Device APIs

W3C TPAC 2022

Vincent Scheib (Google)

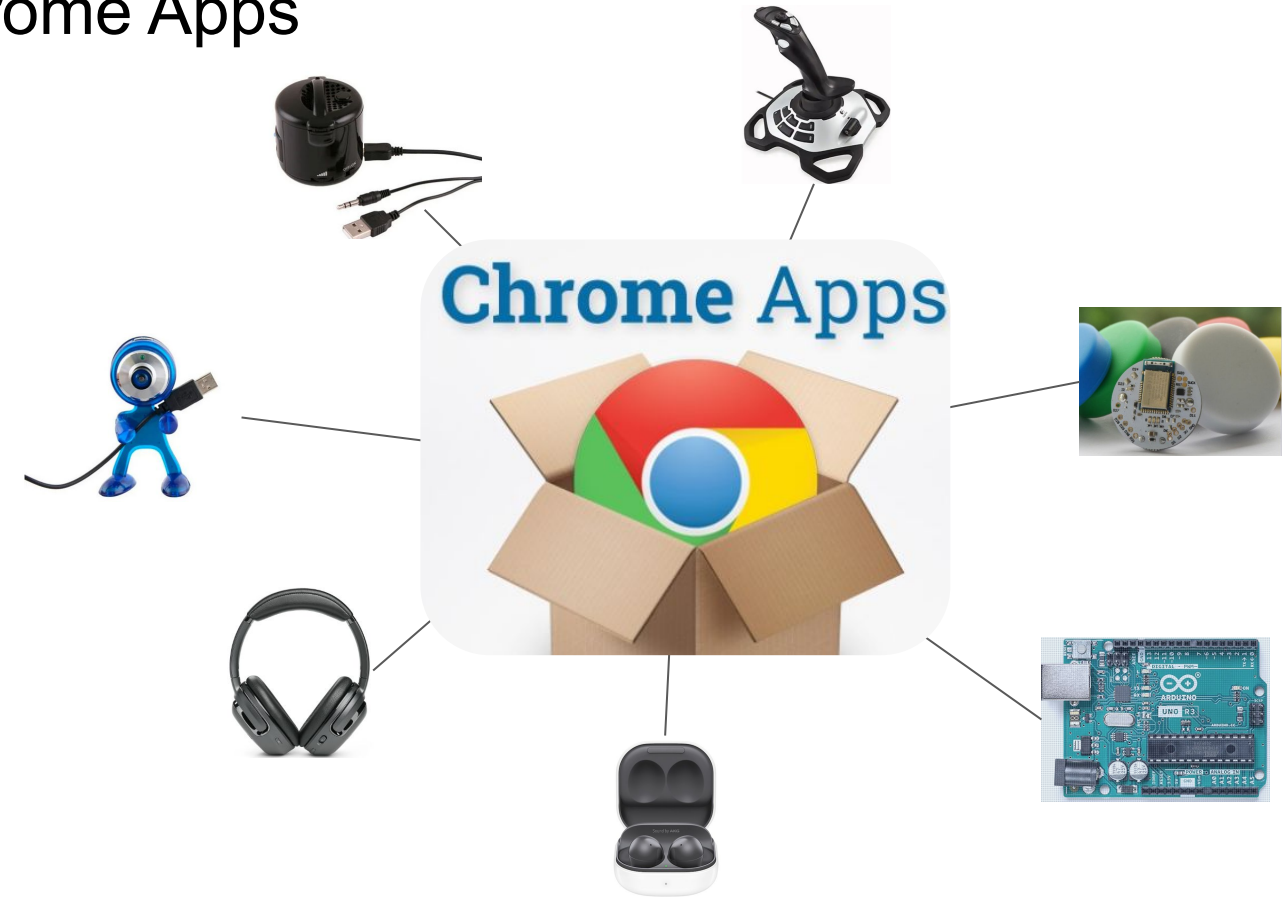
goo.gle/tpac2022-device-apis

Goal:
People can accomplish their daily computing tasks with the benefits of the web.

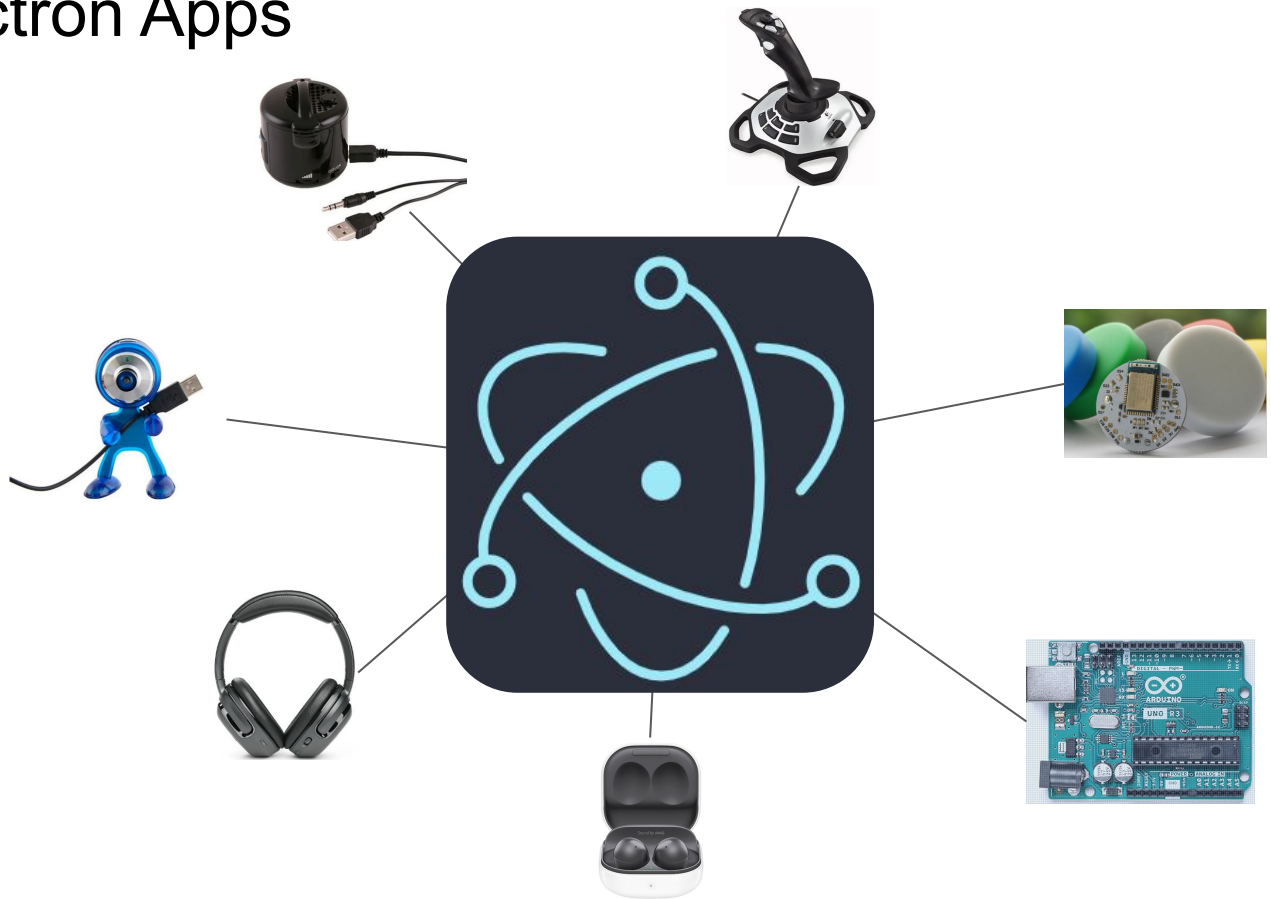
Let's talk about APIs that allow communication with peripherals & other devices using low-level protocols.

Windows, Mac, etc apps

Chrome Apps



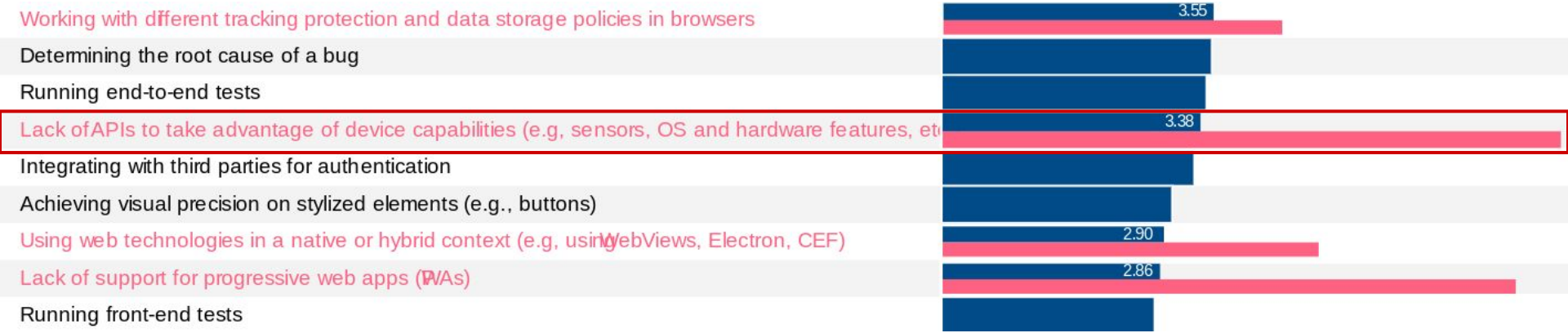
Electron Apps



Web Apps

MDN Web Developer Needs Assessment 2020

"Lack of APIs" is #1 request from "Progressive Programmers" segment.



MDN web docs

moz://a

Bluetooth

- 2017 v56
- 2020 v79
- 2017 v6.0
- 2017 v43

from caniuse.org

USB

- 2017 v61
- 2020 v79
- 2017 v8.0
- 2017 v48

from caniuse.org

HID

- 2021 v89
- 2021 v89
- 2021 v75

from caniuse.org

Serial

- 2021 v89
- 2021 v89
- 2021 v75

from caniuse.org

2017

2021

Bluetooth

from caniuse.org

- Overview
- W3 community group
- MDN Docs
- Specification

USB

from caniuse.org

- Overview
- MDN Docs
- Specification

HID

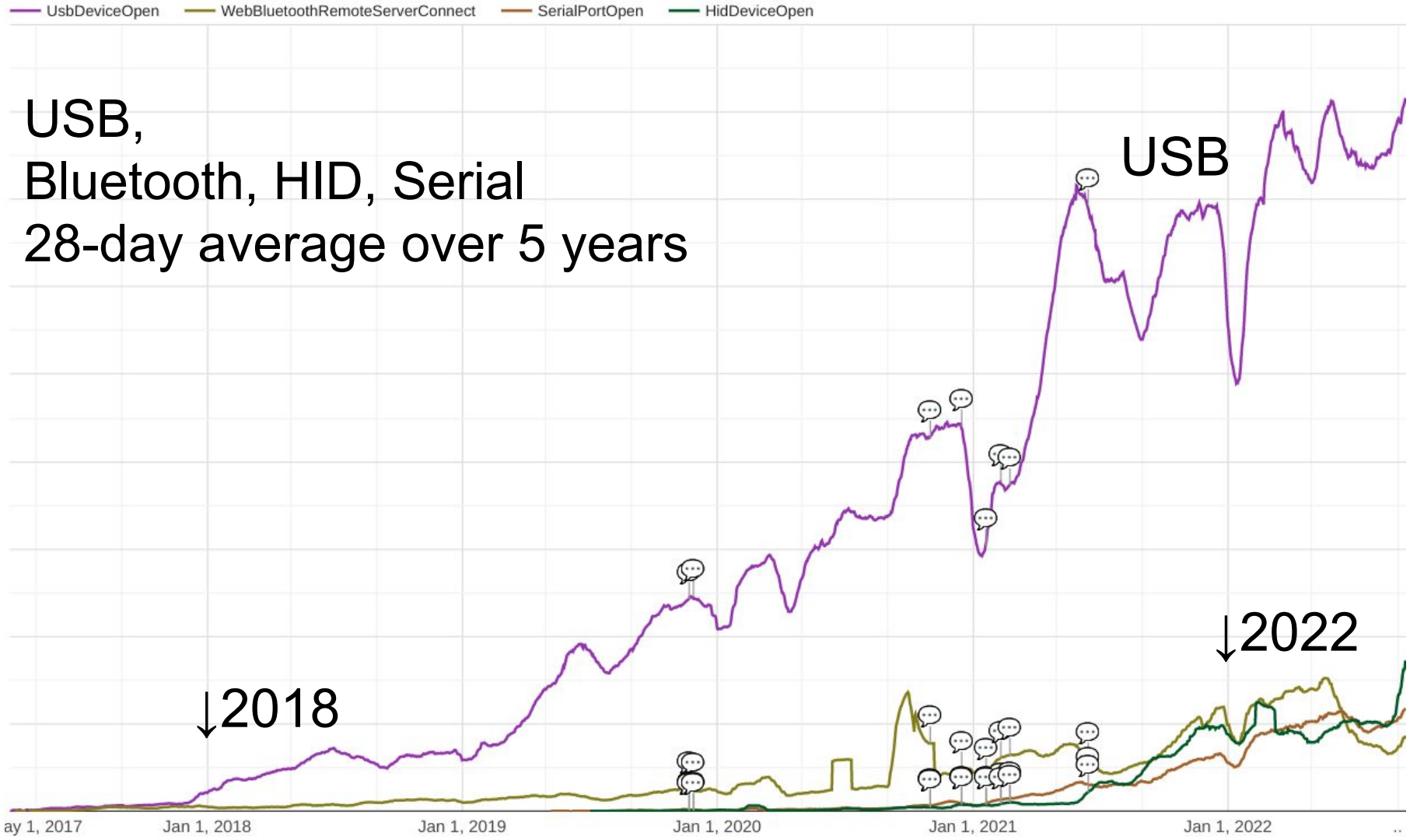
from caniuse.org

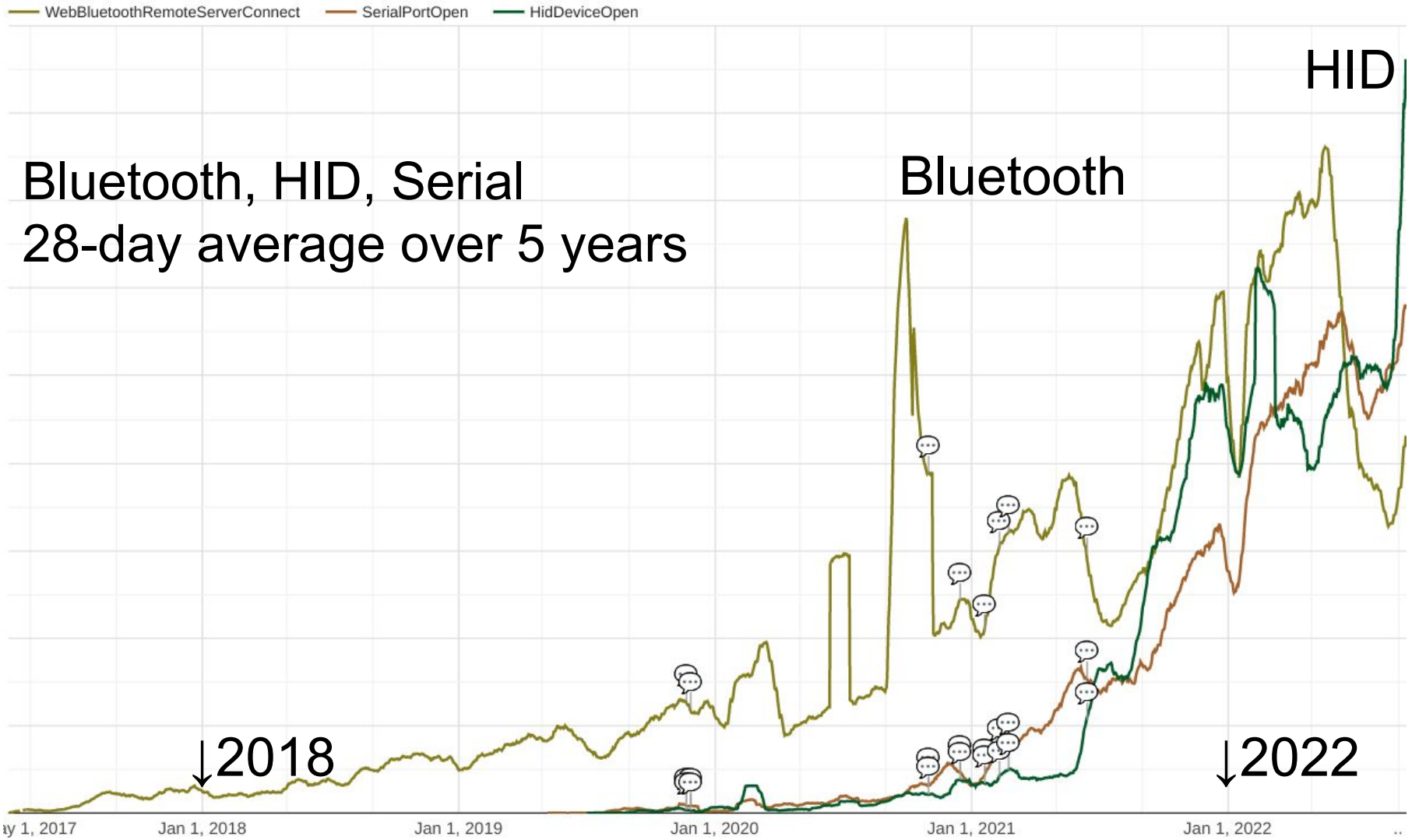
- Overview
- MDN Docs
- Specification

Serial

from caniuse.org

- Overview
- MDN Docs
- Specification


UsbDeviceOpen
WebBluetoothRemoteServerConnect
SerialPortOpen
HidDeviceOpen
USB,
Bluetooth, HID, Serial
28-day average over 5 years
USB
↓2018
↓2022
ay 1, 2017
Jan 1, 2018
Jan 1, 2019
Jan 1, 2020
Jan 1, 2021
Jan 1, 2022


WebBluetoothRemoteServerConnect
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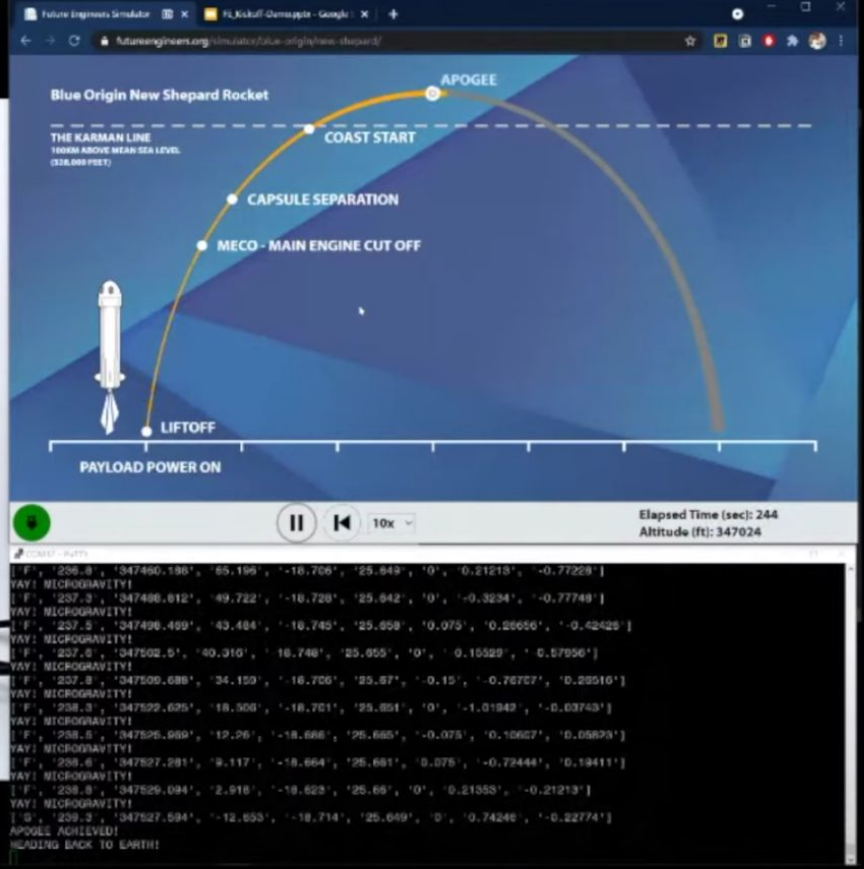
Bluetooth, HID, Serial
28-day average over 5 years
HID
Bluetooth
↓2018
↓2022
Jan 1, 2017
Jan 1, 2018
Jan 1, 2019
Jan 1, 2020
Jan 1, 2021
Jan 1, 2022

Areas of Use

Education: NASA Tech Rise Telemetry Simulator



NASA TECHRISE STUDENT CHALLENGE

Arnold Martin - Assistant Professor of Product Design and Design Consultant, ArtCenter College of Design

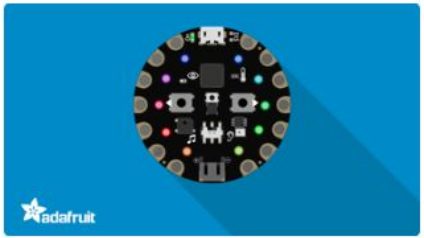
Education: Microsoft MakeCode

"Download your code onto physical hardware devices"

Education: Microsoft MakeCode

"Download your code onto physical hardware devices"

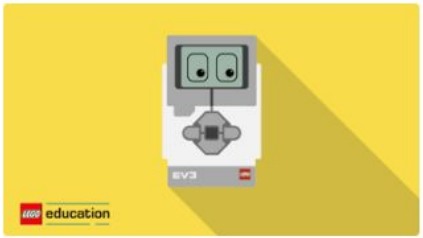
Who else is using the MakeCode Editor?



Adafruit: Circut Playground Express

Learn to code electronics, with an all-in-one board that has sensors and LEDs built in.

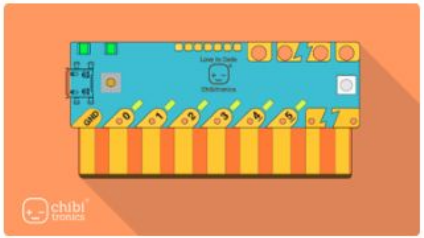
Start coding >



LEGO® MINDSTORMS® Education EV3

Program robots to walk, talk and much more

Start coding >



Chibi Chip

Blend circuit building and programming with arts and crafts

Start coding >

Cue

Use MakeCode to instruct the Cue robot to complete creative problems solving tasks

Learn more >

LEGO Education

Bluetooth

Serial

Select your SPIKE™ solution

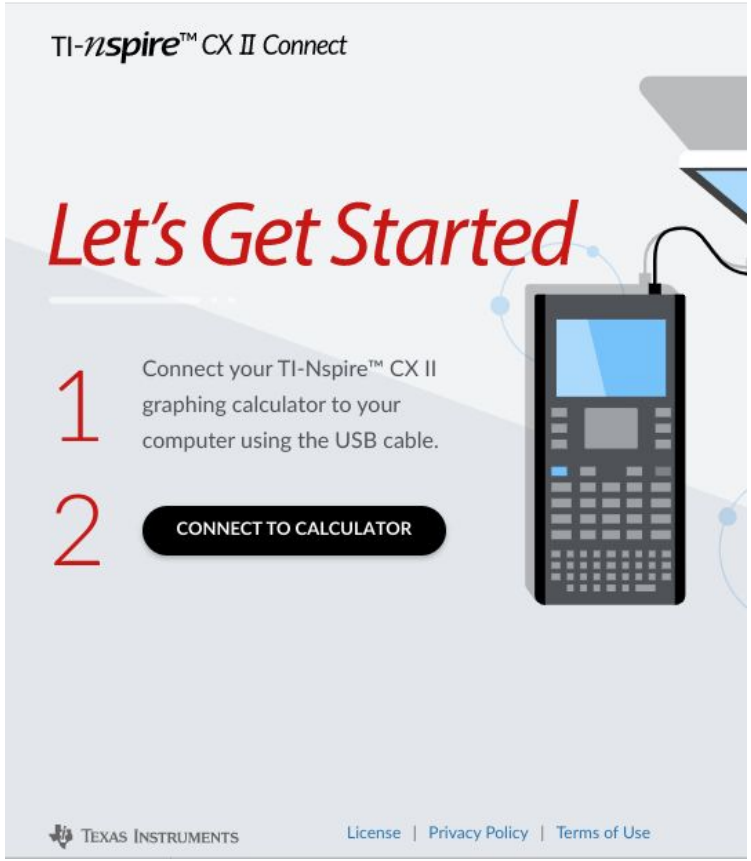
SPIKE Essential

SPIKE Prime

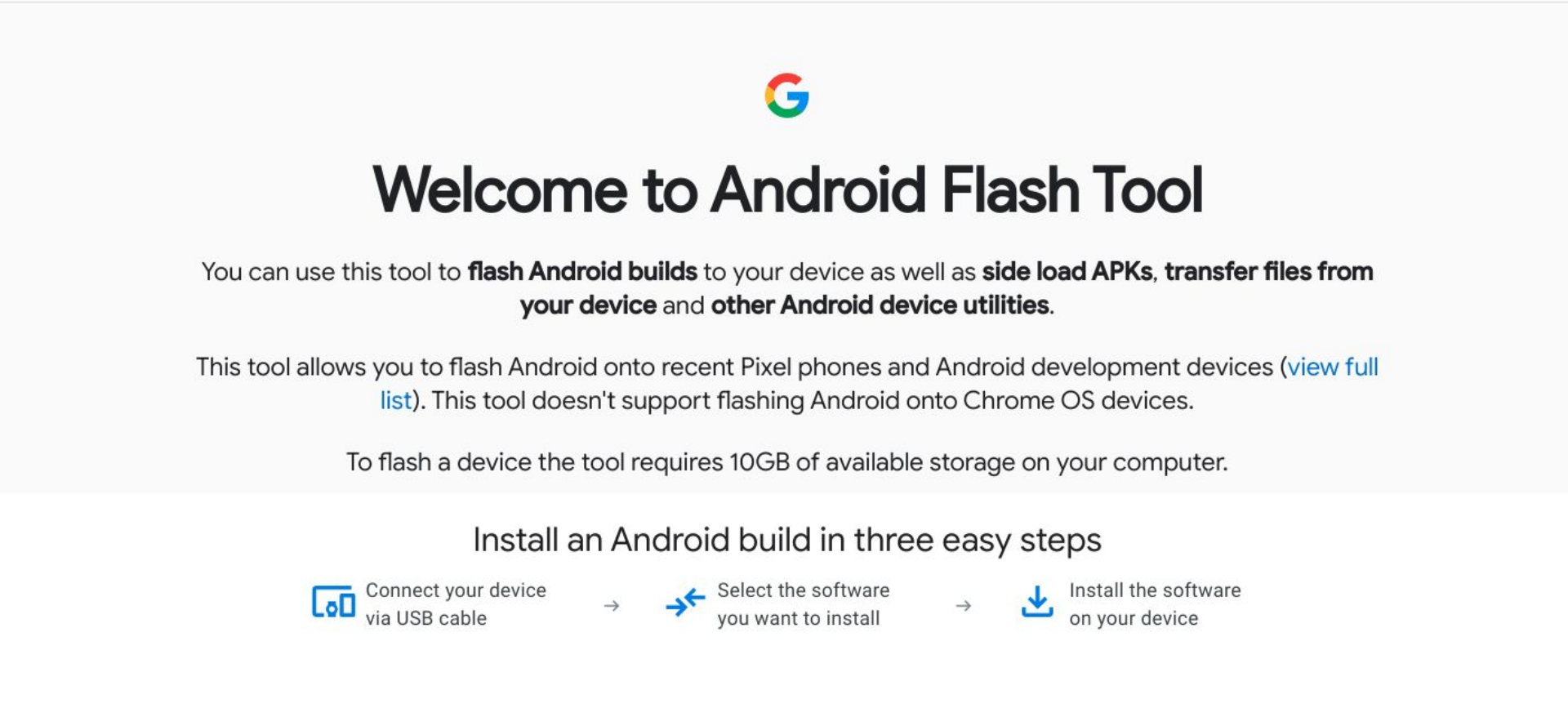
LEGO education

Education: VEX Robotics, The Pocket Lab, more…

Flash Tools: TI & NumWorks Graphing Calculators



Flash Tools: Android / GrapheneOS



Enterprise: Call Control

Google Meet

Settings

- Audio
- Video
- General
- Captions

Microphone

Default - Poly Blackwire 8225 Series ...

Noise cancellation

Filters out sound from your mic that isn't speech

Speakers

Default - Poly Blackwire 8225 Series ...

Call control

Control Meet using your USB device

CONNECTED DEVICES

Poly Blackwire 8225 Series

+ Connect device

Entertainment: Stem Player

Web App using WebUSB is the single application option.

Kanye West & Kano Computing

Exclusive distribution of Donda 2 album

STEM PLAYER
200
ADD TO CART
VIDEO
INFO
COMMUNITY
PLATFORM
FAQ T&C
REGION US UK WORLD

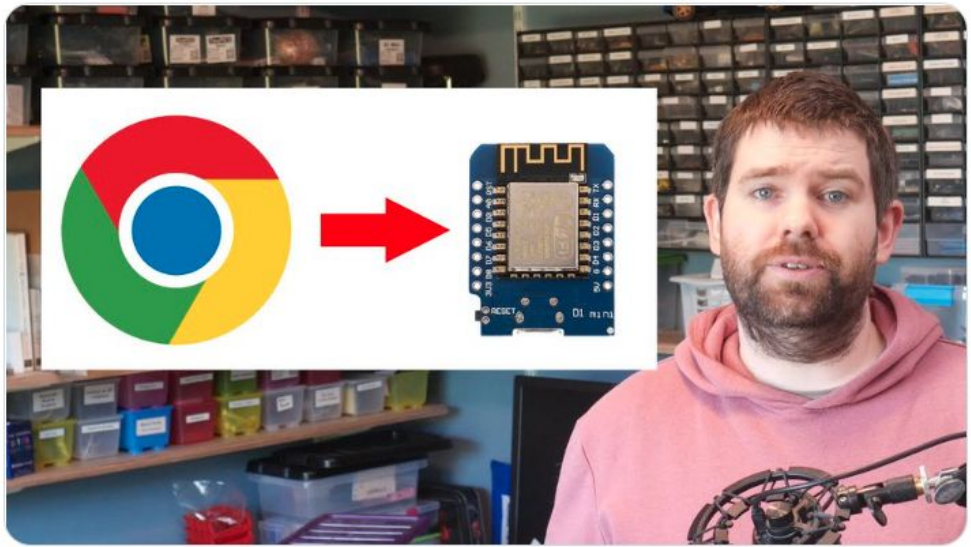
Hobbyist: Microcontrollers Esprino & ESP Web Tools

Javascript interpreter on microcontroller.
[Web IDE]

Brian Lough
@witnessmenow

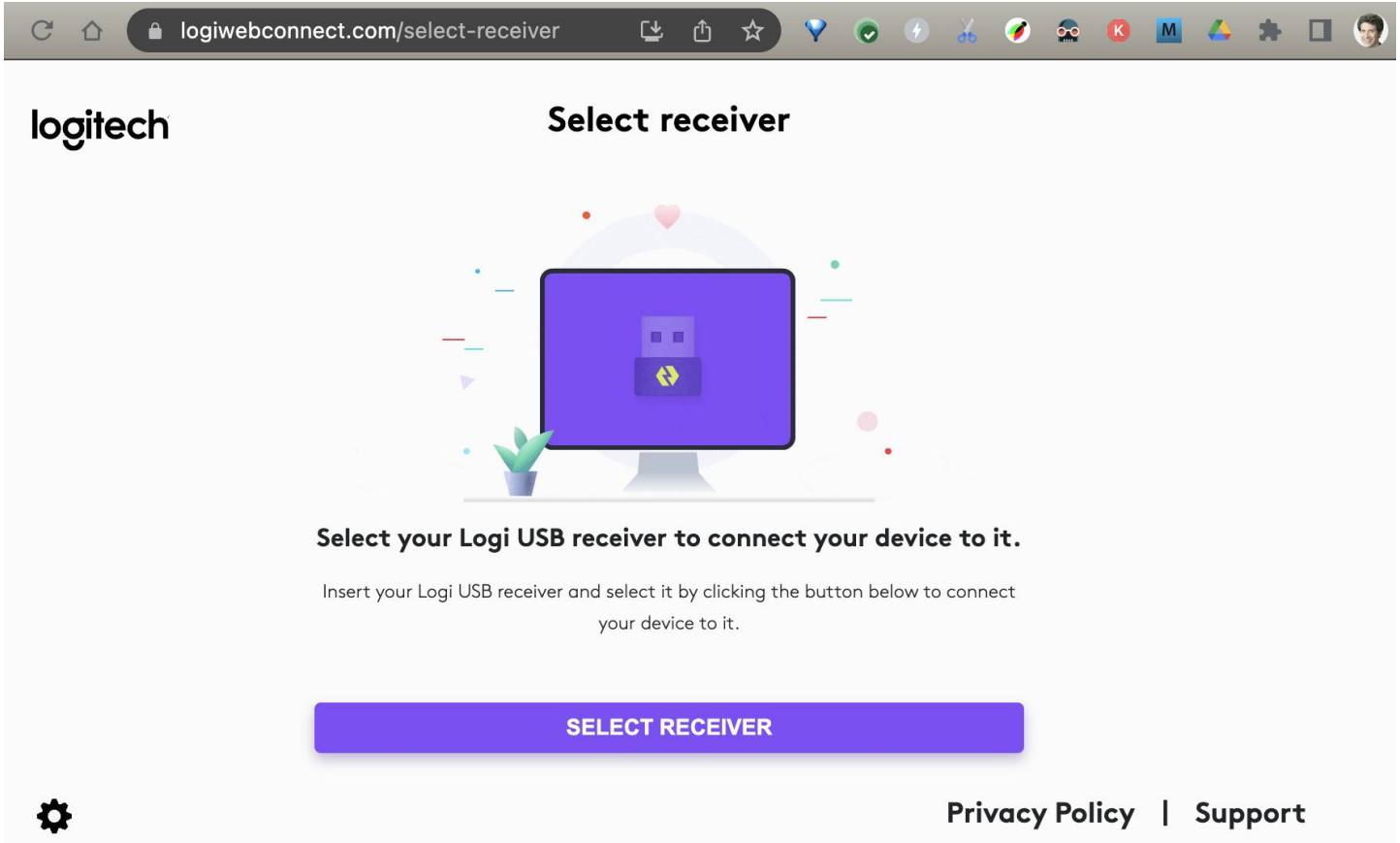
I've just released a video about the Esp web tools, which allow you to flash full projects to your Esp in about a minute without installing any software (not even the Arduino IDE) or downloading any code.

I think this an amazing way of sharing projects with people!

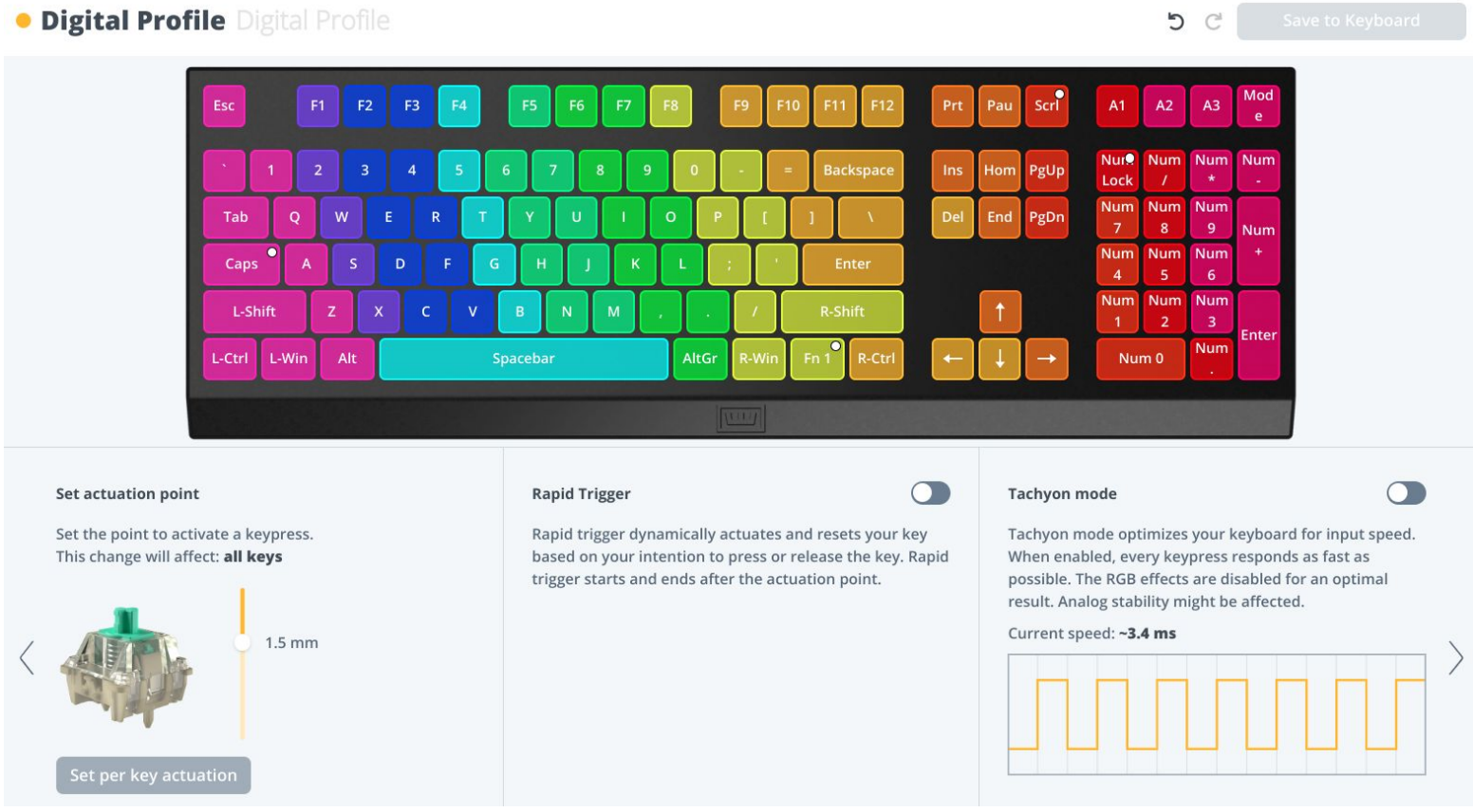


12:31 AM · Apr 4, 2022 · Twitter for Android

Personal Electronics: Logitech Receiver



Personal Electronics: Wooting Keyboard Tooling



Personal Electronics:
remap-keys.app

REMAP

Handyman MACROPAD

Designed by Hayashi

Macro | Integrated | Backlight LED | Underglow LED | Kailh Choc V1 | Kailh Choc V2 | Column Staggered

cocot46

Designed by aki27kbd

40% | Integrated | Column Staggered | Underglow LED | Cherry MX | Hotswap | Wireless

mc2s lp

Designed by abitkeys

40% | Split | Column Staggered | Kailh Choc V1

REVIUNG5

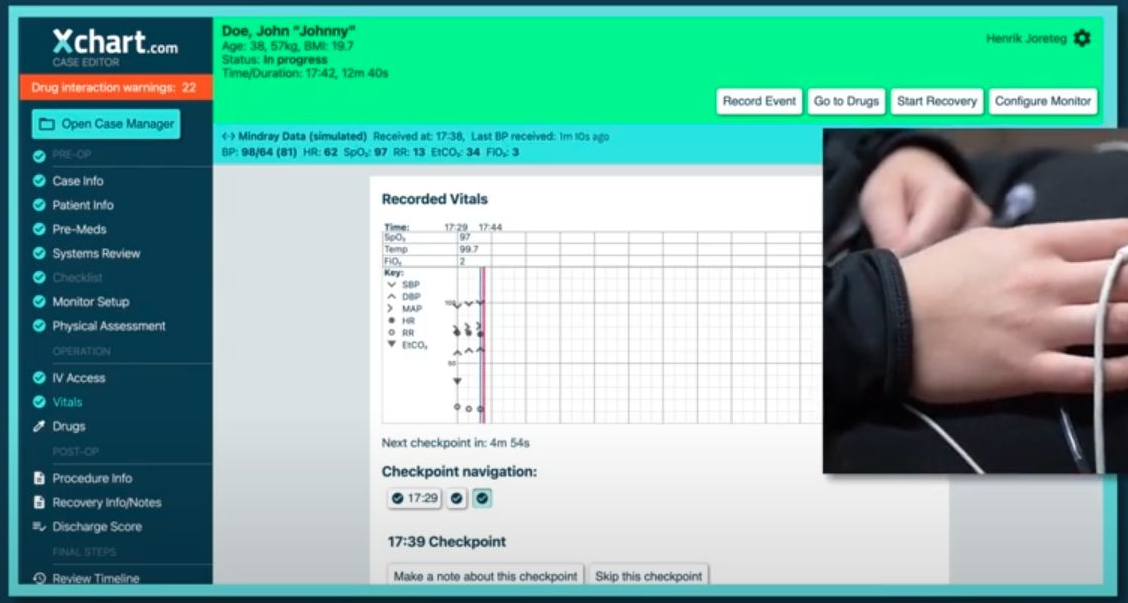
Designed by gtips

Macro | Integrated | Underglow LED | Cherry MX

Health: Tidepool

Electron app to upload diabetes data from devices.

Health: Xchart



Record any needed entry from multiple devices in real-time

People are getting tasks done.

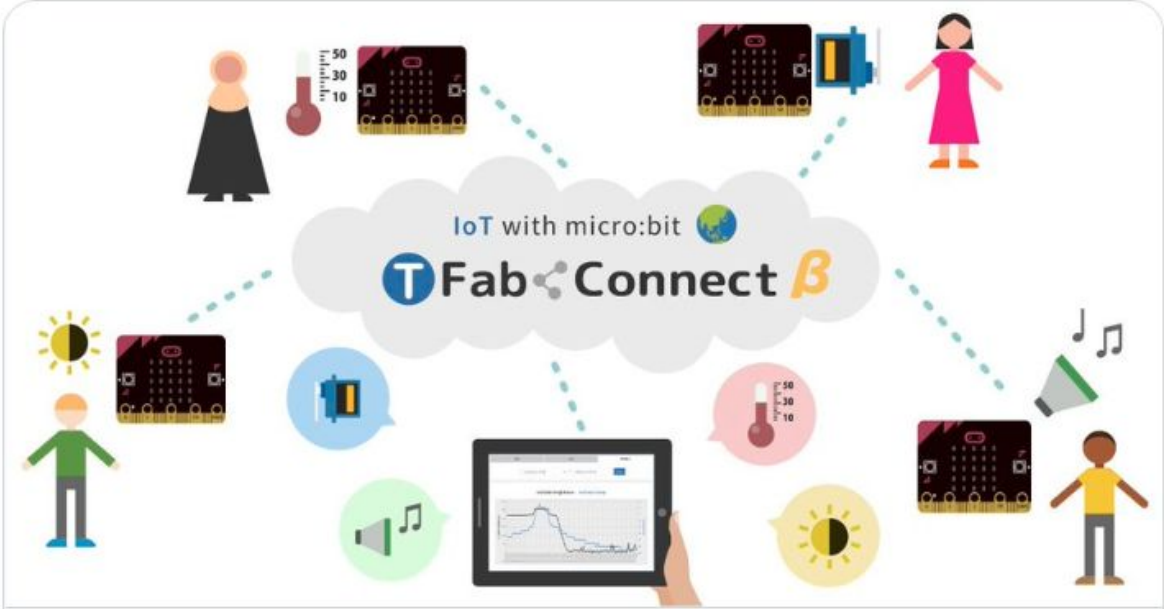
Developer Experimentation
opportunity and potential

Developer Experimentation

@Vincent_Scheib
[Twitter collection]

Awesome micro:bit
@awesomemicrobit

micro:bit Tools - Fab Connect
Online tool & dashboard to bridge multiple #microbits together via the internet using a WebUSB connection to the browser.



Developer Experimentation

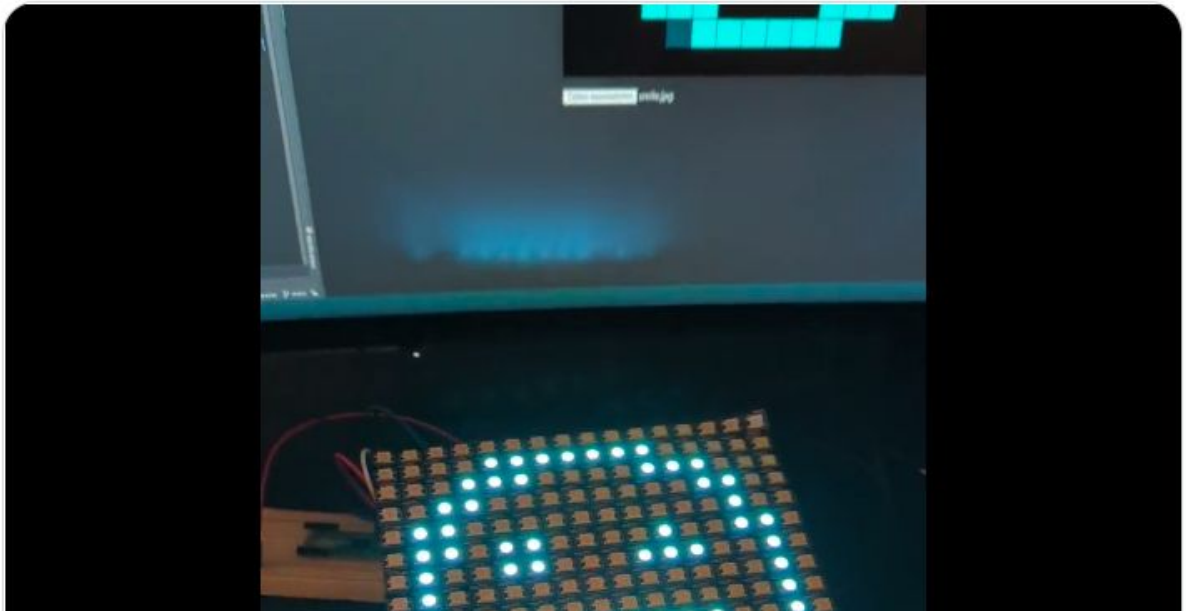
@Vincent_Scheib
[Twitter collection]

Developer Experimentation

@Vincent_Scheib
[Twitter collection]

nico.dev
@nic_o_martin

Thats so cool! I created a webapp, that accepts an image, downsamples and crops it down to 16*16px, gets the RGB values from each px and sends it via #WebUSB to the #Pico, which passes it to the RGB #pixelMatrix.



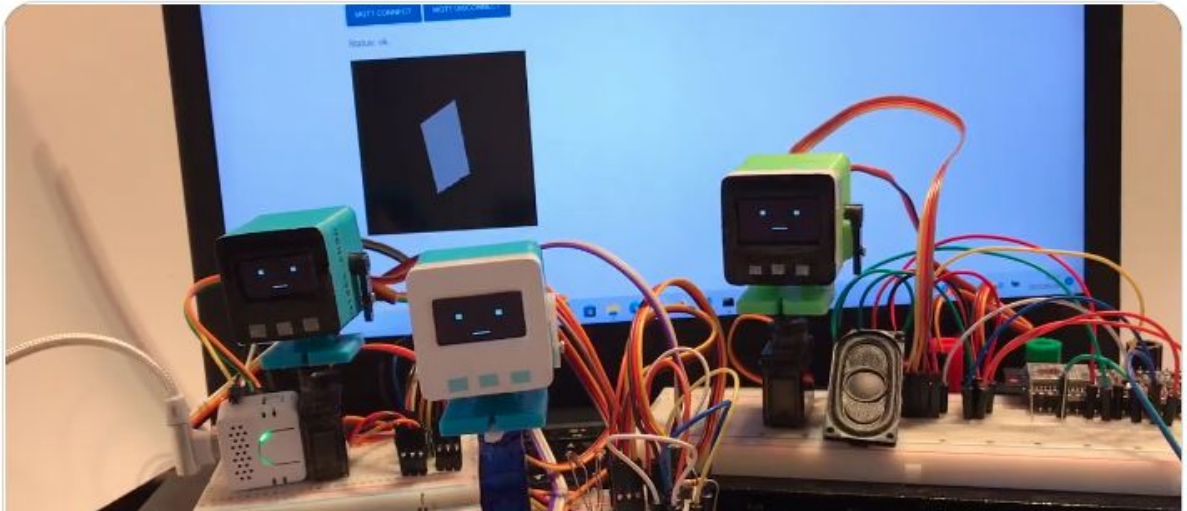
Developer Experimentation

@Vincent_Scheib
[Twitter collection]

verylowfreq
@verylowfreq

小さいｽﾀｯｸﾁｬﾝたちをJINS MEMEで一斉に動かしてみるテスト。JINS MEME → ブラウザのWeb Bluetooth API → MQTT over WebSocket → MQTTブローカー → 小さいｽﾀｯｸﾁｬﾝという経路。
（個体間の動きの同期は取ってない。横回転は顔の傾きで代用。）

Translate Tweet



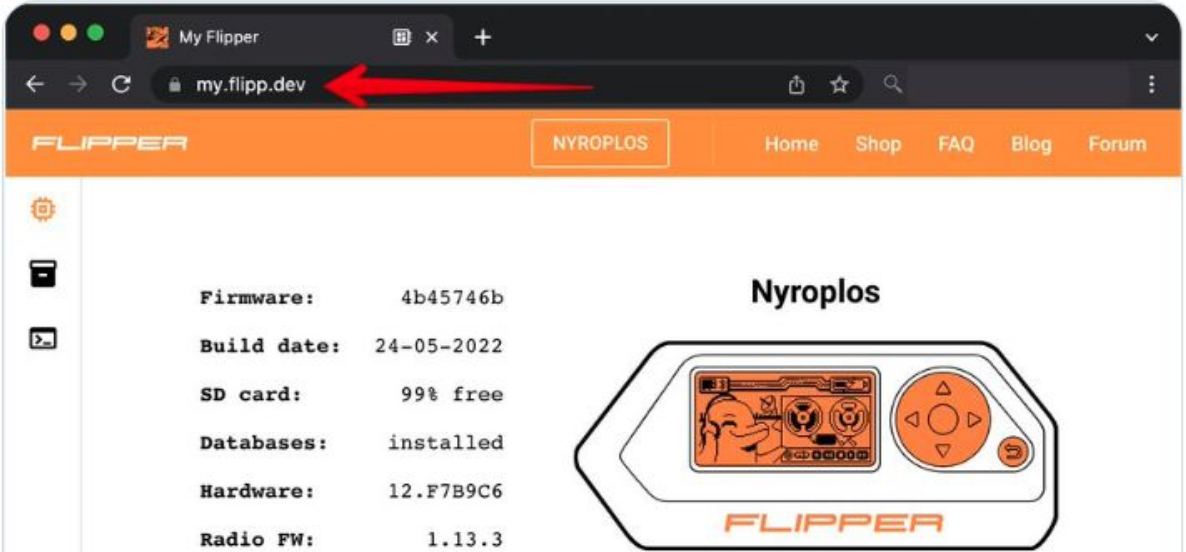
Developer Experimentation

@Vincent_Scheib
[Twitter collection]

Pavel Zhovner
@zhovner

We have resumed development of #flipperzero WebUSB application. Now it can update firmware directly from browser using the new updating protocol. Highly experimental demo: my.flipp.dev

Please check it out if you are brave enough.

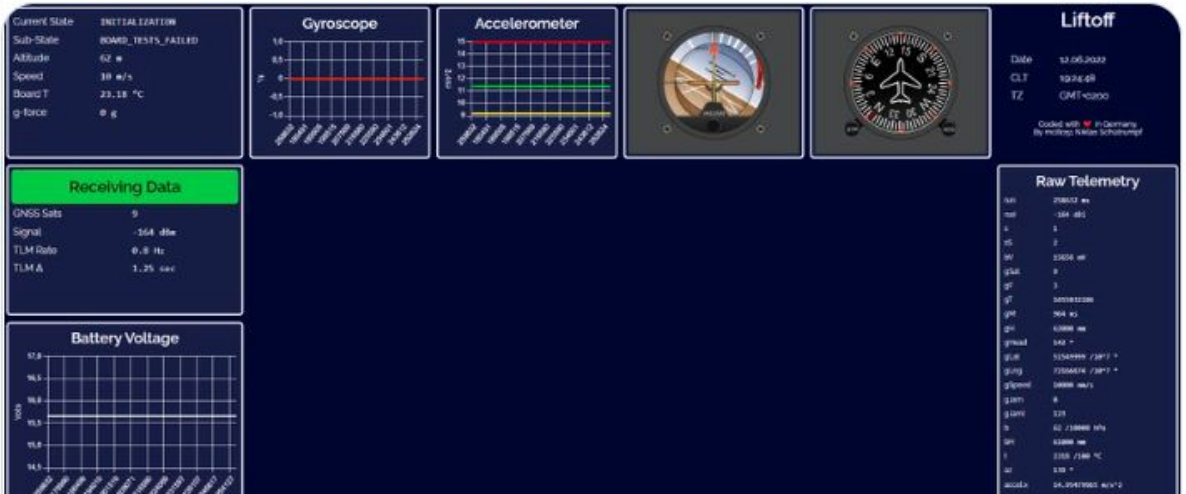


Developer Experimentation

@Vincent_Scheib
[Twitter collection]

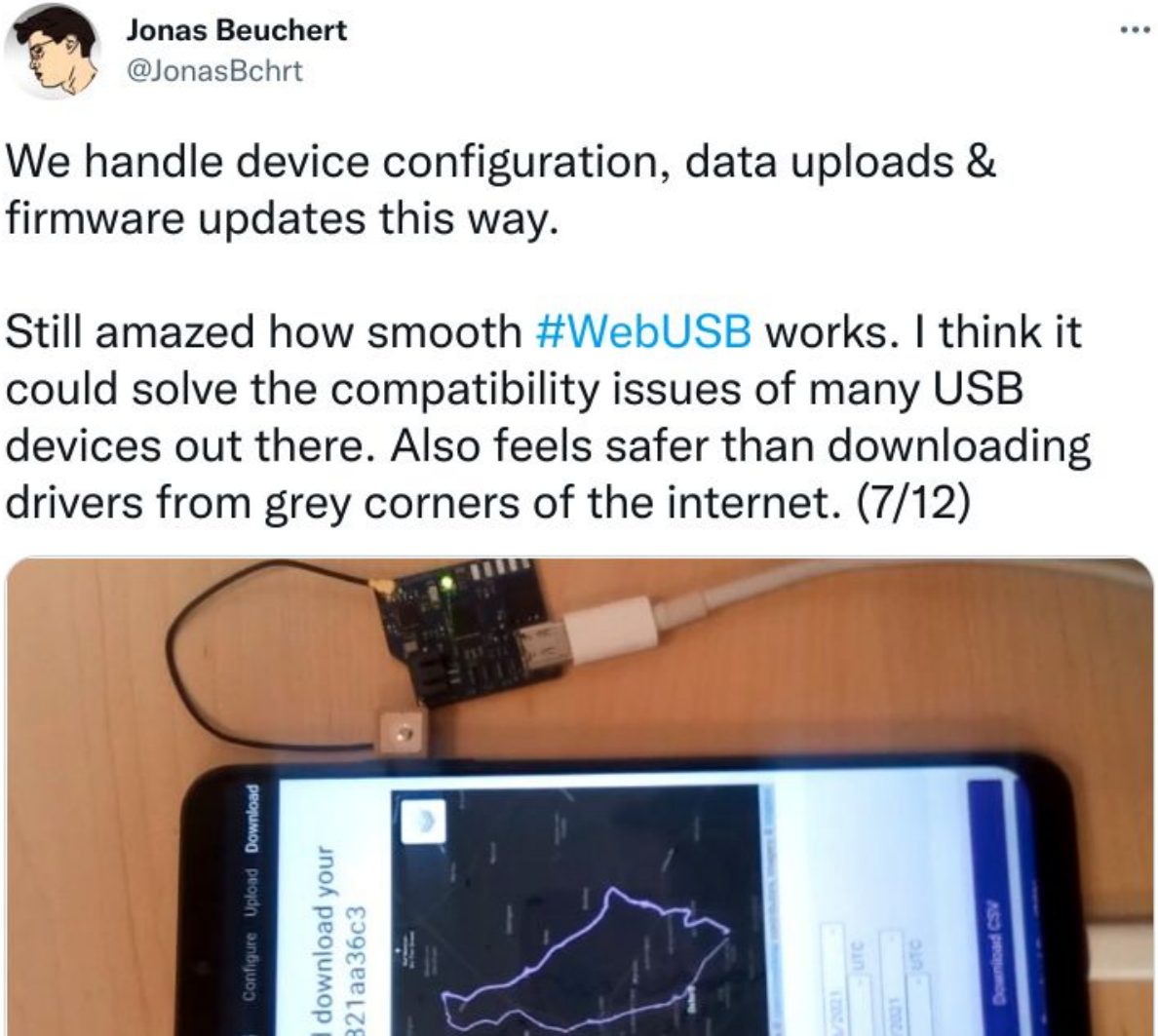
Niklas
@Gurkengewuerz

As @joebarnard said in an interview: "Share your work with the world" 🌍
Inspired by your telemtry view for your rockets i coded a telemtry view for my upcomming drone.
The view is running in the browser and connects via WebUSB to my telemtry receiver.
#RP2040 #raspberrypi #FPV



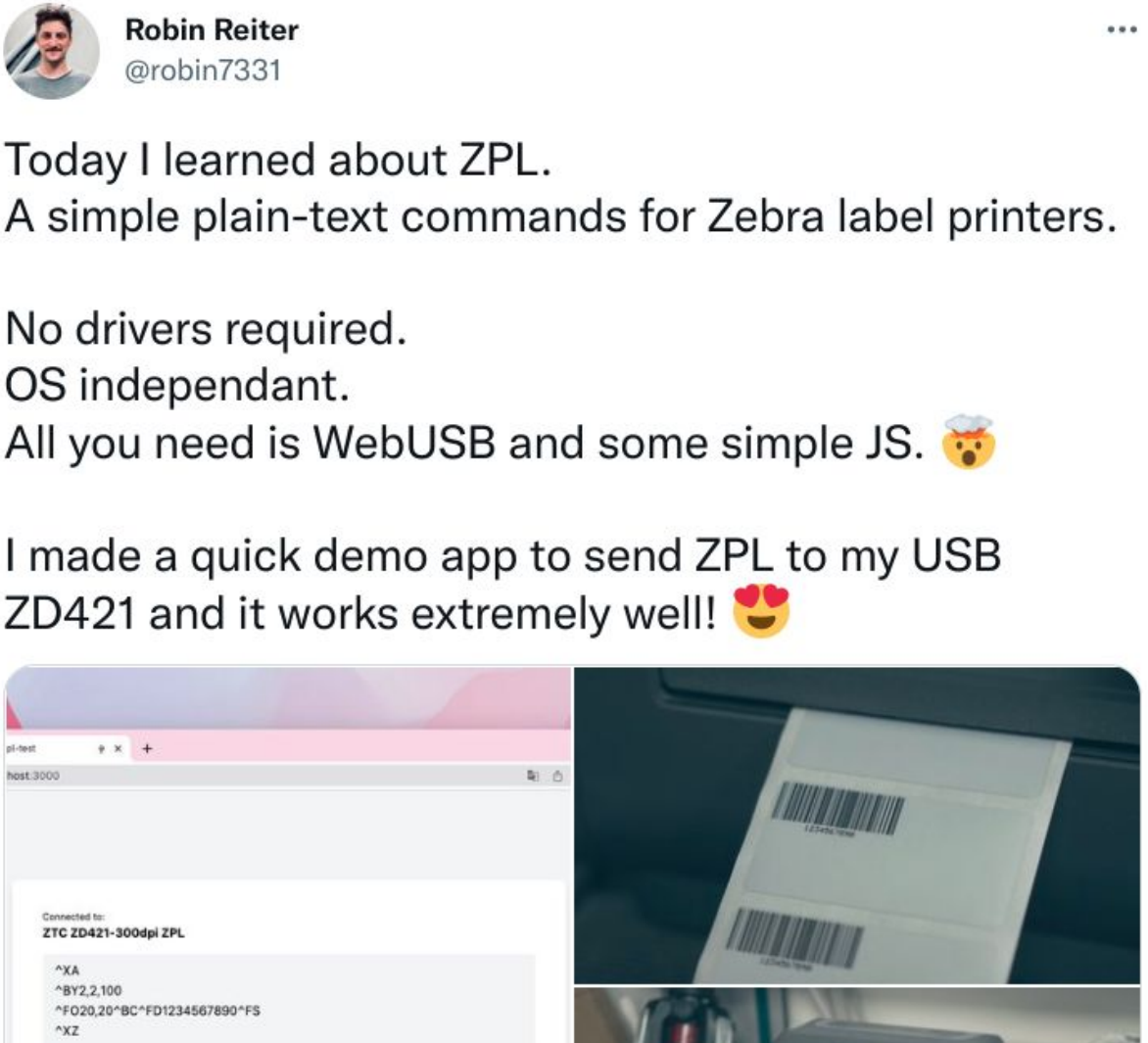
Developer Experimentation

@Vincent_Scheib
[Twitter collection]



Developer Experimentation

@Vincent_Scheib
[Twitter collection]



Developer Experimentation

@Vincent_Scheib
[Twitter collection]

Developer Experimentation

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[Twitter collection]

Developer Experimentation

@Vincent_Scheib
[Twitter collection]

Many possibilities.

Efficient cross platform development,
easy to use APIs,
and distribution are key motivators.

Discussion

Security

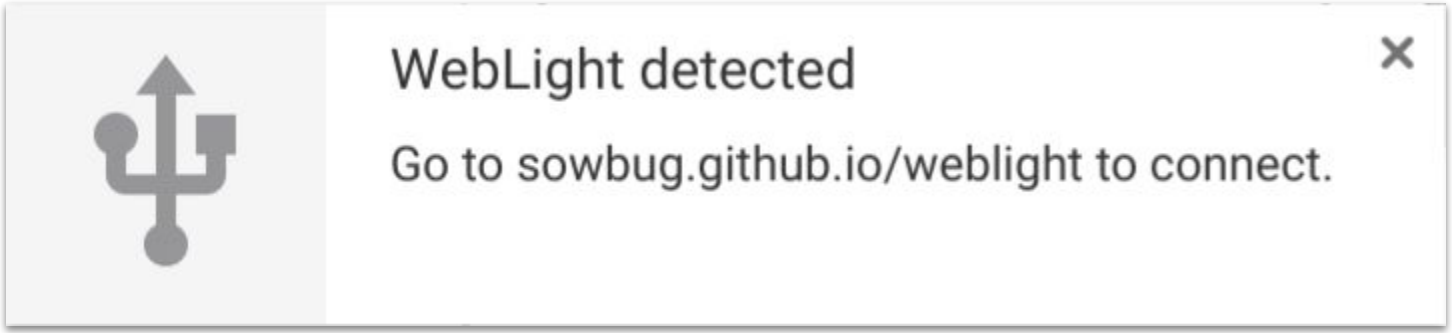
Without Web APIs

- People will still use their devices. But how?
- People will install native apps.
- Pros: install friction reduces how often this is done
  (though security research shows it is not a barrier given incentives)
- Cons: Exposes people to security and privacy issues across many APIs, access to all devices

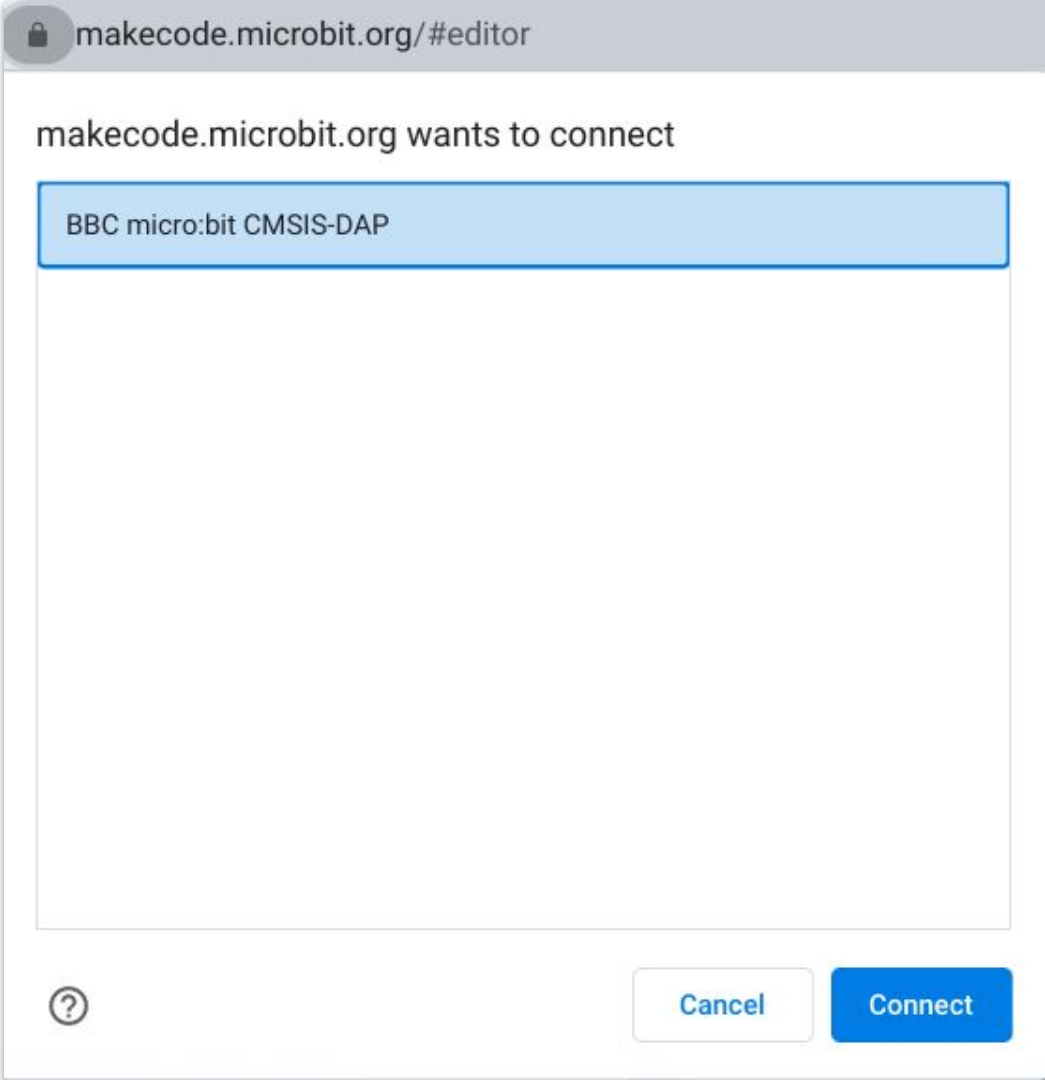
Security Model

- Balancing risk trade offs between
  - Installing Windows/Mac/etc apps with multi-device, multi-api access
  - Web Browser restricted access:
- Requires secure context.
- Permission granted one device to one site. **Least privilege** principle.
- Blocklist device or attributes.
- Users informed when the device is accessed.

WebUSB notification



Chrome’s Chooser Dialog



Risk: Exposing information about user's devices

Sites can not access list of user’s devices

Access to a device only after a person selects one via a chooser.

Risk: Device can be compromised, e.g. firmware update

Users must select and grant access to a device

Sites do not know ahead of time whether a vulnerable device is available. Attempting to connect to many devices is very noticeable.

Devices under active attack can be added to a blocklist

Risk: Cross origin data sharing

Users must grant access to device multiple times, for each origin.

Comparable to saving and opening a file between sites.

Risk: Devices not designed to be accessed by any website

'Not designed' or 'fundamentally unsafe to be accessed by browser'?

Native applications also provide any software to access any device

Devices that are fundamentally unsafe can be added to the blocklist

Risk: Users don't understand the permission

Chooser designed to be hard to "just click yes". Must select a device first. Then connect.

User agents can provide in context help

User agents may add more information to the permission dialog