CEC Continuing Education Center

DesignNews

Developing Machine-Learning Applications on the Raspberry Pi Pico

DAY 3 : Collecting Sensor Data Using Edge Impulse

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Webinar Logistics

- Turn on your system sound to hear the streaming presentation.
- If you have technical problems, click “Help” or submit a question asking for assistance.
- Participate in ‘Group Chat’ by maximizing the chat widget in your dock.
- Submit questions for the lecturer using the Q&A widget. They will follow-up after the lecture portion concludes.

THE SPEAKER

Jacob Beningo

Visit ‘Lecturer Profile’

Beningo Embedded Group - President

Focus: Embedded Software Consulting

An independent consultant who specializes in the design of real-time, microcontroller based embedded software.
He has published two books:

- Reusable Firmware Development
- MicroPython Projects
- Embedded Software Design (https://bit.ly/3PZCtNO)

Writes a weekly blog for DesignNews.com focused on embedded system design techniques and challenges.

Visit www.beningo.com to learn more …

Visit ‘Lecturer Profile’ in your console for more details.

Course Sessions

- Getting Started with the Raspberry Pi Pico and Machine Learning
- Machine-Learning Tools and Process Flow
- **Collecting Sensor Data Using Edge Impulse**
- Designing and Testing a Machine-Learning Model
- Deploying Machine-Learning Models and Next Steps

1 Raspberry Pi Pico Board Setup

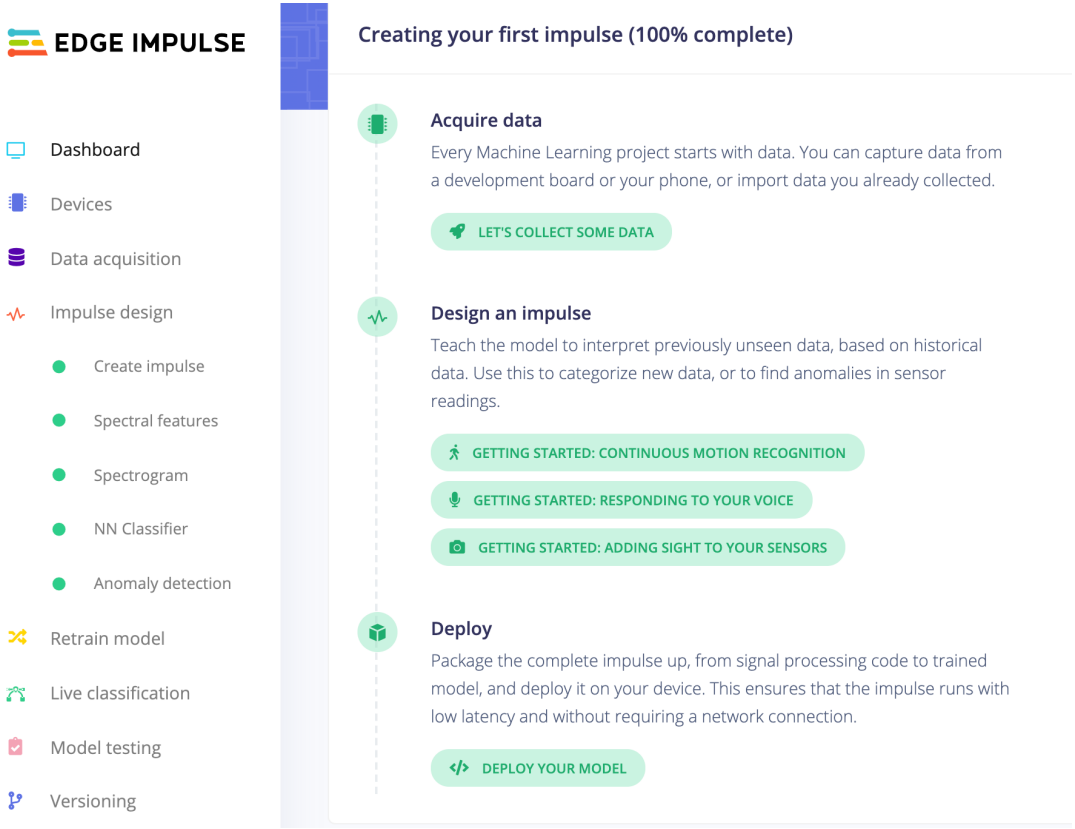
Do you plan on following along while we set up the board?

- Yes
- No

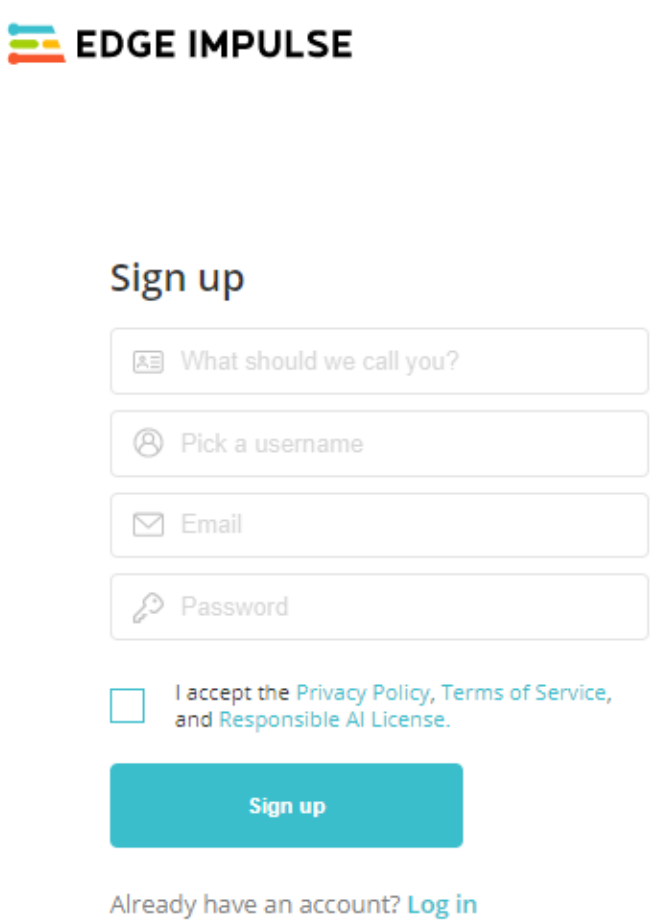
Edge Impulse

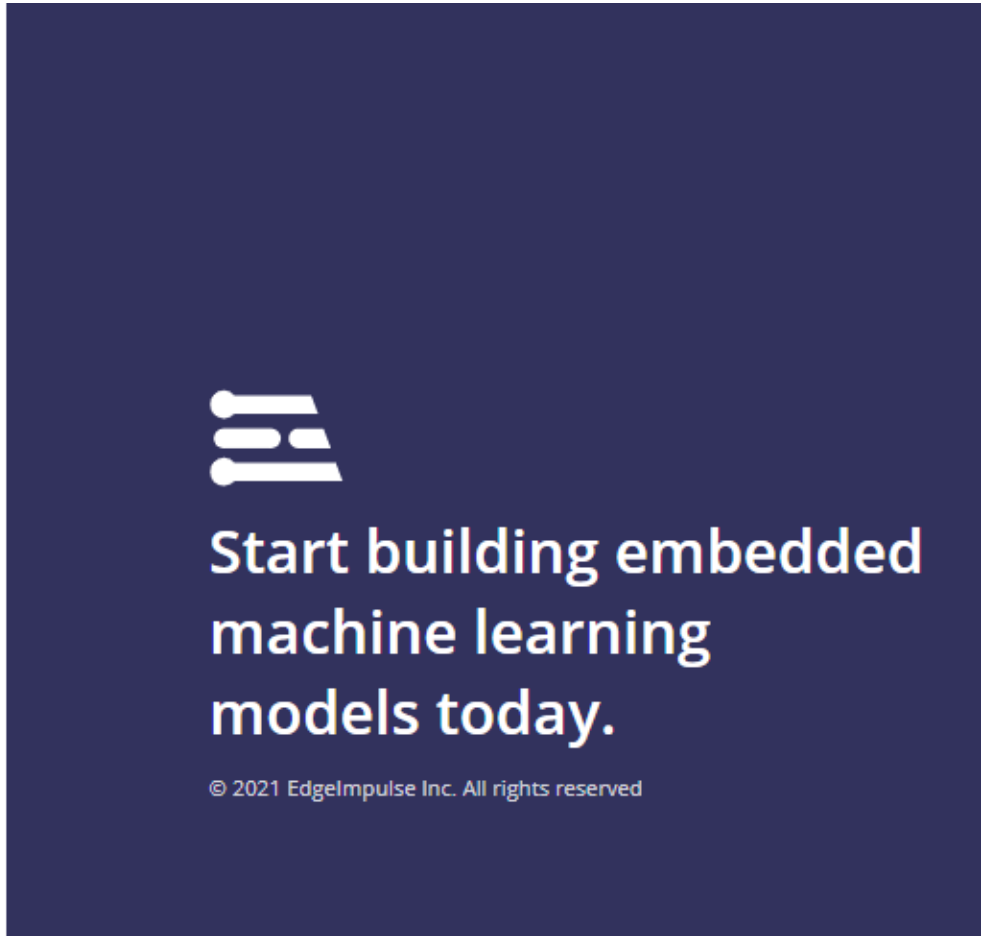
Edge Impulse was designed for software developers, engineers and domain experts to solve real problems using machine learning on edge devices without a PhD in machine learning.

www.edgeimpulse.com



Edge Impulse



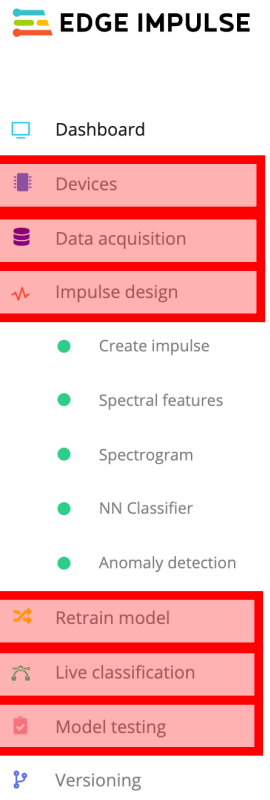


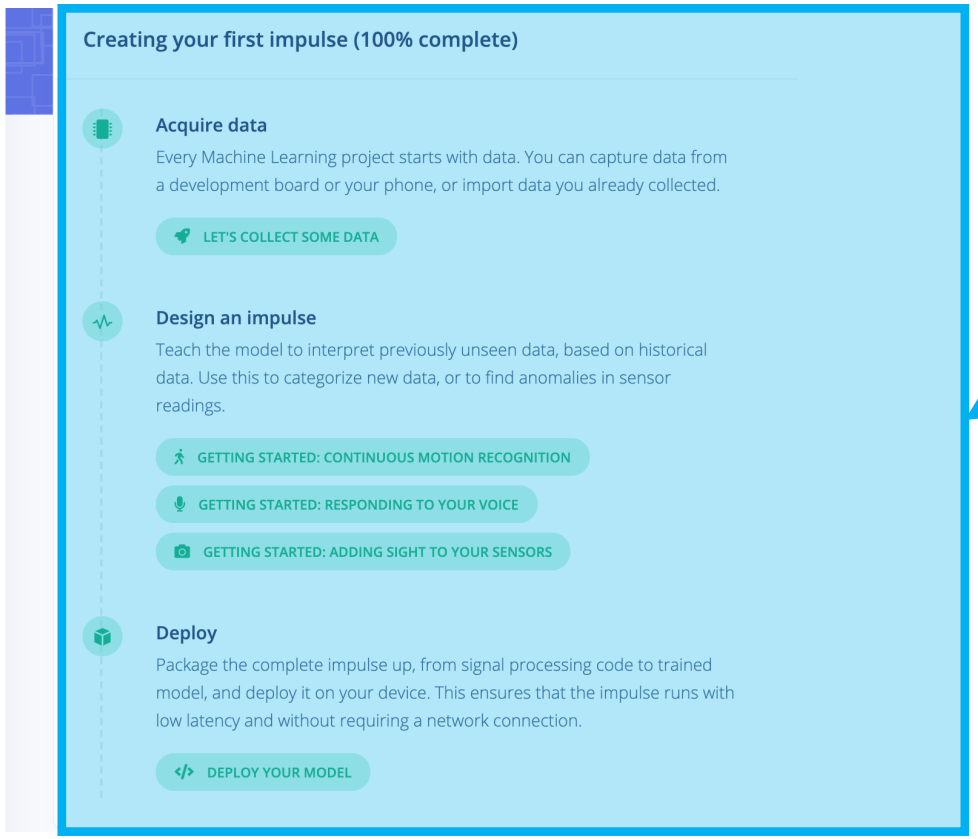
Edge Impulse

DevBoards Running EdgeImpulse Software

Data Collection
Model Design

Training
Live Testing
Model Validation

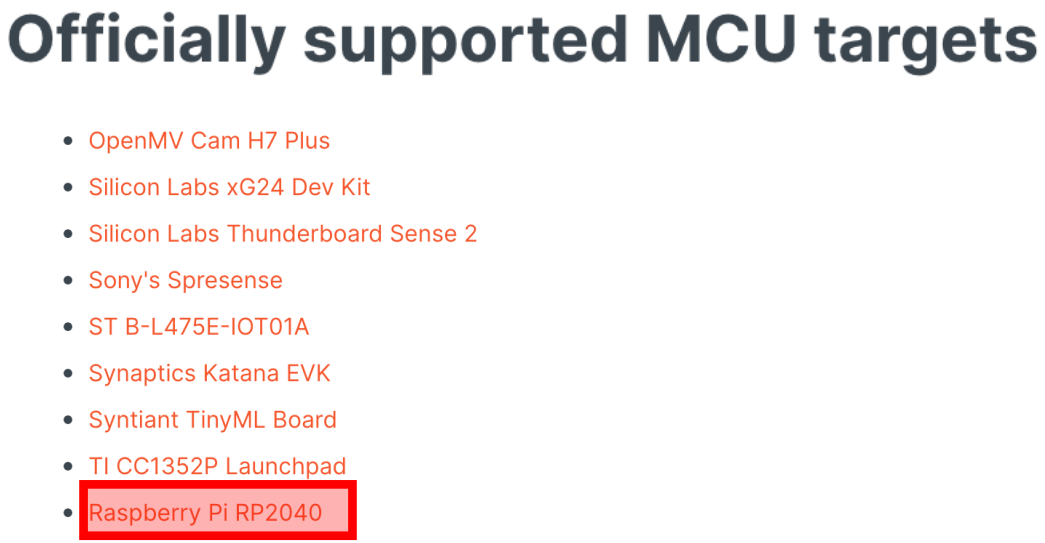




Design Space

Edge Impulse – Board Setup

Visit https://docs.edgeimpulse.com/docs



Edge Impulse – Board Setup

Installation - macOS and Windows

1. Install Python 3 on your host computer.
2. Install Node.js v14 or higher on your host computer.
   - For Windows users, install the **Additional Node.js tools** (called **Tools for Native Modules** on newer versions) when prompted.
3. Install the CLI tools via:

```
npm install -g edge-impulse-cli --force
```

You should now have the tools available in your PATH.

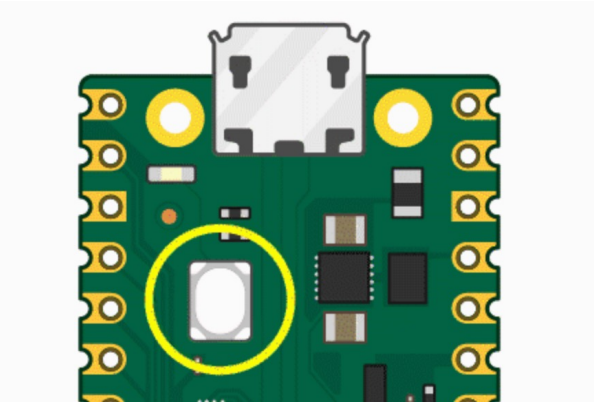
1. If you haven't already, create an edge impulse account. Many of our CLI tools require the user to log in to connect with the Edge Impulse Studio.

Edge Impulse Board Setup

1. Download the Edge Impulse RP2040 Firmware at:

   Power on the Pico while holding the bootsel pin

   Unzip and drag the uf2 image to the mass storage device folder



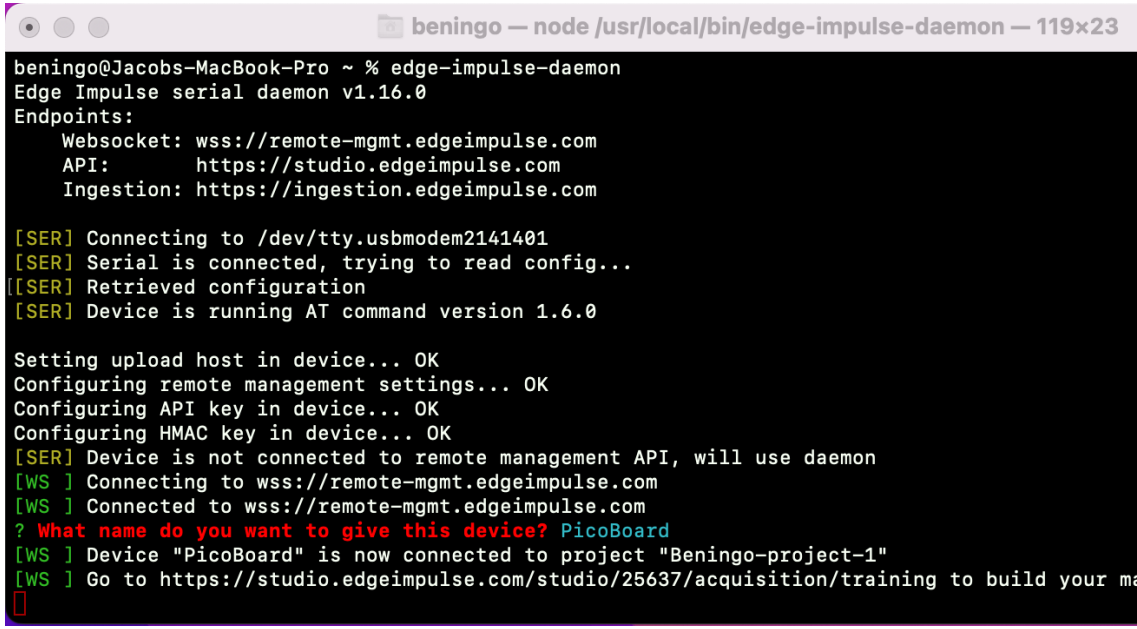
Edge Impulse – Board Setup

2 Update Firmware

1) The development board is mounted as a USB mass-storage device (like a USB flash drive). Make sure you can see this drive.
2) Download the latest Edge Impulse firmware from:
   - https://cdn.edgeimpulse.com/firmware/pi-rp2040.zip **(Warning! Will not be deployable!)**
   - https://github.com/edgeimpulse/firmware-pi-rp2040
3) Drag the ei_rp2040_firmware.uf2 file to the drive.
4) Give the board a minute to finish updating the firmware. There is no need to power cycle the board.

Edge Impulse – Board Setup

3 Setting keys and WiFi credentials



From a command prompt or terminal, run:

$ edge-impulse-daemon

This will start a wizard which will ask you to log in, choose an Edge Impulse project, and set up your WiFi network. If you want to switch projects run the command with --clean.

Edge Impulse – Board Setup

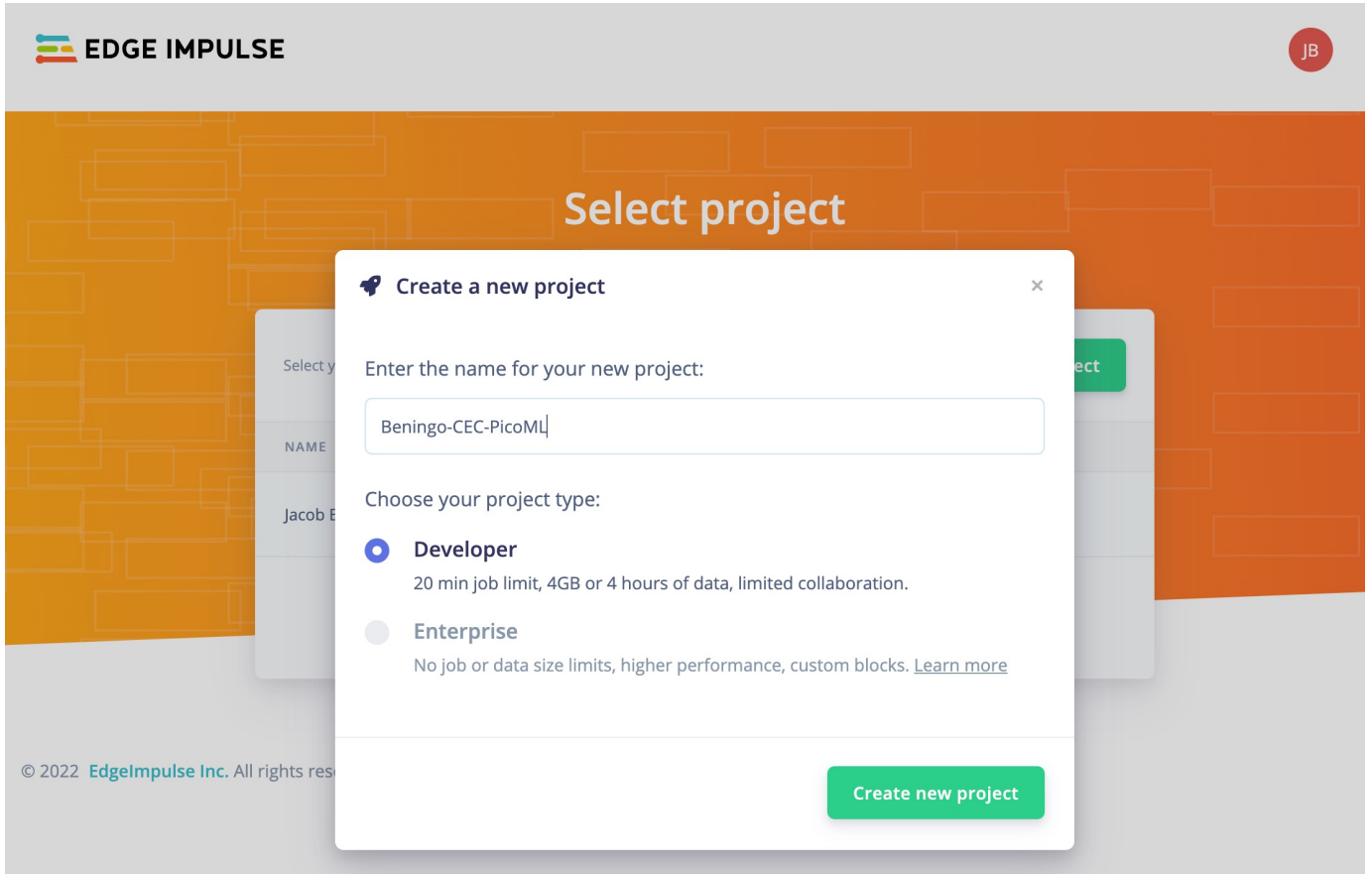
4 Verify that the device is connected

Your devices + Connect a new device

These are devices that are connected to the Edge Impulse remote management API, or have posted data to the ingestion SDK.

NAME	ID	TYPE	SENSORS	REMOTE ...	LAST SEEN
PicoBoard	45:36:31:33:38:39	RASPBERRY_PI_RP2040	Ultrasonic ranger, ADC sensor, Ultr...	●	Today, 11:52:00
C4:7F:51:03:EC:54	C4:7F:51:03:EC:54	DISCO_L475VG_IOT01A	Built-in accelerometer, Built-in micr...	●	Apr 24 2021, 21:31:01

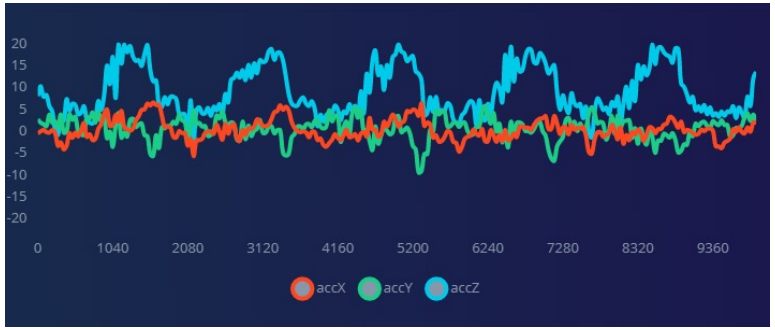
Edge Impulse – Project Creation



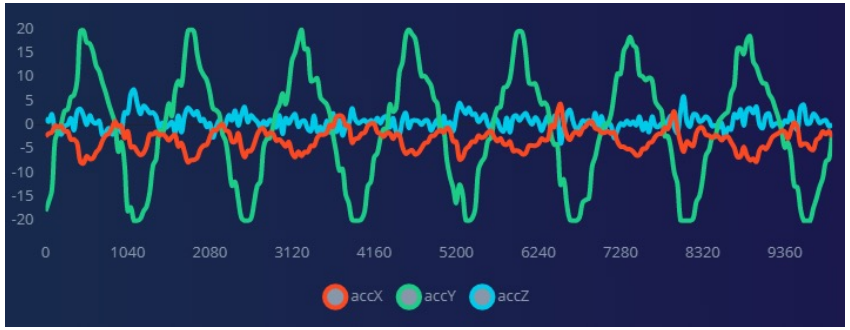
2 Collecting Sensor Data

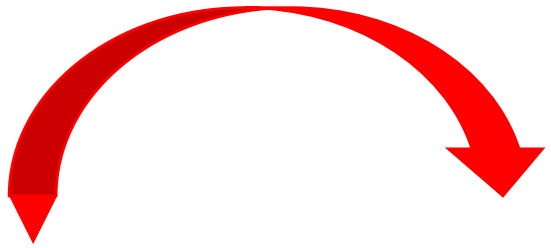
Example Application – Gesture Classification

Label 1 – Up and Down

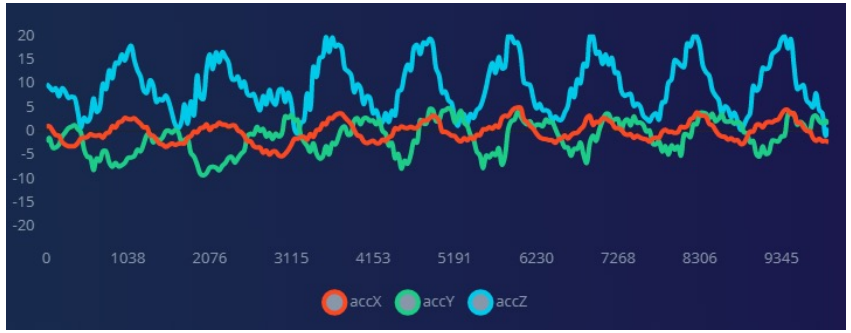


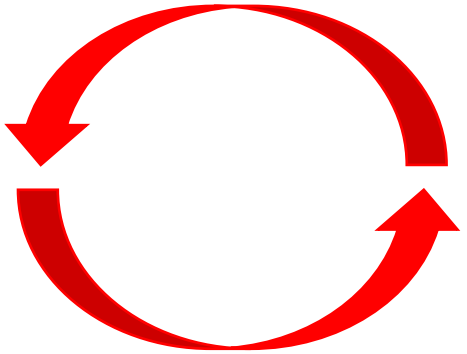
Label 2 – Wave



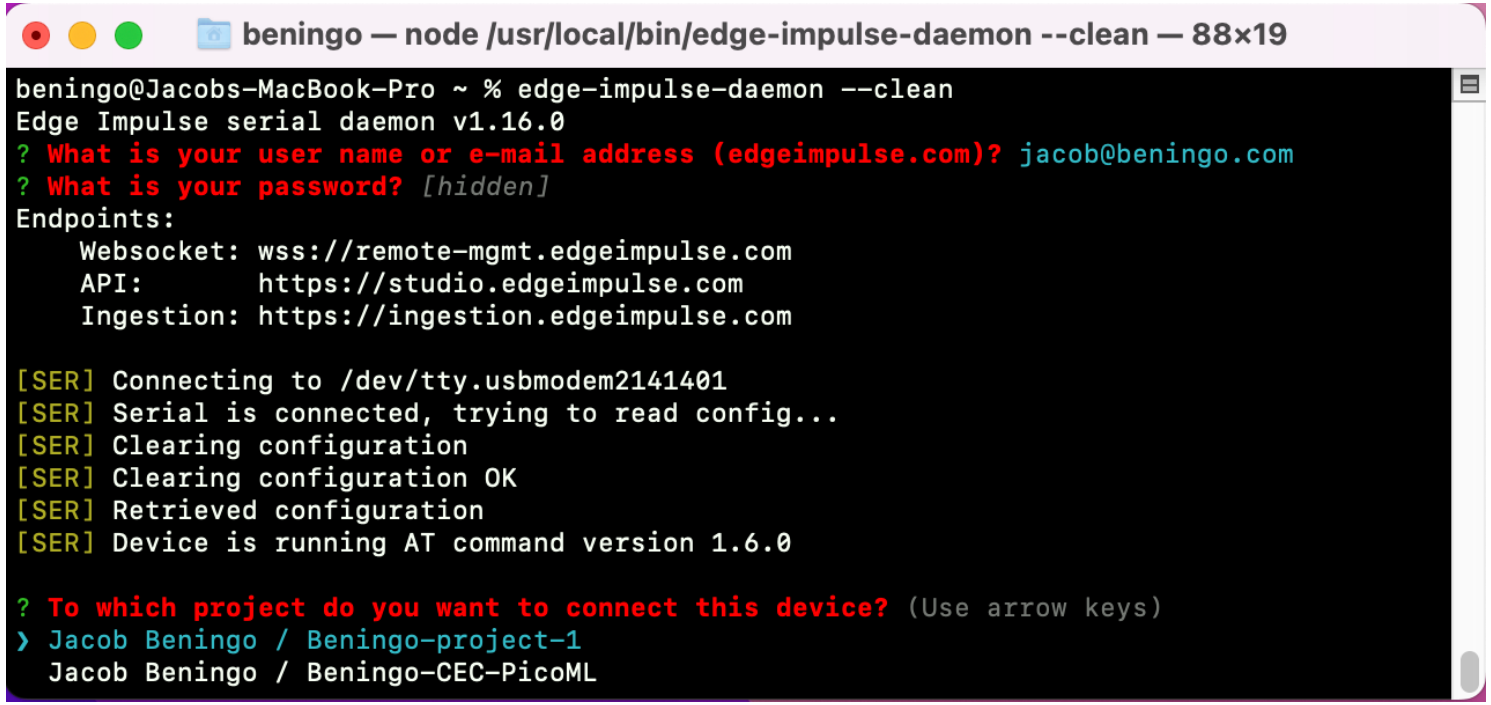


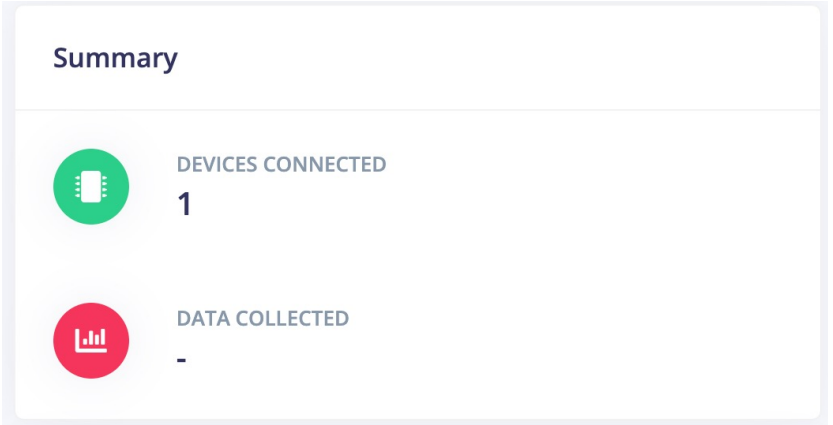
Label 3 – Circle





Connect the Pico to our Project

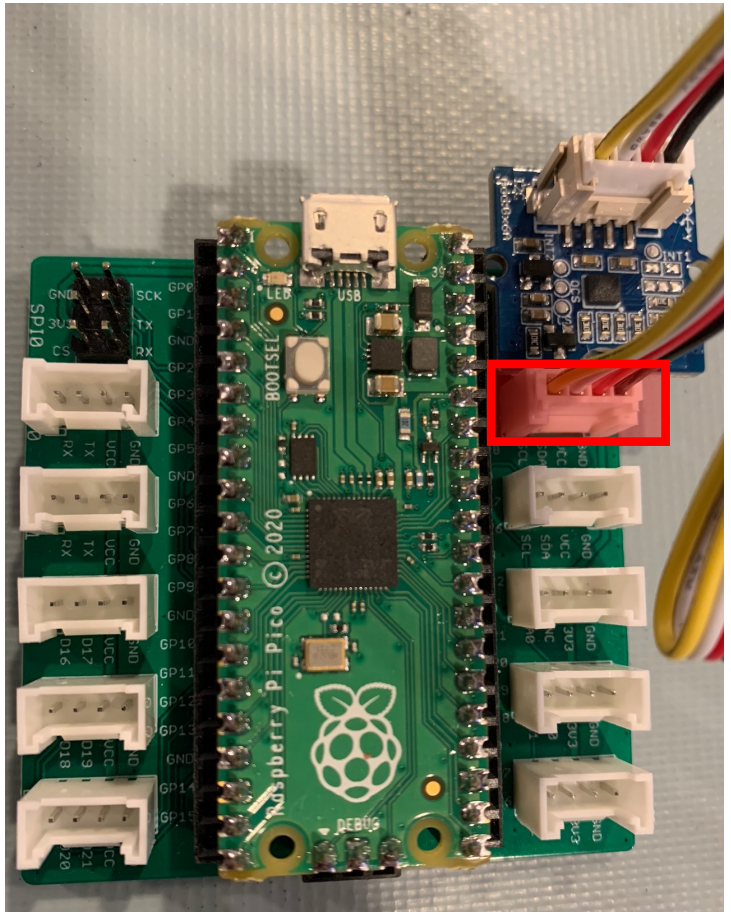




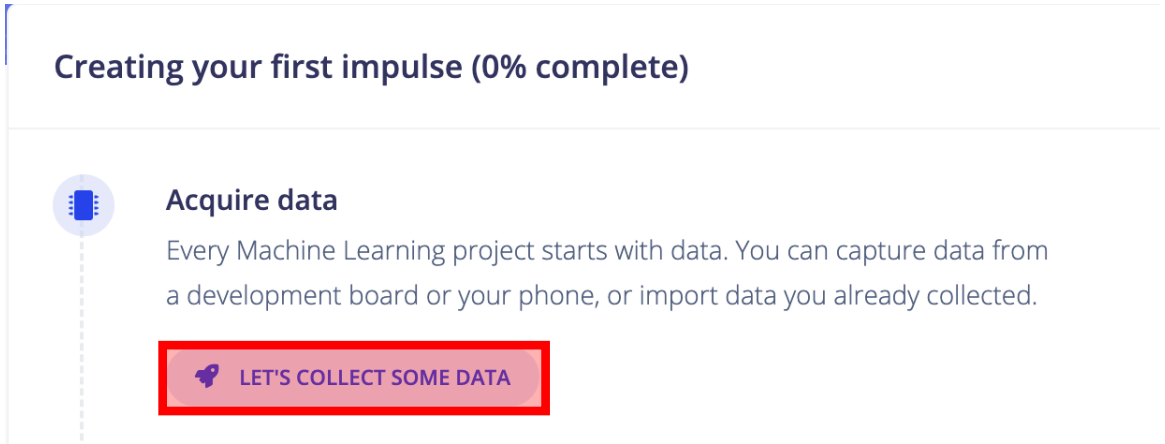
Connect the LSM6DS3 Accelerometer

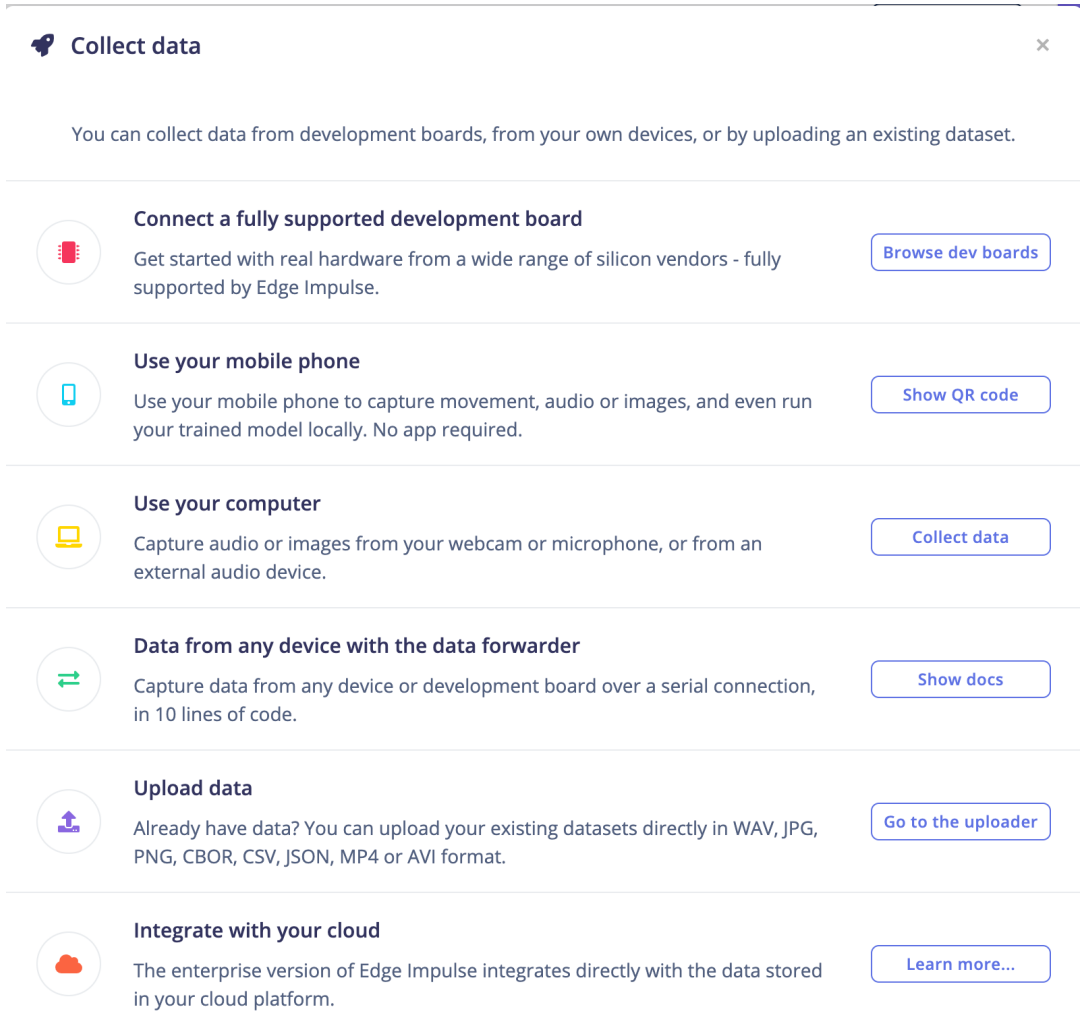
- 3-axis accelerometer
- 3-axis gyroscope
- Connects to I2C1

Parameter	Value
Analog supply voltage:	5V/3.3V(DC)
Power consumption:	0.9 mA in combo normal mode and 1.25 mA in combo high-performance mode up to 1.6 kHz
Linear acceleration measurement range	±2/±4/±8/±16 g full scale (typical value)
Angular rate measurement range	±125, ±245, ±500, ±1000, ±2000 dps(typical value)
Linear acceleration sensitivity	0.061(FS = ±2), 0.122(FS = ±4), 0.244(FS = ±8), 0.488(FS = ±16) mg/LSB
Angular rate sensitivity	4.375(FS = ±125), 8.75(FS = ±245), 17.50(FS = ±500), 35(FS = ±1000), 70(FS = ±2000)

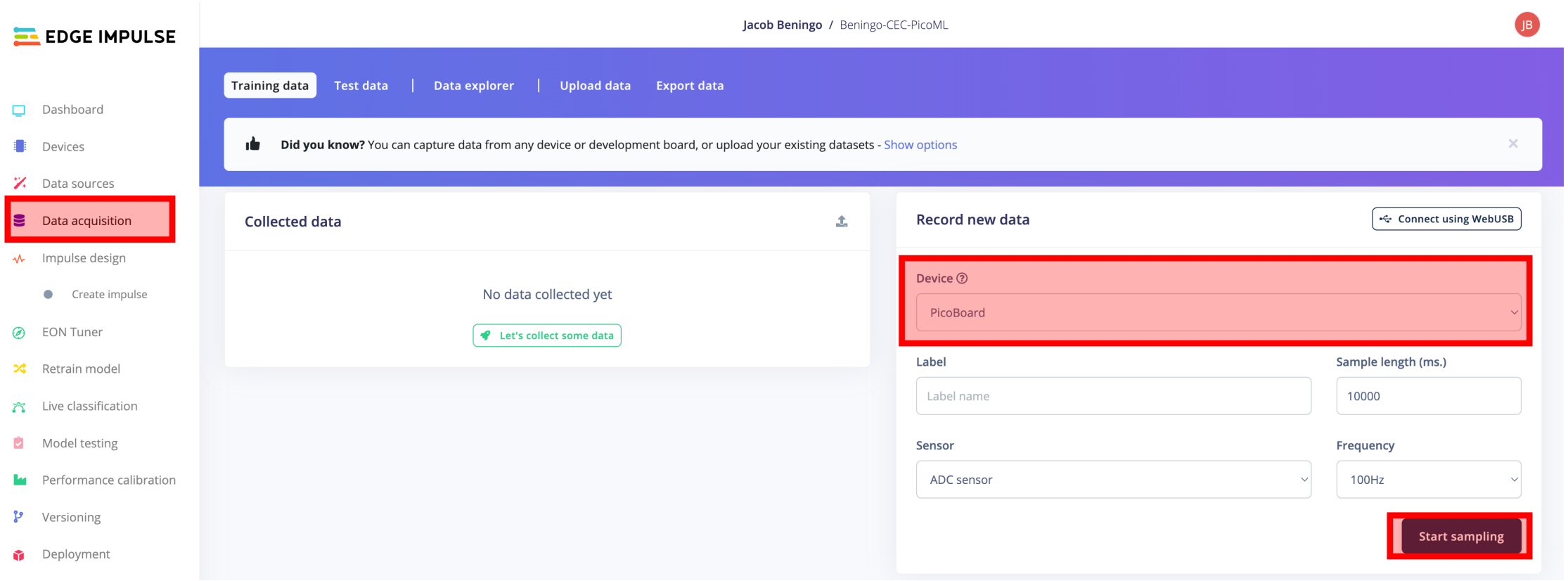


Capturing and Labeling Data





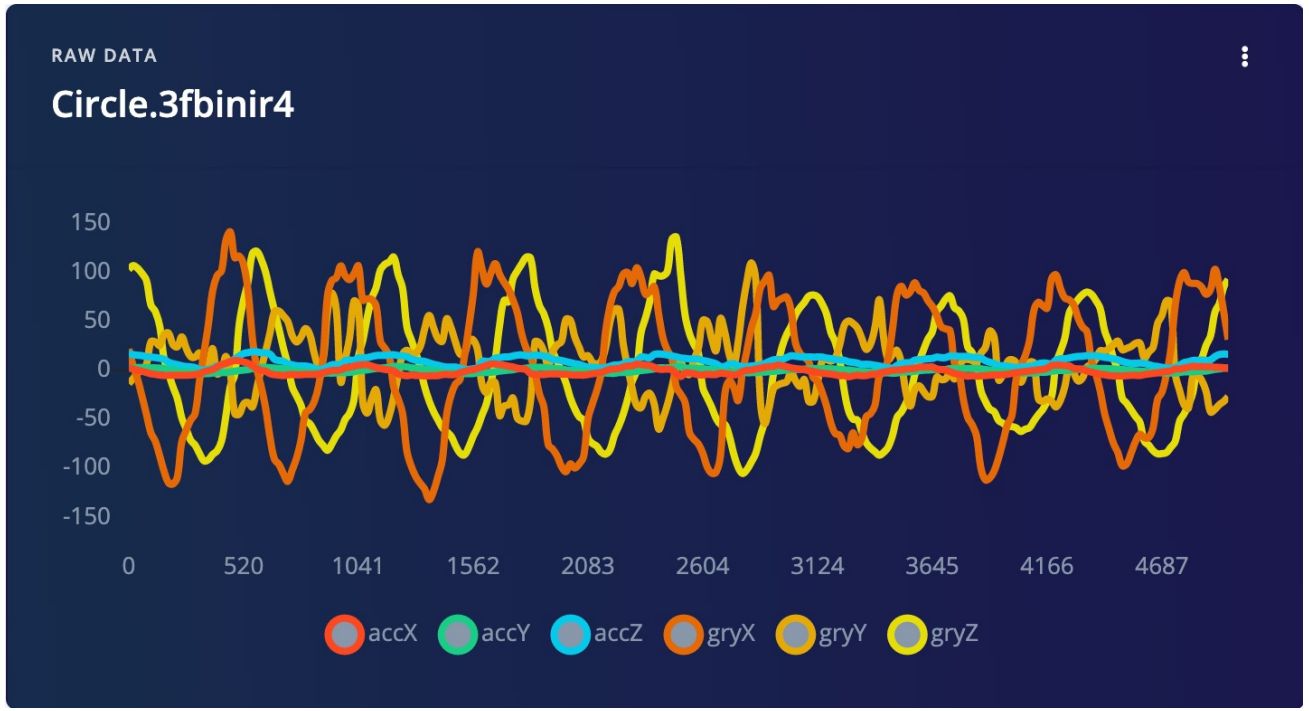
Capturing and Labeling Data



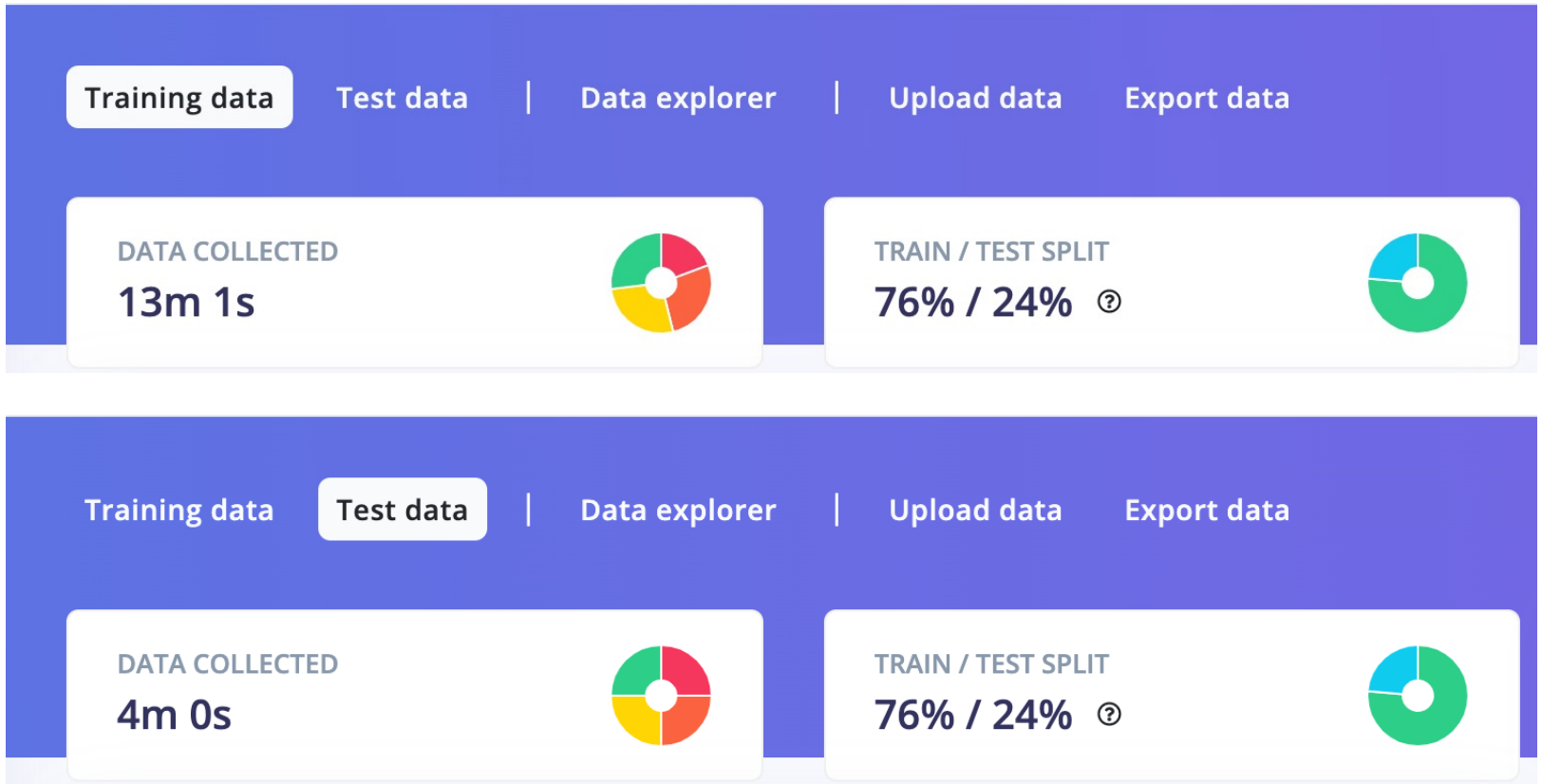
Capturing and Labeling Data

Gestures

- Idle
- Up / Down
- Wave
- Circle
- Snake
- etc



Capturing and Labeling Data



Do you plan on collecting your own data so that you can train your own model during tomorrows class?

- Yes
- No
- undecided

4 Going Further

Thank you for attending

Please consider the resources below:

- www.beningo.com
  - Blog, White Papers, Courses
  - Embedded Bytes Newsletter
    - http://bit.ly/1BAHYXm
  - Embedded Software Design
    - https://bit.ly/3PZCtNO

From www.beningo.com under

- Blog > CEC – Developing Machine-Learning Applications on the Raspberry Pi Pico

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