SciTinyML
Scientific Use of Machine Learning on Low Power Devices
Regional Workshop - ASIA 2022
Hands-On Motion Detection Using Wio Terminal and Edge Impulse

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AGENDA

- A quick recap of yesterday's session
- Brief overview of Motion detection and its application
- An overview of the accelerometer

Demo project walkthrough
- Data collection
- Data processing
- Model Training
- Testing and deploying
- Inferencing

- Recommended resources
- Question and answers
Review

- How many features of Wio Terminal can you remember?
- What is memory size of wio terminal?
- Based on your current knowledge about wio terminal, how many types of projects can you implement with it?
- Have you installed all the libraries and softwares required to start working with wio terminal and edge impulse?

Answers

3
Review

SPI Flash
FPC
RTL8720DN (Wi-Fi & BT)
DC-DC
2.4G & 5G Antenna
5-Way Switch (Behind)
Multifunctional Grove x2

LIS3DHT
Light Sensor
IR Emitter
microSD Card Slot
ATSAMD51P19
Microphone & Buzzer (Behind)
USB TYPE C
Motion / Anomaly Detection

Motion detection:
- detecting moving entities.

Anomaly detection:
- identifying data points that don’t fit a normal patterns.

source: Yijia Lu et al Decoding lip language using triboelectric sensors with deep learning

Image credit: Dale Montrone of Domanisystems
Types of Motion Detection Sensor

- Passive Infrared Sensor
- Ultrasonic Sensor
- Microwave Sensor
- Tomographic Sensor

Accelerator Sensor: Is it a motion sensor?
- Yes it can be classified a motion sensor since it has axis-based motion sensing.

Example: compass on your map, camera app and etc.
Motion Detection Applications

- Earthquake detection.
- Bionic limbs.
- Hard drive protection.
- Drone flight stability.
- To understand the surrounding of an item.
Accelerometer

- Measure vibration or acceleration of motion of an object.
- It uses an electromechanical sensor designed to measure either static or dynamic acceleration.

- For digital device
- Automobile: - e.g. airbag
- Drones: - stability in orientation flight
- Rotating machine: - undulating vibration

- They are generally of two types;
- High and low impedance
- High impedance are common in high end research facilities or high temperature applications.
- Low impedance commonly used in industry
Demo Project Walkthrough

If you've already had an existing account:

Give a name to your project. In my case below, "ictp01"
Click on "Devices" on the left panel to connect a device.

After you click on Devices, there are connected to the Edge Impulse remote management API, or have posted data to the ingestion system.
In the future, you can explore all the features below.

But since today, with are time constrained, we will only focus on how to connect Wio Terminal to edge impulse.
On this page, you will find all the supported devices.

Overview

There is a list of development boards that are fully supported by Edge Impulse. These boards come with a special firmware which enables data collection from all their sensors, allows you to build new ready-to-go binaries that include your trained impulse, and come with examples on integrating your impulse with your custom firmware. These boards are the perfect way to start building Machine Learning solutions on real embedded hardware.

Officially supported MCU targets

Scroll down to the button

- Intel Based Macs
- Linux x86_64
- NVIDIA Jetson Nano
- Raspberry Pi 4

Community boards

- Seeed Wio Terminal
- Ardumova Pico4ML TinyML Dev Kit
- Blues Wireless Swan

Different development board? No problem, you can always collect data using the Edge Impulse for Linux SDK and deploy your model back to the device with the Runtime.
You can read more about Wio terminal with Edge Impulse here.

So here comes one of the challenging parts for most starters.
Download Node.js v12 or higher

Go to the link below and download the Node.js LTS installer.
https://nodejs.org/en/download/

If you also need a step by step to follow for installing node js on your system, here is a good step by step guide to follow:
https://kinsta.com/blog/how-to-install-node-js/
Install Arduino CLI

Go to the link below and download the CLI installer.

Here is the link: https://arduino.github.io/arduino-cli/0.22/installation/

Latest release

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<th>Platform</th>
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<th>64 bit</th>
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<tr>
<td>macOS</td>
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<td>64 bit</td>
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</table>
Adding Arduino CLI to path

Editing environment variables is pretty straightforward but a little mistake can be very frustrating.

Windows: To access your environment variable quick shortcut: Press "windows key + R"
Enter this command:
```
rundll32 sysdm.cpl,EditEnvironmentVariables
```
Or
Press "windows key" and start typing envi
Adding Arduino CLI to path

16. Install Arduino CLI
17. Go to the link bellow and do...
18. Add Arduino CLI to path
19. 
20. Click on npm install -g edge...
Install edge-impulse-cli using npm node package manager

Open your terminal as administrator and enter the command below:

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

- In some cases this command will add the `edge-impulse-cli` to your path but this is not always the case. I had issue with this at first but a quick workaround is instead of adding it to the user environment path, add it to the system path.
Now it's time to connect our Wio Terminal to our computer

Connect your device to your computer and reset Wio Terminal

Use the button on the side wio terminal; push it down and release it twice. See the gif below for your reference.
Add the edge impulse uf2 firmware files when you rest your wio terminal device.

Open your file manager.

You will see a new drive in the file manager.

Open it and paste the uf2 firmware file
Open your command prompt

Type this command:
edge-impulse-daemon --clean
Enter your edge impulse account's email address
Enter your password

Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

edge-impulse-daemon --clean

Edge Impulse serial daemon v1.15.0

What is your user name or e-mail address (edgeimpulse.com)? momodoubjallow@seeed.cc

What is your password? [input is hidden]

edge impulse password
Choose the port your device is connected to

If you don’t know which port your device is connected to, unplug your device, run the command again. In my case COM3 and COM4 will be the only ports available when I unplug my Wio Terminal, that means COM12 is the port corresponding to my device.

Select project
Name your device (Optional but good practice)

Hurray! That's it. Our device is connected, and we are ready to start.
Click on Devices

The green spot below indicates that your device is connected
Since our device is connected, we can now start collecting data by clicking on the Data acquisition tab on your left.

Select your device and start collecting data.
Add a label name

- Label: Jump
- Sensor: Built-in accelerometer
- Sample length (ms): 10000

Select the sensor for your data collection

- Sensor: Built-in accelerometer
- Frequency: 100Hz
Click on the label to see more details

There will be a training/test data split warning
Click on the warning alert to see more details

Edge Impulse has an auto training/test split
Move data to test

Click on Yes, move

Move to testing dataset

you sure you want to move "Rest.34mo14t" to the testing dataset?

Cancel

Yes, move
Now let's create an ML pipeline

Add a data processing pipeline
Now let's create an ML pipeline

Add a data processing pipeline
## Resources

1. **Getting started with wio terminal**  

2. **Repositories with tinyml projects**  
   [https://github.com/topics/tinyml](https://github.com/topics/tinyml)

3. **Organised list of tinyml resources**  

4. **Tinyml cookbook repository**  
   [https://github.com/PacktPublishing/TinyML-Cookbook](https://github.com/PacktPublishing/TinyML-Cookbook)

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1. **Introduction to arduino**  
   [https://wiki.seeedstudio.com/Arduino/](https://wiki.seeedstudio.com/Arduino/)

2. **Arduino reference materials**  
   [https://www.exploringarduino.com/resources/](https://www.exploringarduino.com/resources/)

3. **Arduino lessons with examples**  

4. **Arduino project guides**  

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**Youtube channels to learn machine learning and microboard programming.**  
- [https://www.youtube.com/c/joshstarmer](https://www.youtube.com/c/joshstarmer)
- [https://www.youtube.com/c/DeepLearningTV](https://www.youtube.com/c/DeepLearningTV)
- [https://www.youtube.com/c/mcwhorpj](https://www.youtube.com/c/mcwhorpj)
- [https://www.youtube.com/c/Dronebotworkshop1](https://www.youtube.com/c/Dronebotworkshop1)
Thank you and see you tomorrow.

inference code can be found here: https://drive.google.com/drive/folders/1NWFm-dRXDagdkm3qv0FXmiAvDy3C6Drr?usp=sharing

You can alway reach out to me if you have any questions:-
momodoubjallow@seeed.cc
luka@mbjallow.com
https://linkedin.com/in/in/mbjallow6/