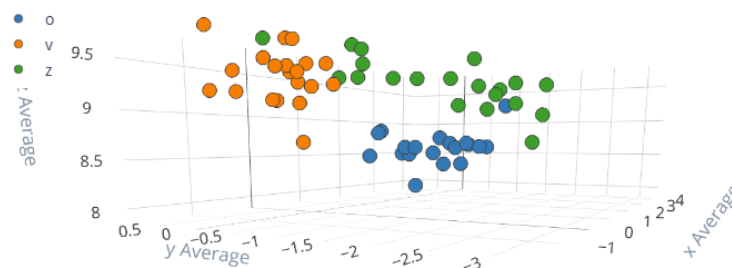


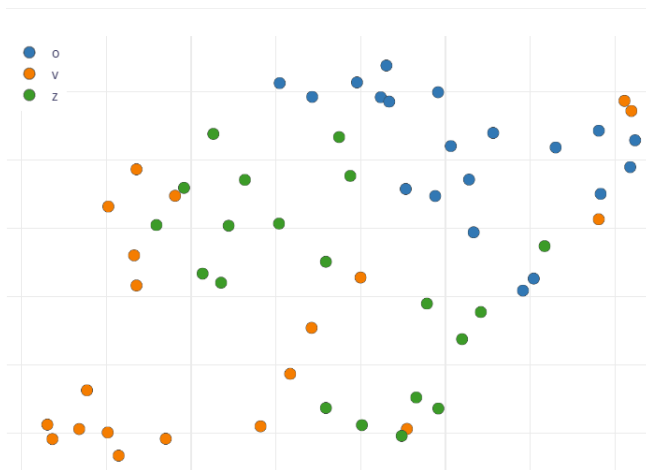
1. Discussion: Why should you use training data collected by multiple students rather than using your own collected data only? Think about the effectiveness and reliability of your wand.
 - It helps improve both the effectiveness and reliability of the wand. When a model is trained only on one person's gestures, it may overfit to their specific motion patterns, hand size, or gesture speed. This makes the model less accurate when used by others so that the generalization will be better. However, as we were not able to collect enough data, the accuracy of the model is not high enough when we use data from multiple students. So, for now, it is just a model of my own.
2. Discussion: Discuss the effect of window size. Consider
 - a. the number of samples generated
 - b. the number of neurons in your input layer of neural network
 - c. effectiveness when capturing slow-changing patterns
 - 151 or 146 samples, 105 features. Longer windows often capture more complete gesture patterns, but it needs more data collection time and filtering process. Around 1.5 seconds is enough for a move.
 - 2 layers, 20 neurons and 10 neurons. A larger window increases the number of extracted features, which would increase the size of the input layer and the network's capacity to learn.
 - A larger window size is more effective at capturing slow-changing gestures, as it includes more temporal context. Shorter windows may miss gradual changes or incomplete gesture transitions, leading to reduced accuracy for such patterns.
3. Discussion: Give at least two potential strategies to further enhance your model performance.
 - Change a more complex model like a neural network classifier or decision tree that may improve performance.
 - Fine-tune the spectral feature extraction parameters to gain access to richer time-frequency features that may improve classification accuracy
- Add a processing block. Read through the available options and pick one for your impulse. Justify your option.



Flatten

And spectral features

Feature explorer



It is not my best feature illustration for the spectral features, but the combined feature leads to my optimal model.

The Flatten block preserves raw time-series structure, which helps capture the shape of the gesture motion. The Spectral Features block extracts frequency-domain information, which is especially useful for identifying rhythmic or oscillatory motions that are hard to detect with raw values alone.

Together, this hybrid approach balances time and frequency information, allowing the model to learn both fast and slow gesture dynamics.

- Add a learning block. Read through the available options and pick one for your impulse. Justify your option.

Classifier. It works better than simpler models like K-Nearest Neighbors because it can learn more complex patterns in the data—especially when using both time and frequency features. The network has two hidden layers with 20 and 10 neurons, which is enough to tell different gestures apart without making the model too big.

XIAO_ESP32C3

LIBRARY MANAGER

Filter your search...

Type: All

Topic: All

AIPLC_Opta by Arduino

Arduino IDE PLC runtime library for Arduino Opta This is the runtime library and plugins for...
More info

1.2.0

INSTALL

AIPLC_PMC by Arduino

Arduino IDE PLC runtime library for Arduino Portenta Machine Control This is the runtime...
More info

1.0.6

INSTALL

Arduino Cloud Provider Examples by Arduino

Examples of how to connect various Arduino boards to cloud providers
More info

1.2.1

INSTALL

Arduino Low Power by Arduino

Power save primitives Features for SAMD and nRF52 32bit

wand.ino

```
150  * @brief    Arduino main function
151  */
152  void loop() {
153      // 读取当前按钮状态
154      bool currentButtonState = digitalRead(BUTTON_PIN);
155
156      // 检测从 HIGH -> LOW 的下降沿 (按下瞬间)
157      if (lastButtonState == HIGH && currentButtonState == LOW && !capturing) {
158          Serial.println("Button pressed: Starting gesture capture...");
159          sample_count = 0;
160          capturing = true;
161          capture_start_time = millis();
162          last_sample_time = millis();
163      }
164
165      // 更新按钮状态记录
166      lastButtonState = currentButtonState;
167
168      // 如果处于采集模式, 则持续采样
169      if (capturing) {
170          capture_accelerometer_data();
171      }
172  }
173
174  void print_inference_result(ei_impulse_result_t result) {
```

Output

Serial Monitor X

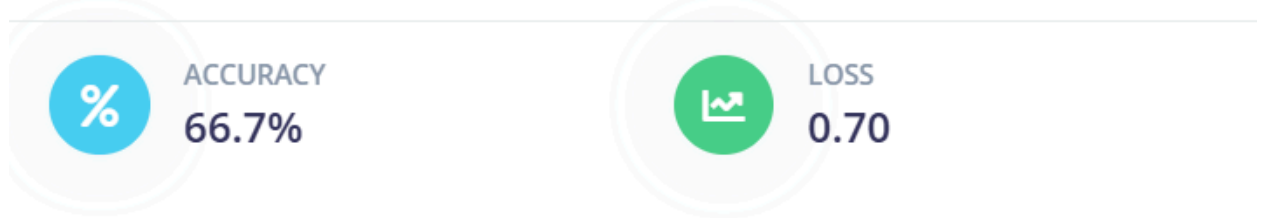
Message (Enter to send message to 'XIAO_ESP32C3' on '/dev/cu.usbmodem2101')

New Line

9600 baud

Button pressed: Starting gesture capture...
Capture complete
Prediction: o (61.33%)
Button pressed: Starting gesture capture...
Capture complete
Prediction: o (81.64%)
Button pressed: Starting gesture capture...
Capture complete
Prediction: v (49.61%)
Button pressed: Starting gesture capture...
Capture complete
Prediction: z (70.70%)

Last training performance (validation set)



Confusion matrix (validation set)

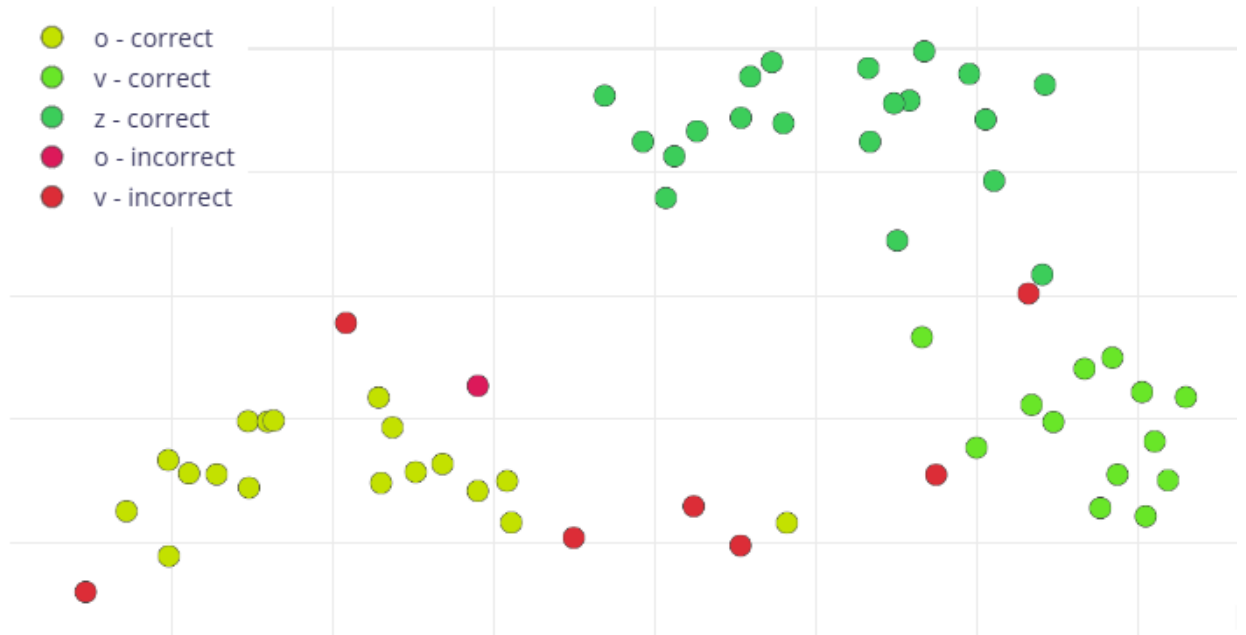
	O	V	Z
O	100%	0%	0%
V	50%	33.3%	16.7%
Z	0%	0%	100%
F1 SCORE	0.57	0.50	0.89

Metrics (validation set)



METRIC	VALUE
Area under ROC Curve ?	0.88
Weighted average Precision ?	0.83
Weighted average Recall ?	0.67
Weighted average F1 score ?	0.64

Data explorer (full training set) ?



On-device performance ?

Engine: ?

EON™ Compiler ▾



INFERENCE TIME
1 ms.



PEAK RAM USAGE
1.5K



FLASH USAGE
17.4K



ACCURACY

40.00%

Metrics for Classifier

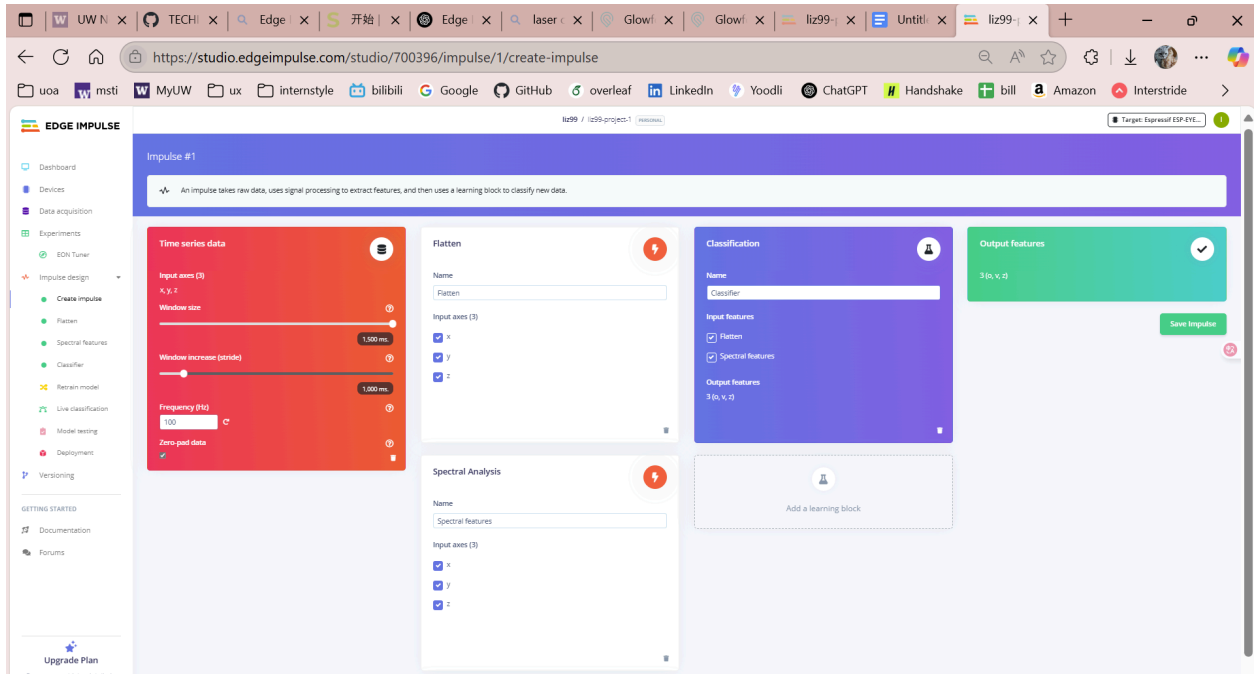
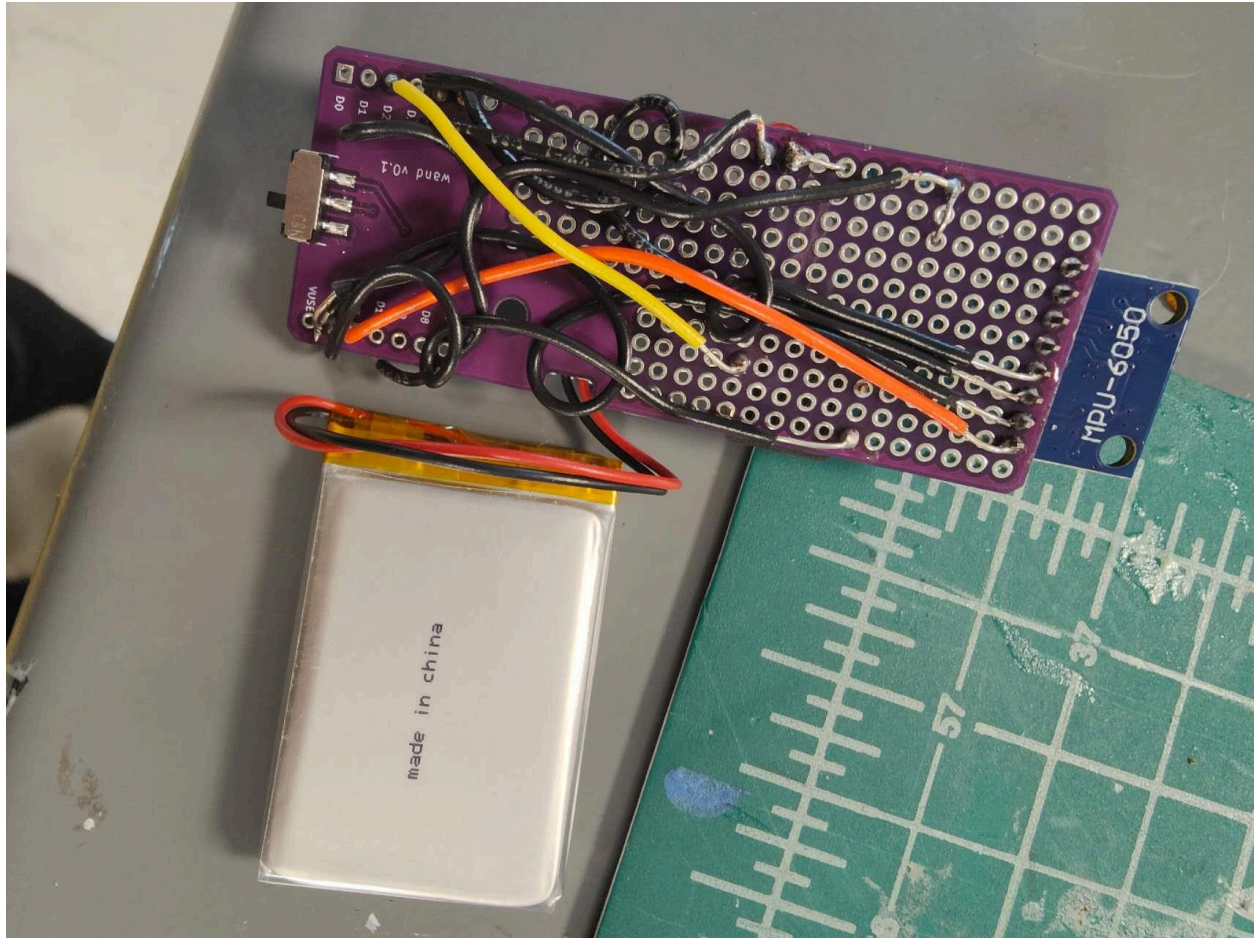


METRIC	VALUE
Area under ROC Curve ?	0.93
Weighted average Precision ?	0.94
Weighted average Recall ?	0.93
Weighted average F1 score ?	0.93

Confusion matrix

	O	V	Z	UNCERTAIN
O	20%	0%	0%	80%
V	20%	0%	0%	80%
Z	0%	0%	100%	0%
F1 SCORE	0.29	0.00	1.00	

Others are in Github [SyHilichurl/515lab5](https://github.com/SyHilichurl/515lab5)



EDGE IMPULSE

Dashboard

Devices

Data acquisition

Experiments

EON Tuner

Impulse design

- Create impulse
- Flatten
- Spectral features
- Classifier

Retrain model

Upgrade Plan

Get access to higher job limits and more collaborators.

View plans

Dataset

Training (60)Test (15)

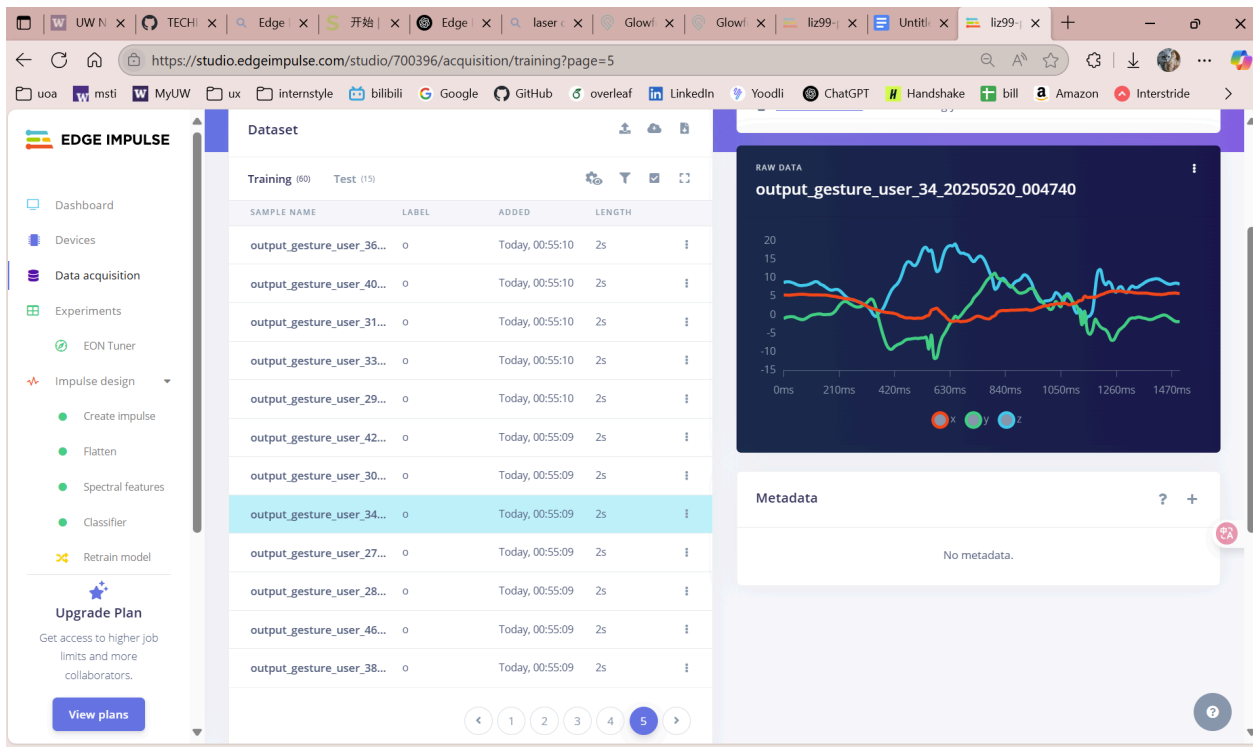
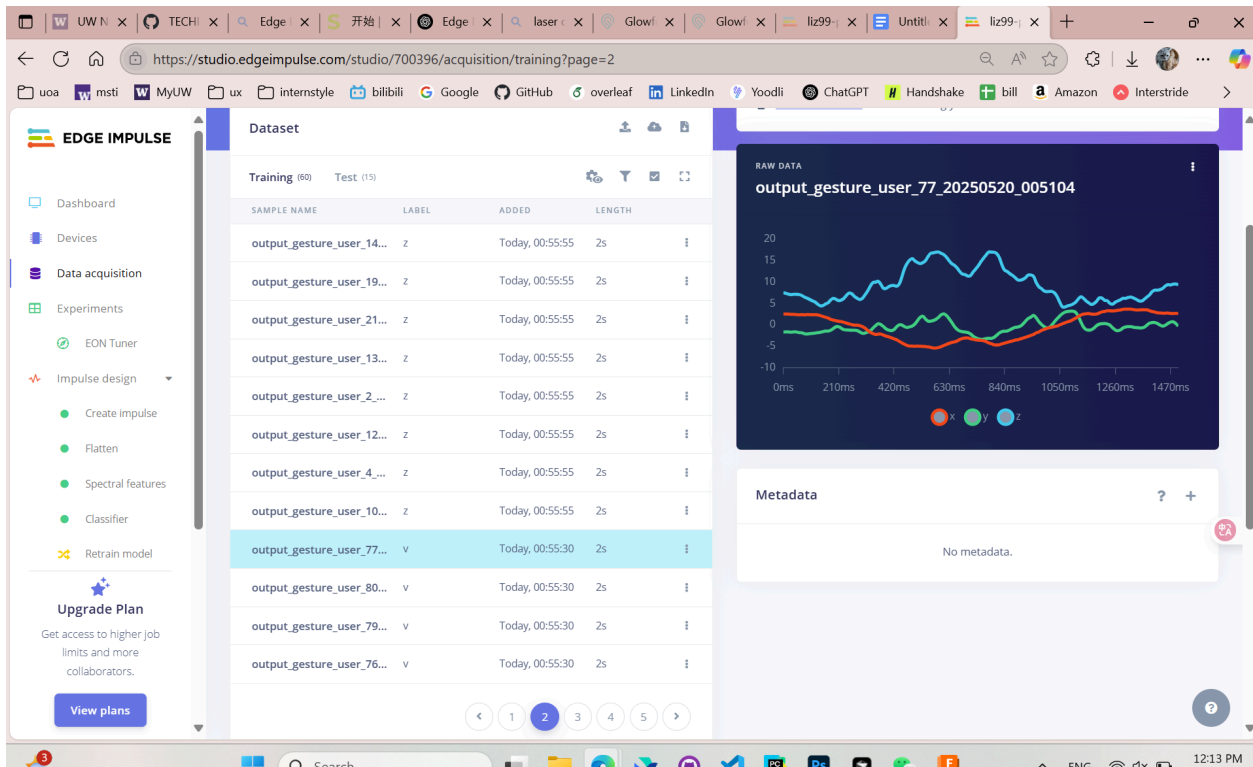
SAMPLE NAME	LABEL	ADDED	LENGTH
output_gesture_user_7_...	z	Today, 00:55:55	2s
output_gesture_user_9_...	z	Today, 00:55:55	2s
output_gesture_user_8_...	z	Today, 00:55:55	2s
output_gesture_user_5_...	z	Today, 00:55:55	2s
output_gesture_user_3_...	z	Today, 00:55:55	2s
output_gesture_user_17_...	z	Today, 00:55:55	2s
output_gesture_user_23_...	z	Today, 00:55:55	2s
output_gesture_user_1_...	z	Today, 00:55:55	2s
output_gesture_user_15_...	z	Today, 00:55:55	2s
output_gesture_user_11_...	z	Today, 00:55:55	2s
output_gesture_user_16_...	z	Today, 00:55:55	2s
output_gesture_user_20_...	z	Today, 00:55:55	2s

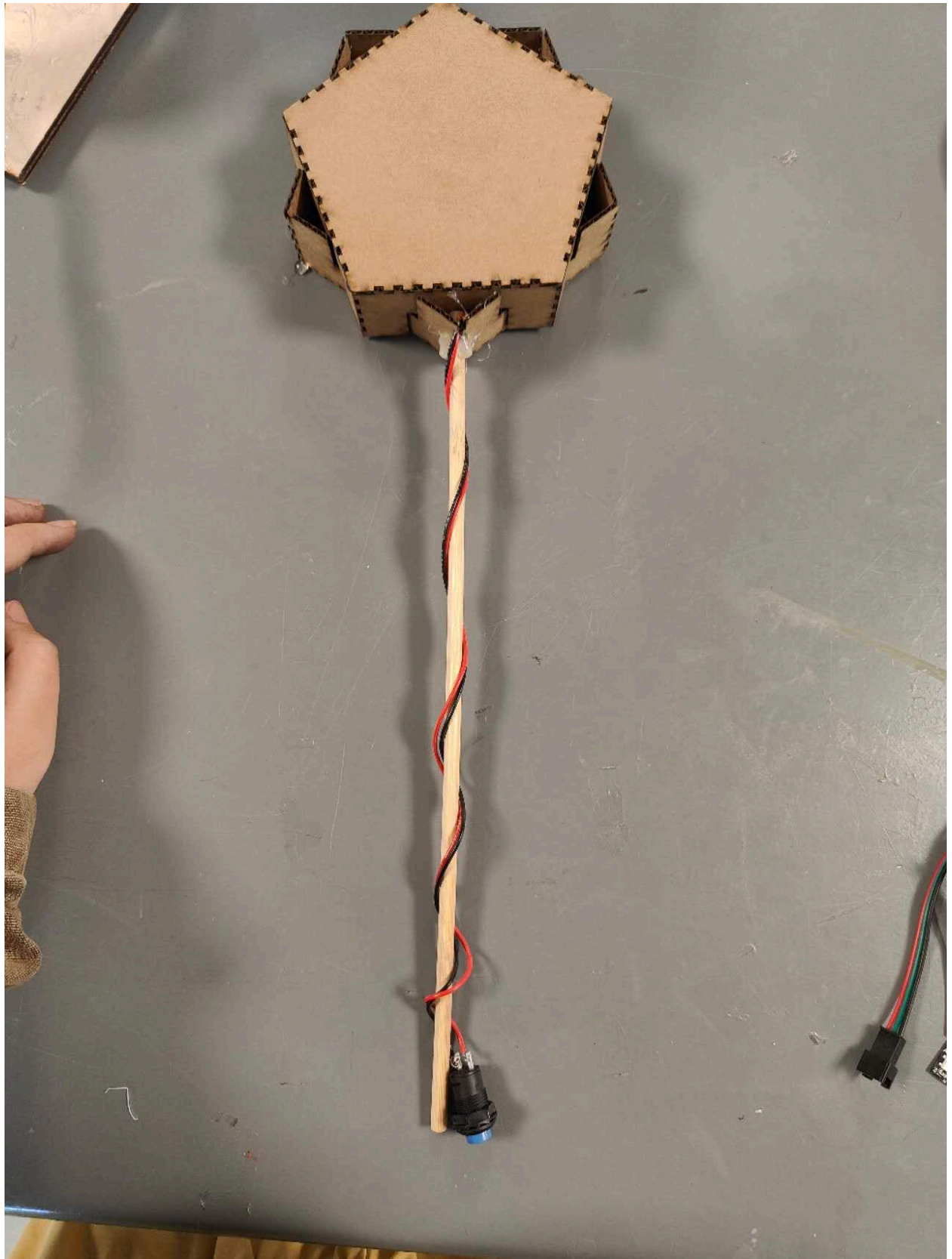
RAW DATA

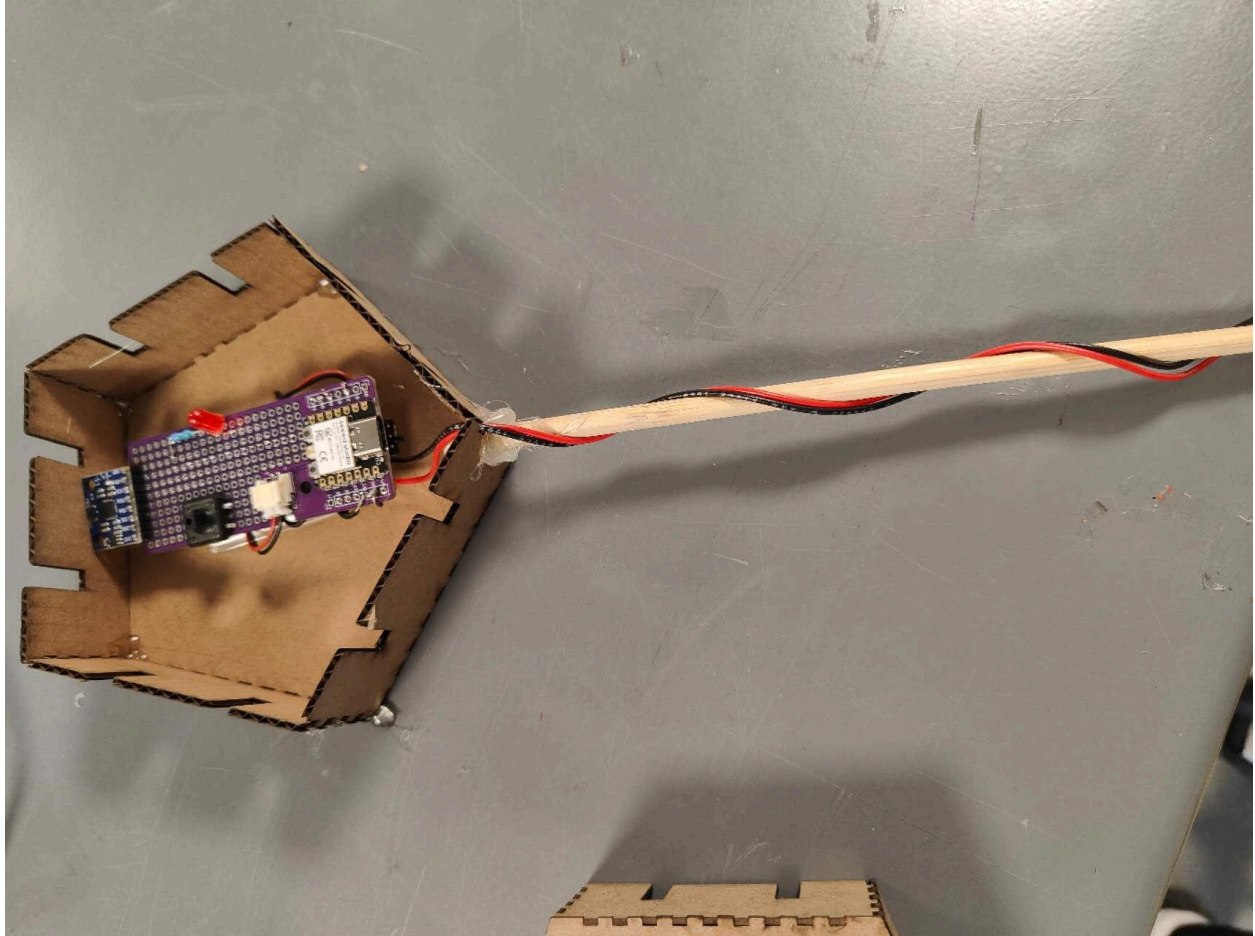
output_gesture_user_7_20250520_004503

Metadata

No metadata.







The board will be fixed by another part of the enclosure.