

Micro:bit Magic

Engaging K-12, CS1/2, and non-majors with IoT & Embedded

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Northwest Missouri State University

Outline

- Intros: Us, You, the micro:bit
- ★ Setup
- ★ “Hello, World!”: First Program
- ★ Programming: Logic & Action
- ★ Broadcast Basics
- ★ Awesome Audio & Motor Mayhem
- ★ Bluetooth Basics & Phone Phun
- ★ Extensions & Graphing
- ★ Cutting the Cord
- Conclusions

- **Intros: Us & You**

• Intros: Us & You

- Us

• Intros: Us & You

- Us
- You: Roll Call & Intros

• Intros: Us & You

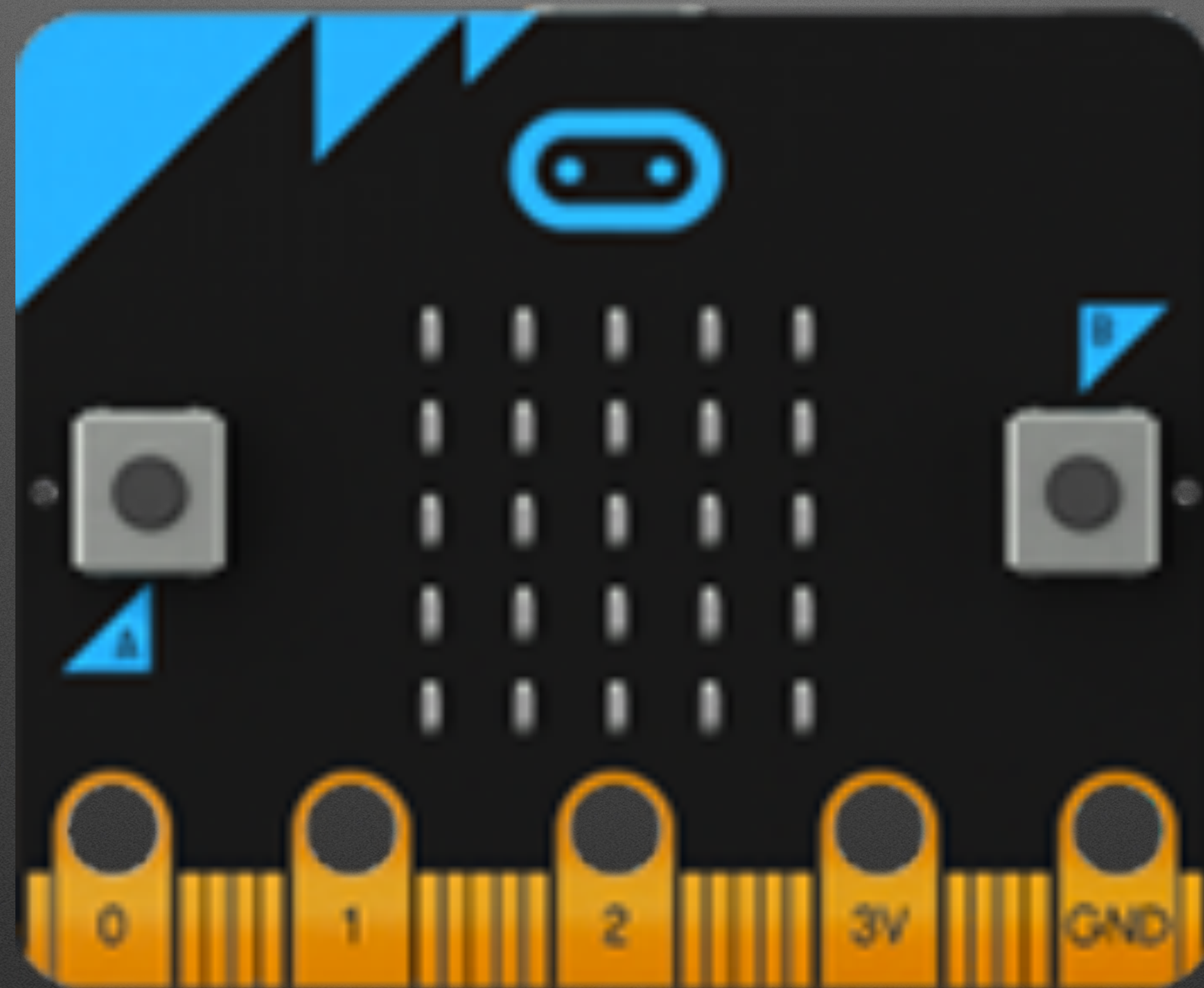
- Us
- You: Roll Call & Intros
 - Who has Chrome? Who has an iOS Device with the App?

Intros: Us & You

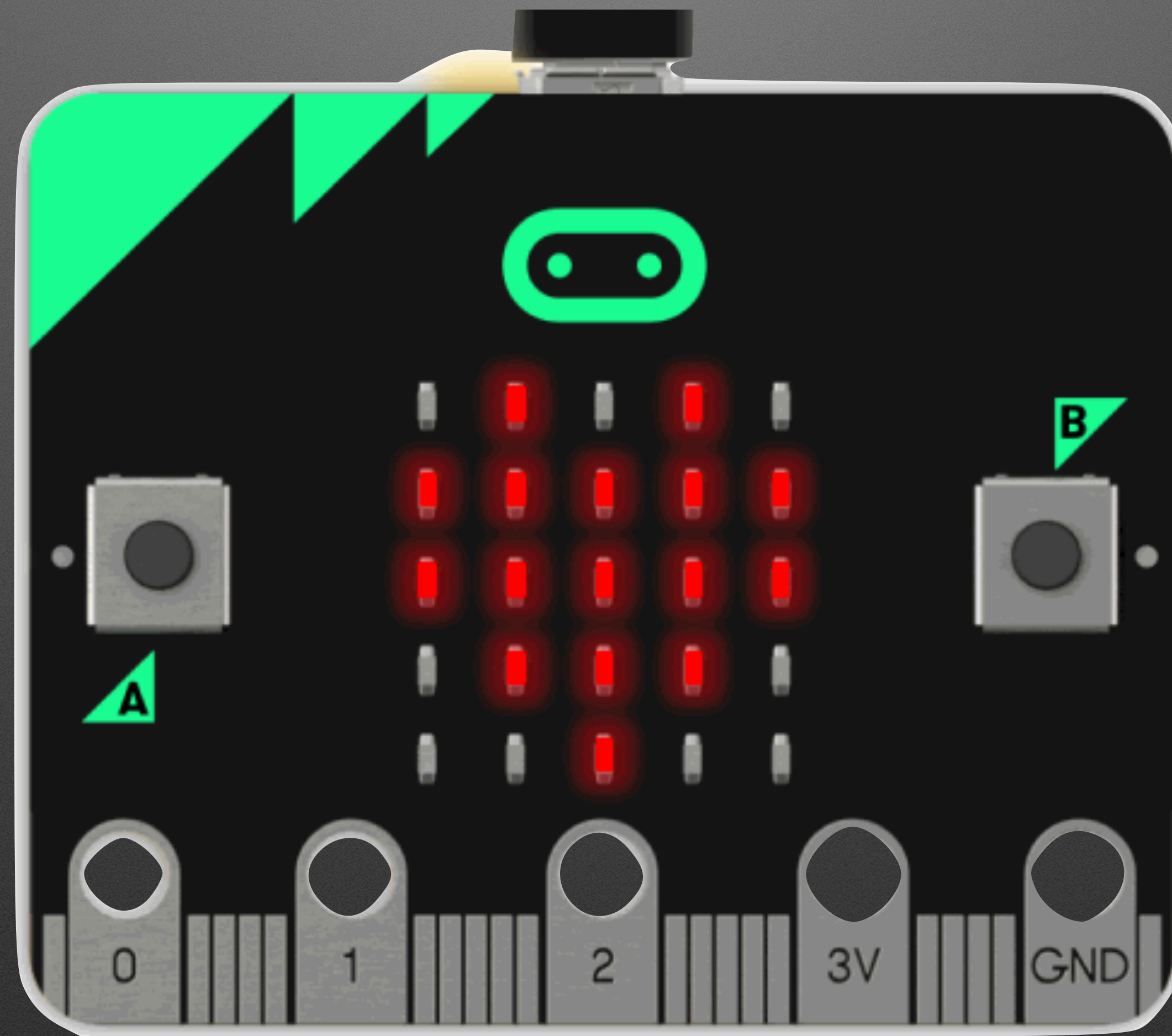
-
- Us
- You: Roll Call & Intros
 - Who has Chrome? Who has an iOS Device with the App?
- Pair programming — pair up!

Intros: the micro:bit

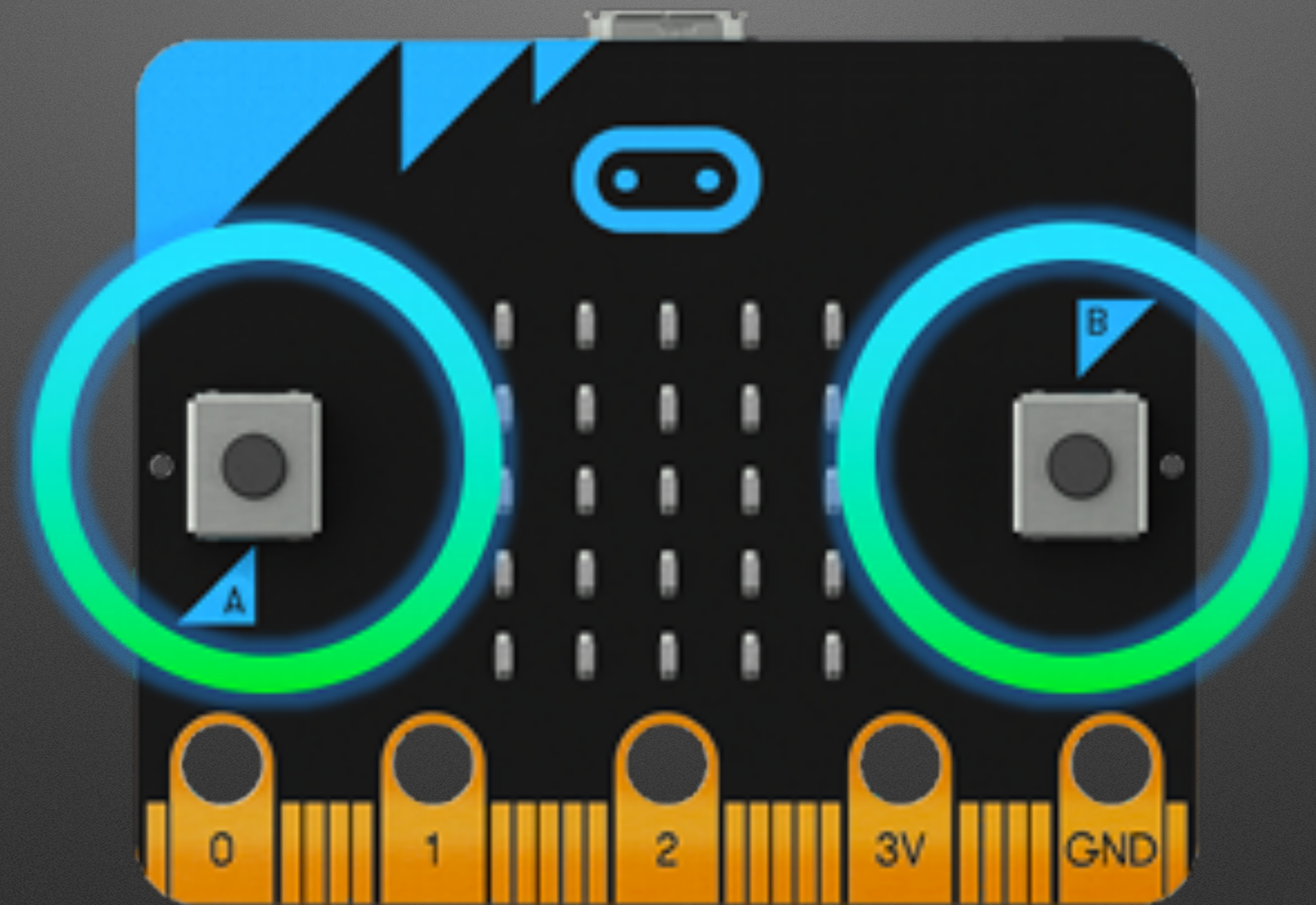
Small



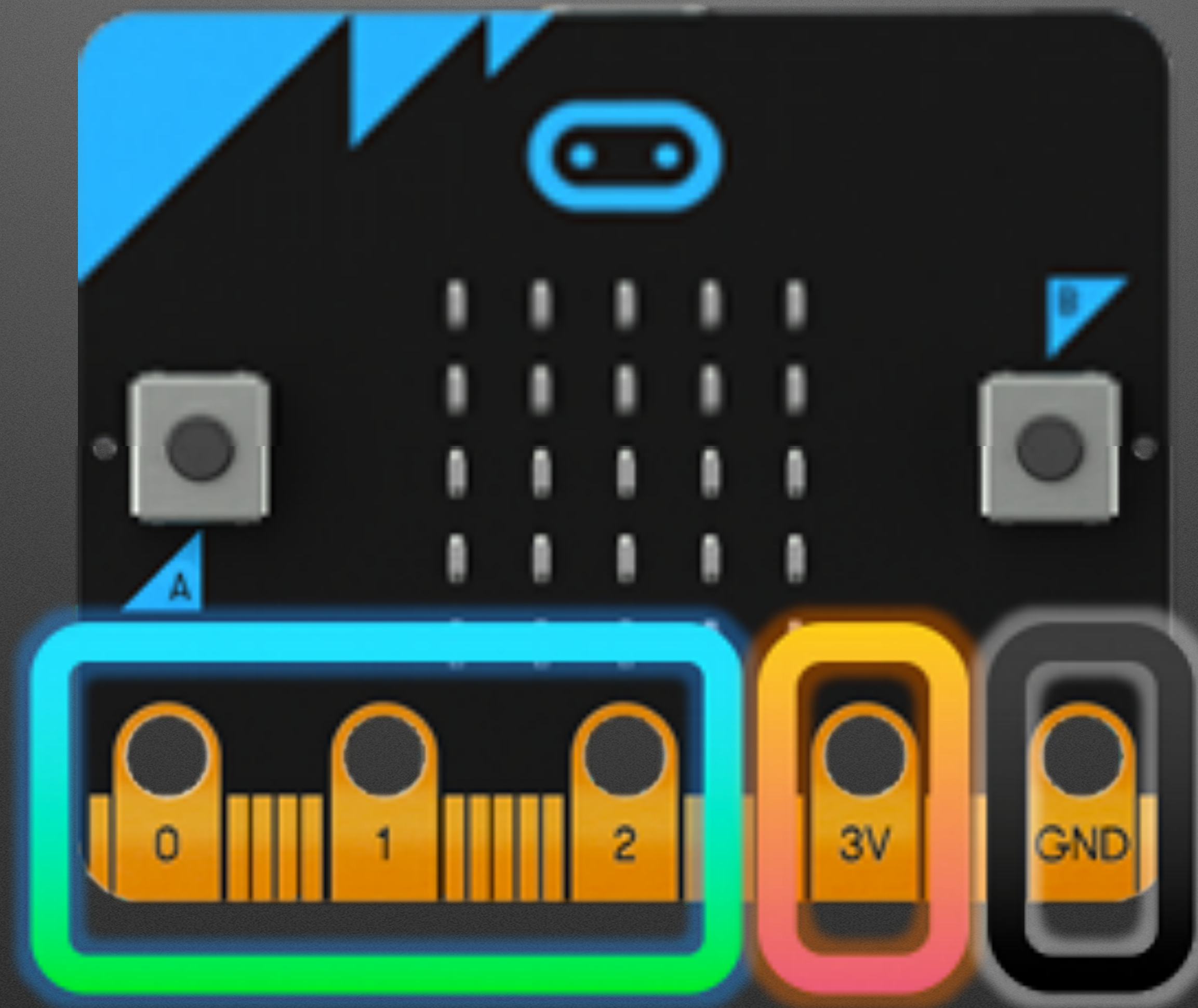
LED Grid



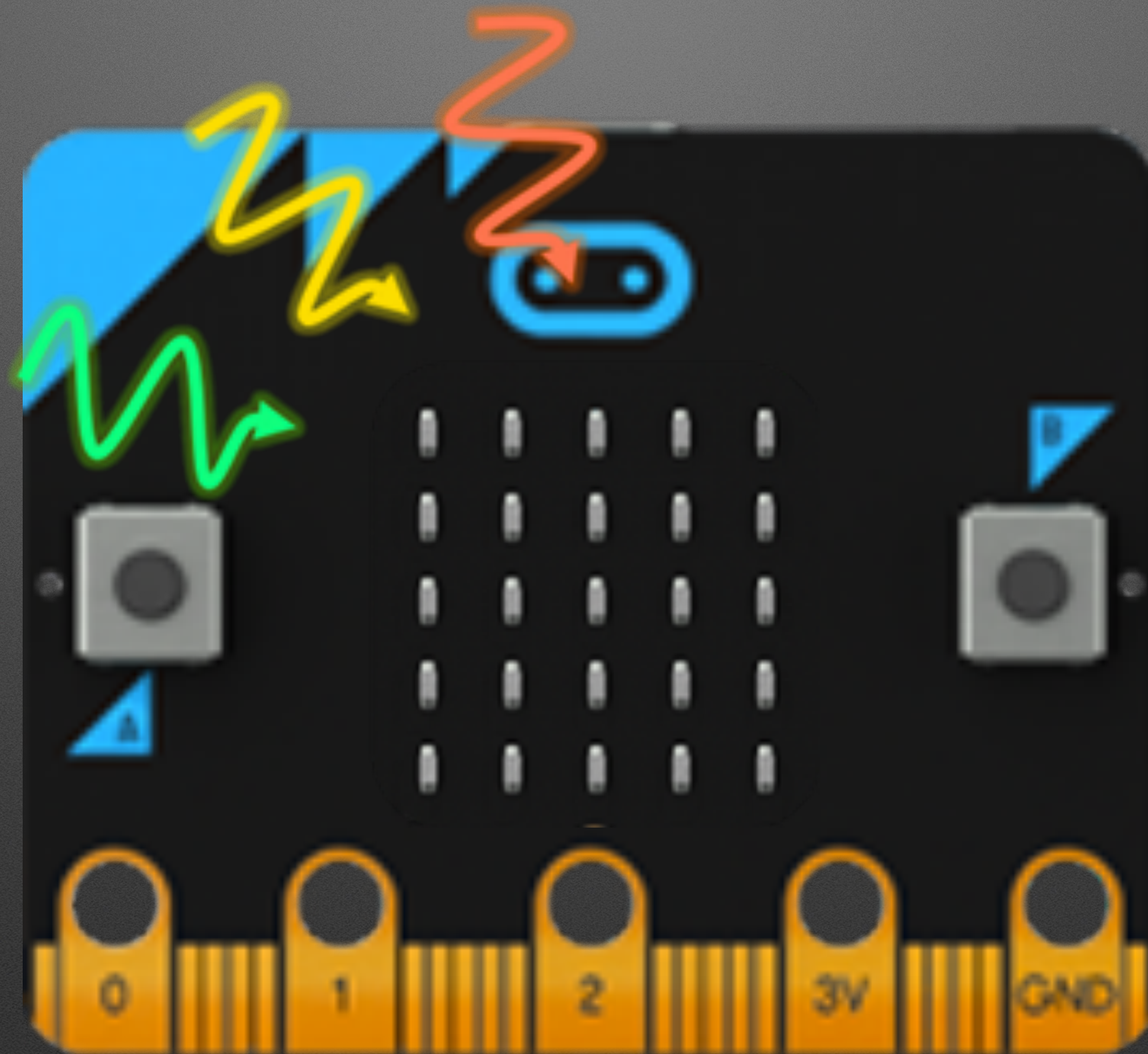
Buttons



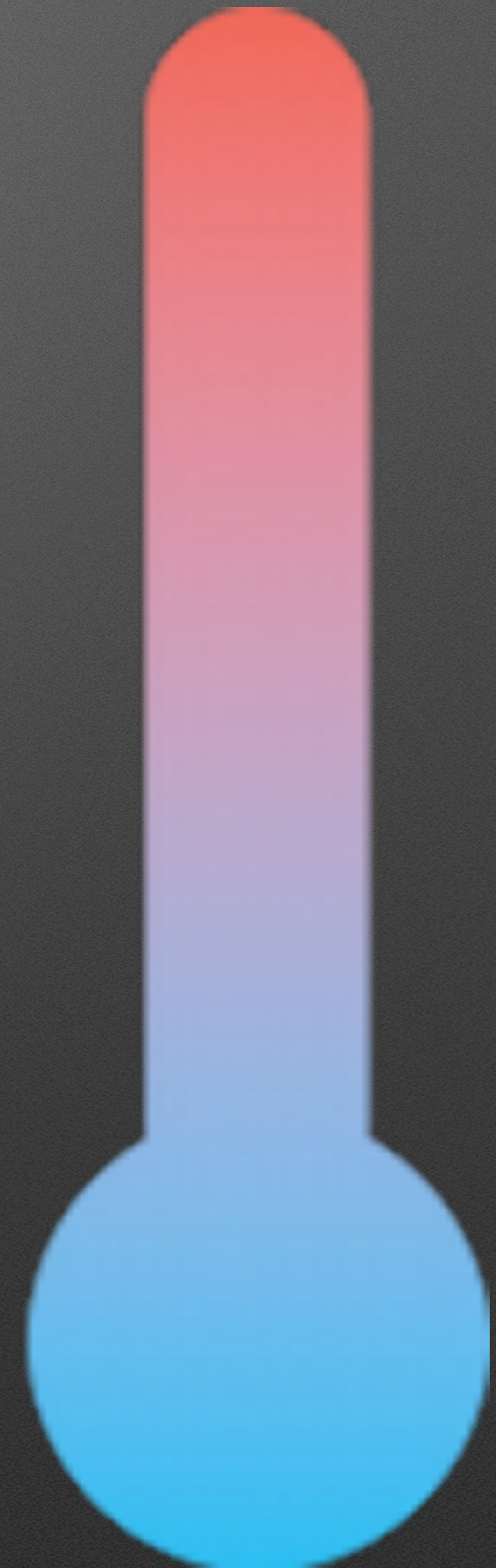
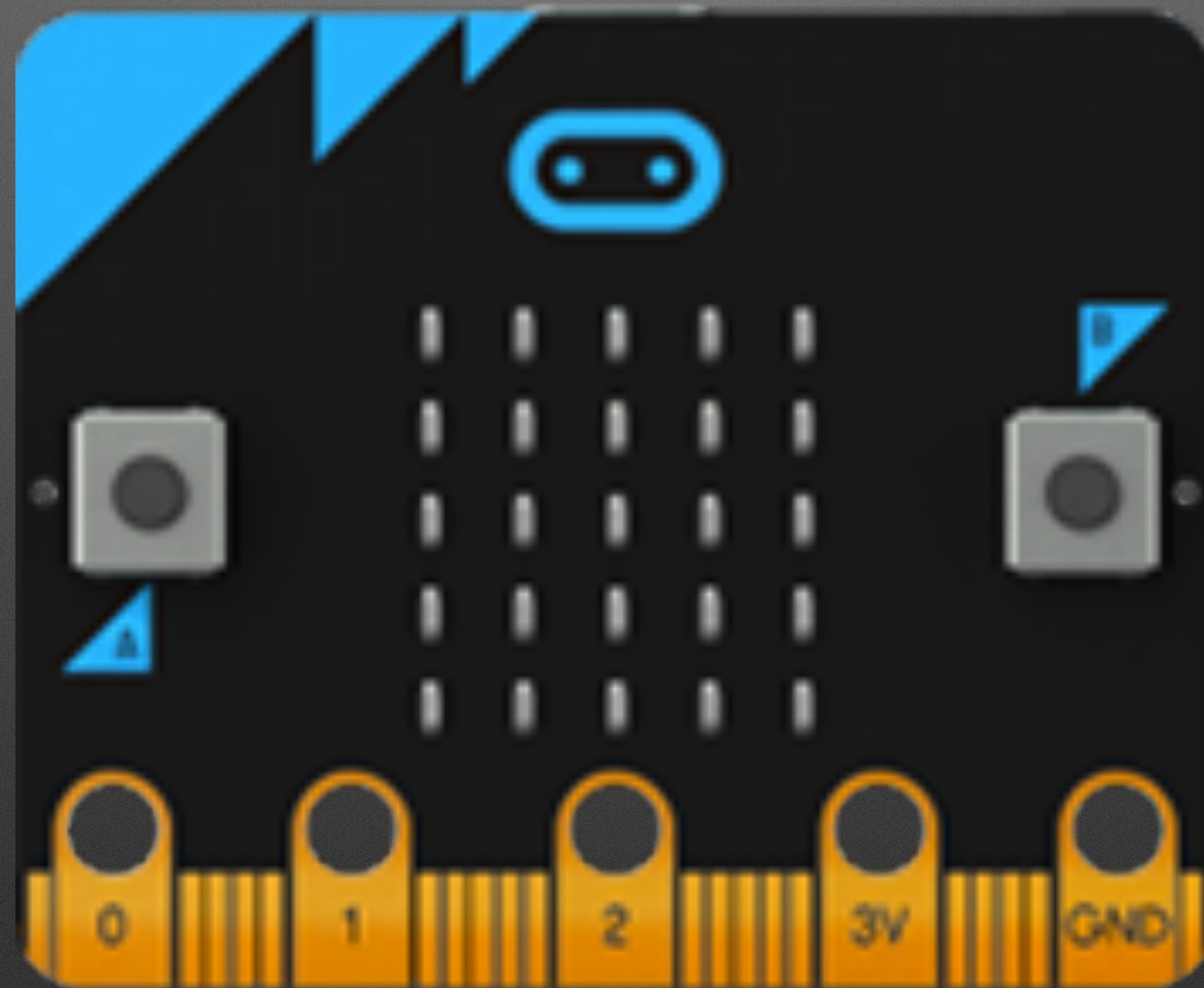
Connectors



Light Sensor



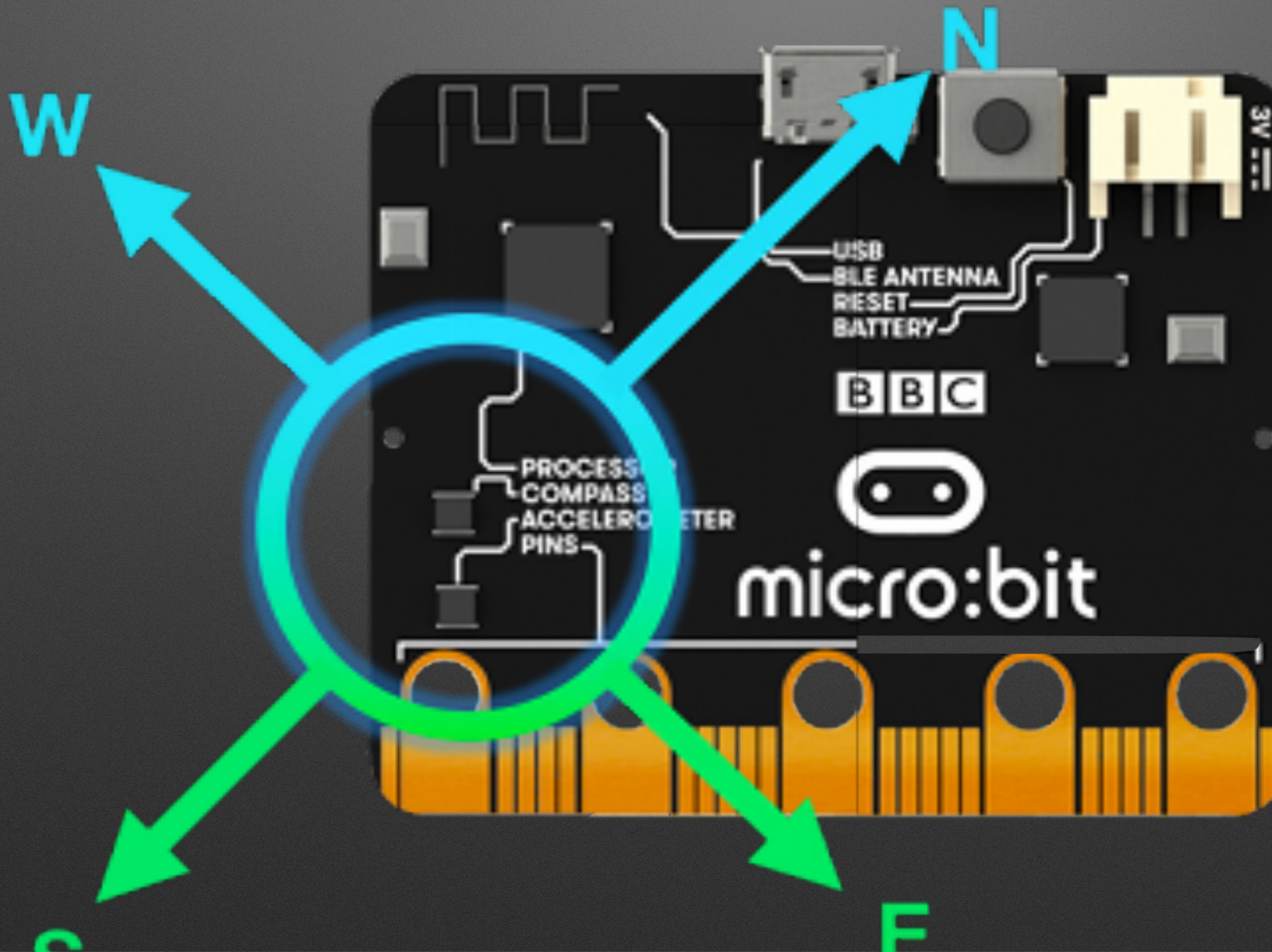
Temperature Sensor



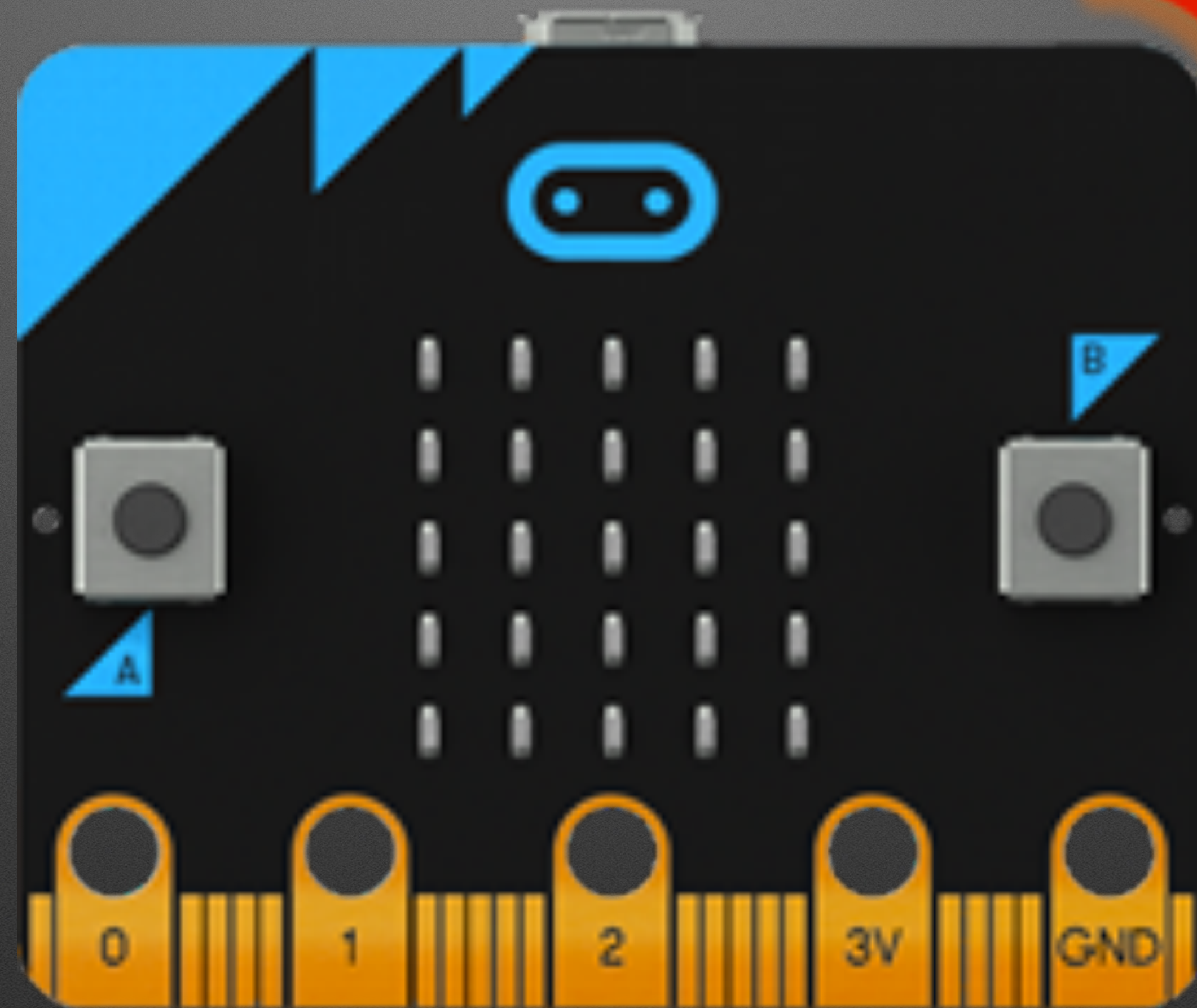
Accelerometer



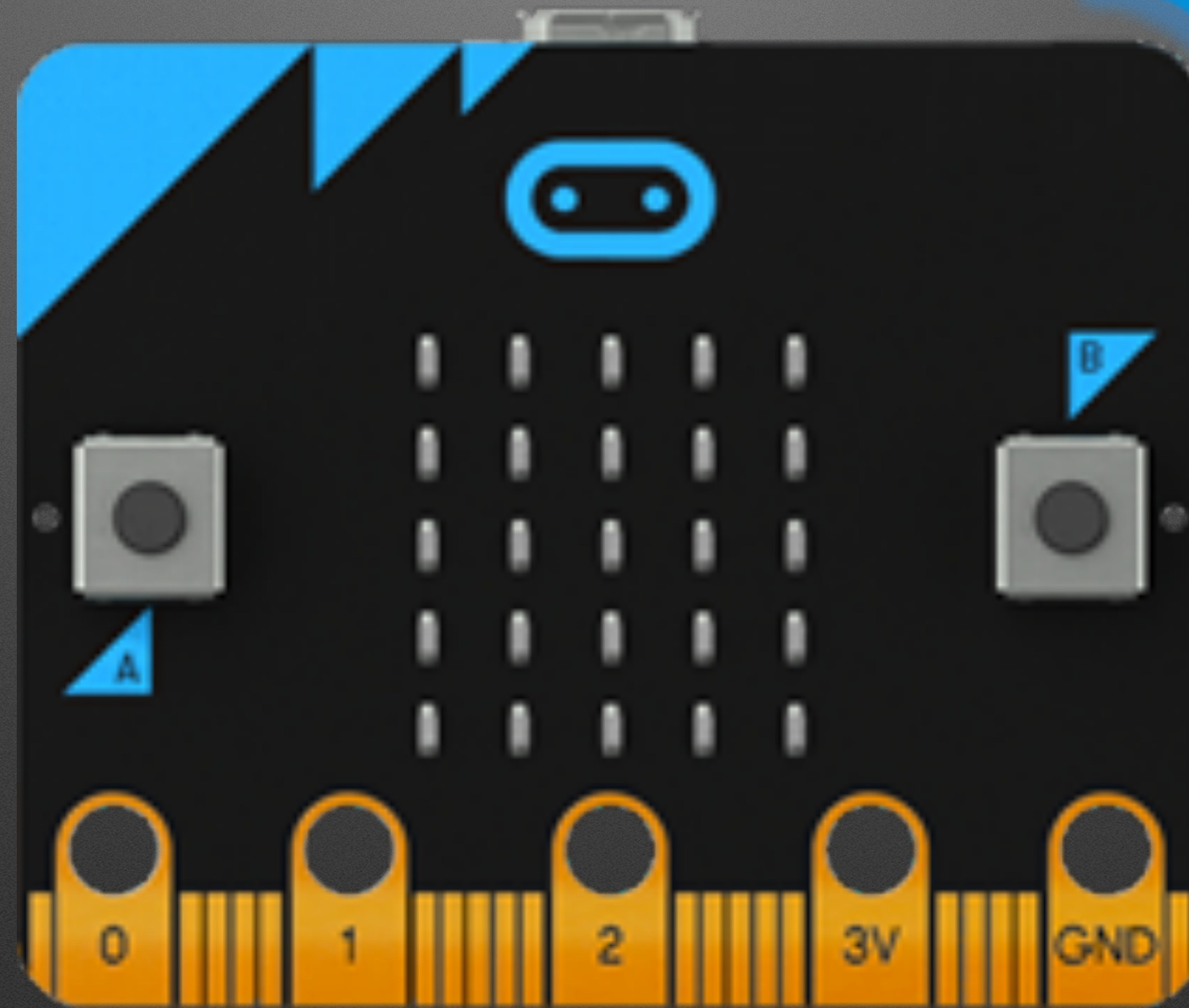
Compass



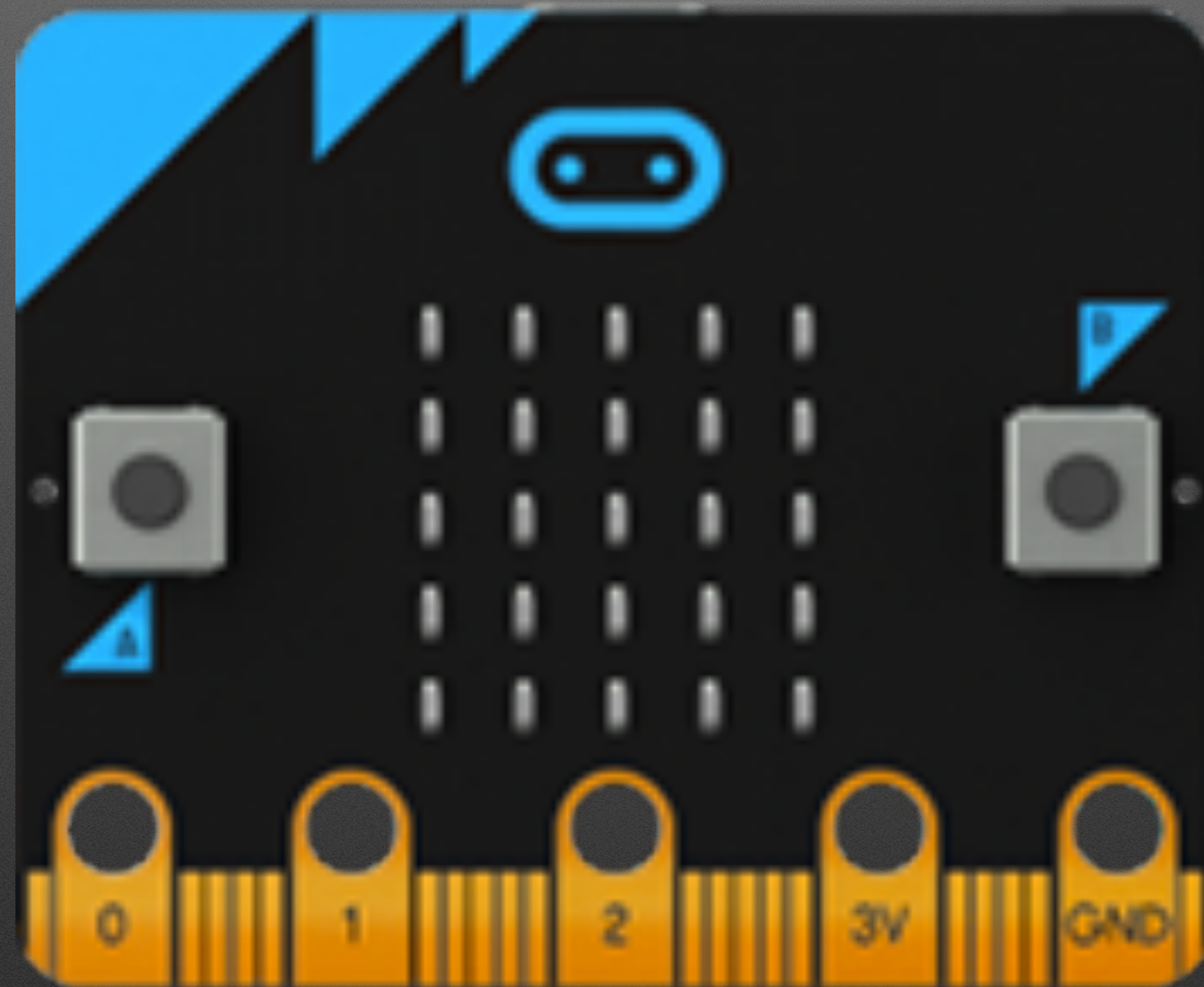
Radio



Bluetooth



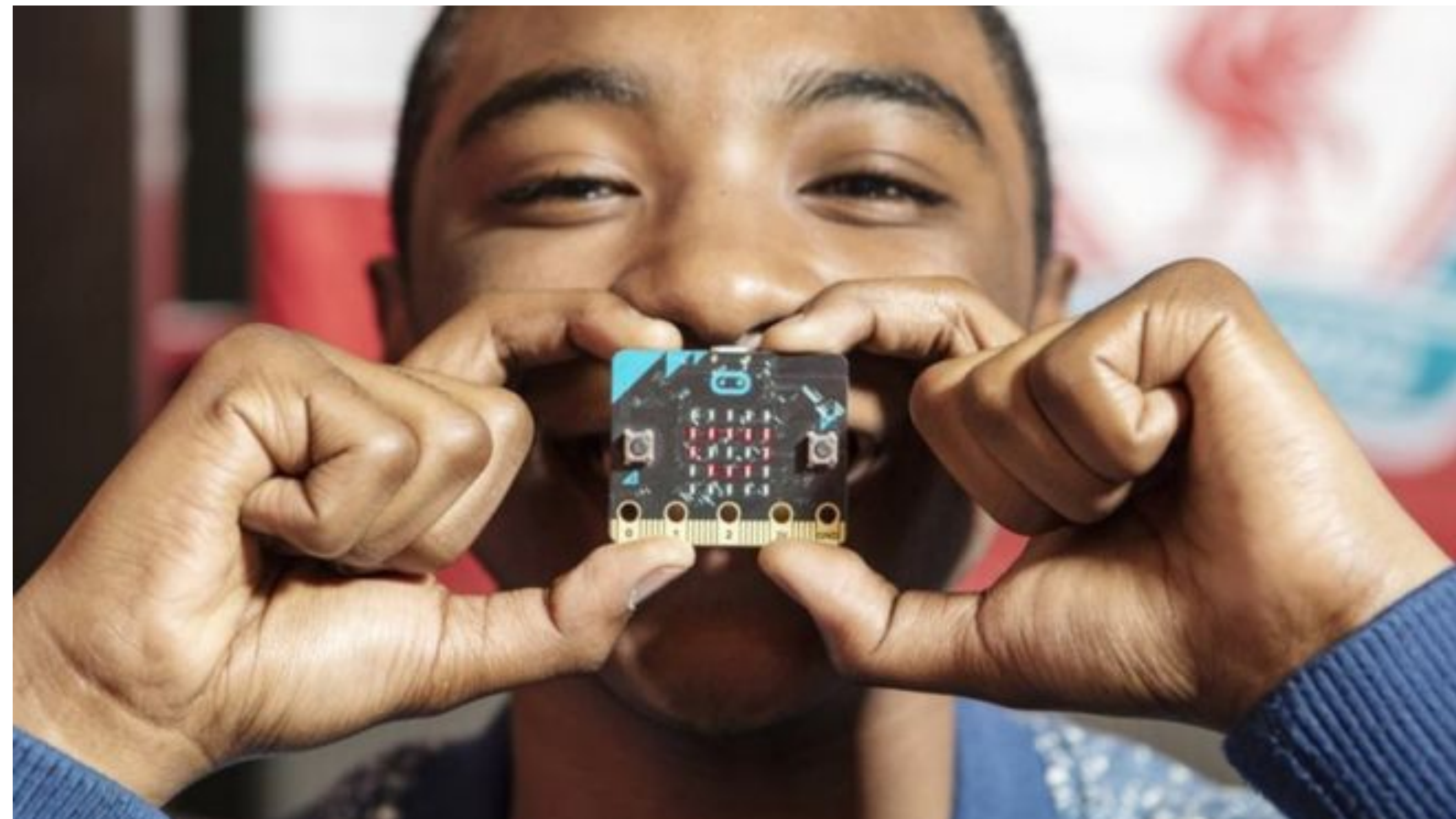
Low Cost: ~\$13 US



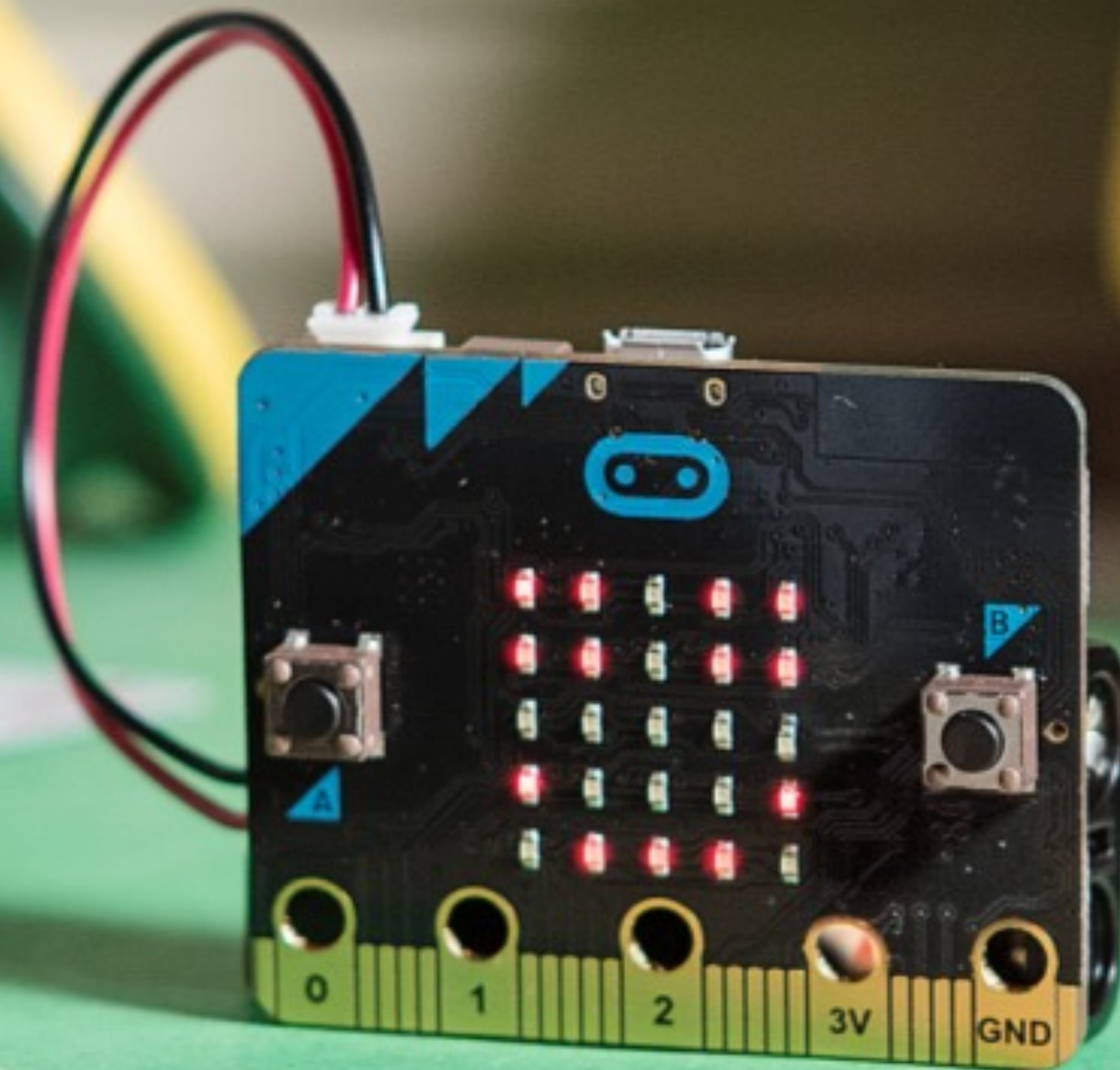
**Thanks: Micro:bit Educational
Foundation
and Hal Speed**

2015

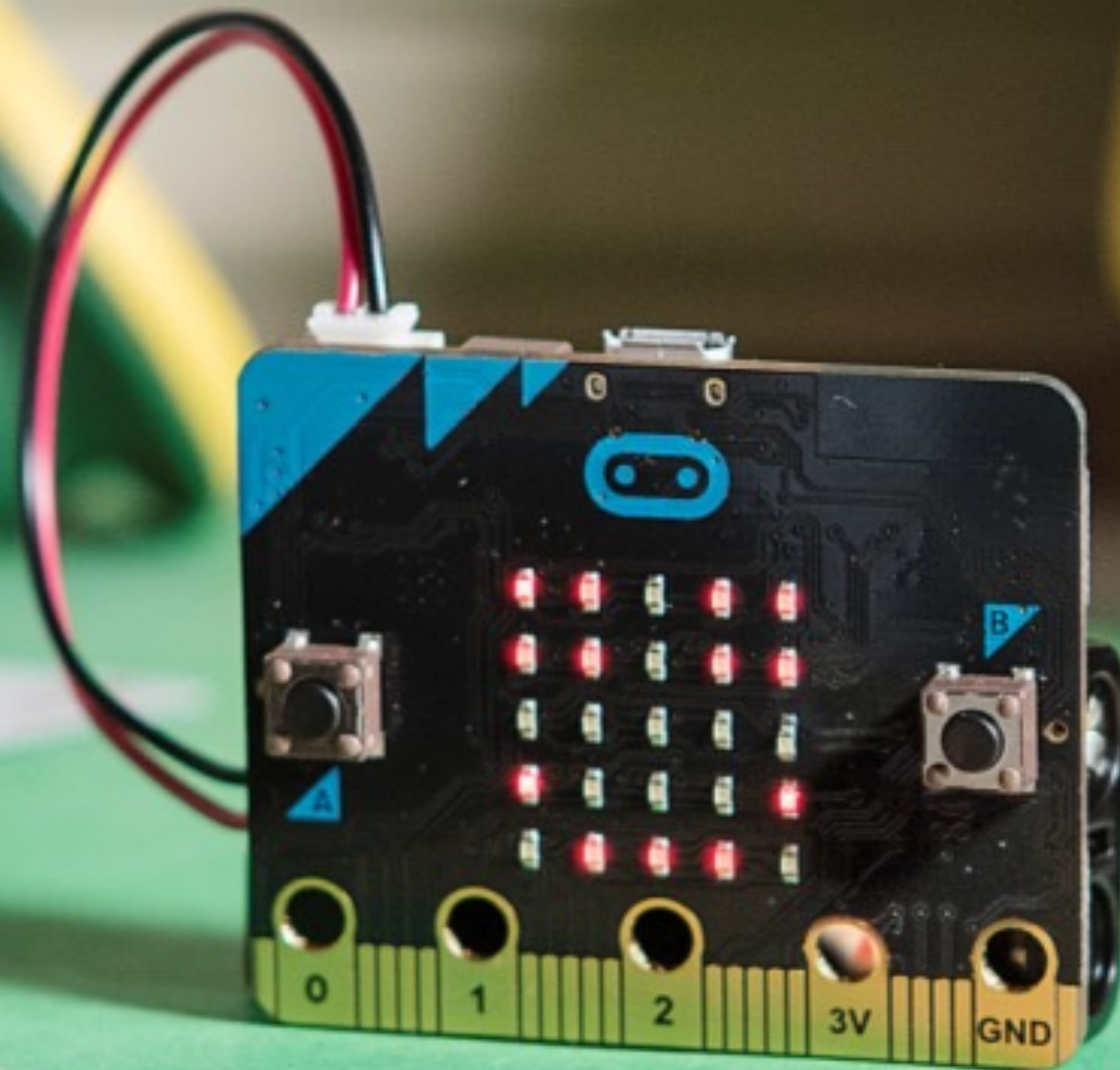
- BBC Make It Digital
- 29 partners
- 1 million micro:bit devices
- 11-12 year olds
- Across the U.K.



90% of students said it helped
show that anyone can code



70% increase in the number of girls that said they would definitely choose computing



2016 Micro:bit Educational Foundation Formed

To empower children, parents and teachers around the globe to learn and innovate using the micro:bit

2017

micro:bit available in the U.S.



10 New & Innovative EdTech
Products Announced at ISTE 2017

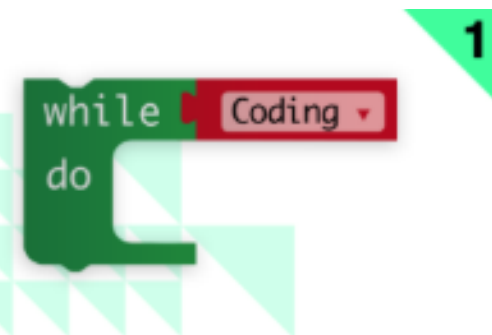
Lessons Aligned to Code.org CS Fundamentals

- Lessons extend the concepts taught in the Code.org curriculum by using micro:bit and MakeCode
 - Course E – Loop and Functions
 - Course F – Variables and Conditionals



4th Grade
Course E

5th Grade
Course F



Lesson
Course E - Loops 1 - Loops and Animations



Lesson
Course E - Loops 2 - Nested Loops and Scoreboards



Lesson
Course E - Functions 1 - A Simple Function for a Superhero



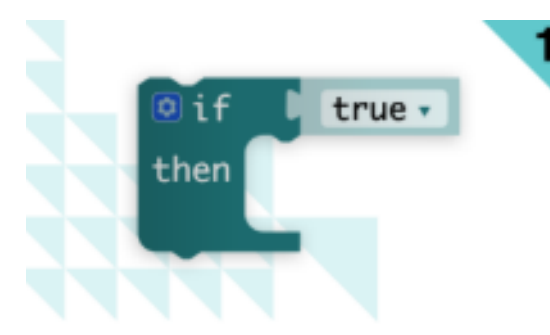
Lesson
Course E - Functions 2 - Functions for a Digital Pet



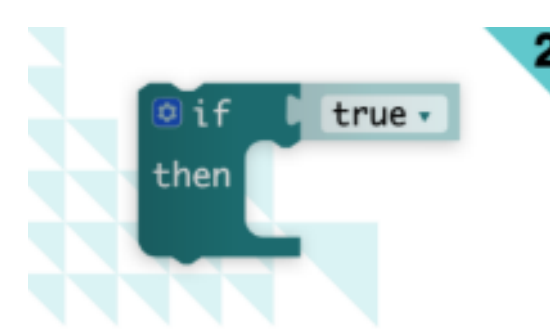
Lesson
Course F - Variables 1 - Variables With A Counter



Lesson
Course F - Variables 2 - Variables and Emotions



Lesson
Course F - Conditionals 1 - Conditionals with the Weather Predictor



Lesson
Course F - Conditionals 2 - Conditionals with Rock Paper Scissors Game

Third-Party Curricula



Microsoft MakeCode Intro to CS

<https://aka.ms/intro2cs>

- | | |
|---------------------------|-------------------------------|
| 1. Making | 8. Coordinate Grid System |
| 2. Algorithms | 9. Booleans |
| 3. Variables | 10. Music and Arrays |
| 4. Conditionals | 11. Bits, Bytes, and Binary |
| 5. Iteration | 12. Radio |
| 6. Review/Mini-Project | 13. Arrays |
| 7. Coordinate Grid System | 14. Independent Final Project |



PLTW Gateway:
Computer Science for
Innovators and Makers

<https://www.pltw.org/our-program-pltw-gateway-curriculum#curriculum-4>

Let's Play



“Hello, World!”: First Program



“Hello, World!”: First Program

- Block-based editor



“Hello, World!”: First Program

- Block-based editor





“Hello, World!”: First Program

- Block-based editor
- Built-in simulator





“Hello, World!”: First Program

- Block-based editor
- Built-in simulator
- Deployment to Micro:bit





“Hello, World!”: First Program

- Block-based editor
- Built-in simulator
- Deployment to Micro:bit

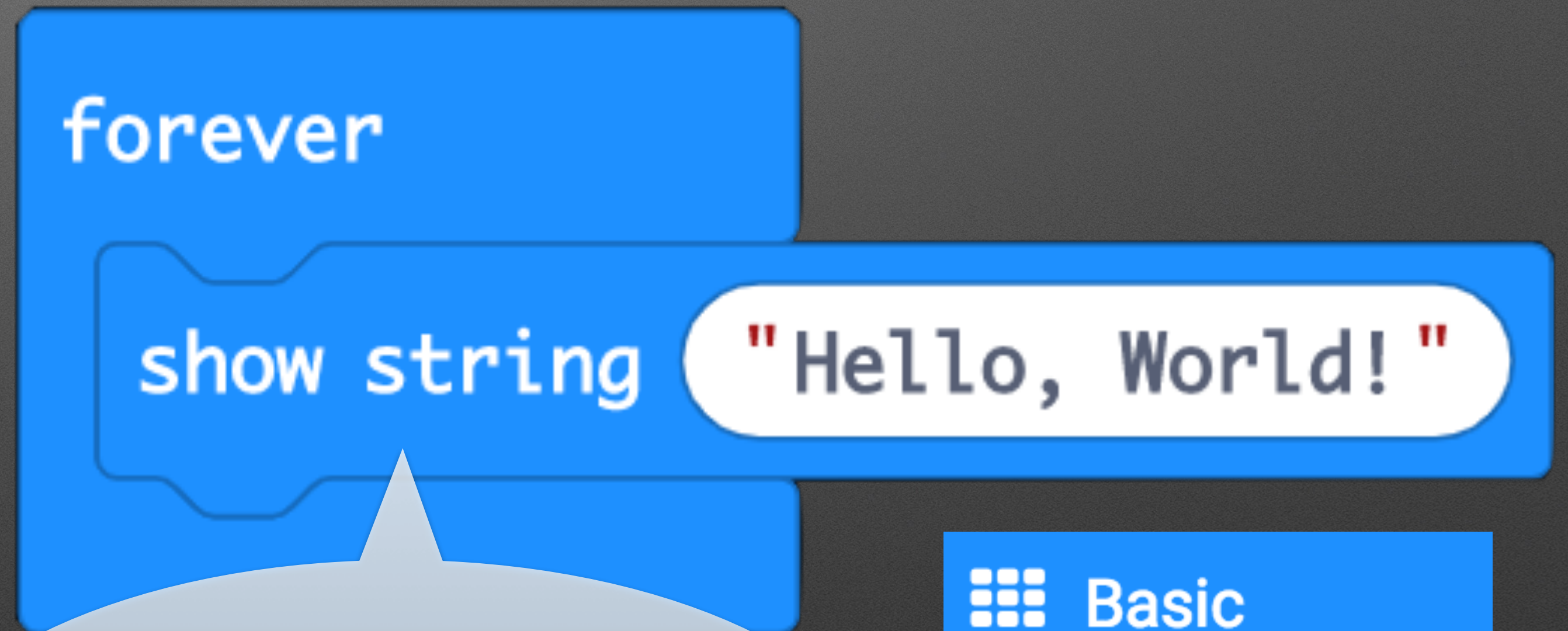


Block Color Indicates Palette

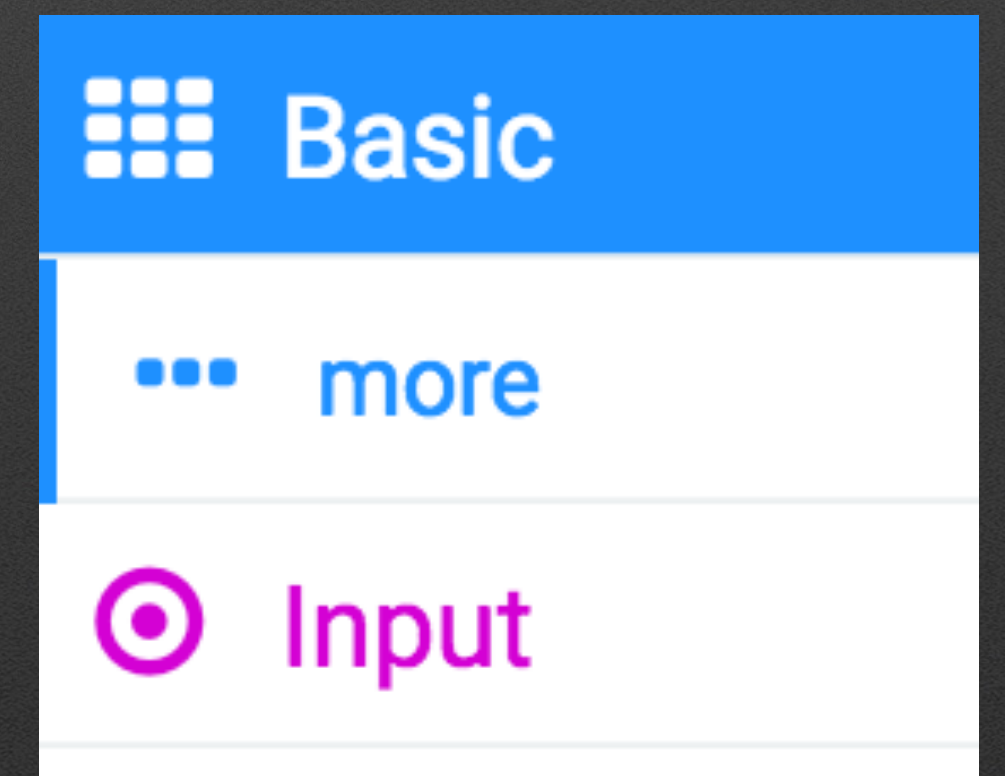


“Hello, World!”: First Program

- Block-based editor
- Built-in simulator
- Deployment to Micro:bit



Block Color Indicates Palette



Blocks are just the beginning...

Blocks are just the beginning...

- JavaScript

Blocks are just the beginning...

- JavaScript
- Python w/ REPL

Blocks are just the beginning...

- JavaScript
- Python w/ REPL
- Arduino / C++

Blocks are just the beginning...

- JavaScript
- Python w/ REPL
- Arduino / C++
- Commercial IDEs / C++

Workshop Format

Workshop Format

- Moderate pace with small examples

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- Only covering blocks-based approach

Workshop Format

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- Only covering blocks-based approach
- Will cover many “building blocks”, but not much depth

Workshop Format

- Moderate pace with small examples
- Only covering blocks-based approach
- Will cover many “building blocks”, but not much depth
 - Putting pieces together for awesome projects left as an exercise for you...



Setup

- Hardware Handout
 1. Open Box
 2. Pull out micro:bit
 3. Pull out micro USB cable (under cardboard)
 4. Connect via USB cable

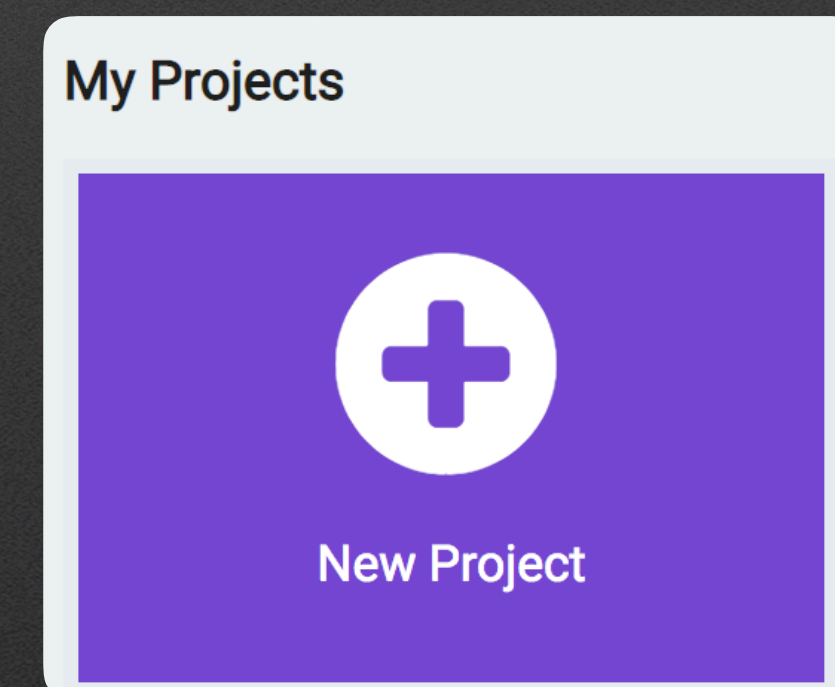


Setup

- Browser
 1. Open microbit.org
 2. Select “Let’s Code”
 3. Click “Let’s Code” button on MakeCode
 4. Select “New Project”

Let's Code

Let's Code



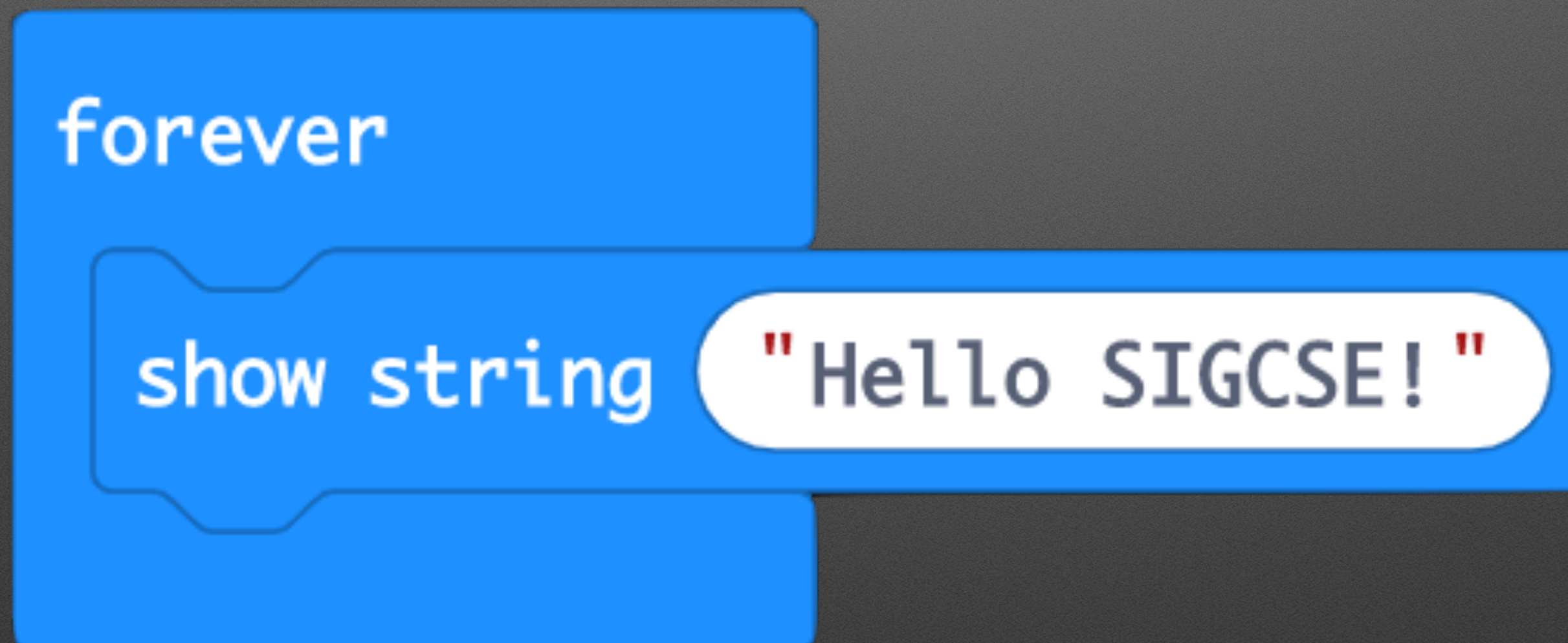
Personalization!

Personalization!

- Hello Bill / Hello Michael / Hello

Personalization!

- Hello Bill / Hello Michael / Hello



Aside: Text-based Languages

 micro:bit

 Home



 Blocks

 JavaScript

Aside: Storage

Aside: Storage

- Projects are stored in the cloud

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- Projects are stored in the cloud
 - No accounts (by default, but GitHub repositories can be used)

Aside: Storage

- Projects are stored in the cloud
 - No accounts (by default, but GitHub repositories can be used)
 - Based on *machine you're on!*

Aside: Storage

- Projects are stored in the cloud
 - No accounts (by default, but GitHub repositories can be used)
 - Based on *machine you're on!*
- But...Downloaded files can be restored via Drag & Drop!

WebUSB

WebUSB

- Why: Get rid of Files!

WebUSB

- Why: Get rid of Files!
 - Faster programming

WebUSB

- **Why: Get rid of Files!**
 - **Faster programming**
 - **Additional Features: a Console!**

WebUSB

- Why: Get rid of Files!
 - Faster programming
 - Additional Features: a Console!
- How: Chrome 65+ & Setup



WebUSB Setup

1. Go to Gear Menu

2. Select Pair Device

The screenshot shows the Microsoft Edge browser's gear menu. The menu is open, displaying various settings and options. The 'Pair device' option is highlighted with a grey background. A red arrow points from the text '1. Go to Gear Menu' to the gear icon in the top left of the menu. Another red arrow points from the text '2. Select Pair Device' to the 'Pair device' option.

- Project Settings
- Extensions
- Delete Project
- Report Abuse...
- Language
- High Contrast On
- Reset
- Pair device**
- Pair Bluetooth
- About...




Setup: Chrome v65+

3. Select Pair Device

Pair device for one-click downloads

First time here?
You must have version 0249 or above of the firmware



Check your firmware version here and update if needed

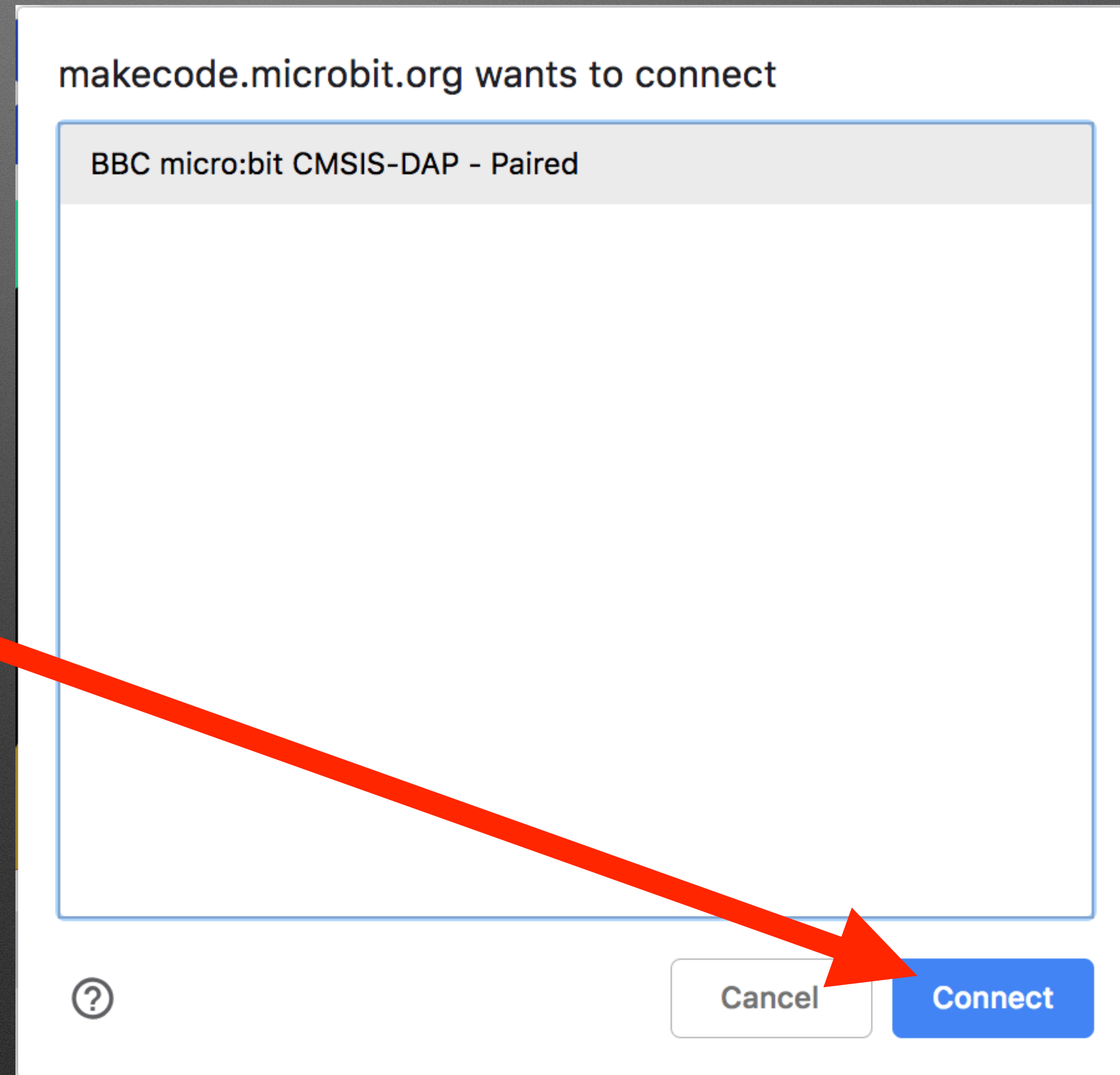
- 1** Connect the micro:bit to your computer with a USB cable
Use the microUSB port on the top of the micro:bit
- 2** Pair your micro:bit
Click 'Pair device' below and select BBC micro:bit CMSIS-DAP or DAPLink CMSIS-DAP from the list

Help ? **Pair device**



Setup: Chrome v65+

4. Connect

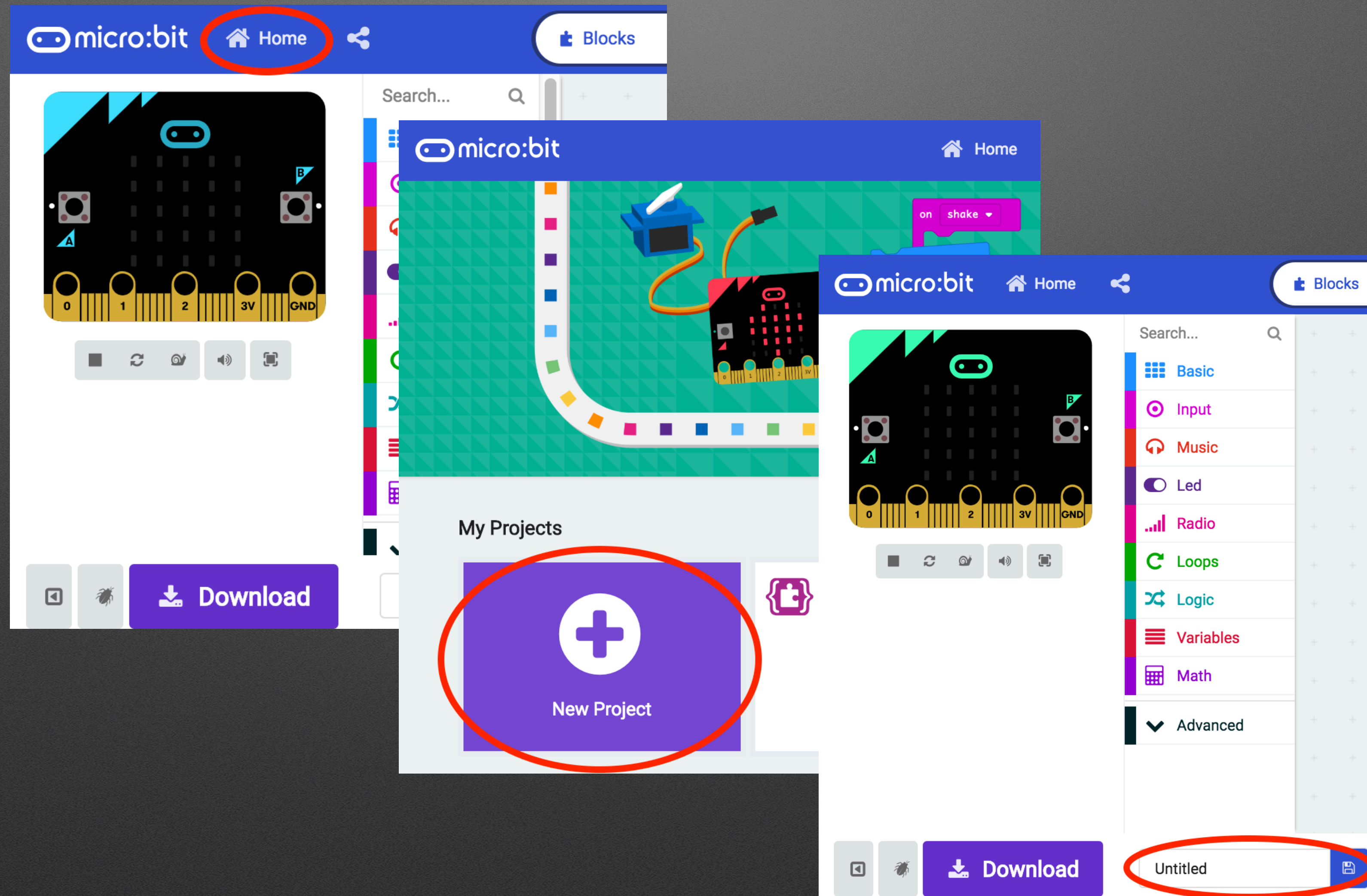


Try It!

 Download

New Project: Home > New Project...

New Project: Home > New Project...



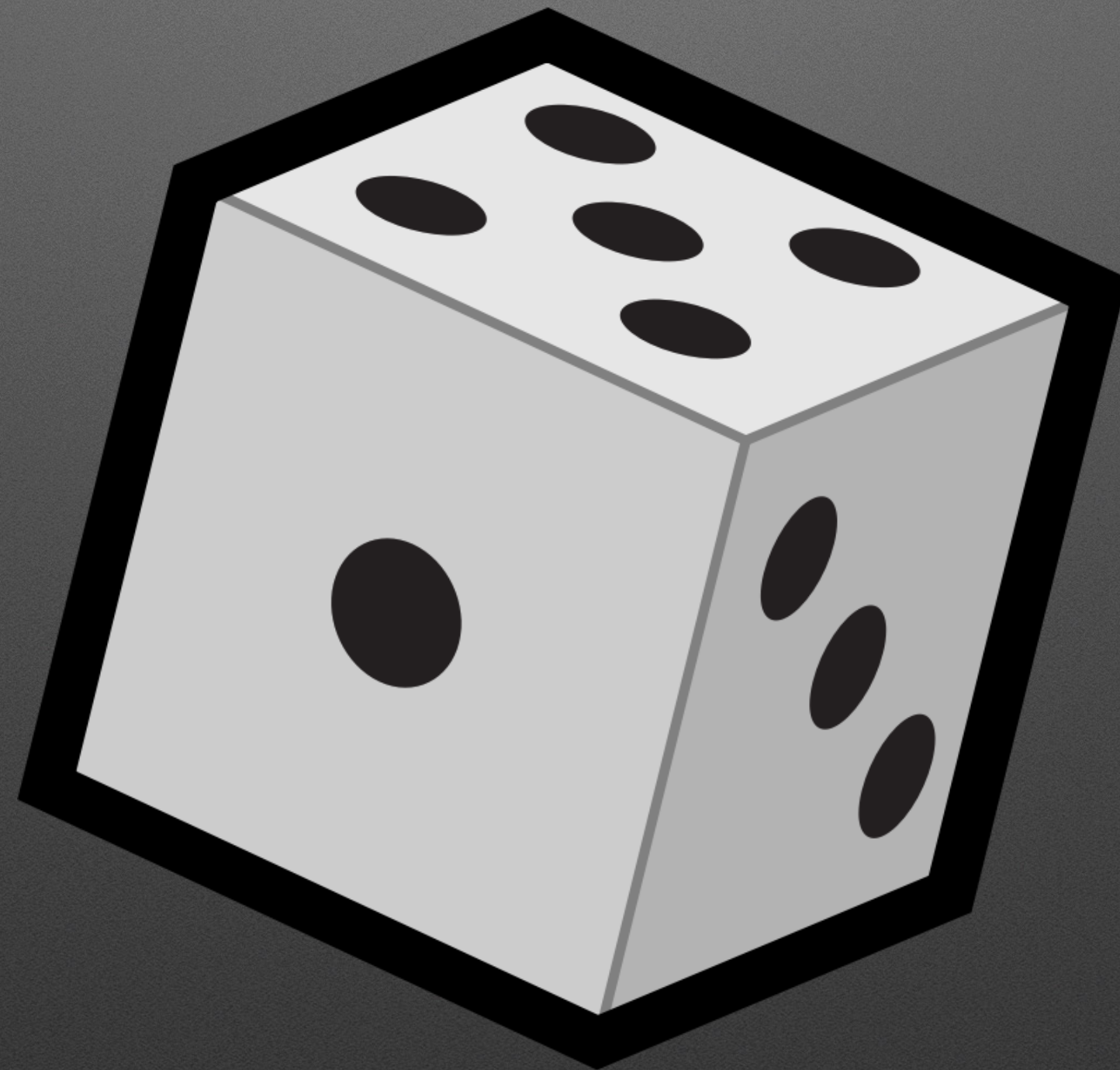


Programming: Logic & Action

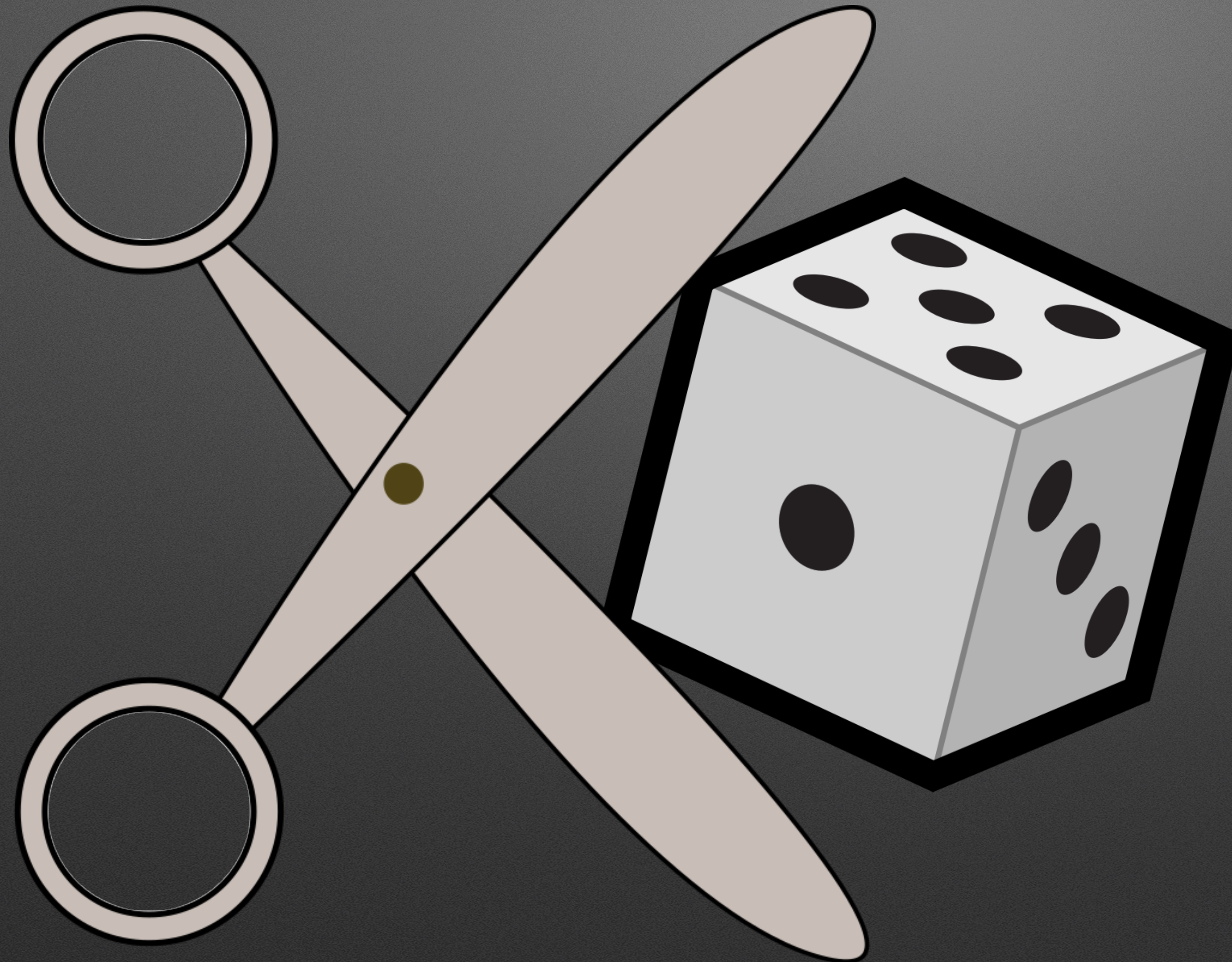
- Picking between *three* tough choices
 - Cookie, Cake, Pie
 - Super Strength, Invisibility, Telekinesis
 - ...

Obvious Solution...

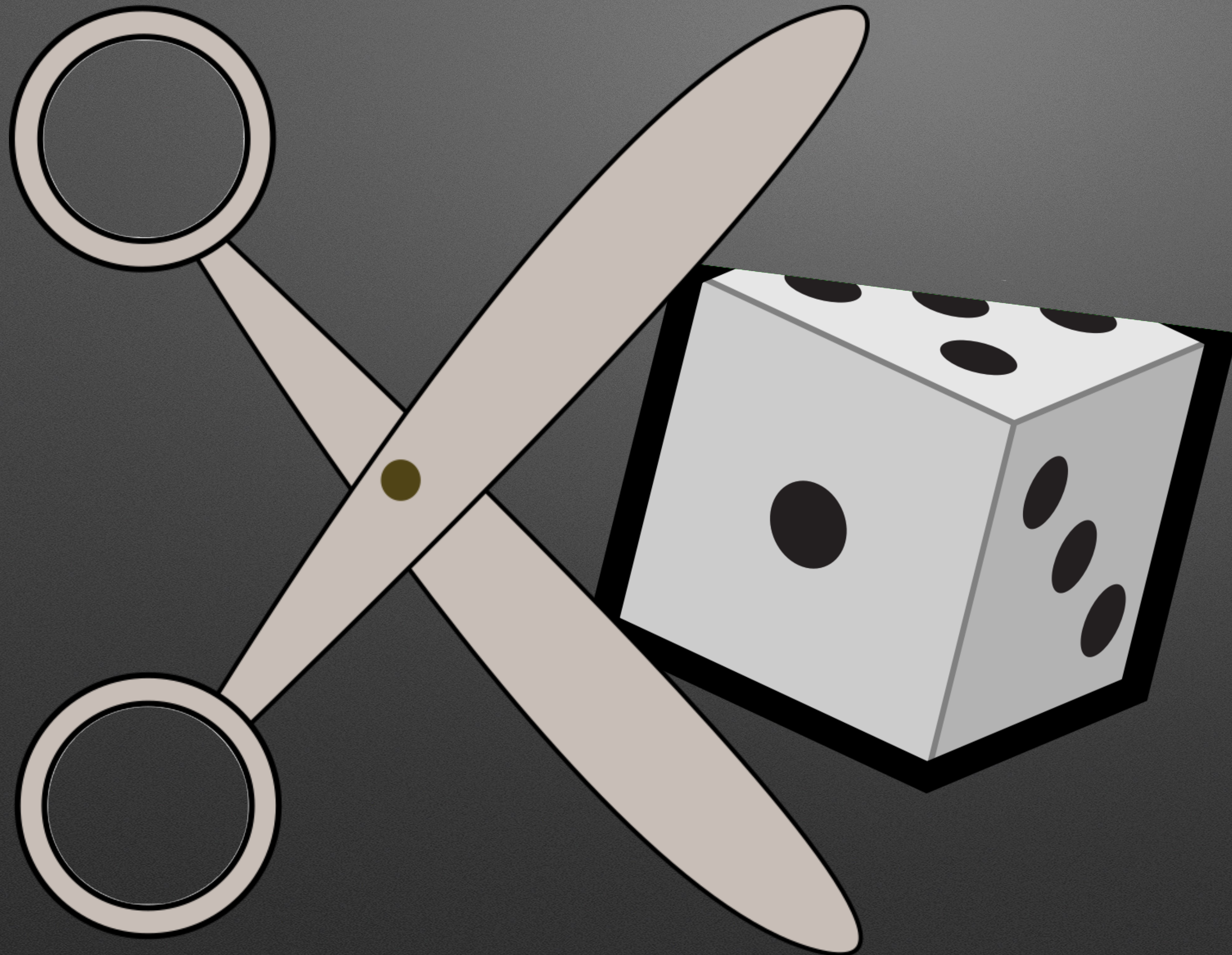
Obvious Solution...



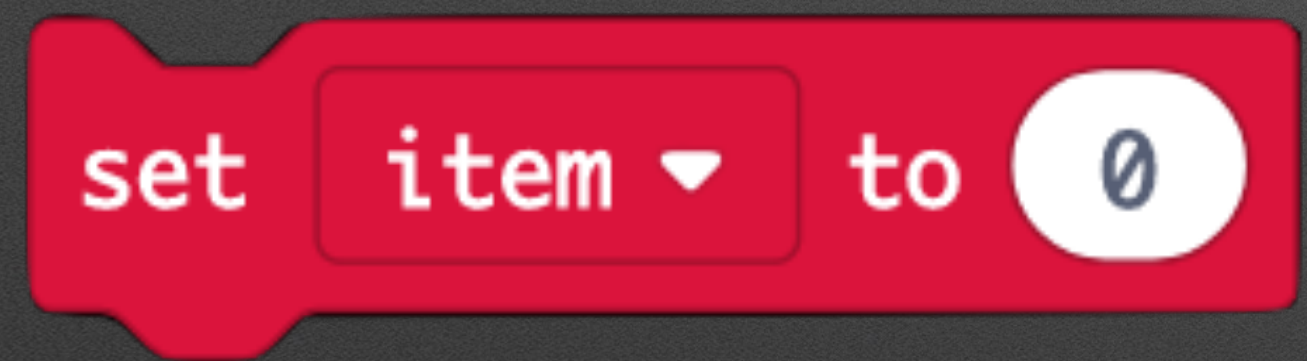
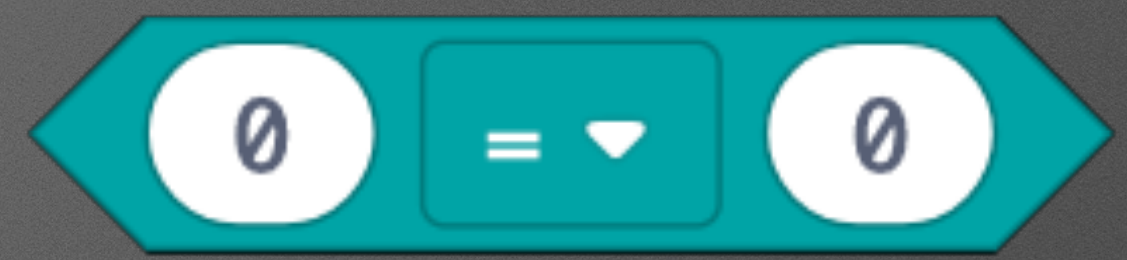
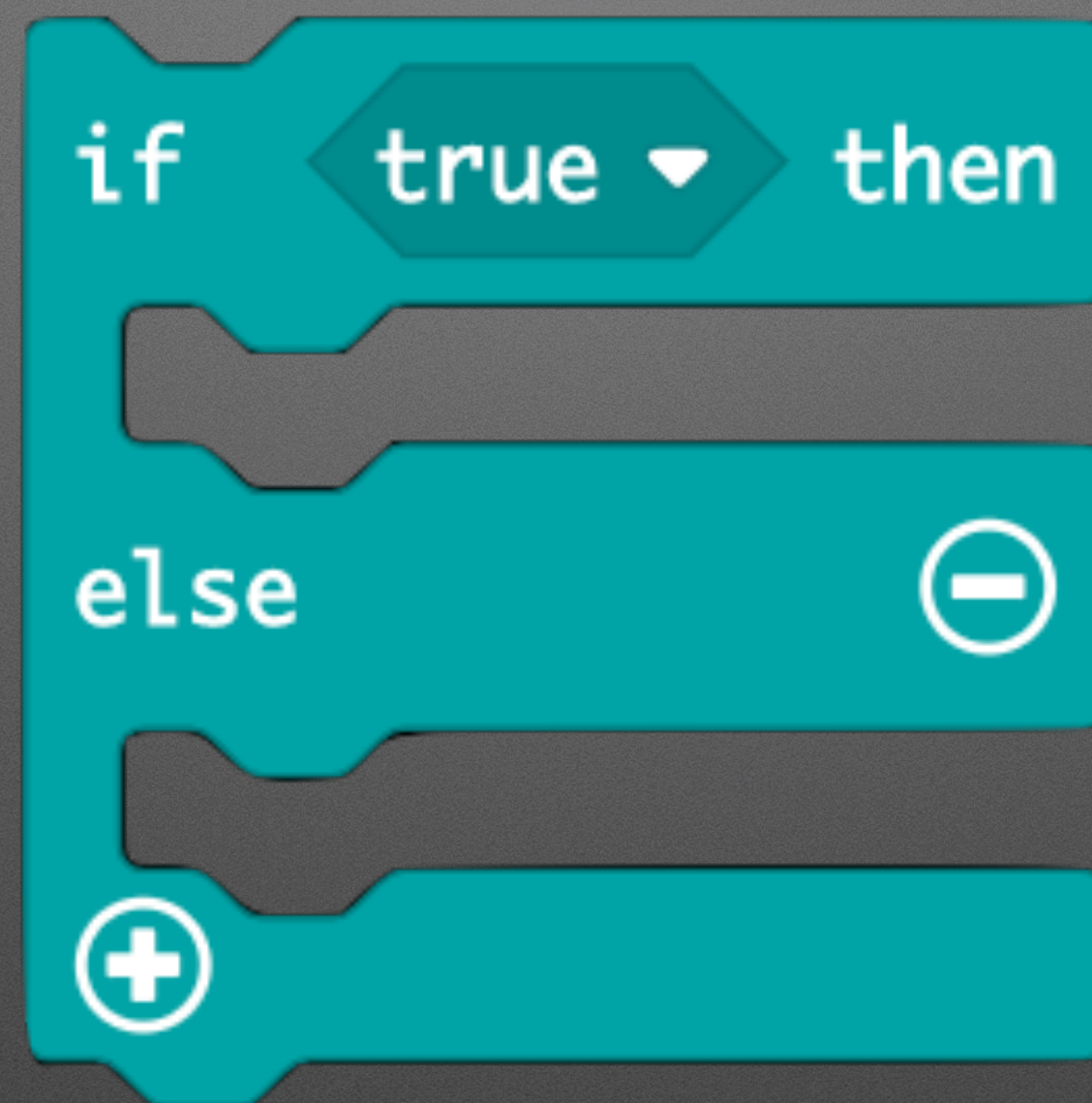
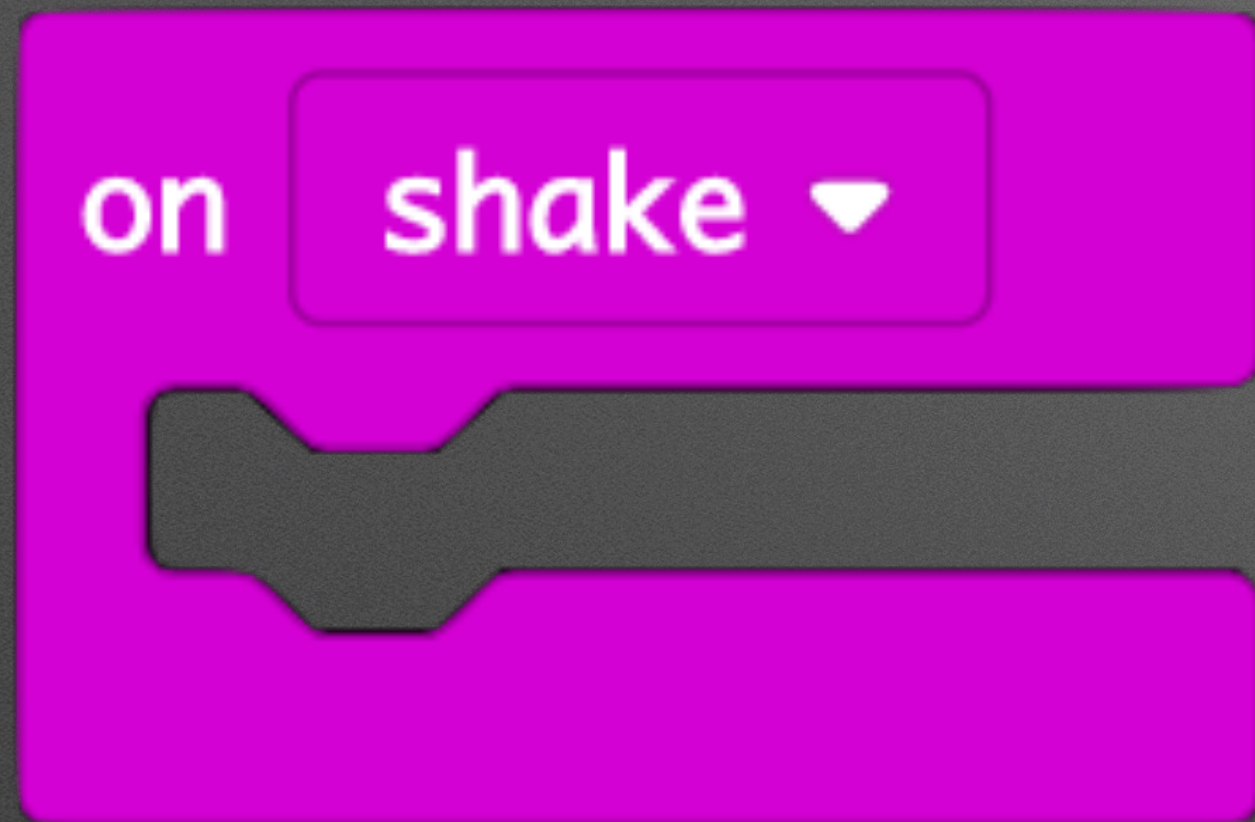
Obvious Solution...



Obvious Solution...



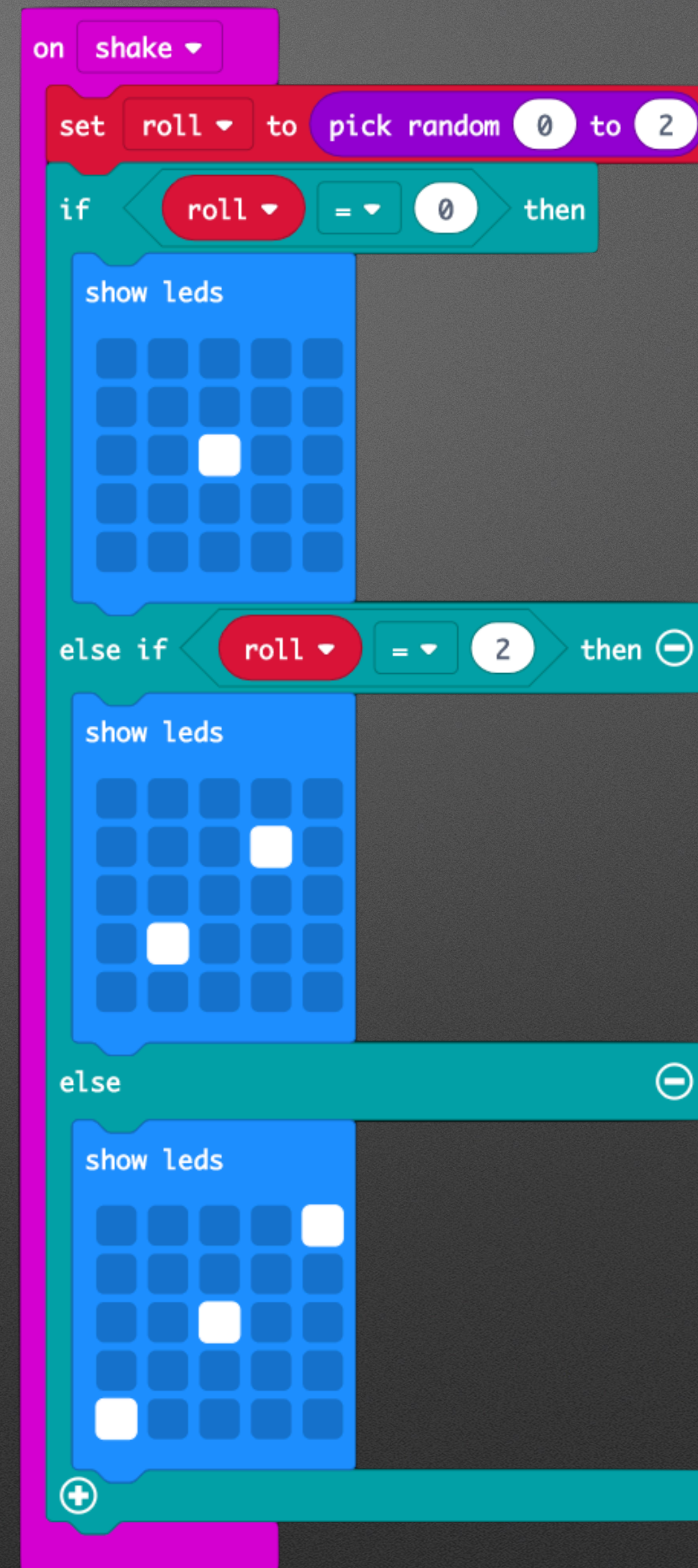
Parts



1. Color indicates Palette
2. Incremental Development:
Try parts in Simulator
3. Play...Start with showing 0/1

Let's play...

A solution



Concepts

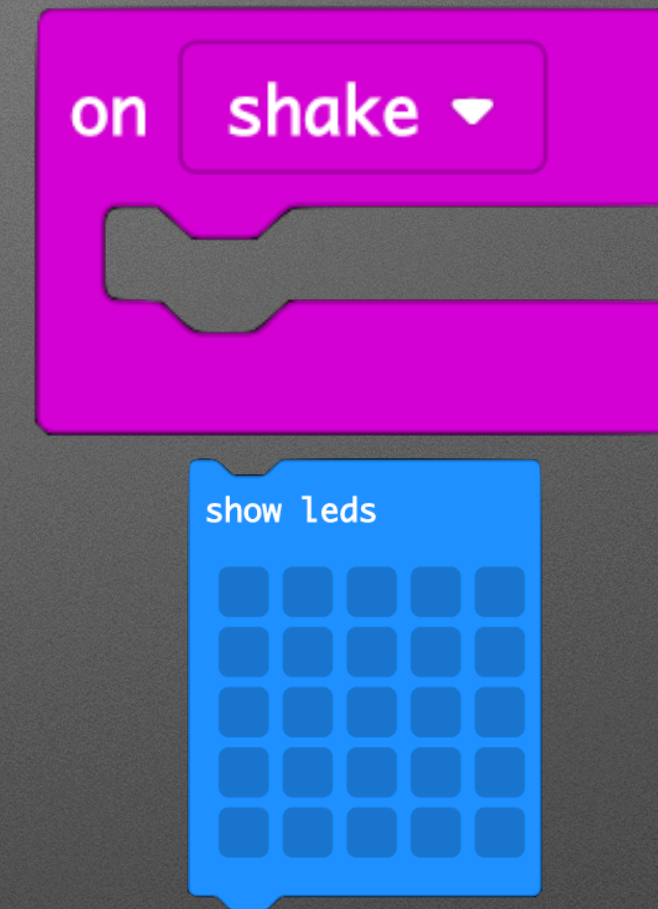
Concepts

- Event driven programming



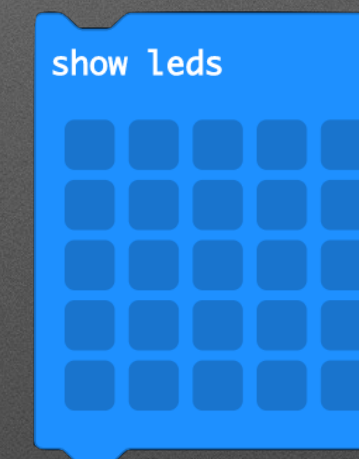
Concepts

- Event driven programming
- Bitmapped Graphics



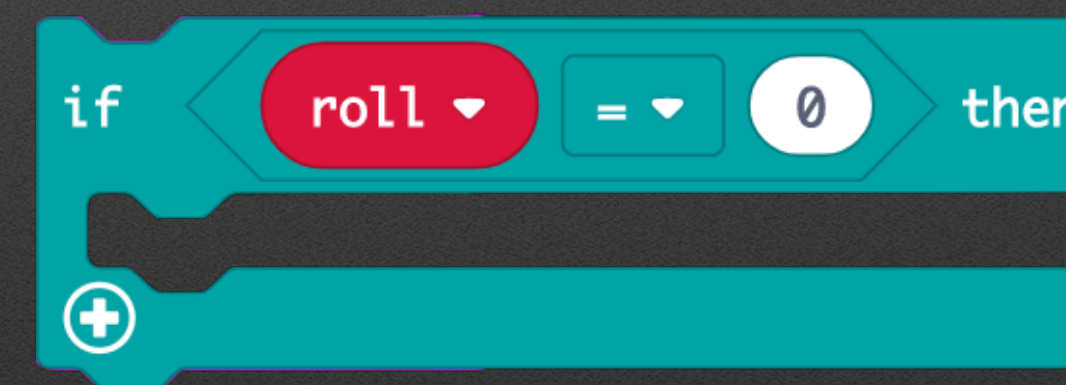
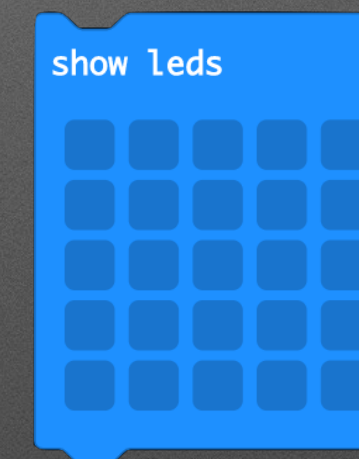
Concepts

- Event driven programming
- Bitmapped Graphics
- Ranges & Representations



Concepts

- Event driven programming
- Bitmapped Graphics
- Ranges & Representations
- Boolean Logic

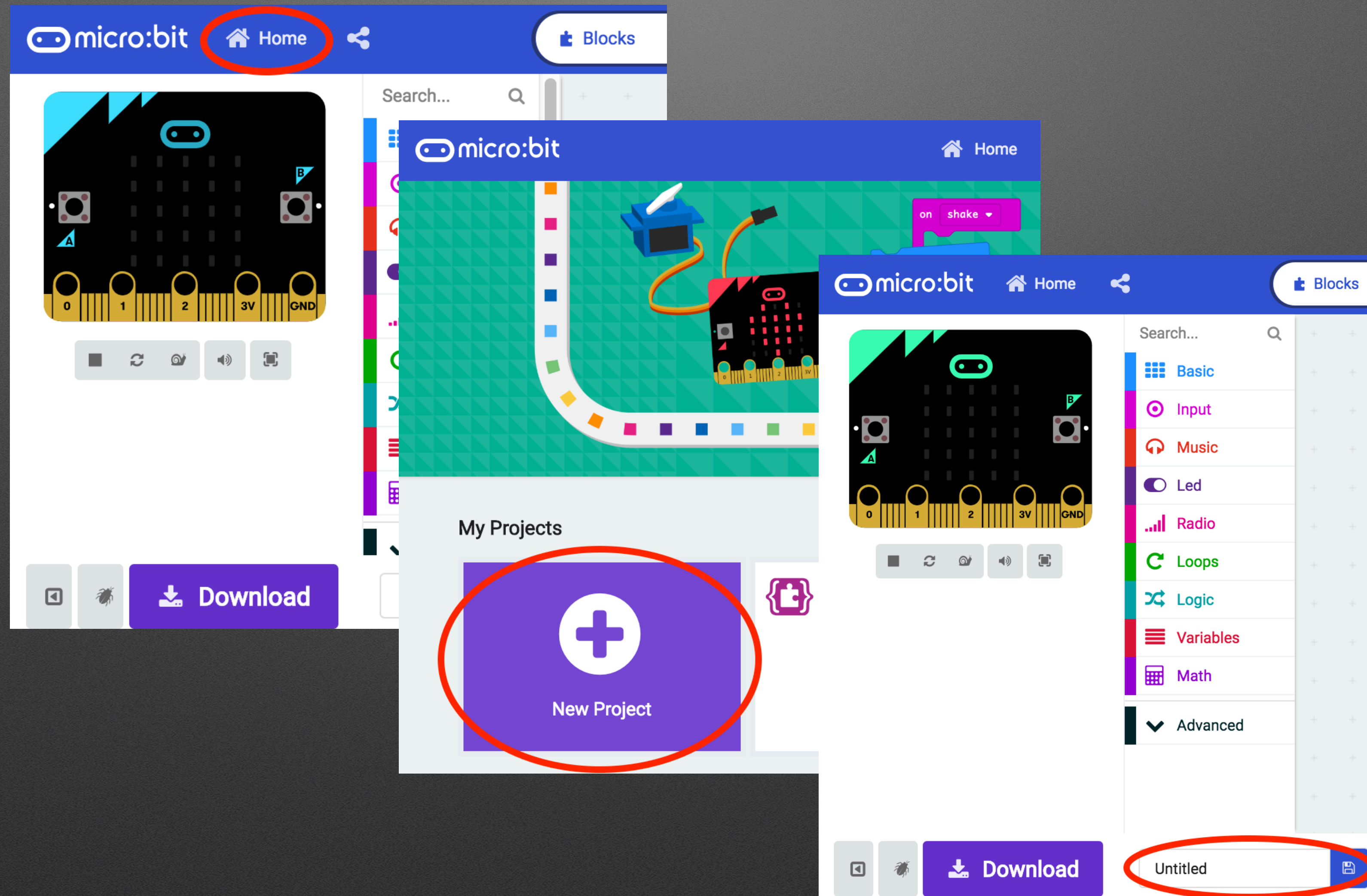


Pedagogy

- Active Learning
- Discovery Based
- Constructionist

New Project: Home > New Project...

New Project: Home > New Project...





Broadcast Basics

- Radio Palette: Broadcast Based Radio Transmissions
 - String, Number, Key/Value Pairs, ...

Receiver

on start

radio set group 1

on radio received receivedNumber ▼

change score by 1

Receiver

```
on start  
  radio set group 1
```

```
on radio received receivedNumber  
  change score by 1
```

“Game” blocks in “Advanced”
Section of Palette

▼ Advanced

Full Boadcaster

on radio received

change score by

on button pressed

radio send number

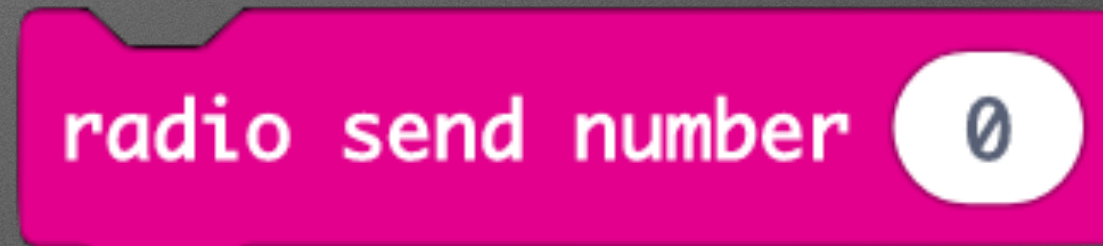
on start

radio set group

Concepts

Concepts

- Broadcasting



Concepts

- Broadcasting
- Network Addresses

radio send number 0

radio set group 1

Concepts

- Broadcasting
- Network Addresses
- Asynchronous clocks / Sync problems

radio send number 0

radio set group 1

on radio received receivedNumber ▼



& Firefly Fun



& Firefly Fun

micro:bit **Home** Blocks

Search...

- Basic
- Input
- Music
- Led
- Radio

Radio Games



Multi Dice



Mood Radio



Tele-potato



Fireflies

Concepts

Concepts

- Broadcasting

 radio send number 

Concepts

- Broadcasting
- Network Addresses

radio send number 0

radio set group 1

Concepts

- Broadcasting
- Network Addresses
- Asynchronous clocks / Sync problems

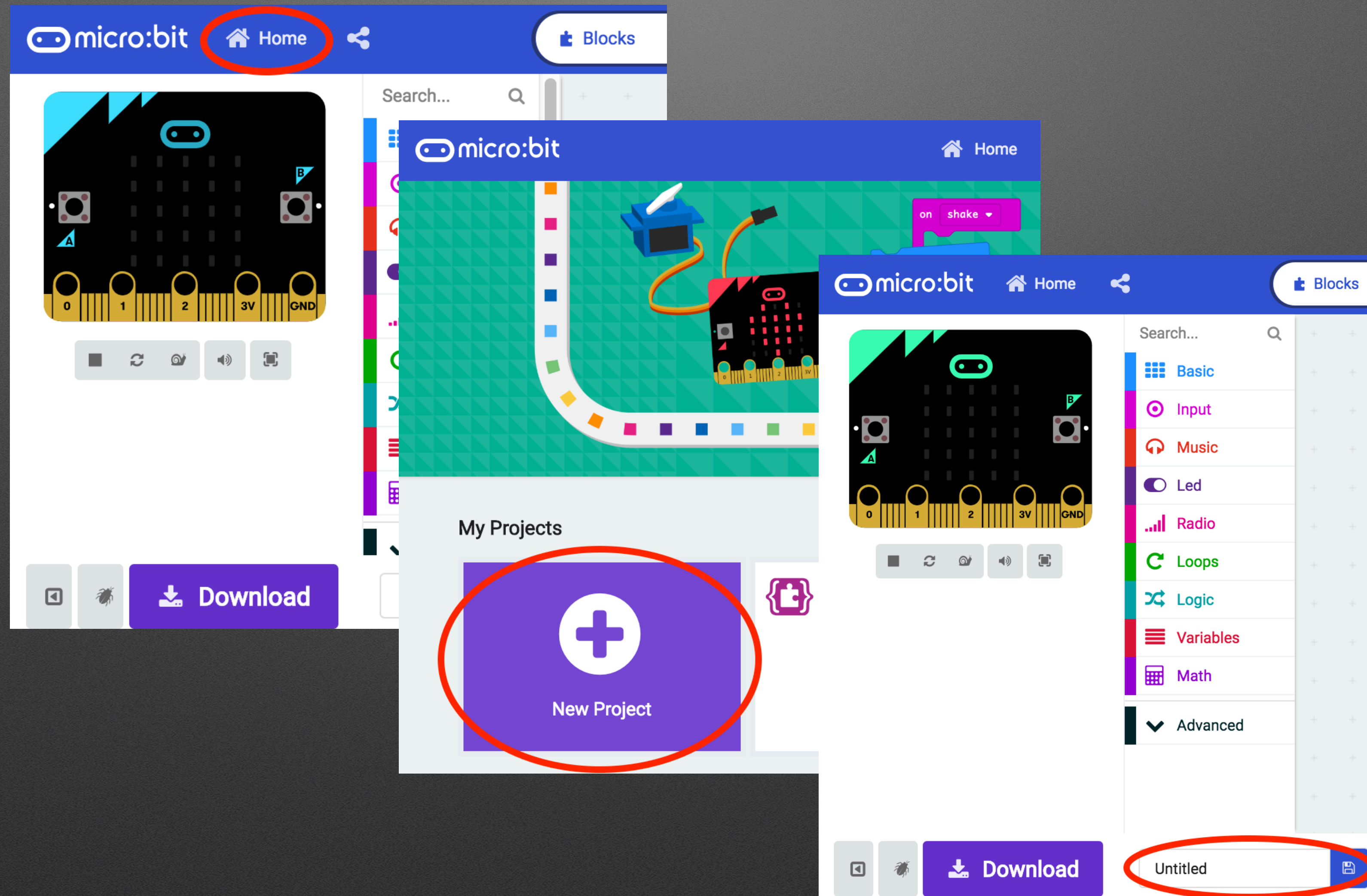
radio send number 0

radio set group 1

on radio received receivedNumber

New Project: Home > New Project...

New Project: Home > New Project...



Goody Bag: Hardware



Awesome (?) Audio

Parts: 2 Clips + Headphone



Concepts

Concepts

- I/O

Concepts

- I/O
- Basic Electric Circuits/Electronics



Motor Mayhem

An Intro to Servos



Motor Mayhem

An Intro to Servos

on button pressed

servo write pin to

on button pressed

servo write pin to



Motor Mayhem

An Intro to Servos

```
on button A ▼ pressed
  servo write pin P0 ▼ to 0
```

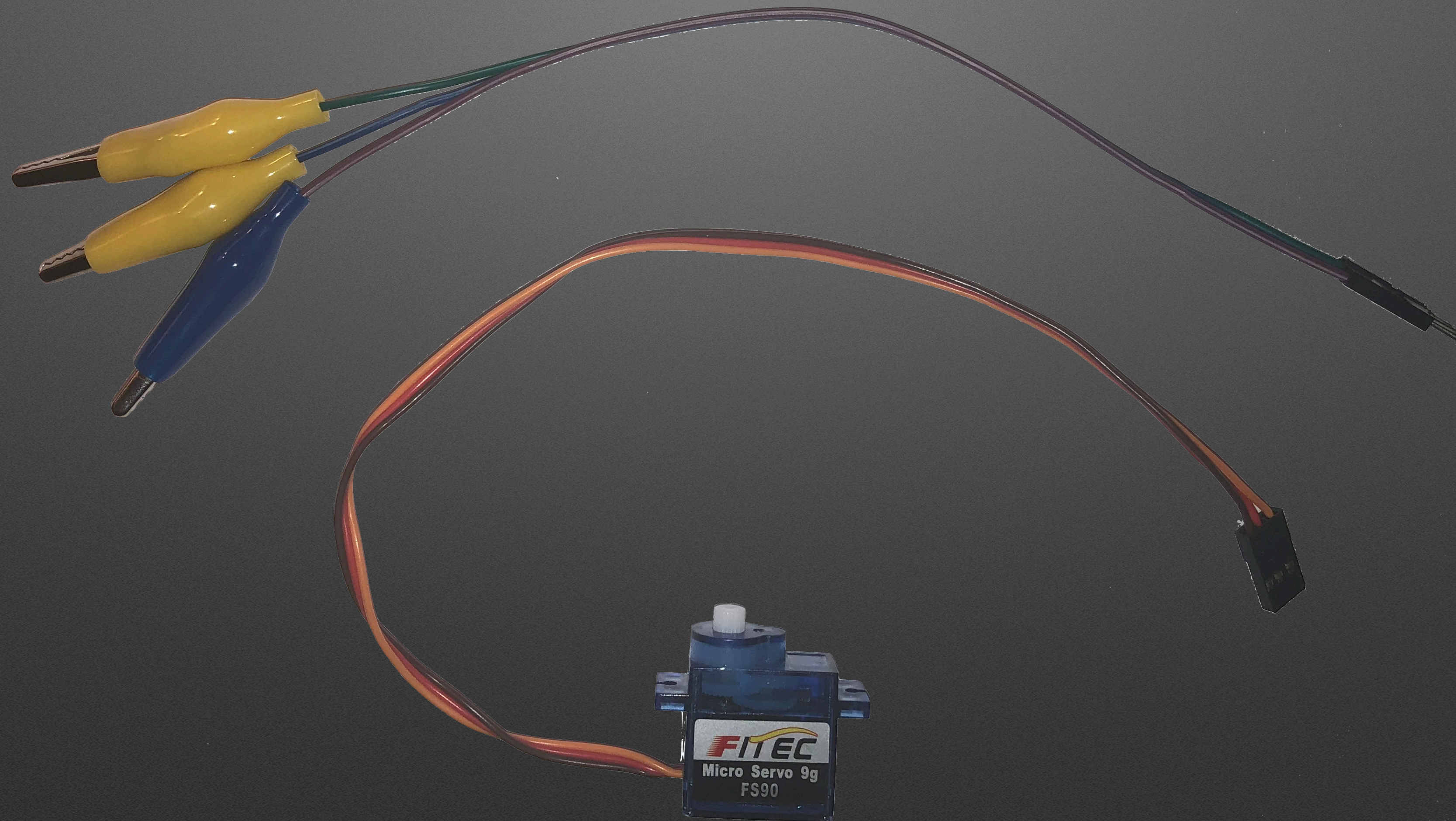
```
on button B ▼ pressed
  servo write pin P0 ▼ to 120
```

These servos are limited to 0-120°

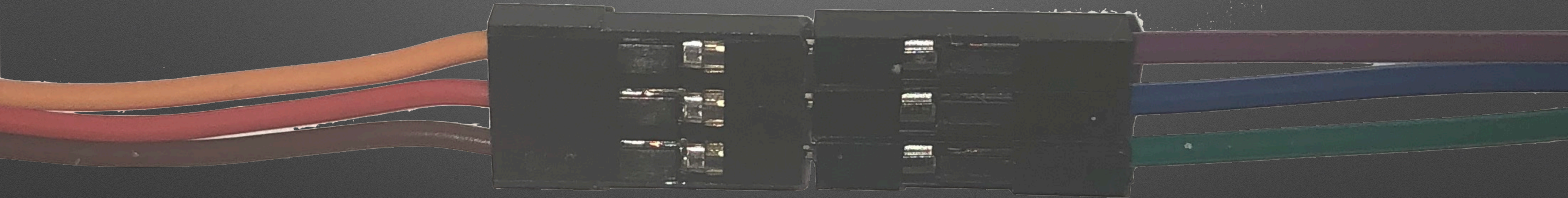
Testing...

- Test in Simulator

Parts



Connect them...



Add a Horn



Clip to micro:bit

- Match color on Servo to pad name on micro:bit (clip colors don't matter)
 - Brown on Servo to GND on micro:bit
 - Red on Servo to 3V on micro:bit
 - Orange on Servo to 0 on micro:bit

Inchworm Insanity

<https://makecode.microbit.org/projects/inchworm>

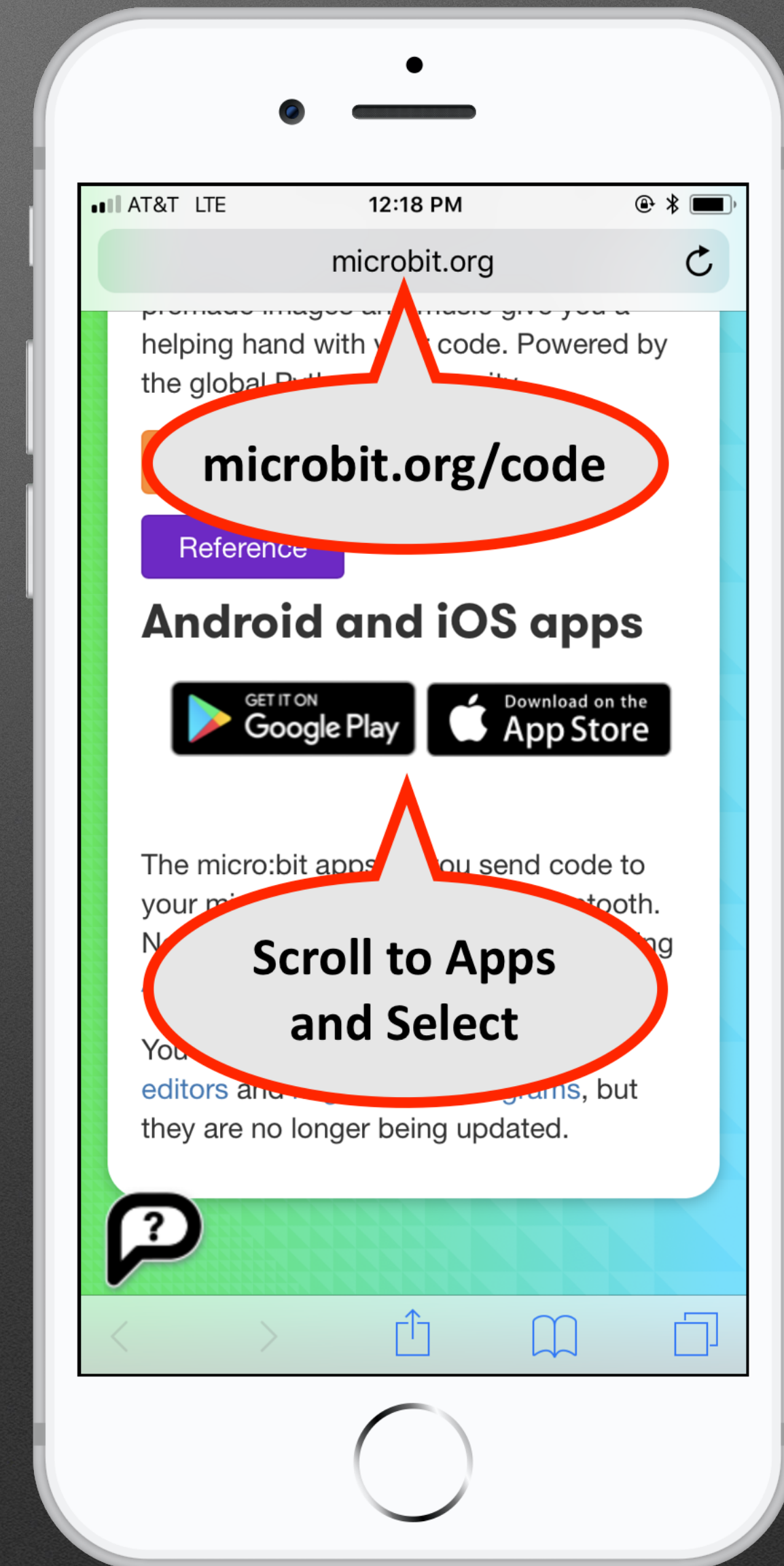
Break

1. Firmware Update

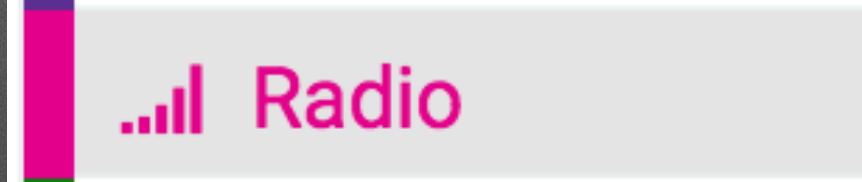
- A. Go to <https://tinyurl.com/uBitUpdate>
- B. Follow Instructions to Upgrade

2. App Install

- A. Open Browser on phone to <http://microbit.org/code>
- B. Scroll to Apps and Select



Bluetooth Background

- Uses different protocol than  Radio
- Not a group broadcast

Bluetooth Background

Bluetooth Background

Central

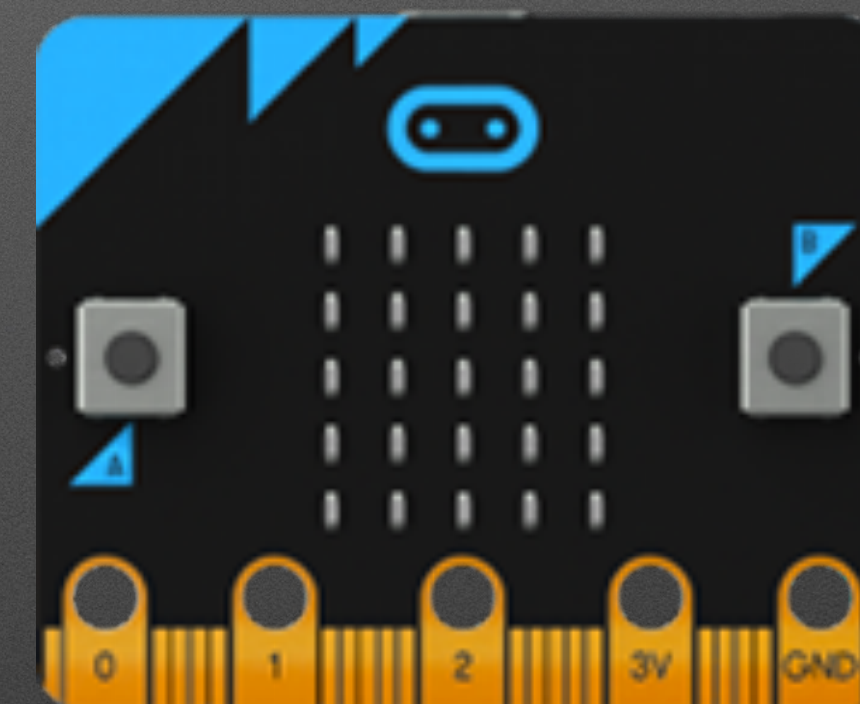


Bluetooth Background

Central



Peripheral



Bluetooth Background

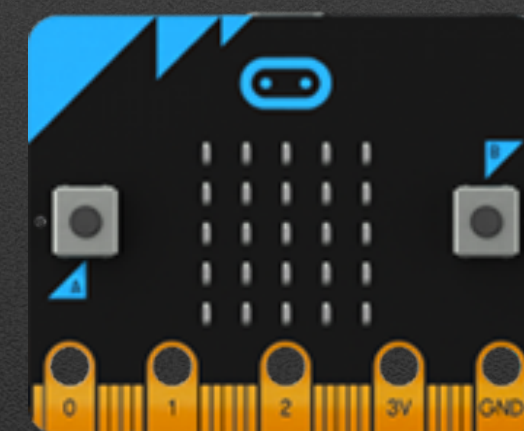
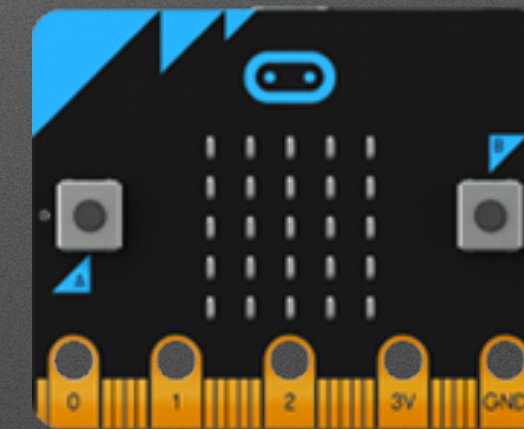
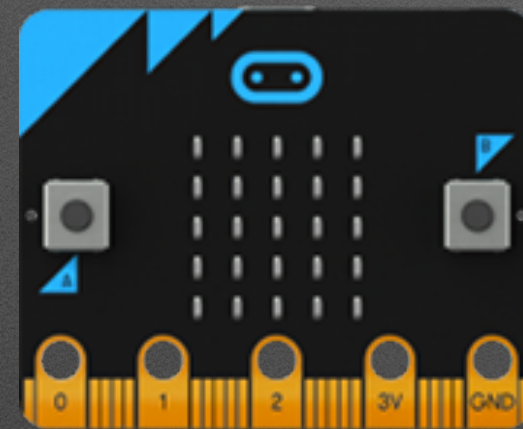
Bluetooth Background

Central



Bluetooth Background

Central

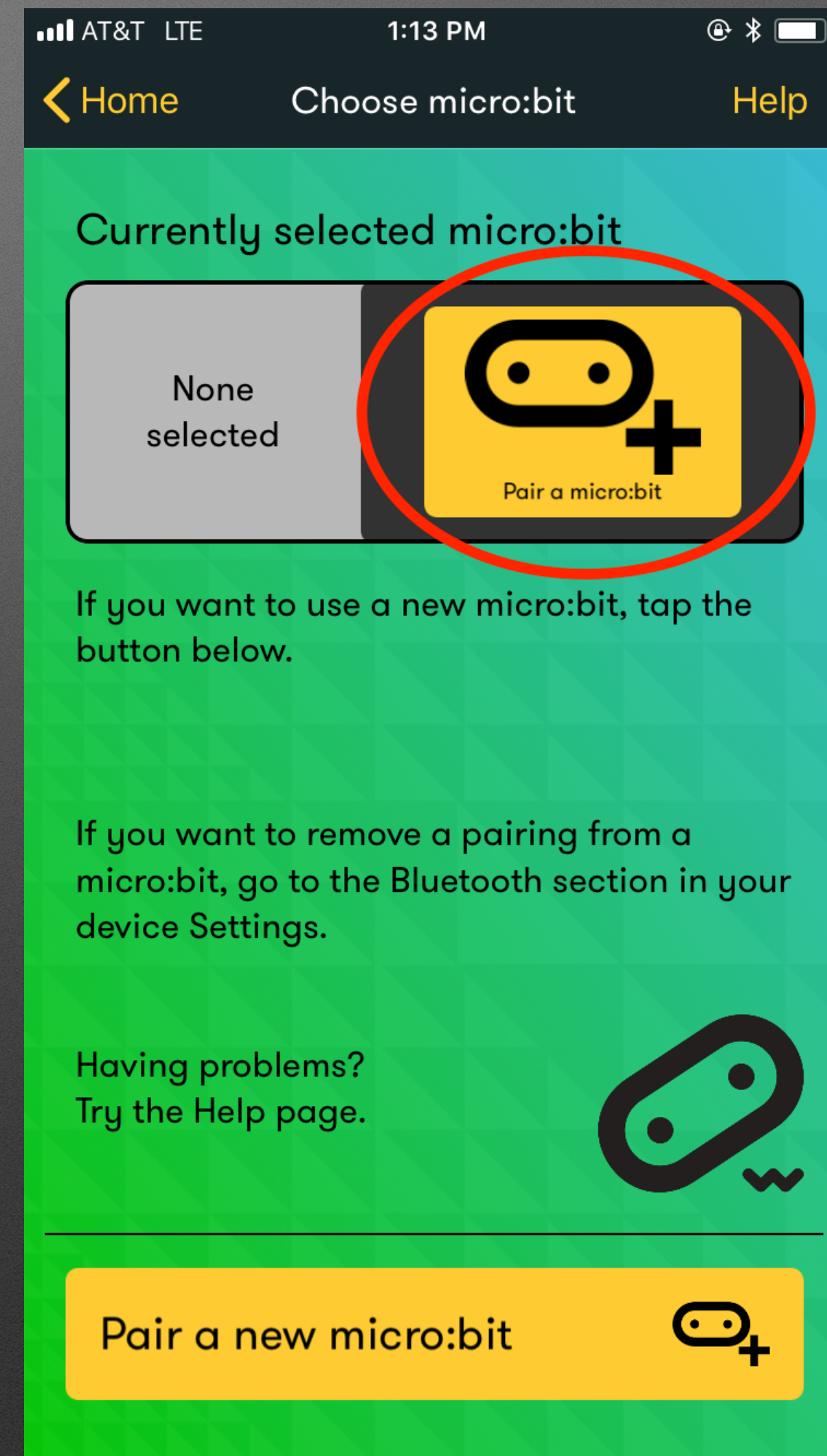
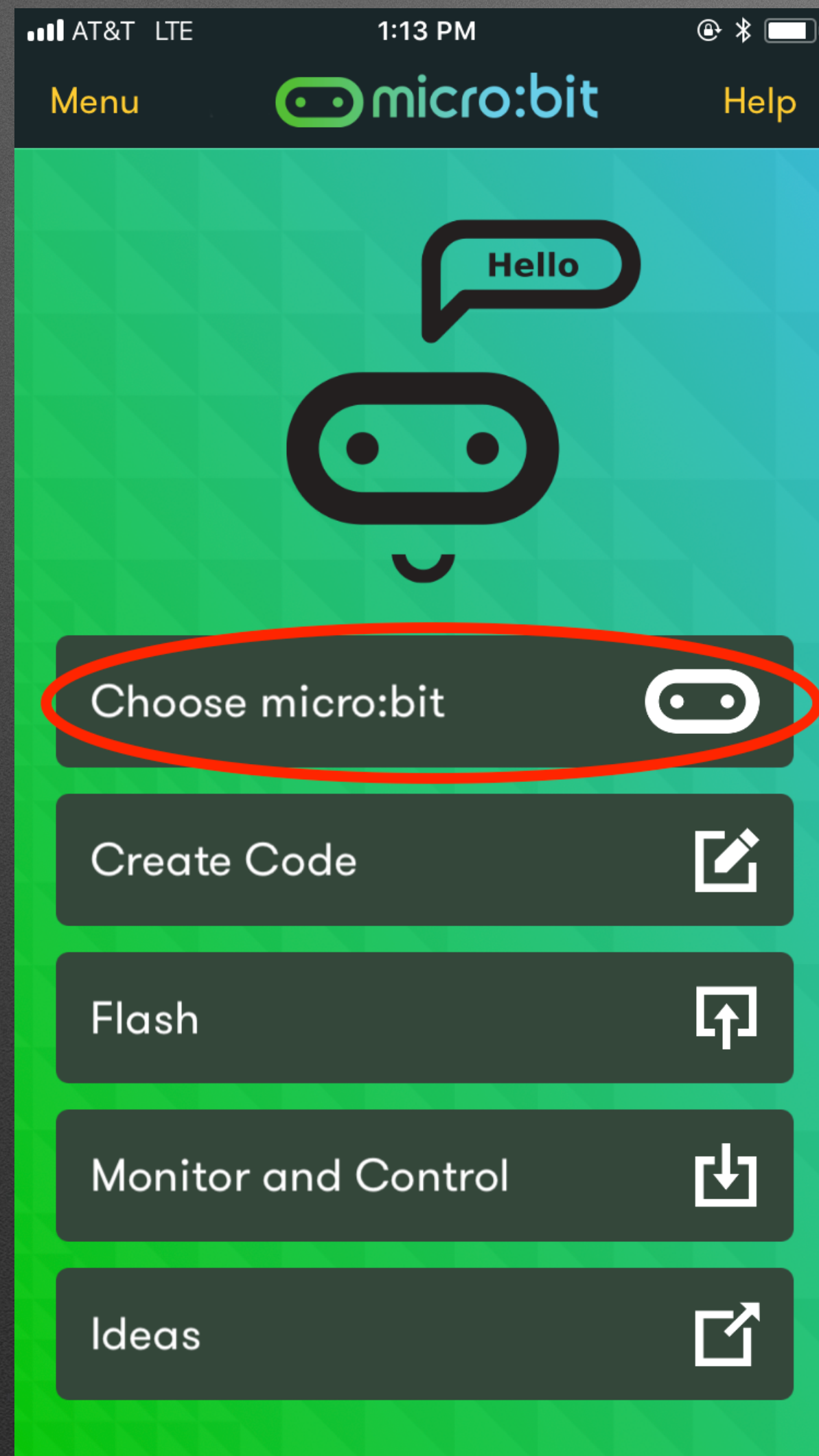


Bluetooth Basics

- Bluetooth has various levels of security
 - “Pairing” — Forming a “permanent” bond
(Exchanging security info. once and storing it)
- Block editor supports three types
 - No pairing (“insecure” - we’ll use this)
 - Just Works (default; pretty safe)
 - Passkey Pairing (more secure)

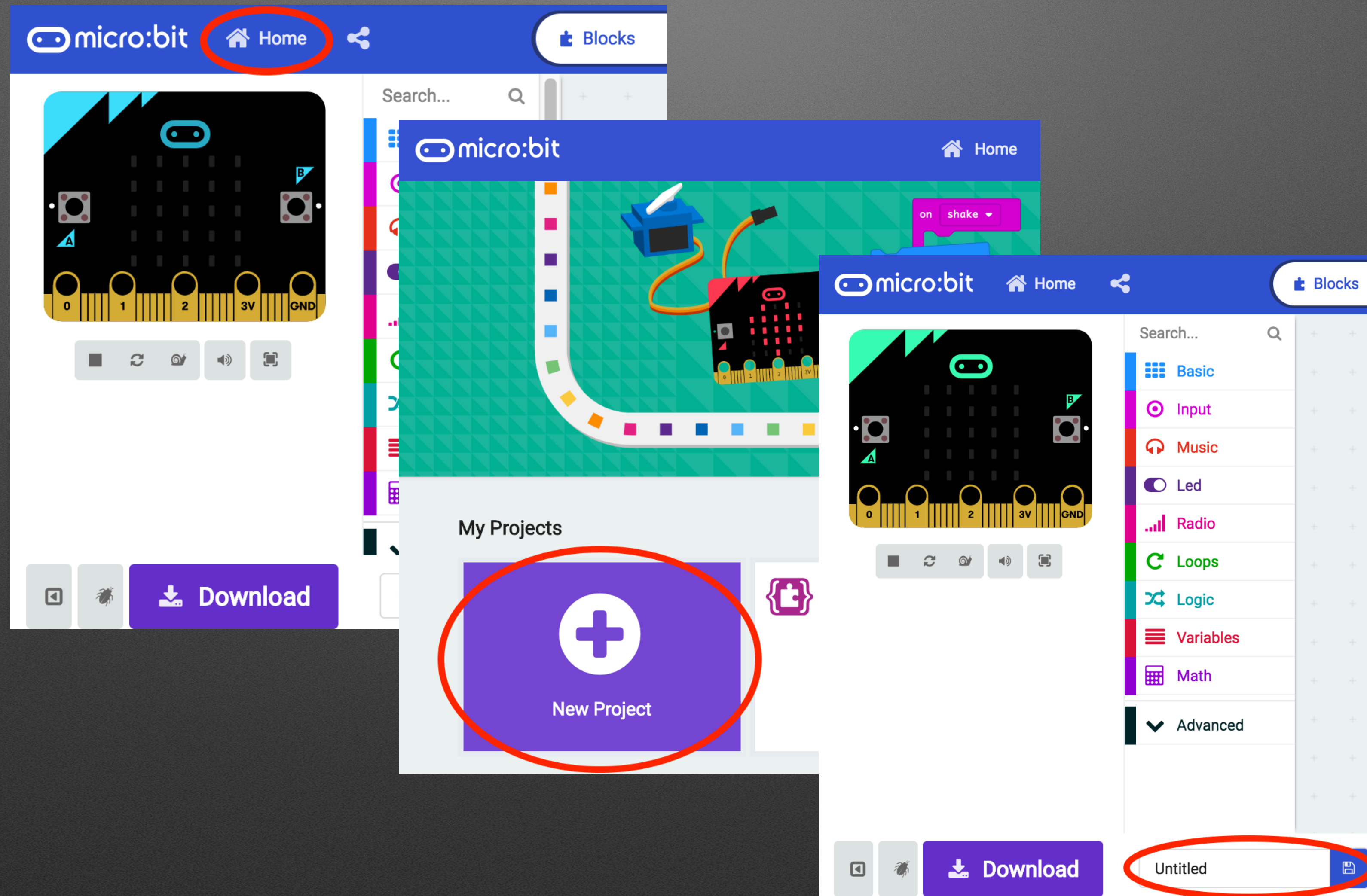
Pairing

Pairing



New Project: Home > New Project...

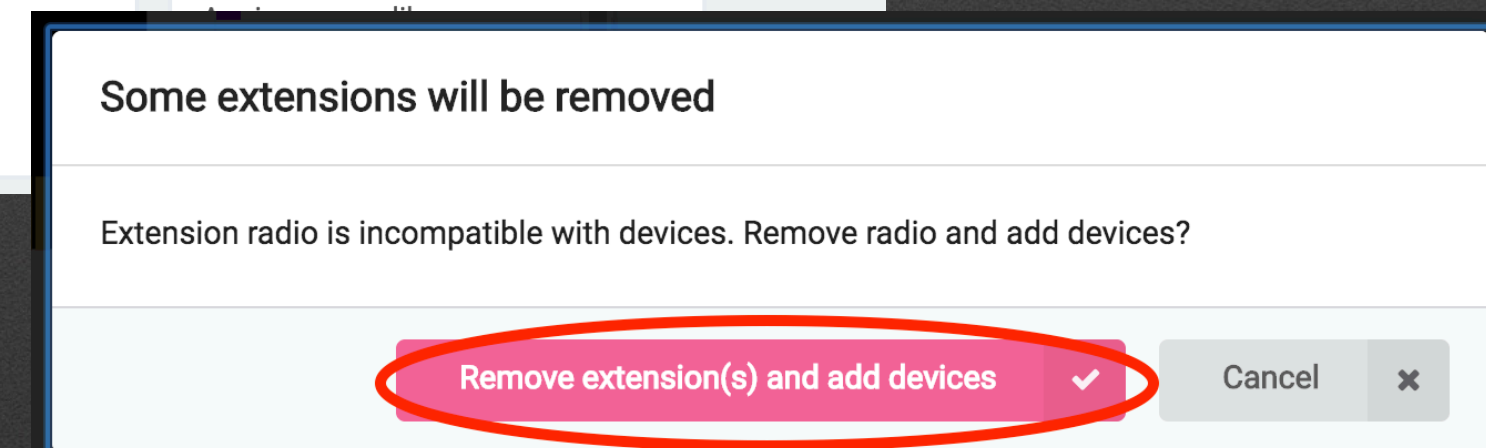
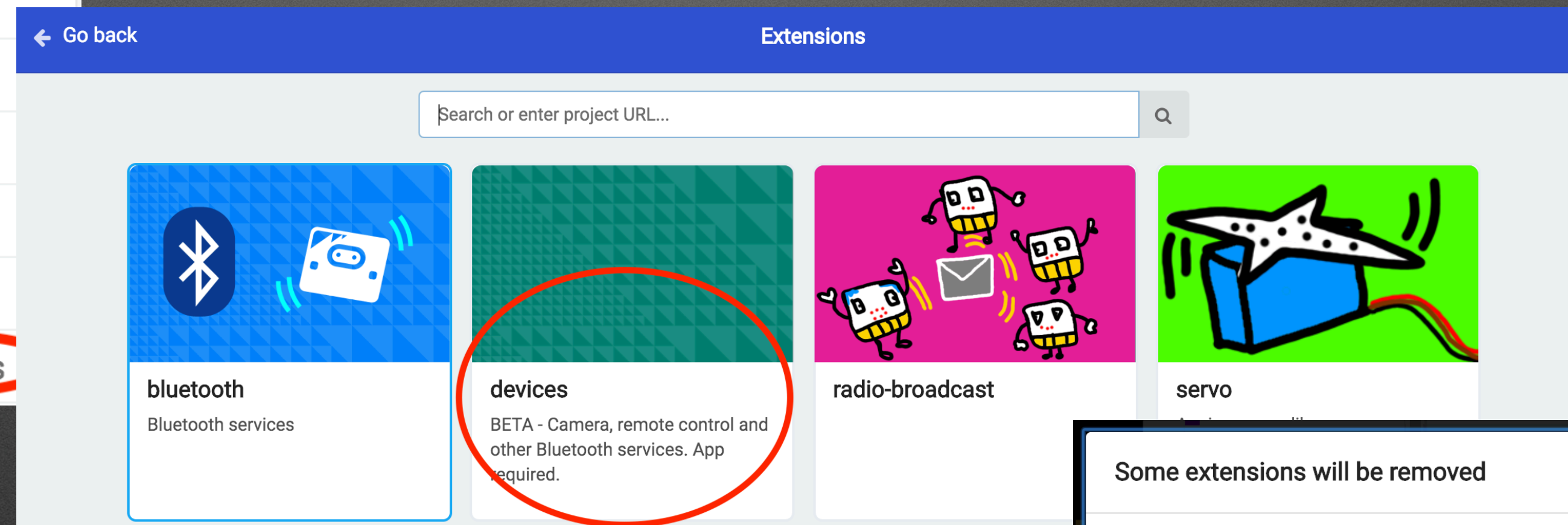
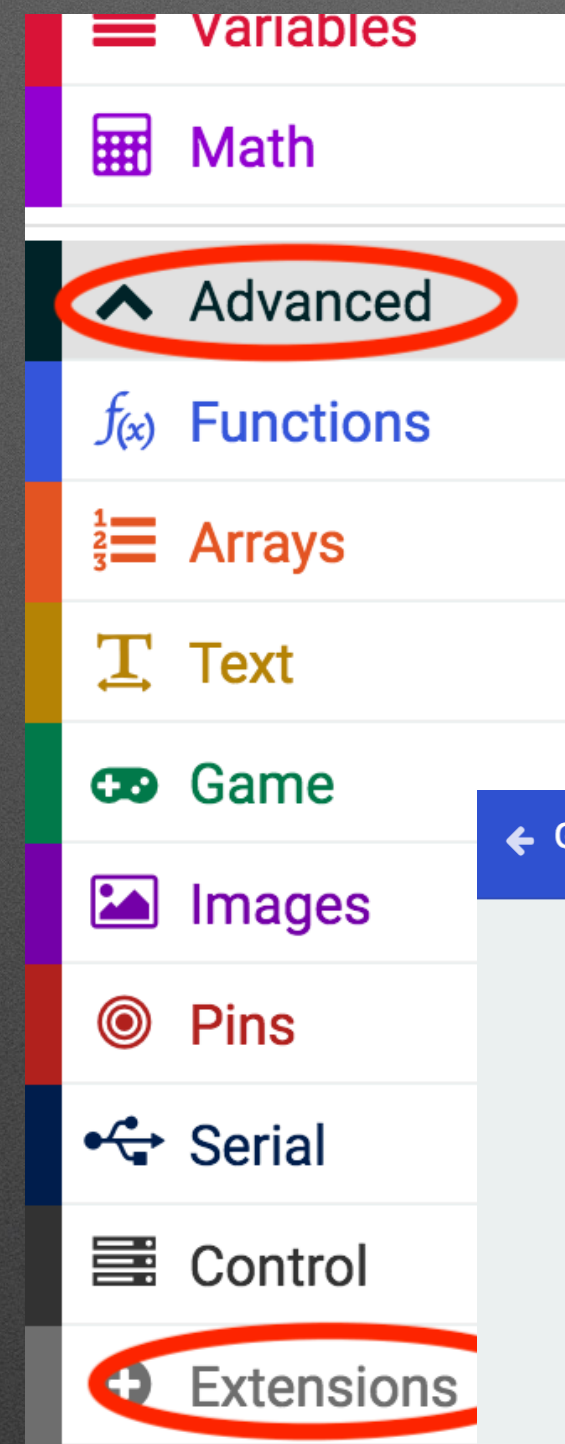
New Project: Home > New Project...



Add Bluetooth

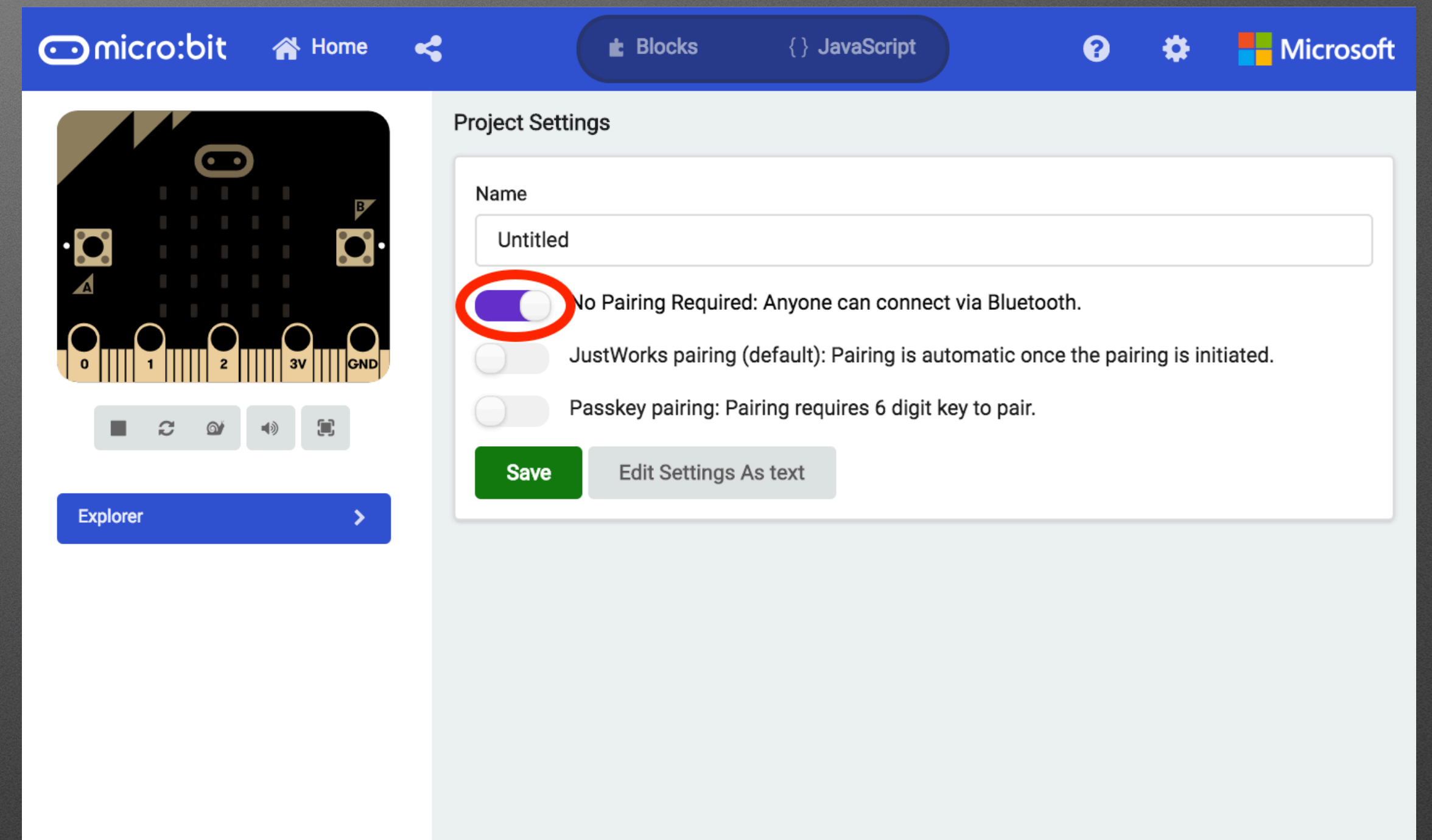
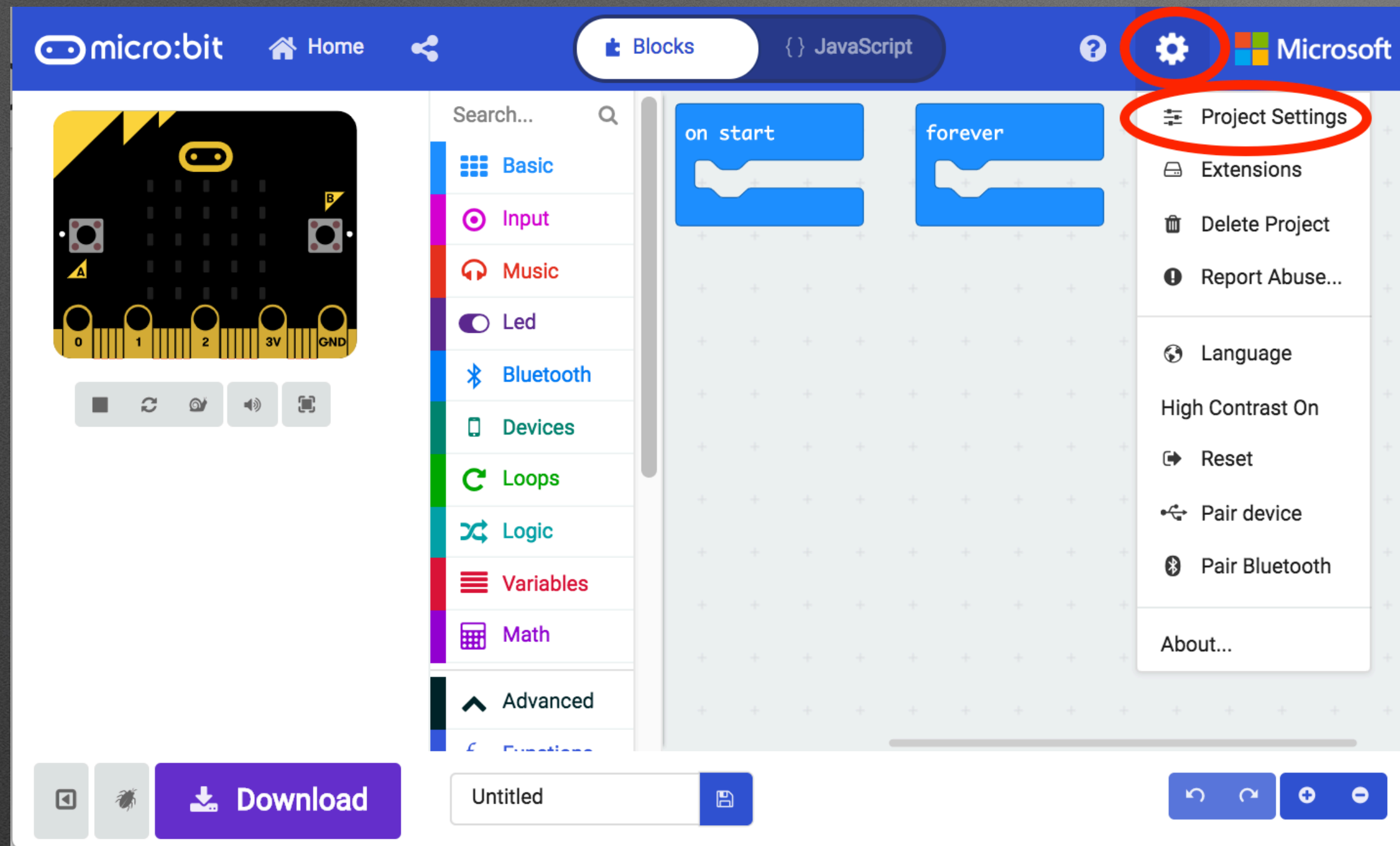
(& remove Radio)

Add Bluetooth (& remove Radio)



Project Settings

Project Settings



Phone Phun: Program

on start

set character to create sprite at x: 2 y: 2

bluetooth led service

bluetooth button service

on gamepad button B down

character change y by 1

on gamepad button C down

character change x by -1

on gamepad button A down

character change y by -1

on gamepad button D down

character change x by 1

Phone Phun: Program

```
on start
  set character to create sprite at x: 2 y: 2
  bluetooth led service
  bluetooth button service
```

Devices Palette

```
on gamepad button B down
  character change y by 1
```

```
on gamepad button C down
  character change x by -1
```

```
on gamepad button A down
  character change y by -1
```

```
on gamepad button D down
  character change x by 1
```

Phone Phun: Program

```
on start
  set character to create sprite at x: 2 y: 2
  bluetooth led service
  bluetooth button service
```

Devices Palette

Game Palette
(Under Advanced)

```
on gamepad button B down
  character change y by 1
```

```
on gamepad button C down
  character change x by -1
```

```
on gamepad button A down
  character change y by -1
```

```
on gamepad button D down
  character change x by 1
```

Phone Phun: Program

```
on start
  set character to create sprite at x: 2 y: 2
  bluetooth led service
  bluetooth button service
```

Devices Palette

Game Palette
(Under Advanced)

Game Palette
(Under Advanced)

```
on gamepad button B down
  character change y by 1
```

```
on gamepad button C down
  character change x by -1
```

```
on gamepad button A down
  character change y by -1
```

```
on gamepad button D down
  character change x by 1
```

Phone Phun: Program

```
on start
  set character to create sprite at x: 2 y: 2
  bluetooth led service
  bluetooth button service
```

```
on gamepad button B down
  character change y by 1
```

```
on gamepad button A down
  character change y by -1
```

```
on gamepad button C down
  character change x by -1
```

```
on gamepad button D down
  character change x by 1
```

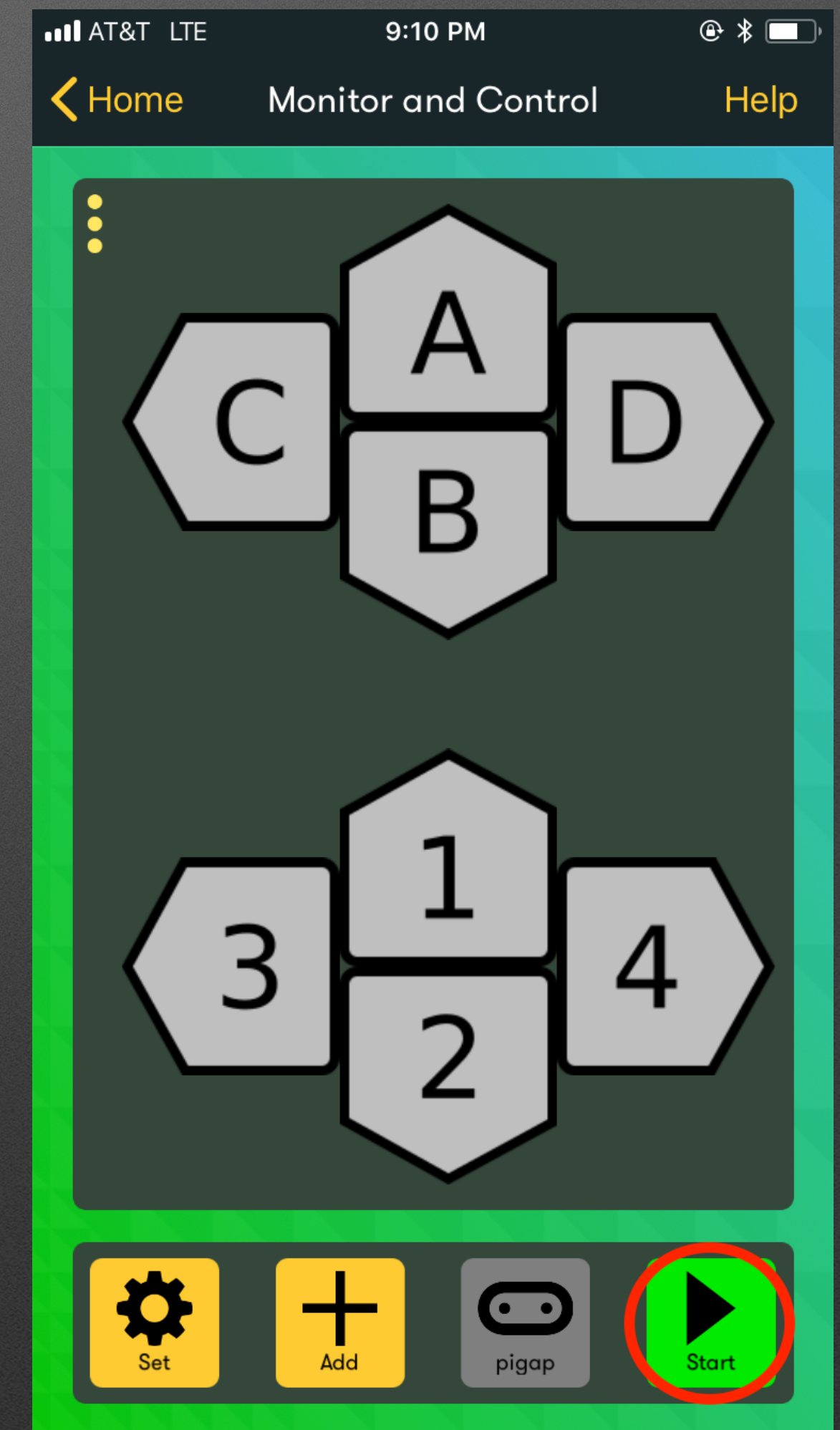
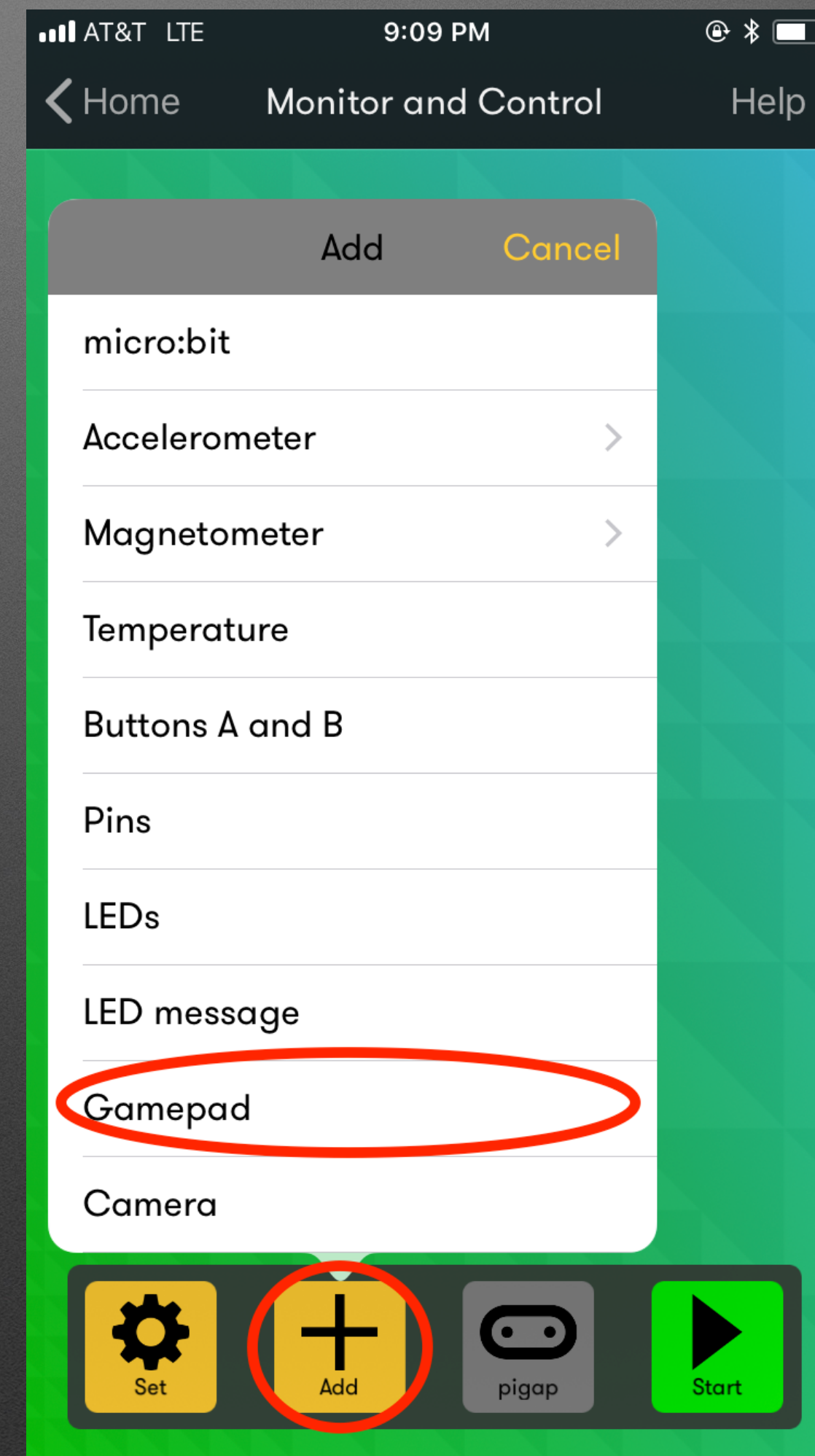
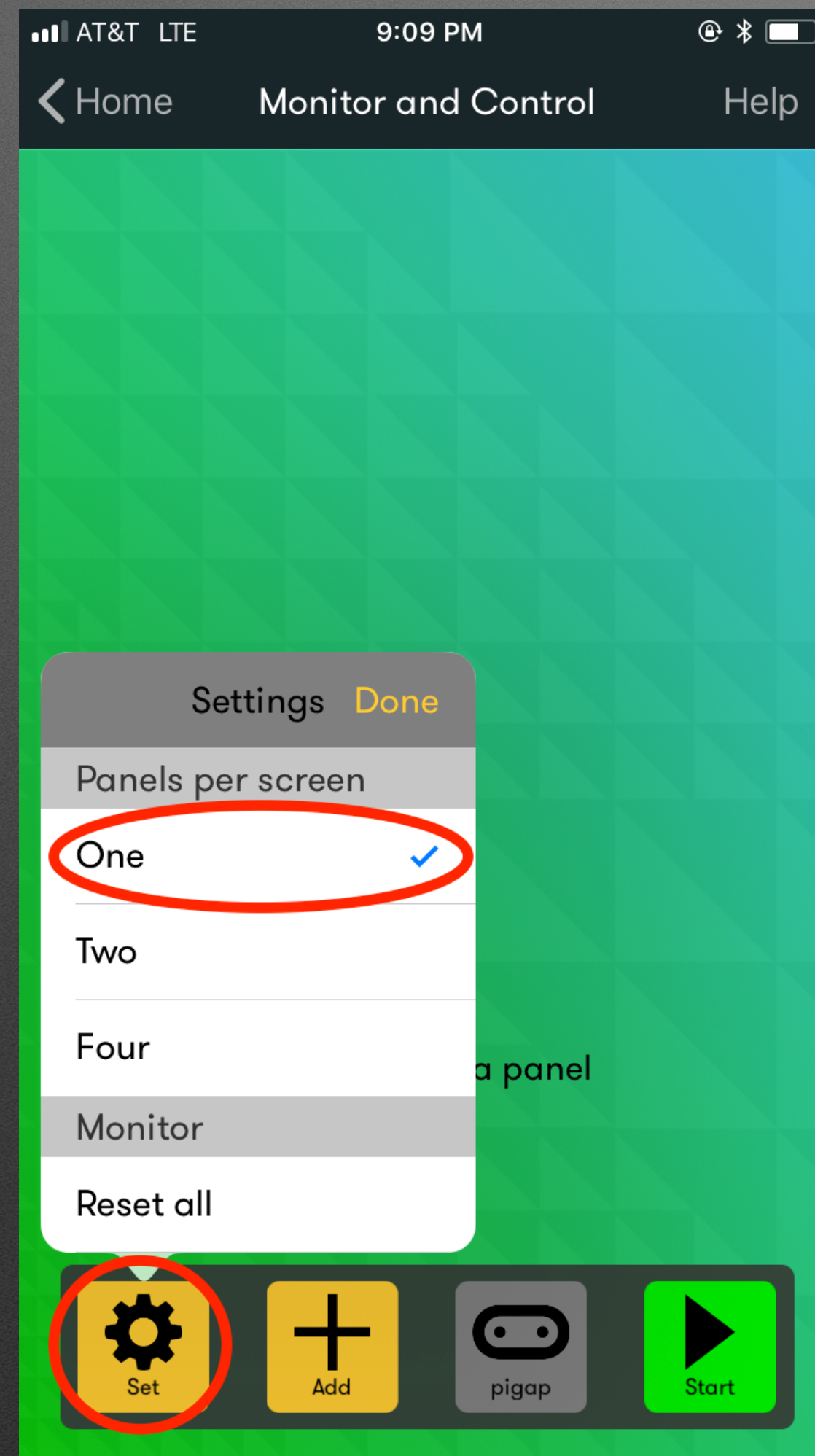
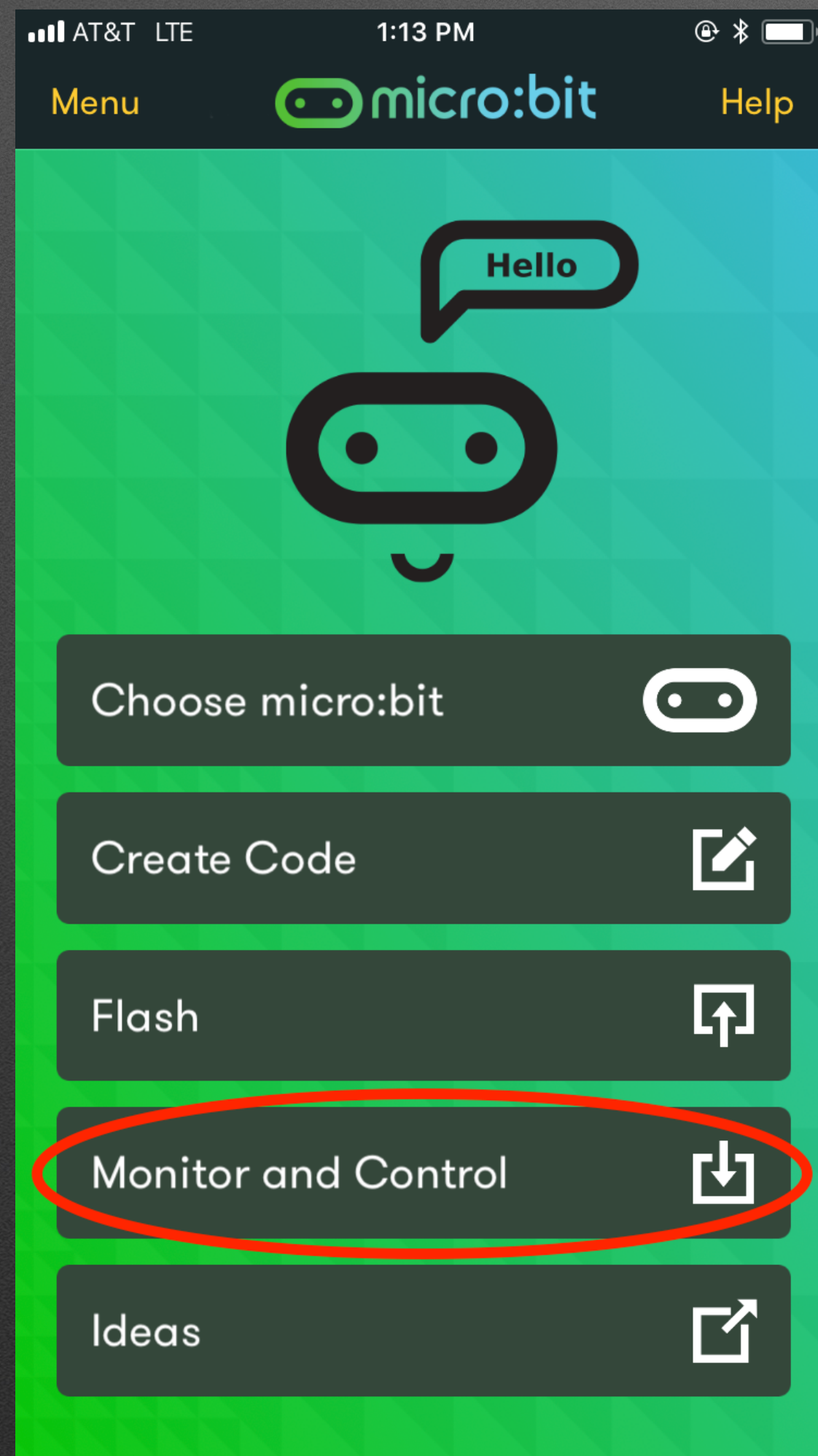
Game Palette
(Under Advanced)

Game Palette
(Under Advanced)

Devices Palette

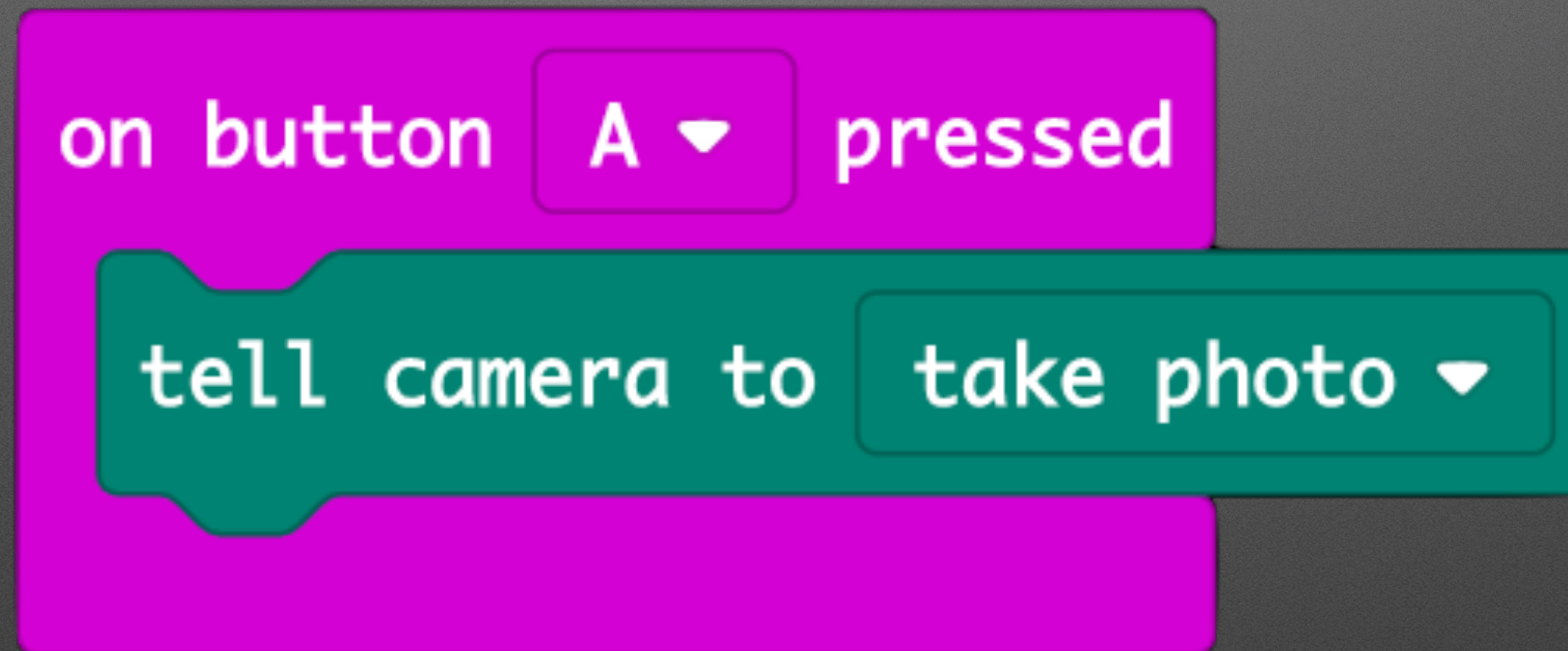
Pro tip:
Create one of these, then right-click and "duplicate" 3x, then modify

App Configuration



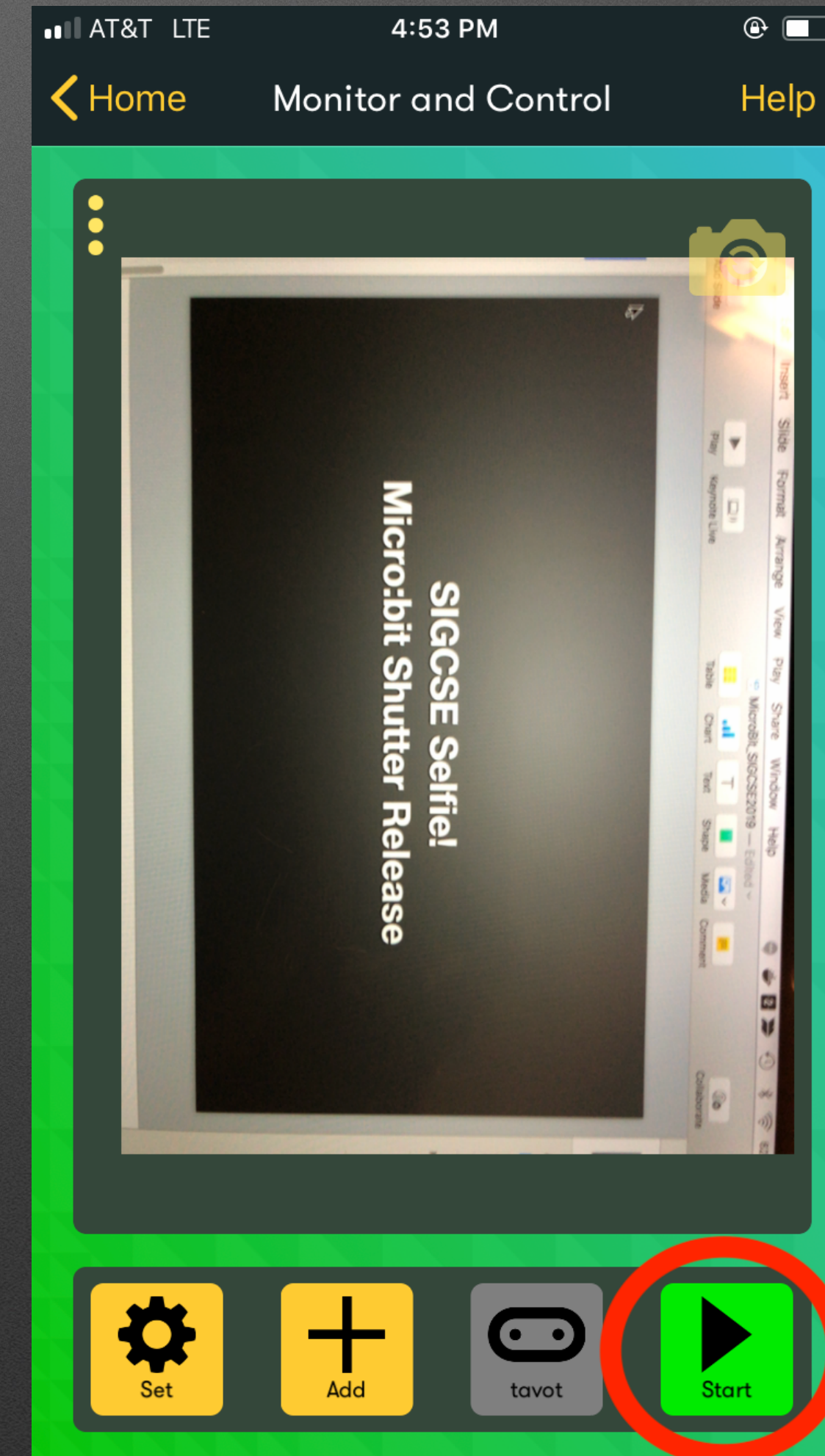
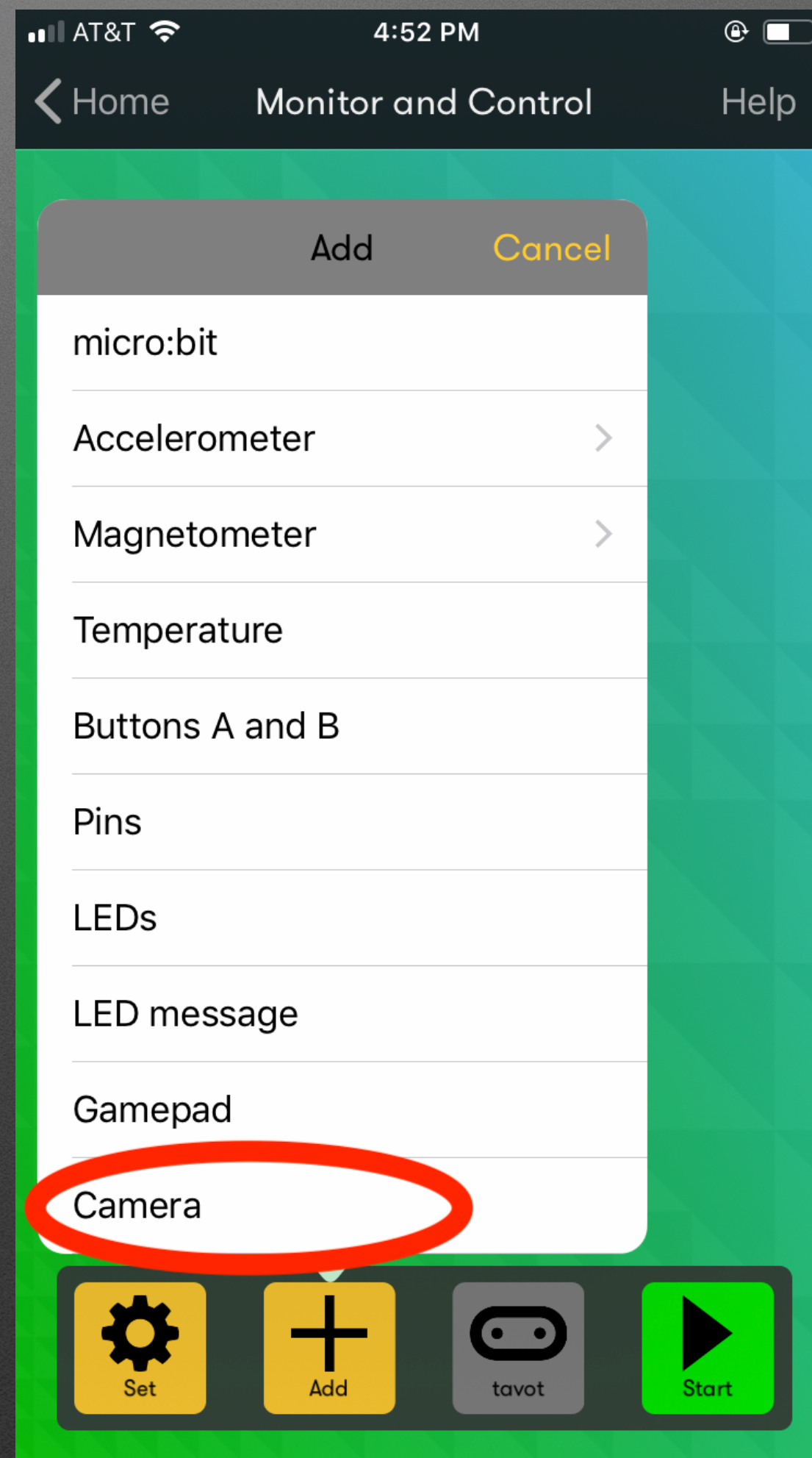
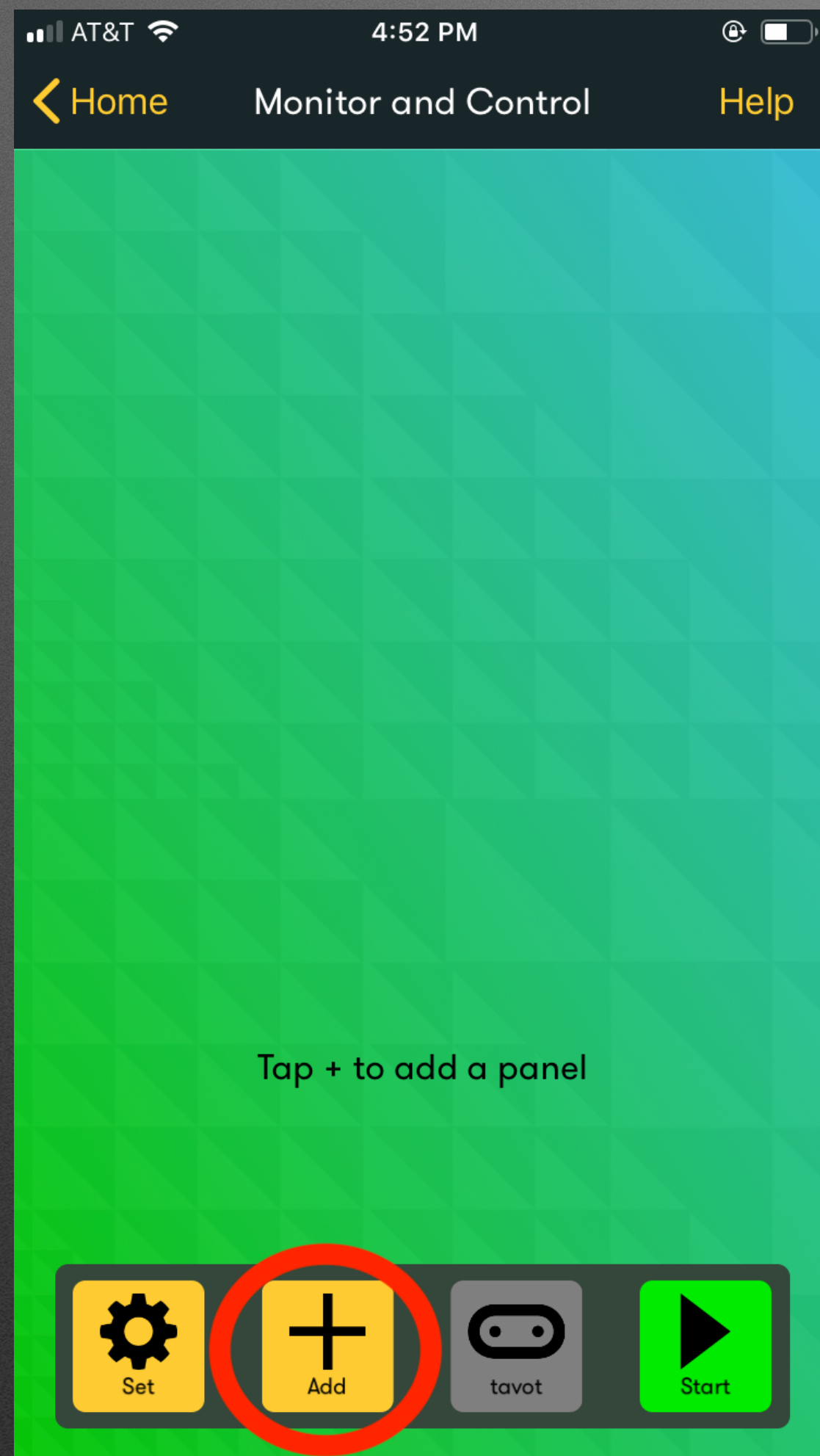
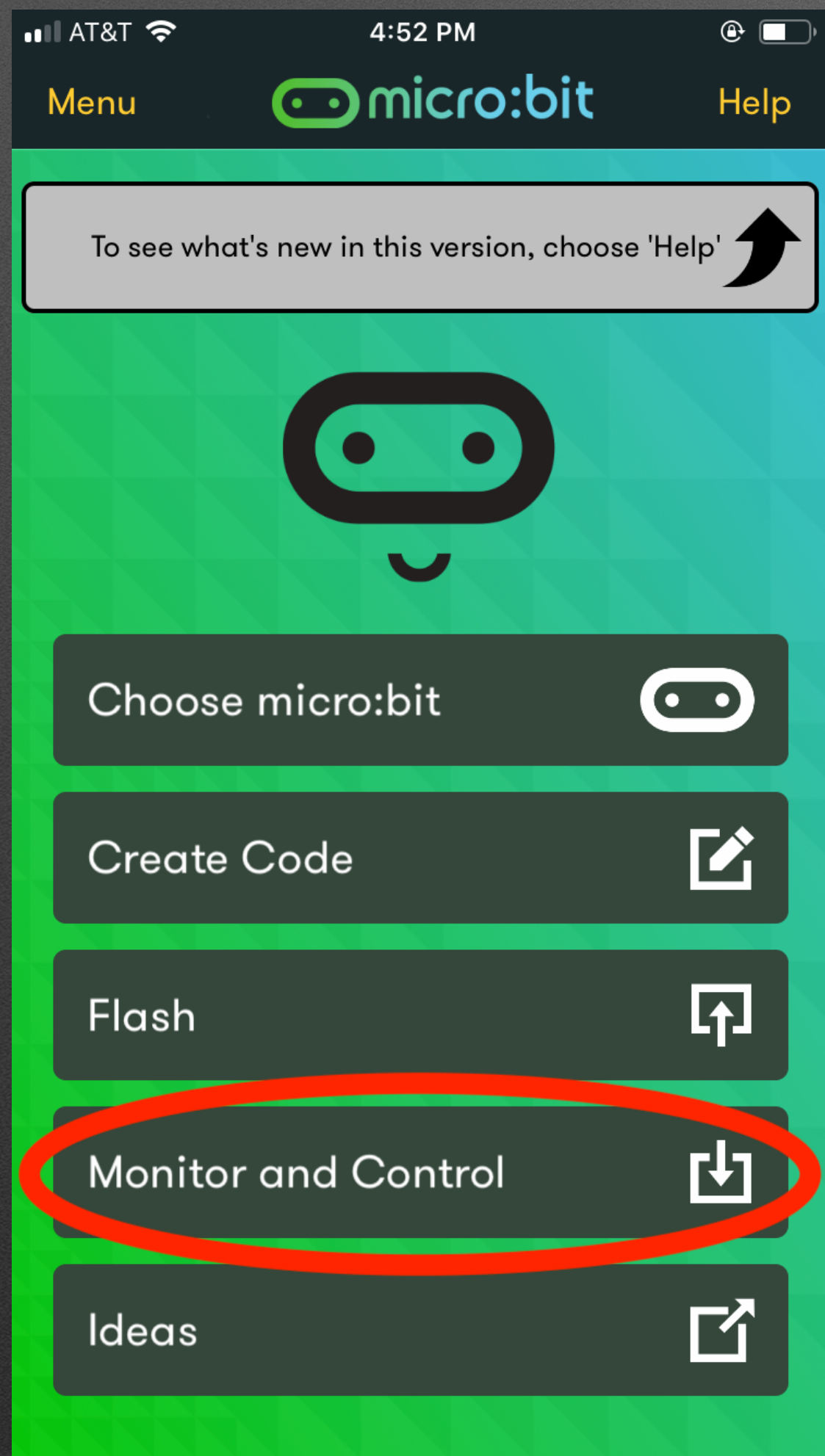
Micro:bit Shutter Release

Program



App Config

App Config



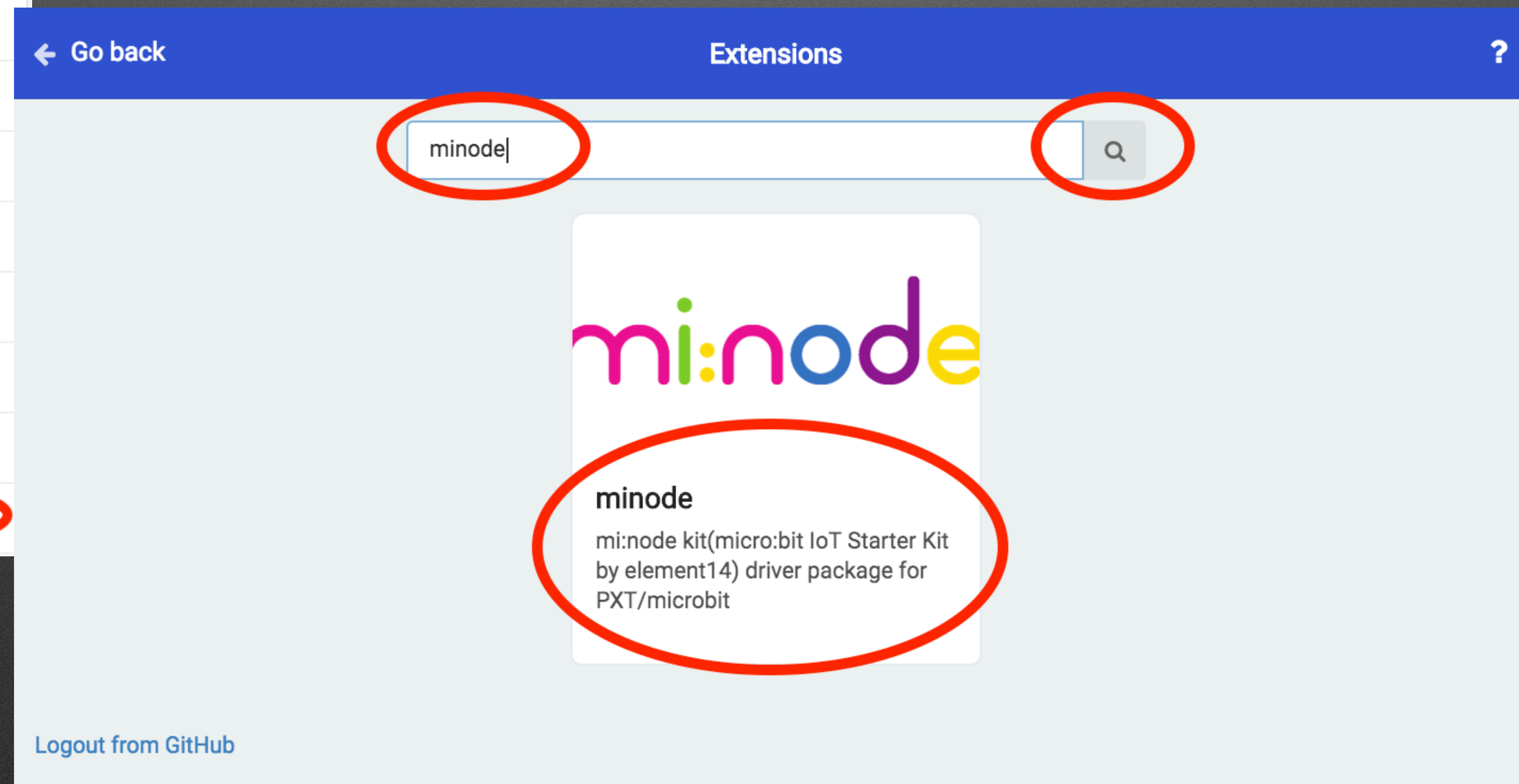
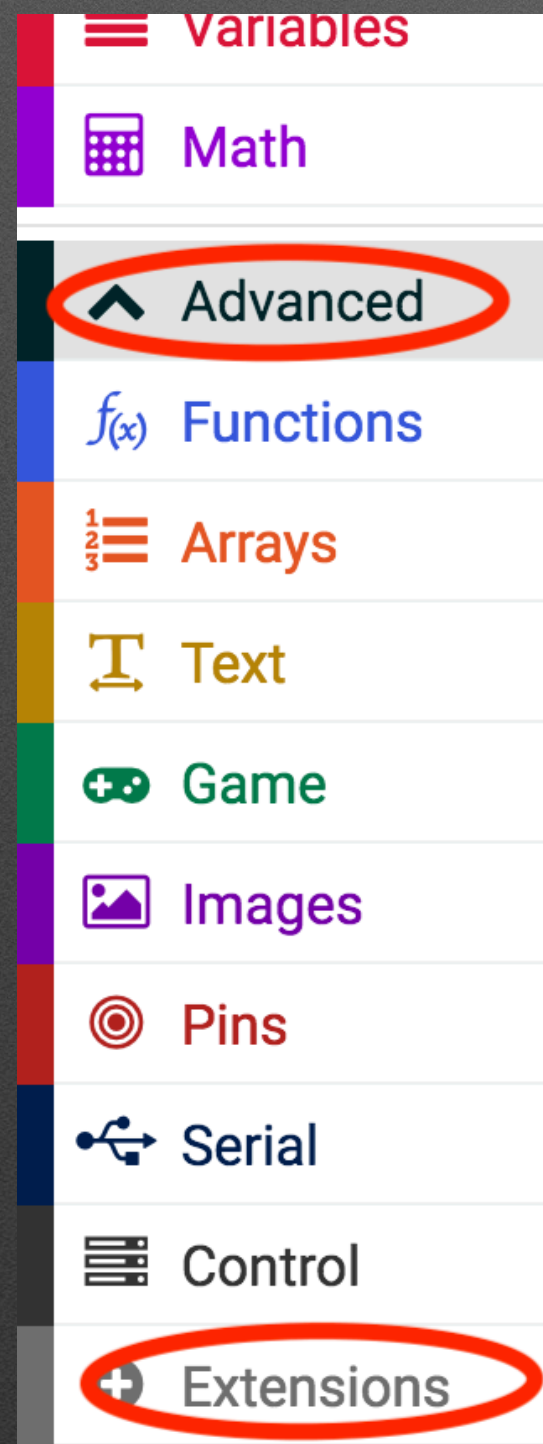
SIGCSE Selfie!

Extra Hardware: Extensions

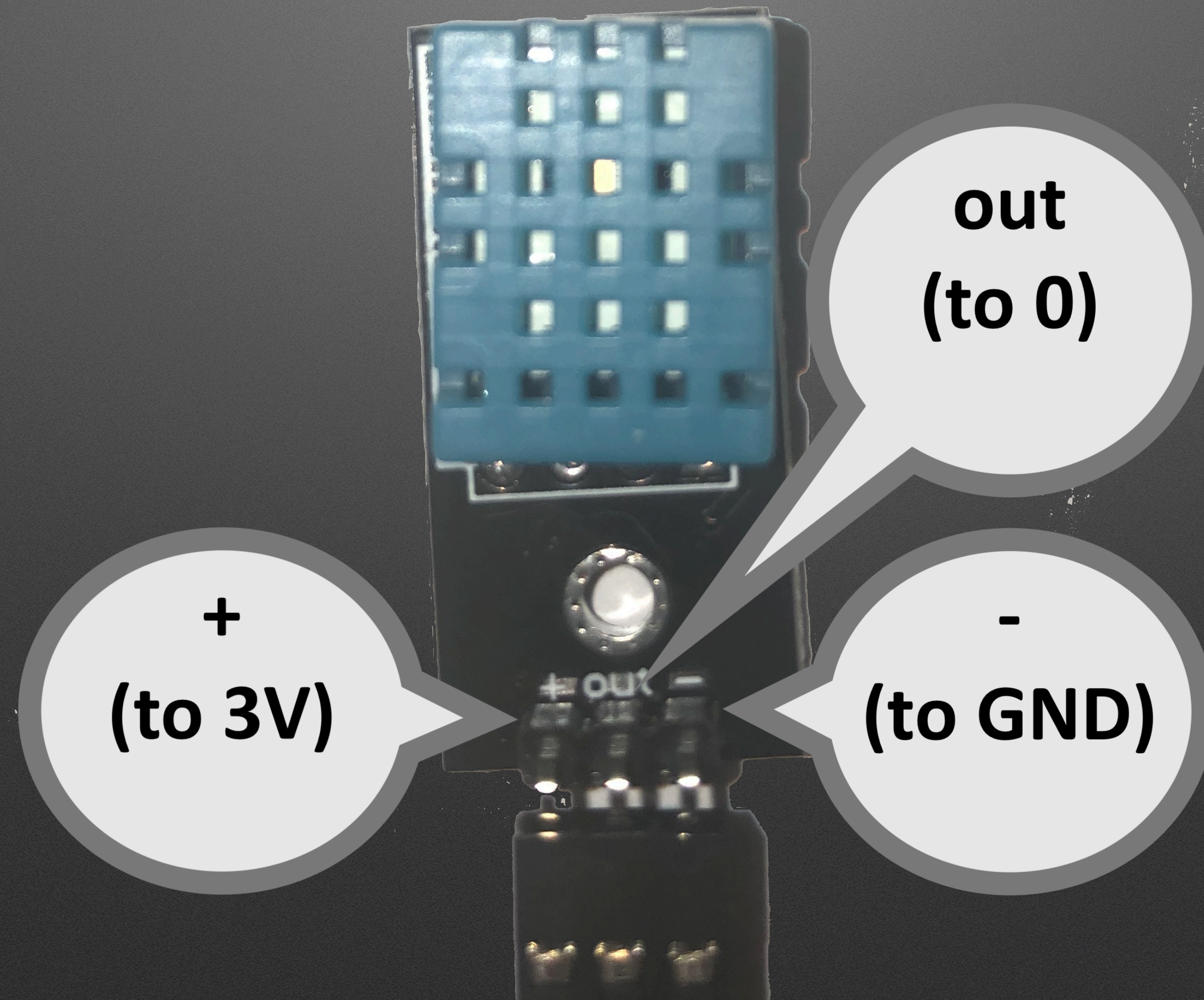
- Extensions...extend
 - Additional hardware support (today)
 - Additional simulator features

Extra Hardware: Extensions

Extra Hardware: Extensions



Wiring Sensor



Collecting Data

forever

serial write value "Temp" = dht11 A0 ▼ temperature Celsius ▼

serial write value "Humidity" = dht11 A0 ▼ humidity

Collecting Data

Minode Palette

forever

serial write value "Temp" = dht11 A0 ▼ temperature Celsius ▼

serial write value "Humidity" = dht11 A0 ▼ humidity

Collecting Data

```
forever
  serial write value "Temp" = dht11 A0 ▼ temprature Celsius ▼
  serial write value "Humidity" = dht11 A0 ▼ humidity
```

Minode Palette

Minode's
"...more" Palette

Collecting Data

```
forever
  serial write value "Temp" = dht11 A0 ▼ temperature Celsius ▼
  serial write value "Humidity" = dht11 A0 ▼ humidity
```

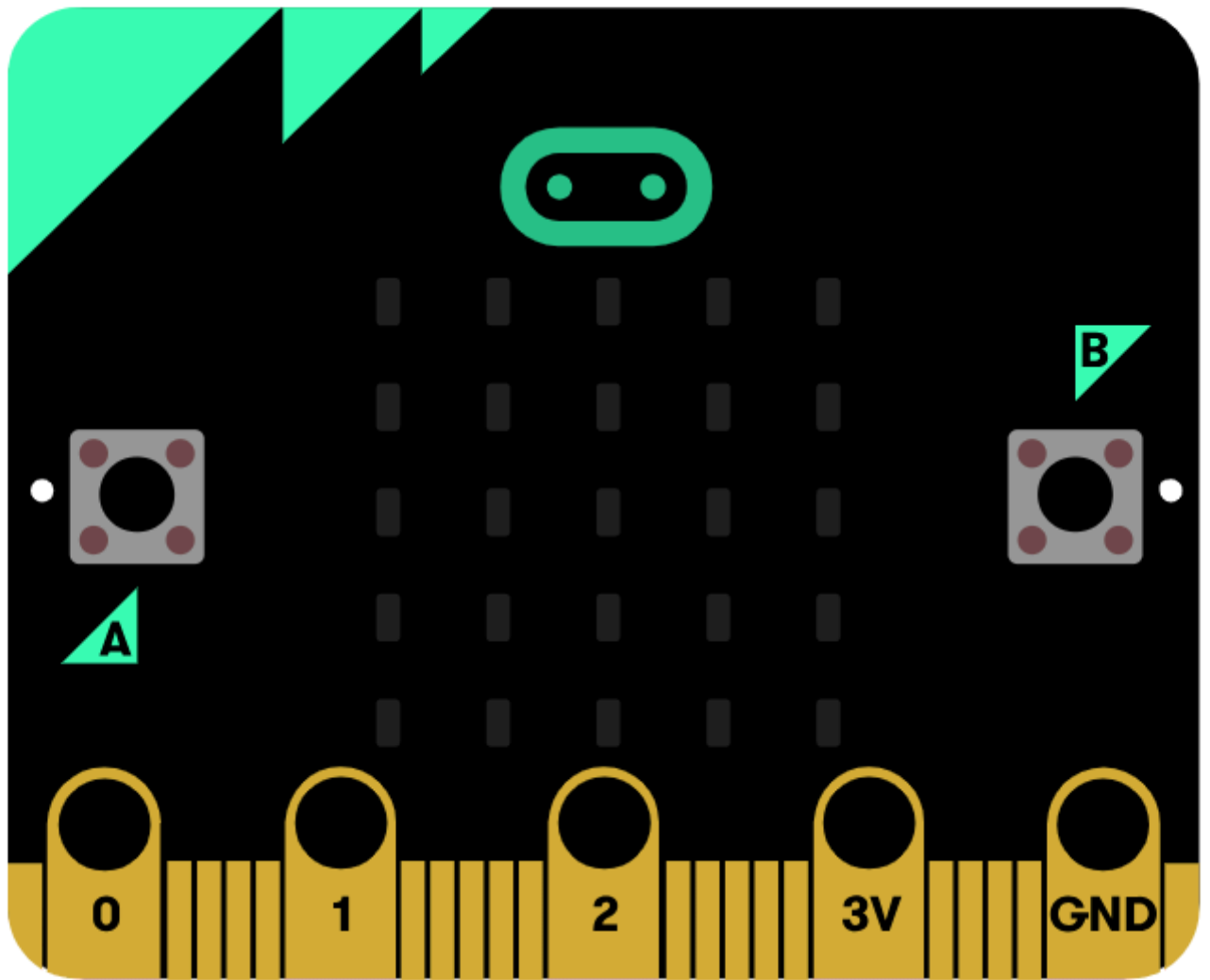
Minode Palette

Advanced Serial Palette

Minode's
"...more" Palette

Graphing

micro:bit Home Share



A diagram of a micro:bit board simulator. The board is black with a grid of pins. Two pins are labeled 'A' and 'B' with green triangles. The bottom edge has five pins labeled '0', '1', '2', '3V', and 'GND'. A green micro:bit logo is at the top center.

■ ↺ ↻ 🔊 📷

📊 Show console Simulator

📊 Show console Device

Bluetooth Streaming: Setup

Bluetooth Streaming: Setup

The image shows a screenshot of the Microsoft MakeCode IDE interface. On the left, a menu is open with the 'About...' option circled in red. The 'About' dialog box is displayed in the center, showing version information for 'makecode.microbit.org' (1.2.13), 'Microsoft MakeCode' (4.4.7), and 'microbit runtime' (v2.1.1). The 'Experiments' button at the bottom of the dialog is also circled in red. On the right, the 'Bluetooth Console' extension is shown, which is 'Enabled'. The extension's description states: 'Receives UART message through Web Bluetooth'. A red circle highlights the extension's title and description. The background shows a Micro:bit board with red LEDs and a graph of a signal.

Microsoft

- Project Settings
- Extensions
- Delete Project
- Report Abuse
- Language
- High Contrast On
- Reset
- Pair device
- Pair Bluetooth
- About...

About

makecode.microbit.org version: 1.2.13

Microsoft MakeCode version: 4.4.7

microbit runtime version: v2.1.1

[Terms of Use](#) [Privacy](#)

Experiments

Bluetooth Console

Enabled

Receives UART message through Web Bluetooth

Feedback

Bluetooth Streaming: Program

on start

bluetooth uart service

forever

bluetooth uart write value "a.x" = acceleration (mg) x ▼

bluetooth uart write value "a.y" = acceleration (mg) y ▼

bluetooth uart write value "a.z" = acceleration (mg) z ▼

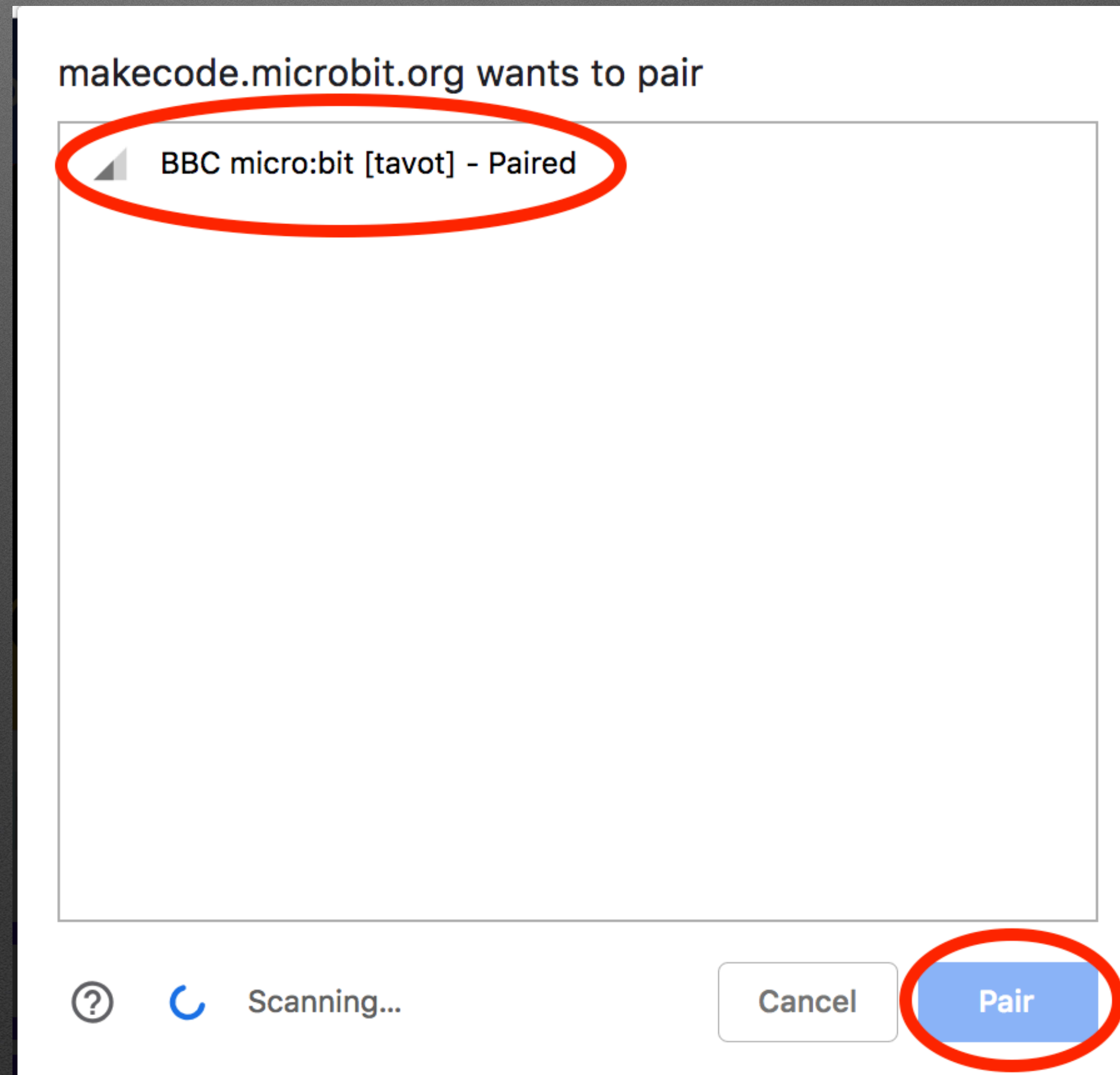
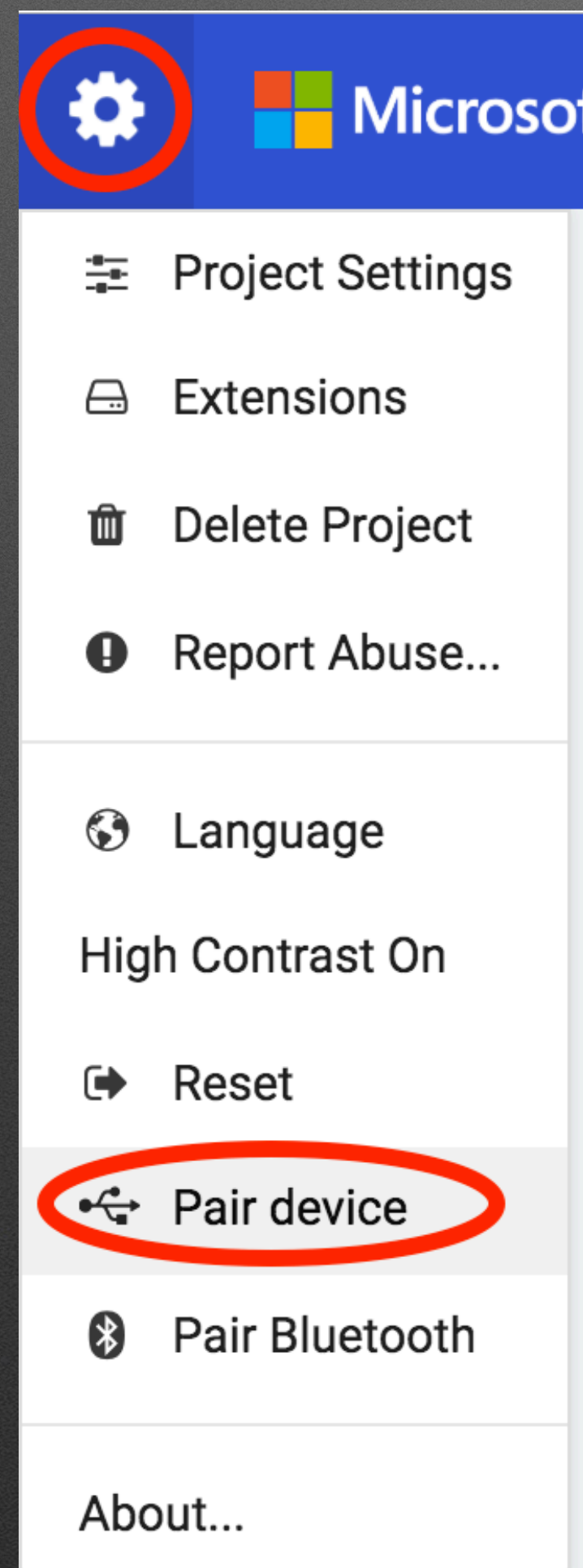
bluetooth uart write value "str" = acceleration (mg) strength ▼

Pairing Process

(Settings>No Pairing Required;
but need to connect to micro:bit)

Pairing Process

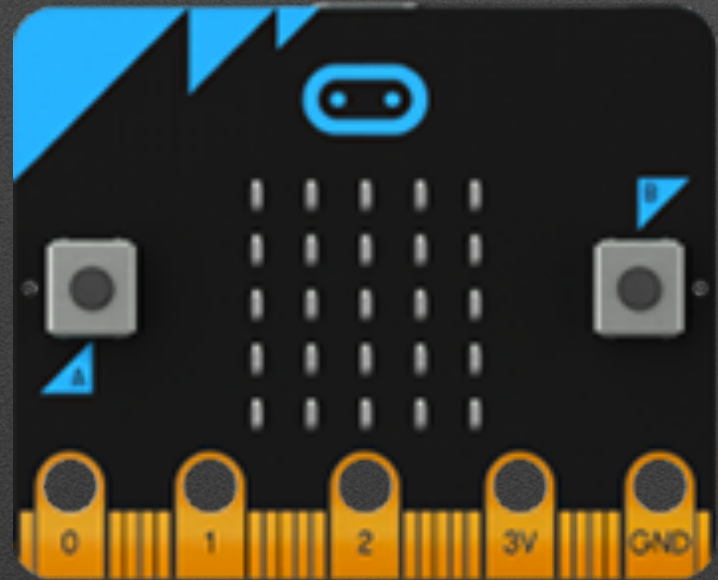
(Settings>No Pairing Required;
but need to connect to micro:bit)



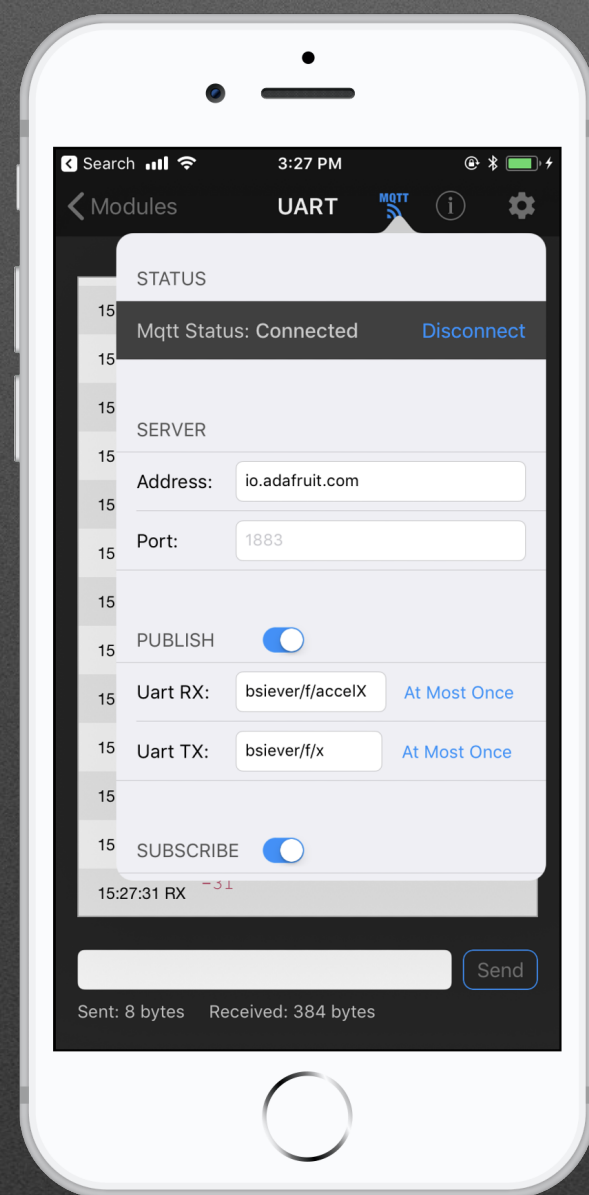
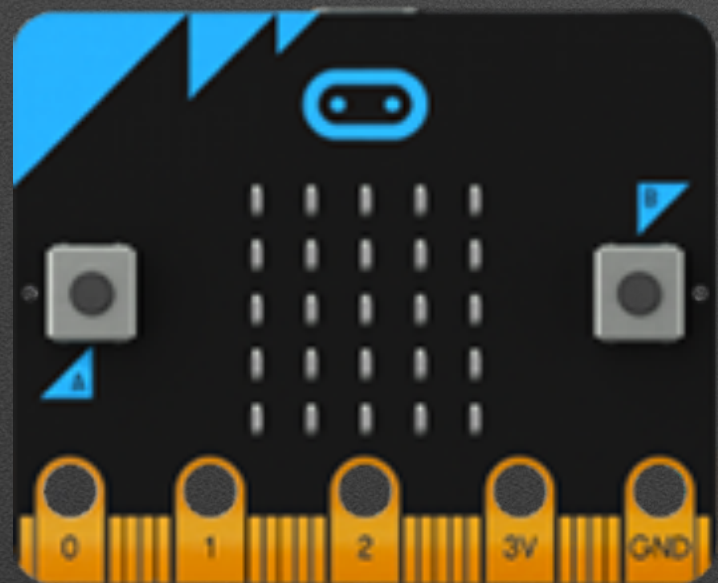
IoT Example Overview

AdaFruit.io

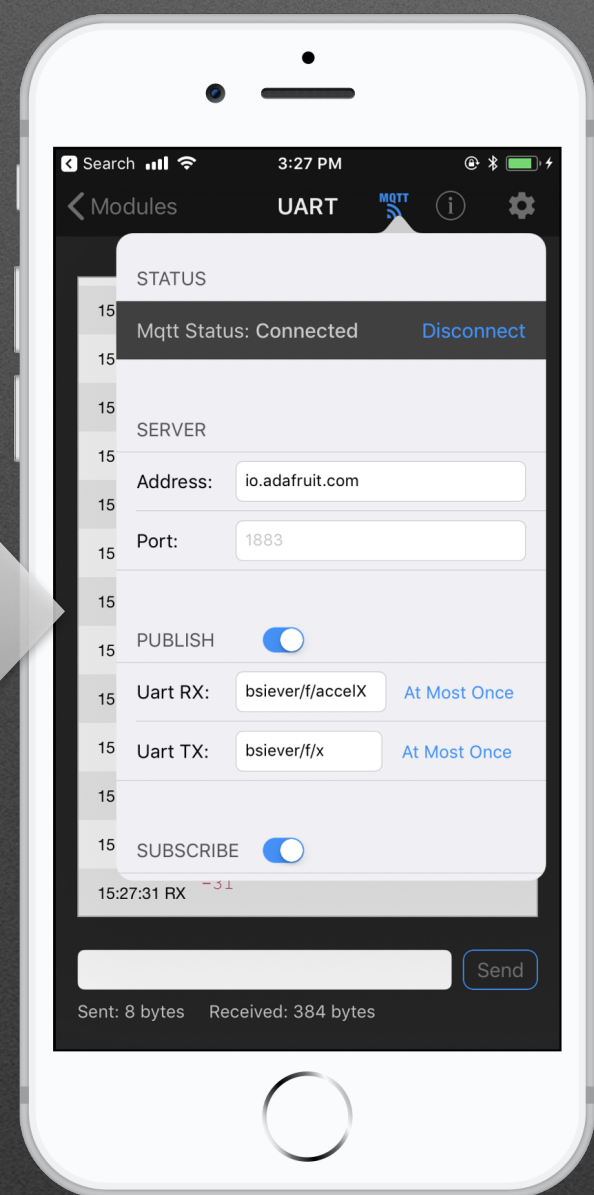
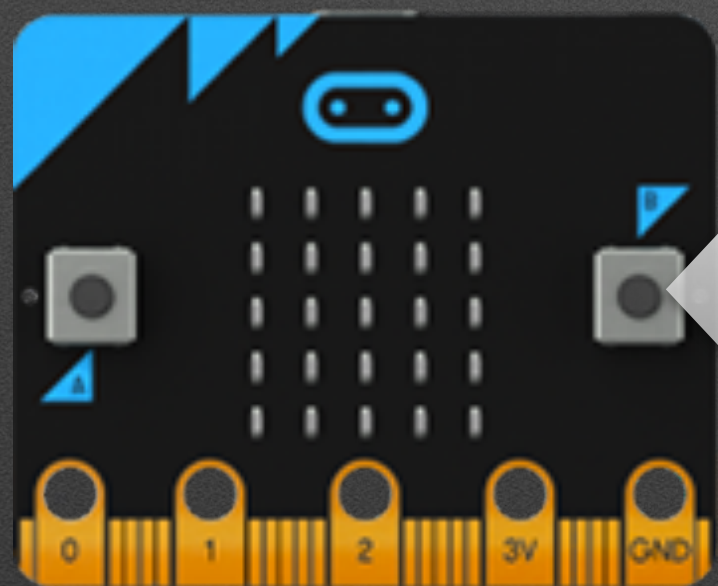
AdaFruit.io



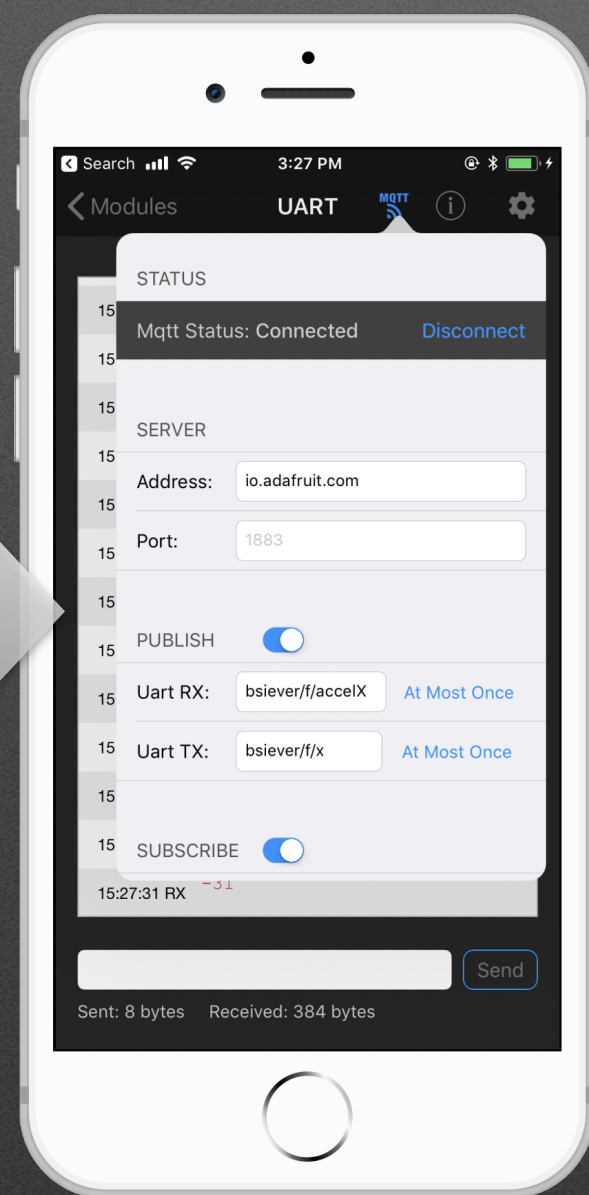
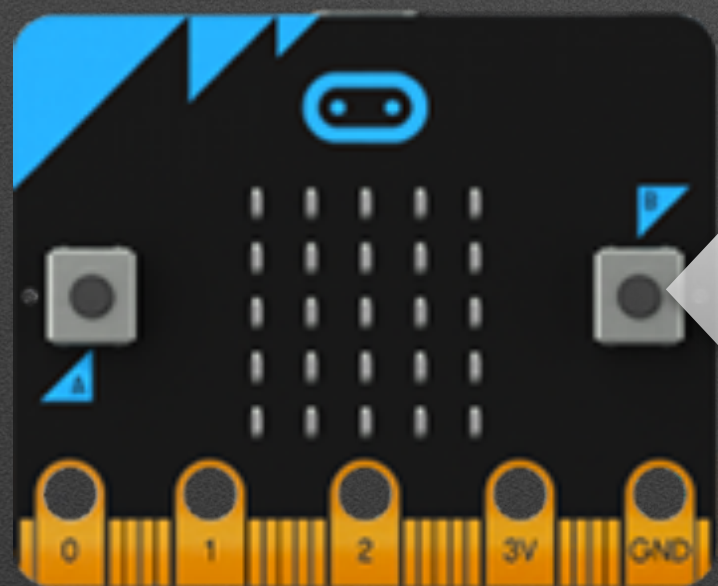
AdaFruit.io



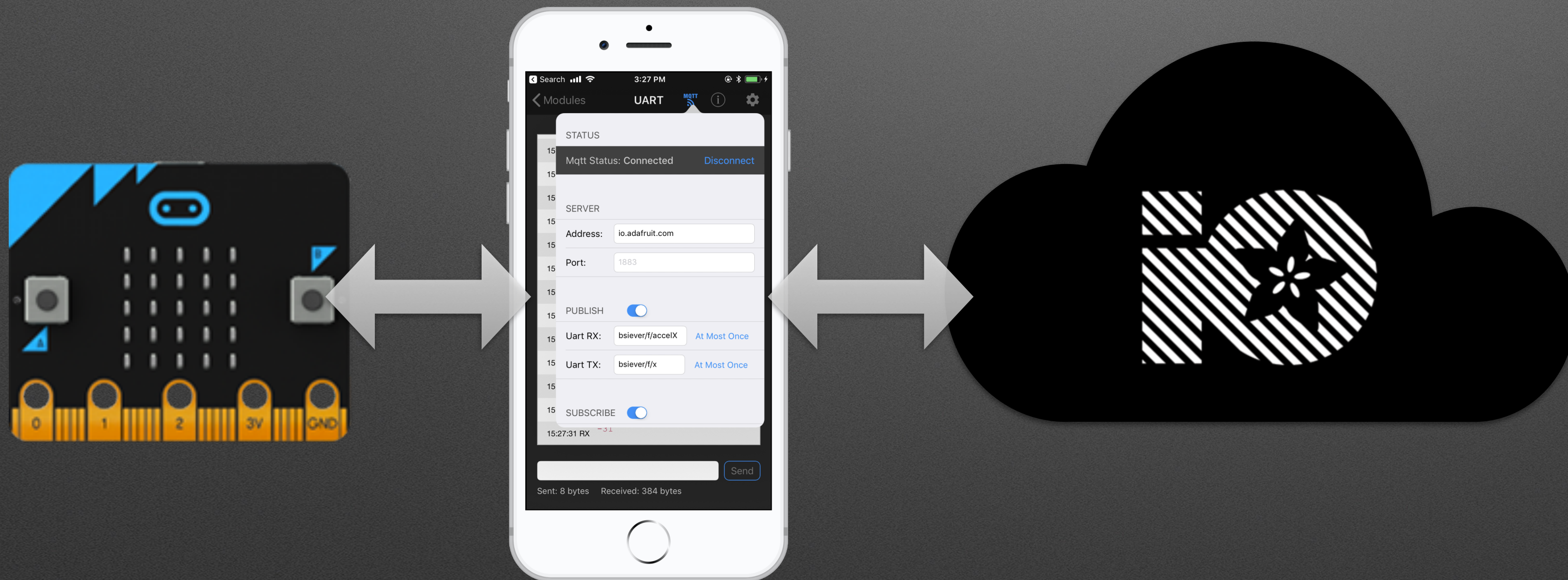
AdaFruit.io



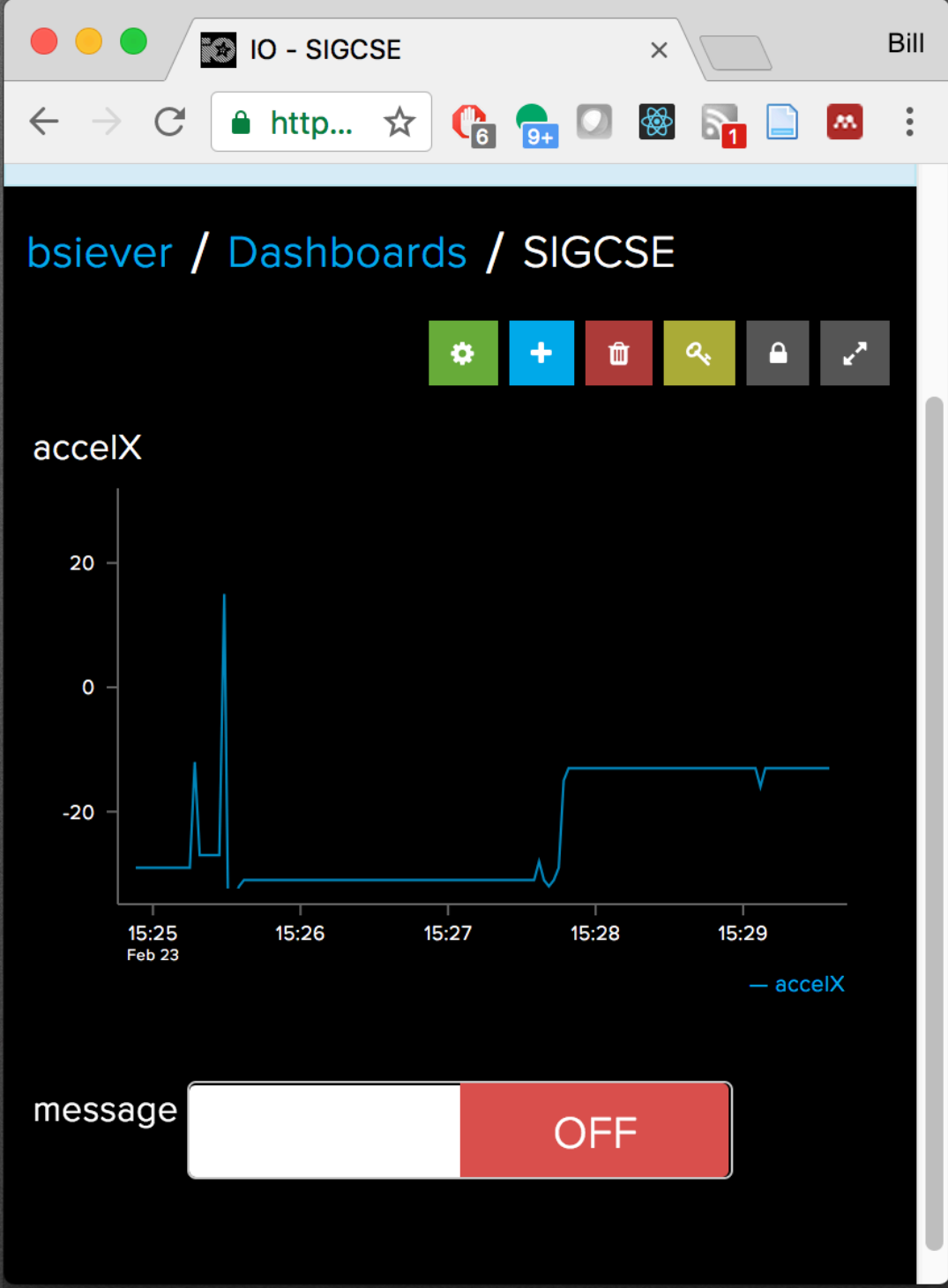
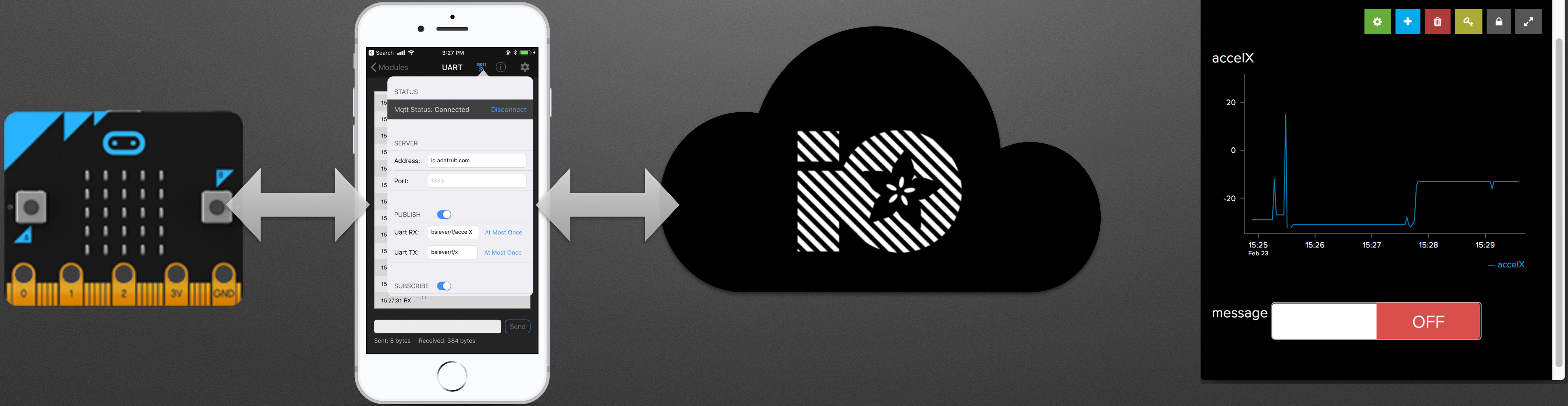
AdaFruit.io



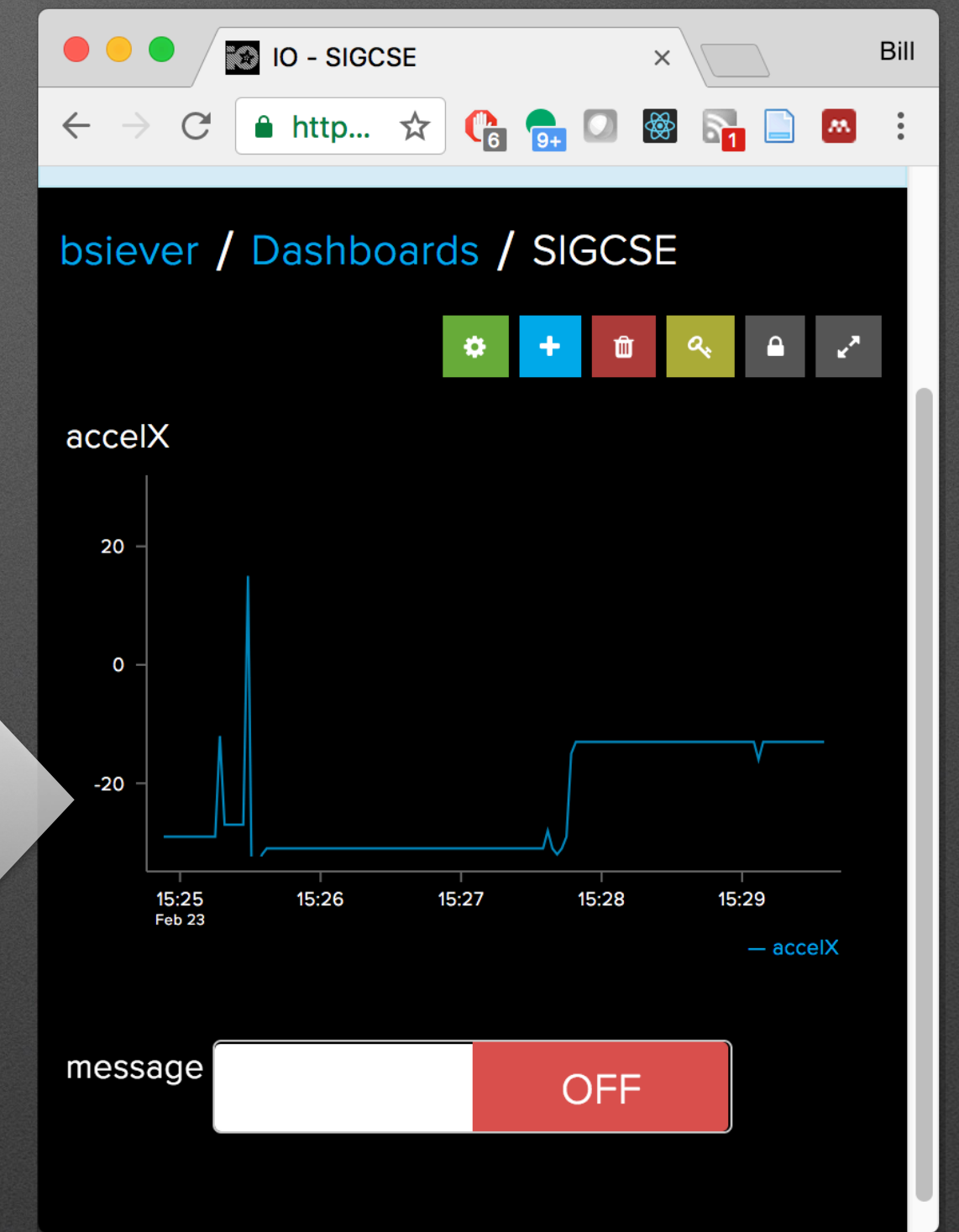
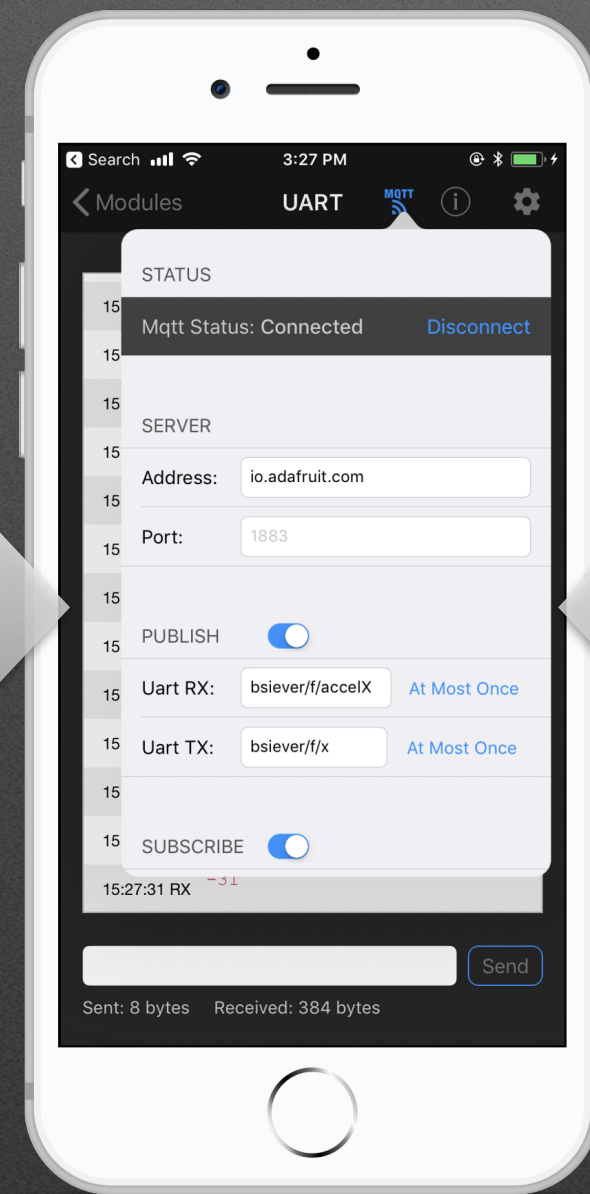
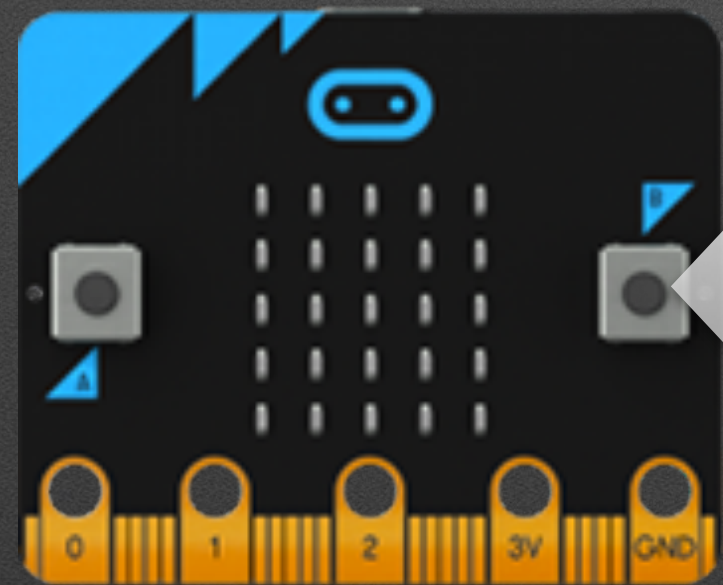
AdaFruit.io



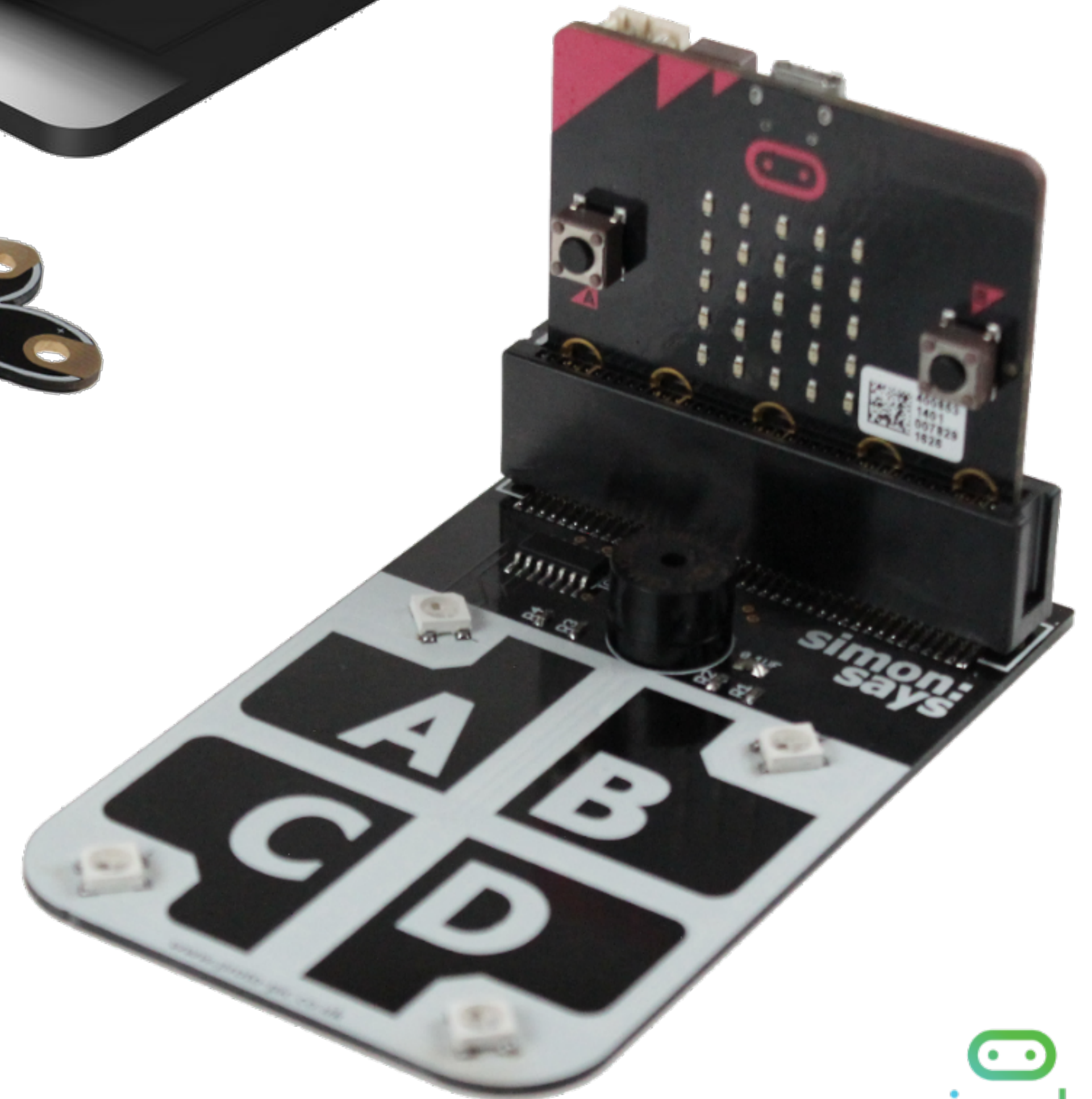
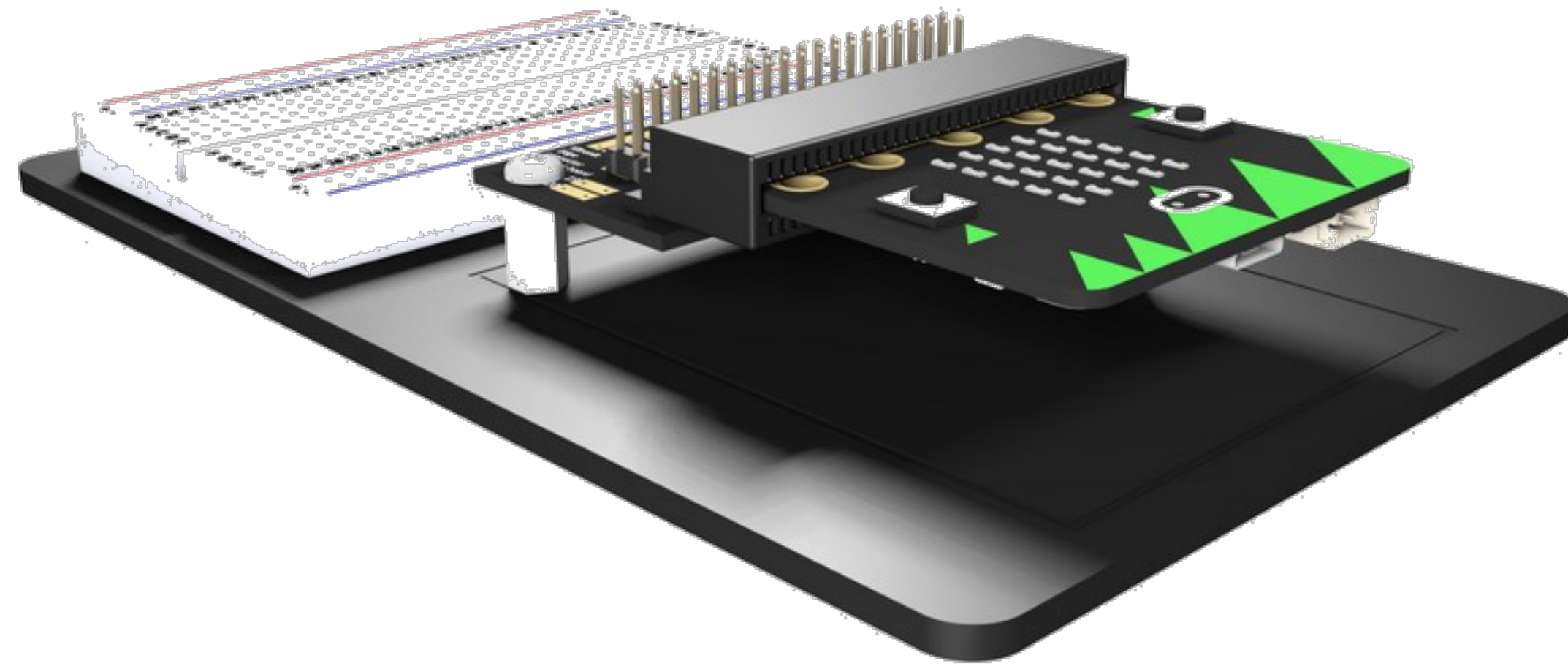
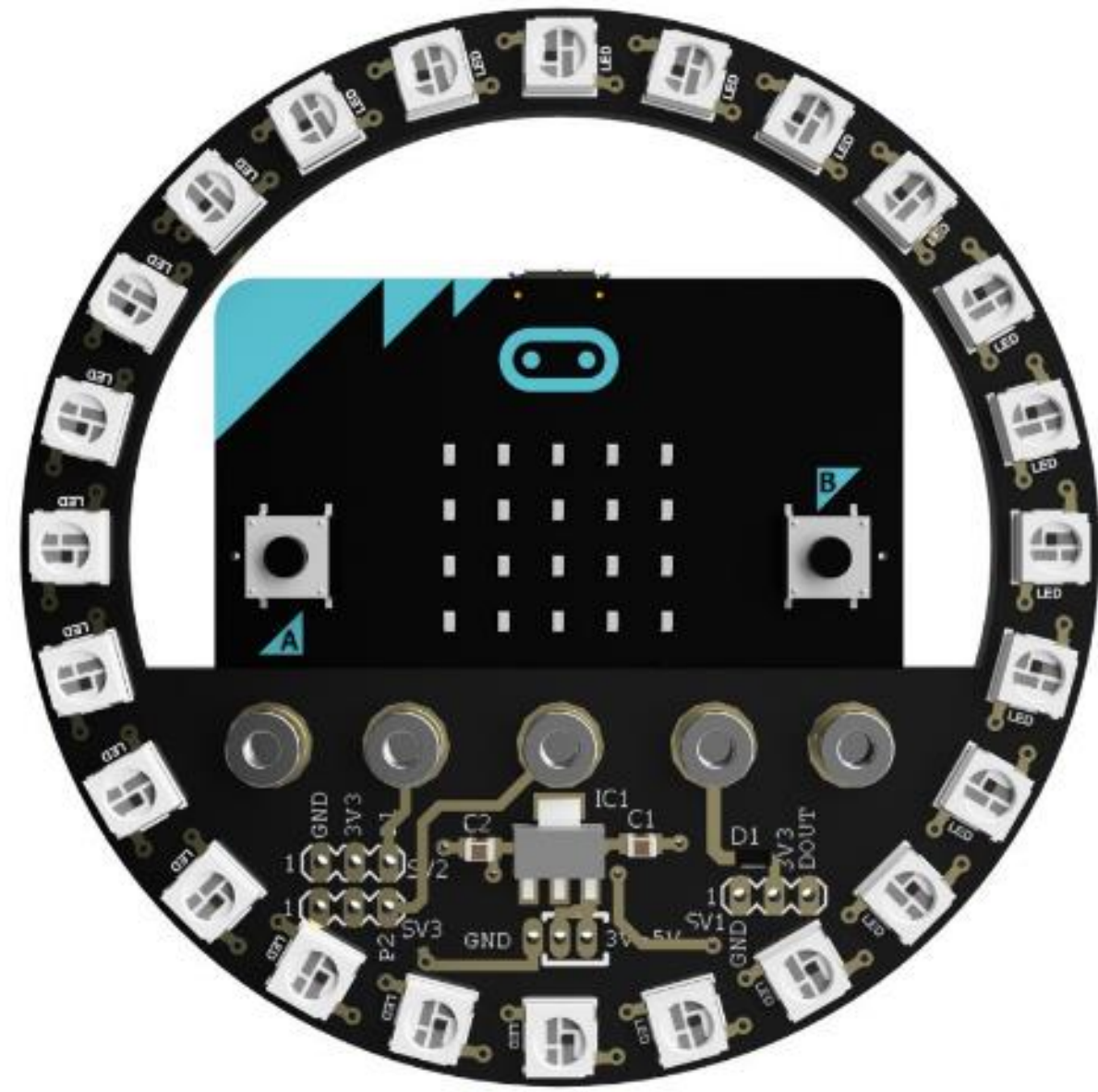
AdaFruit.io



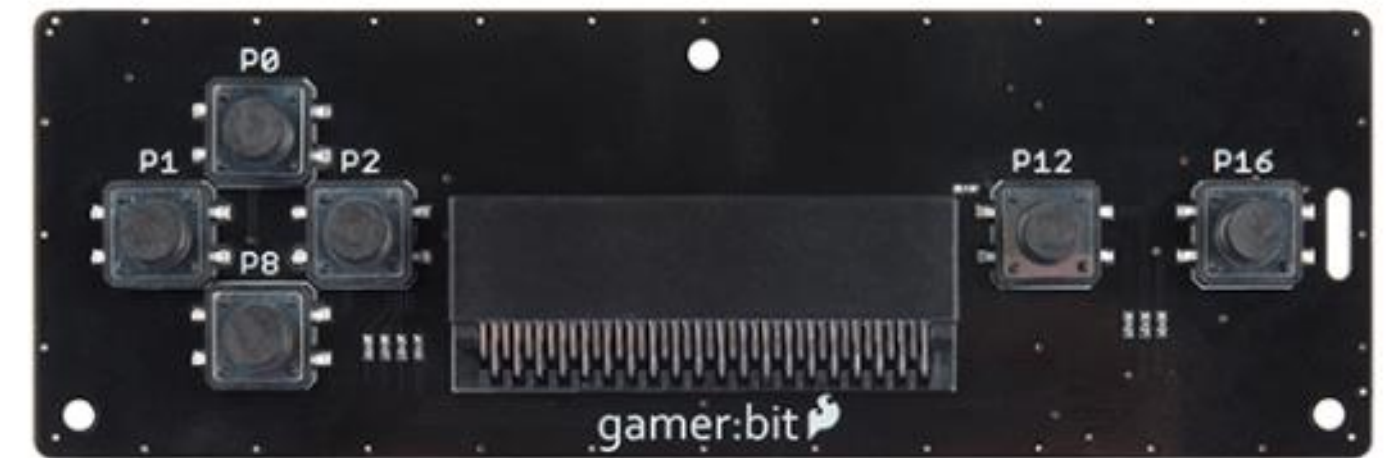
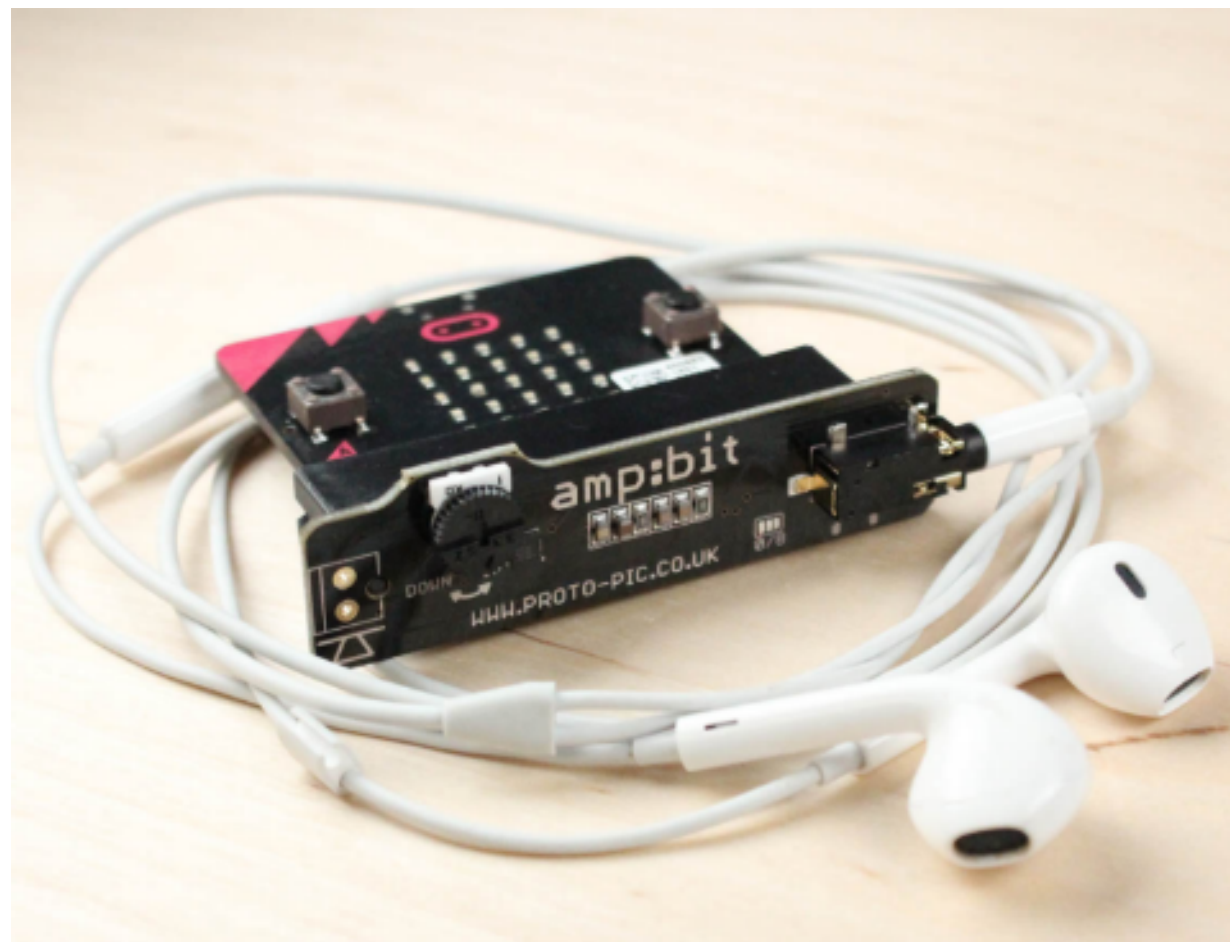
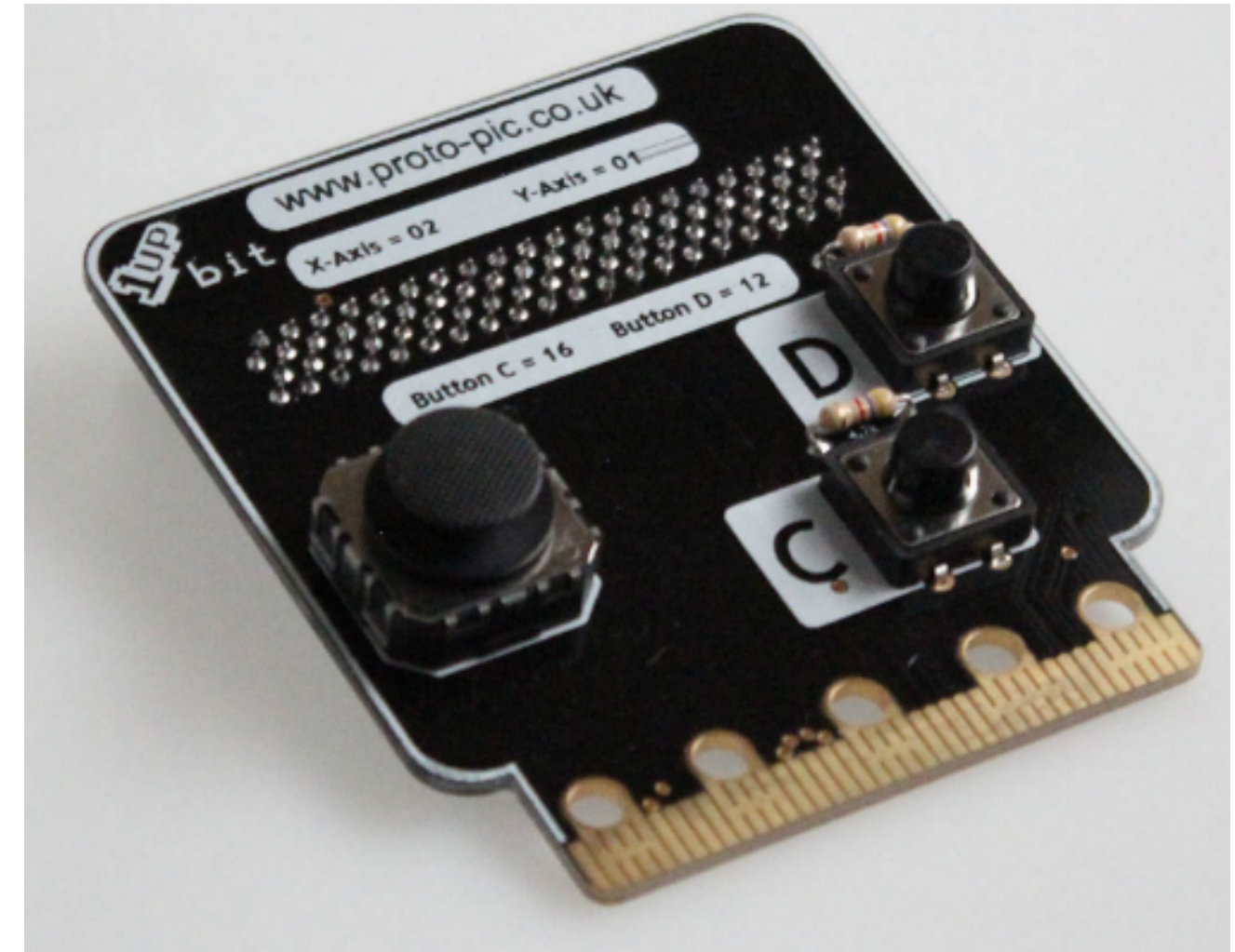
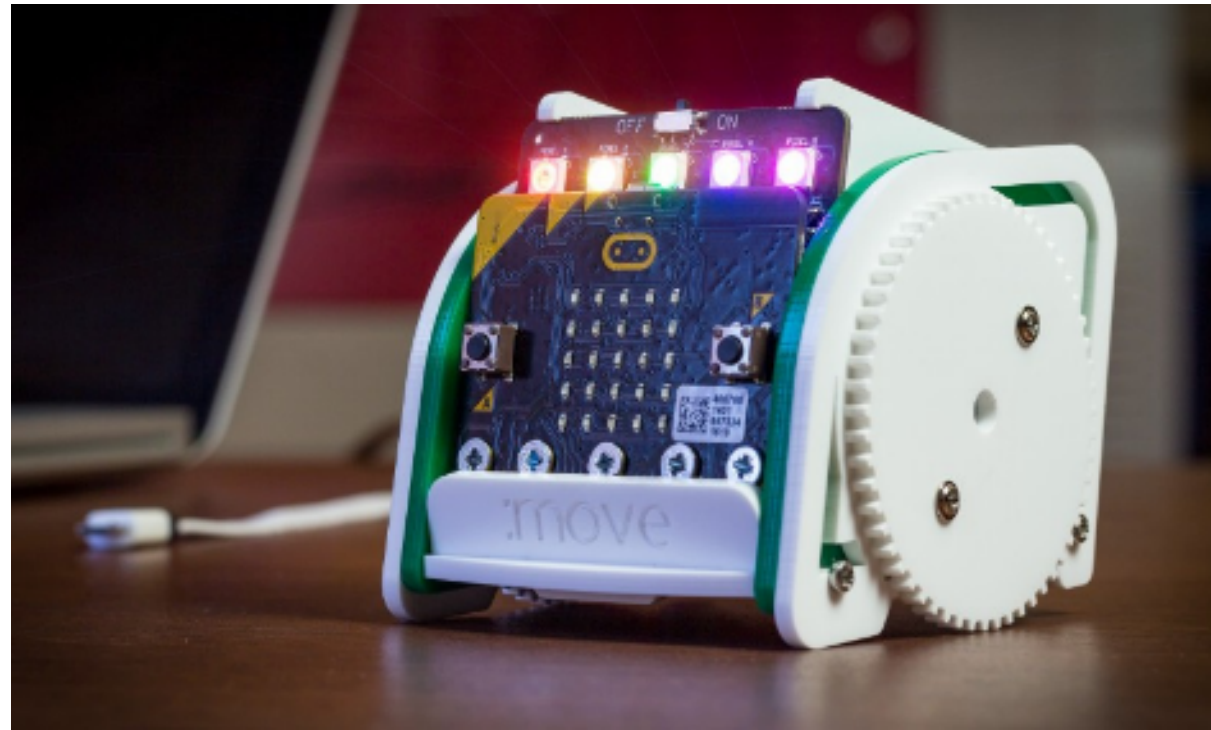
AdaFruit.io



Hardware Ecosystem



<http://microbit.org/assets/documents/microbit-accessories.pdf>



U.S. Resellers



Available via DonorsChoose.org



- AKJ Education is an approved DonorsChoose.org vendor and micro:bit reseller
- Teachers enter projects and request classroom materials
- Individuals and companies can donate money towards the purchase of those materials

Misc.

- Address Safety!
 - Low voltage / low current vs. Mains power

Bill's SIGCSE Blog Post

<https://tinyurl.com/SIGCSE19uBit>

Questions / Discussion

Remove Add Bluetooth

(& remove Radio)

Remove Add Bluetooth

(& remove Radio)

