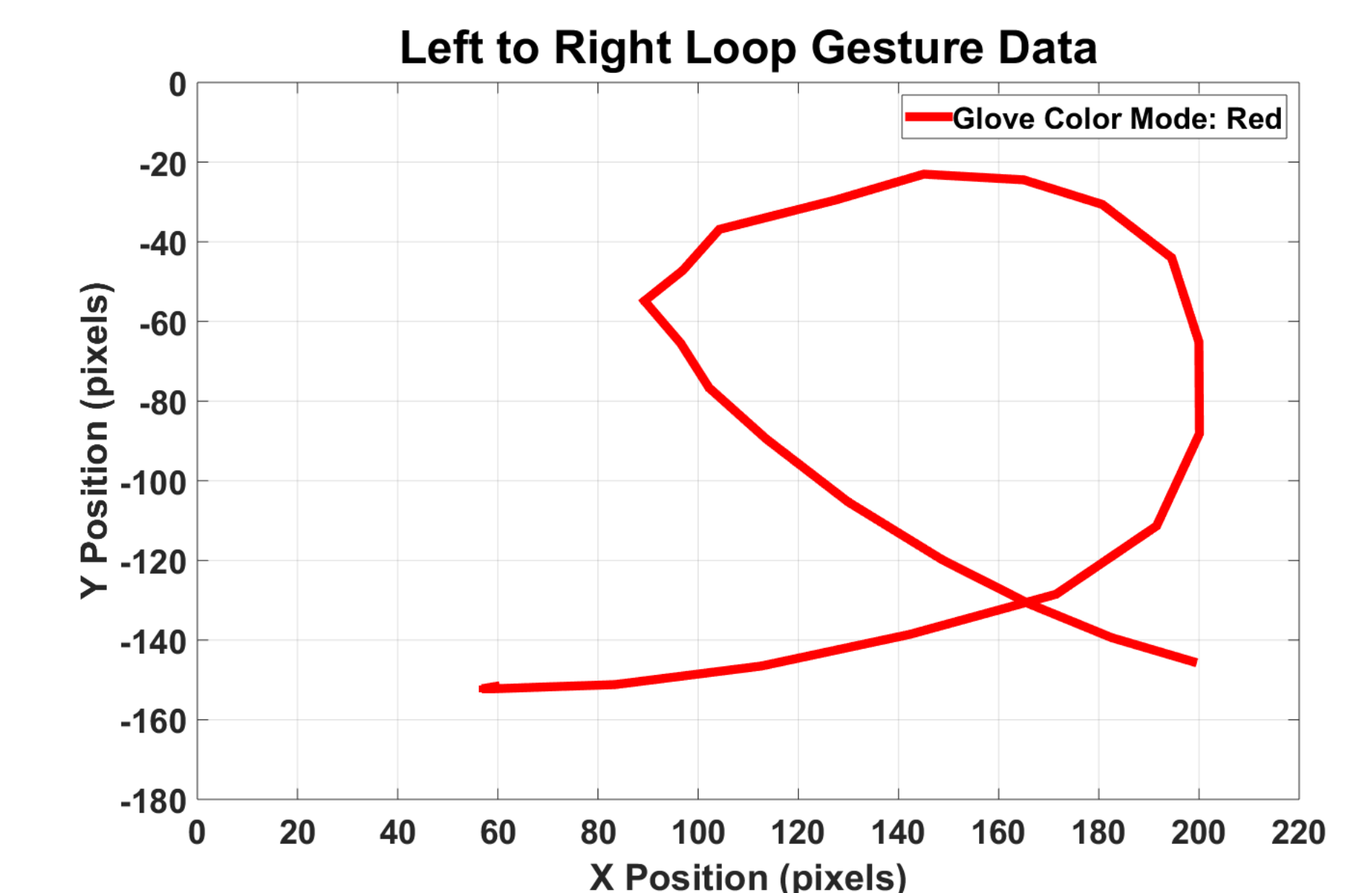**Find Center of Glove**

Gesture Recognition

A hidden Markov model (HMM) is a system of algorithms that use a series of observations to determine the most likely state sequence. The angles from a gesture's trajectory serve as the observation sequence. Gestures are represented by a predefined state sequence. Based on the observations, the HMM uses state transition and emission probabilities to determine which gesture is being performed.

HMM State Diagram

Audio Effect Execution

Once a gesture is recognized by the HMM, a pre-mapped MIDI command is sent by the Raspberry Pi to the DJ's computer. The DJ software is trained to recognize the commands sent from the Raspberry Pi and execute the corresponding audio effect.

MIDI Signal Breakdown

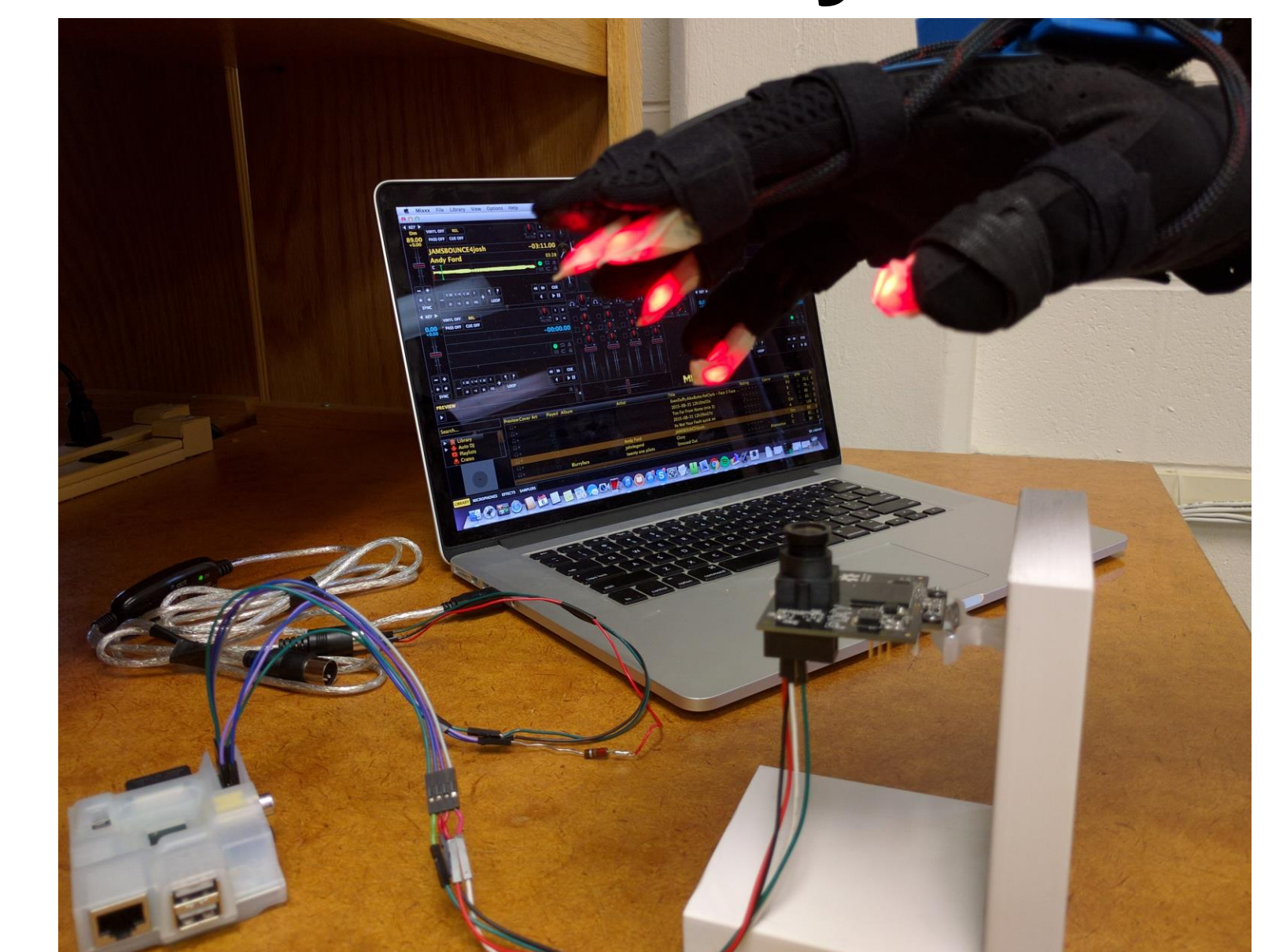| Status byte		Data byte		Data byte	
1000	0001	0010	0101	0011	0001
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III. Results

Gestures are acquired in a variety of lighting conditions. Gesture data is saved to the Raspberry Pi for processing by the HMM. Forward, backward and Viterbi algorithms have been successfully simulated.
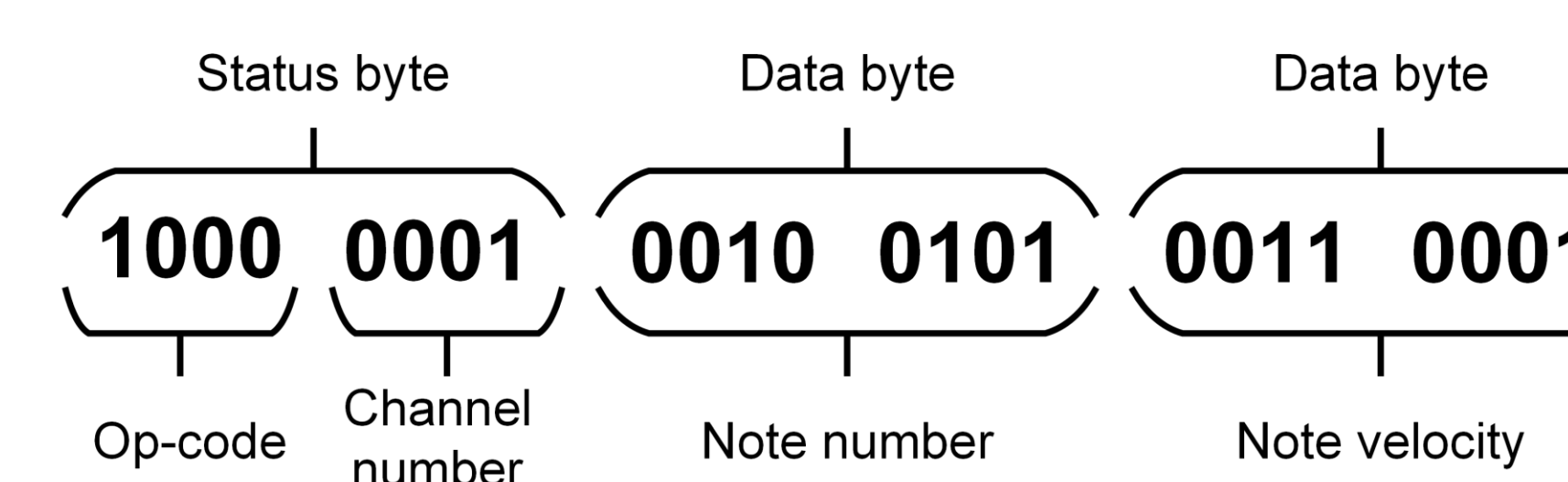

DJ Glove System

IV. Conclusion

The DJ glove adds a new dimension to gesture recognition by combining color with natural movements. Implementation of the HMM will connect gestures with MIDI commands, completing a gesturally controlled DJ system.