Wio Terminal
TinyML Starter Kit
Intro

>>> print("Hello World of AI")

This Wio Terminal Kit has everything you need to get started with TinyML.

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Prof. Vijay Janapa Reddi

Wio Terminal
www.seeed.cc
Overview

- Brief introduction on Wio Terminal
  - Hardware
  - Add-on
  - Software
- Preparation on Wio Terminal & Edge Impulse
  - Environment setup (prepare for the workshop)
  - Demo
- Community project samples
Wio Terminal – Hardware overview
# Hardware – MCU

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main MCU</td>
<td>ATSAMD51P19</td>
</tr>
<tr>
<td>Architecture</td>
<td>ARM® Cortex®-M4F</td>
</tr>
<tr>
<td>Speed</td>
<td>120MHz (Boost up to 200MHz)</td>
</tr>
<tr>
<td>Program Memory Size</td>
<td>512KB</td>
</tr>
<tr>
<td>RAM Size</td>
<td>192KB</td>
</tr>
<tr>
<td>External Flash</td>
<td>4MB</td>
</tr>
</tbody>
</table>

![ATSAMD51P19 microSD Card Slot](image)
<table>
<thead>
<tr>
<th><strong>Hardware – LCD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resolution</strong></td>
</tr>
<tr>
<td><strong>Display Size</strong></td>
</tr>
<tr>
<td><strong>Driver IC</strong></td>
</tr>
</tbody>
</table>
### Hardware – Built-in Modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-axis Accelerometer</td>
<td>LIS3DHTR</td>
</tr>
<tr>
<td>Microphone</td>
<td>1.0V-10V -42dB</td>
</tr>
<tr>
<td>Buzzer</td>
<td>≥78dB @10cm 4000Hz</td>
</tr>
<tr>
<td>Light Sensor</td>
<td>400-1050nm</td>
</tr>
<tr>
<td>Infrared Emitter</td>
<td>940nm</td>
</tr>
</tbody>
</table>
# Hardware – Wireless Connectivity

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>WiFi &amp; BT Module</td>
<td>RTL8720DN</td>
</tr>
<tr>
<td>KM4 CPU</td>
<td>ARM® Cortex®-M4F</td>
</tr>
<tr>
<td>KM0 CPU</td>
<td>ARM® Cortex®-M0</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>802.11 a/b/g/n 1x1, 2.4GHz &amp; 5GHz</td>
</tr>
<tr>
<td>Bluetooth</td>
<td>Support BLE5.0</td>
</tr>
<tr>
<td>Hardware Engine</td>
<td>AES/DES/SHA</td>
</tr>
</tbody>
</table>

- **FPC**
- **SPI Flash**
- **RTL8720DN (Wi-Fi & BT)**
- **DC-DC**
- **2.4G & 5G Antenna**
Hardware – I/O Ports

- Raspberry Pi 40-pin Compatible GPIO
- 2 x Grove Port
- Type-C Port
- Support protocol:
  - i2c
  - UART
  - SPI
  - PWM
  - Analog
  - Digital
Hardware – Other Peripherals

- Micro SD card Slot
- 3 Programable buttons
- 5 way Joystick
- Power/Reset Slide Switch
Software Overview
Software – UF2 bootloader

- UF2 stands for USB Flashing Format
- Developed by Microsoft for PXT (now known as MakeCode) for flashing microcontrollers over the Mass Storage Class (MSC)

Enter Bootloader:
slide the switch further away from “ON” position, let go and slide again
Software – Arduino

- Arduino IDE
- C programming language
- Extensive libraries
- Cross platform
  - Windows
  - Mac
  - Linux/ARM

Additional Board Manager URLs:
https://files.seeedstudio.com/arduino/package_seeeduino_boards_index.json

WIKI:
https://wiki.seeedstudio.com/Wio-Terminal-Getting-Started/#software
Software – Codecraft

- Graphical programming platform
- Powered by EDGE IMPULSE
- Whole TinyML pipeline
- Web IDE: https://ide.tinkergen.com/
Software – Onboard Python

MicroPython
- UF2 Firmware: https://micropython.org/download/SEEED_WIO_TERMINAL/

CircuitPython
- UF2 Firmware: https://circuitpython.org/board/seeeduino_wio_terminal/
Software – IoT Platforms

- Blynk

- Microsoft Azure IoT
Software – TinyML Platform

- Edge Impulse:
  Enables developers to create the next generation of intelligent device solutions with embedded Machine Learning
Part II : Getting Started
Preparation for Wio Terminal with Edge Impulse
Development Environment Preparation

**Hardware requirement:**
- PC
  - Windows
  - Mac
  - Linux
- USB Type-C data cable
- Wio Terminal
  - Edge Impulse UF2 firmware
  
  https://github.com/Seeed-Studio/Seeed_Arduino_edgeimpulse/releases/download/1.4.0/wio-terminal-ei-1.4.0.uf2

**Software requirement:**
- Python3
- Arduino IDE
- Arduino-cli (optimal)
- Nodejs
- Edge-impulse-cli
LIVE DEMO
Install Arduino and add library

- Arduino IDE: https://www.arduino.cc/en/software
- Additional Boards Manager URLs: https://files.seeedstudio.com/arduino/package_seeeduino_boards_index.json
- Add library for Grove Ultrasonic sensor and Grove BME280
- (Optional) Arduino CLI: https://arduino.github.io/arduino-cli/0.23/installation/
Install Edge Impulse CLI

- Setup instruction: https://docs.edgeimpulse.com/docs/edge-impulse-cli/cli-installation
- Node.js: https://nodejs.org/en/
- CLI install script: `npm install -g edge-impulse-cli --force`
Wio Terminal Edge Impulse Firmware

- Download Firmware: https://github.com/Seeed-Studio/Seeed_Arduino_edgeimpulse/releases
- Plug-in Wio Terminal and put in uf2 bootloader mode
- Drag’n’drop the wio-terminal-ei-1.4.0.uf2 file to the Wio Terminal USB drive

Enter Bootloader:
slide the switch further away from “ON” position, let go and slide again
Connect Wio Terminal with Edge Impulse

- Open Edge Impulse website and create account: https://studio.edgeimpulse.com/signup
- Login to Edge Impulse: https://studio.edgeimpulse.com/login
- Create project
- Run CLI script: edge-impulse-daemon
- login with the Edge Impulse login credentials
- Choose project to connect to
- Collect Data
Data Collection Through Wio Terminal

- Choose sensor
- Create Label
- Collect Data
Model Training

- Choose and add processing block
- Choose and add a learning block
- Save impulse
- Extract features, Save parameters and Generate features
- Start training
Model Testing

- Live classification
- Collect data sample
- Model testing and Classify test data
Deployment

- Download library
- Import library in Arduino
- Build and Upload firmware to Wio Terminal
- Test the result
Part III:
Community project samples
Handwriting Recognition

Play Chrome's Dino Game Physically
