BBC

micro:bit

Inventors Kit

v2

www.abra-electronics.com

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INTRODUCTION

Welcome to the wonderful world of *micro:bit!*
The *micro:bit v2* is an easy to use yet surprisingly powerful piece of hardware that will allow you to create many impressive gadgets.
The board was designed in the UK by the BBC and measures only 4 x 5 cm.
The system is an ARM-based embedded system microcontroller (ARM Cortex M0).
The module is best suited for beginners or younger users as an educational introduction to computing, coding and hardware.
*Before getting started, review the basic safety tips here:
https://microbit.org/get-started/user-guide/safety/

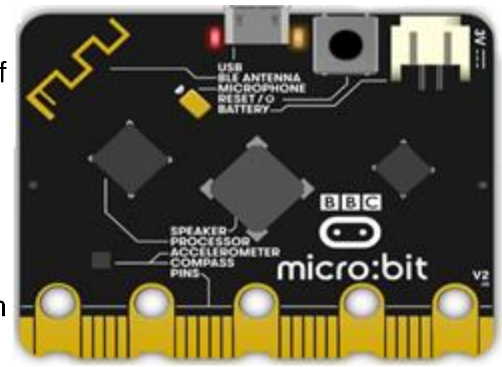


Figure 1 - BBC micro:bit v2

HARDWARE

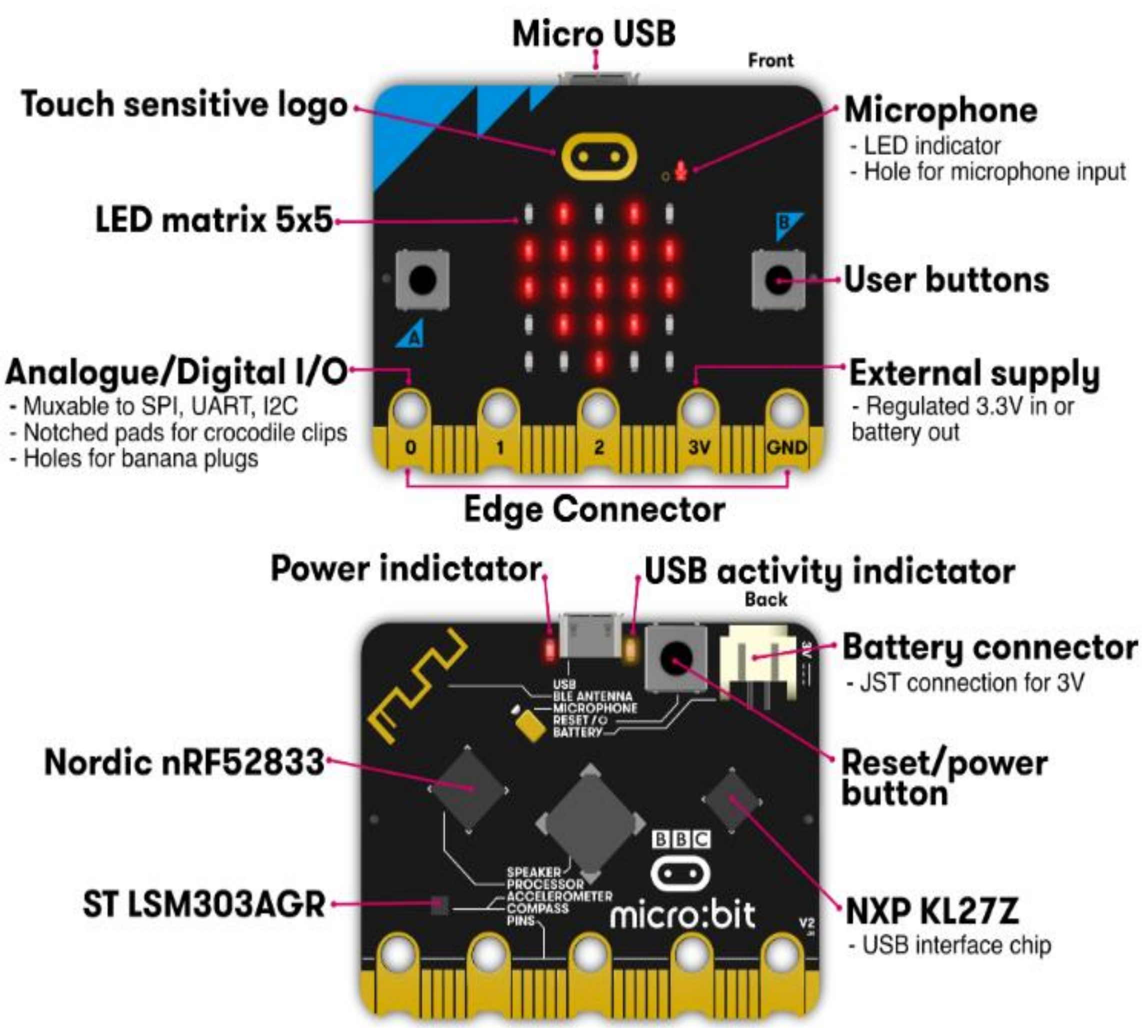


Figure 2 - Technical Specifications

Hardware block diagram:

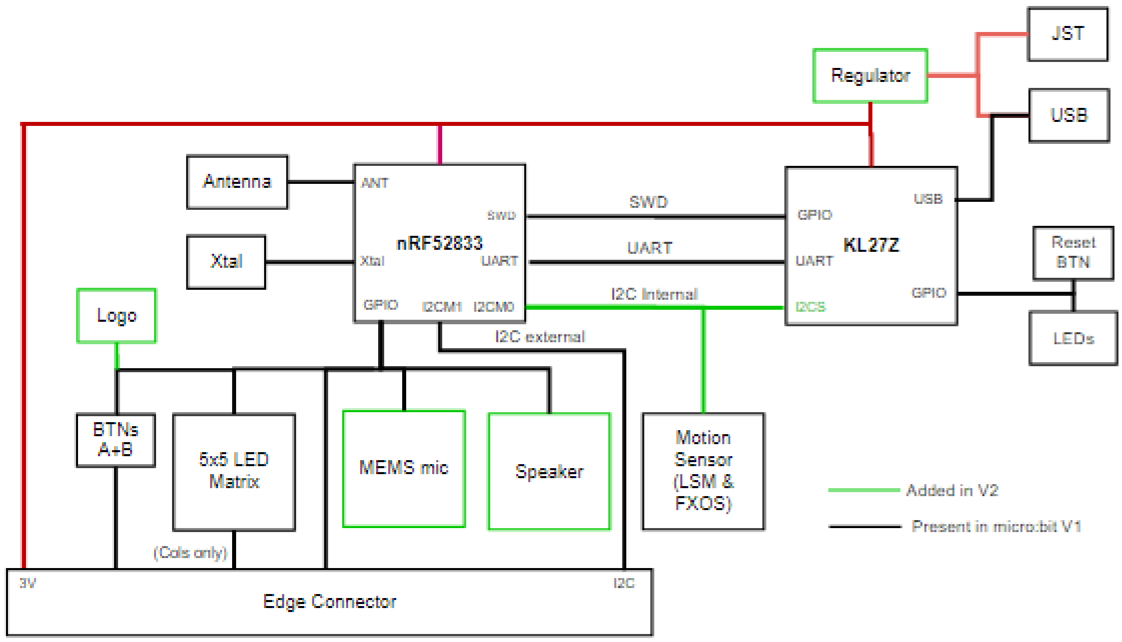


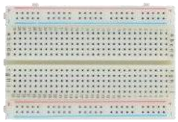
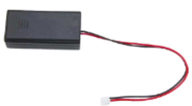
Figure 3 – Hardware Block Diagram

Hardware built-in micro:bit v2:

- 16MHz 32 bit ARM Cortex M4 Nordic nRF52833
- 512 kB Flash
- 128 kB RAM
- 2.4 GHz Bluetooth BLE
- USB 2.0 OTG (On-The-Go)
- 3.3V regulator (for USB only)
- 3 axis accelerometer and magnetometer (I2C) – NXP/Freescale LSM303AGR
- 5x5 LED array
- 2 programmable tactile push buttons – 1 reset button
- Ring connectors (3 x I/O, Power, Ground)
- 19 assignable GPIO pins
- PCB mounted magnetic speaker 80dB @ 5V, 10cm (2700Hz)
- Microphone with sensitivity -38dB ±3dB @ 94dB SPL

Reference**:** https://tech.microbit.org/hardware/

Hardware included in this kit:

	Description	Abra Part NO.	Project
	Micro:bit v2	MICROBIT	All
	400 Tie solderless bread-board	ABRA-6	3,4,5,6,7,8,9
	Breakout Connector with Headers	BOB-13989	3,4,5,6,7,8,9
	Alligator Clips	TL-155-1/2	3,4,5,6,7,8,9
	Male/Male Jumper Wires	759-ADA	3,4,5,6,7,8,9
	AAA Batteries	30-AAA-4	All
	Battery Holder	BAT-H-2AAA	All
	USB Cable	CAB-600-R	All
	LED - Green	LED-5G	3
	RGB LED	LED-5RGB-4	6
	Pushbuttion - N.O	PBS-155	3
	Potentiometer - 1kΩ	P1K-MIN-PC	3
	Photocell 5kΩ (Light, Detecting Resistor)	PHOTO-300	4
	Piezo Buzzer	BUZ-120	5
	Temperature Sensor	TMP36	7
	Servo Motor	FS90	8
	DC Motor	MOT-500	9,10
	Transistor	BC337	9,10
	Resistor - 150Ω (Brown-Green-Brown) 10kΩ (Brown-Black-Orange) 2.2kΩ (Red-Red-Red)	R1/4-150 R1/4-10K R1/4-2.2K	3,4,6,9,10

CODE

We've seen how powerful *micro:bit v2* hardware is. Now let's learn how to unleash it with code.

Reference: http://microbit.org/code/

Pseudo Code:

Every program begins in Pseudo Code. Pseudo code is the list of instructions written in plain English that is worked out before the program is coded. This helps the programmer logically decide on code structure and operations. (See PROJECTS section for examples)

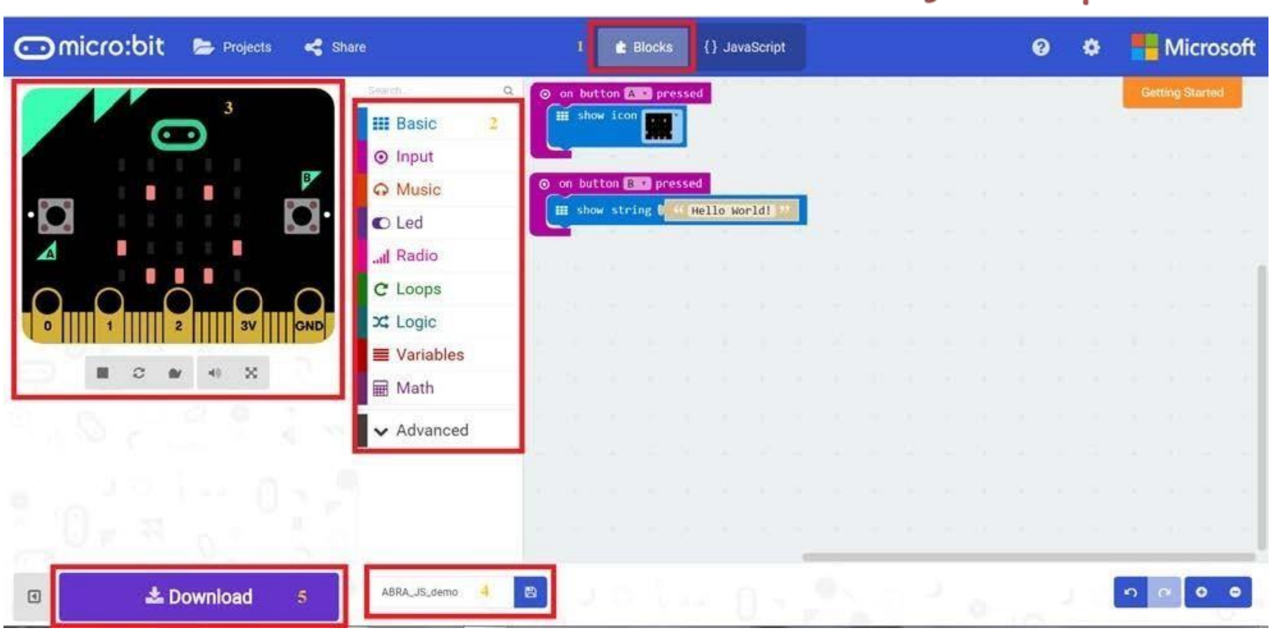
Coding Tools:

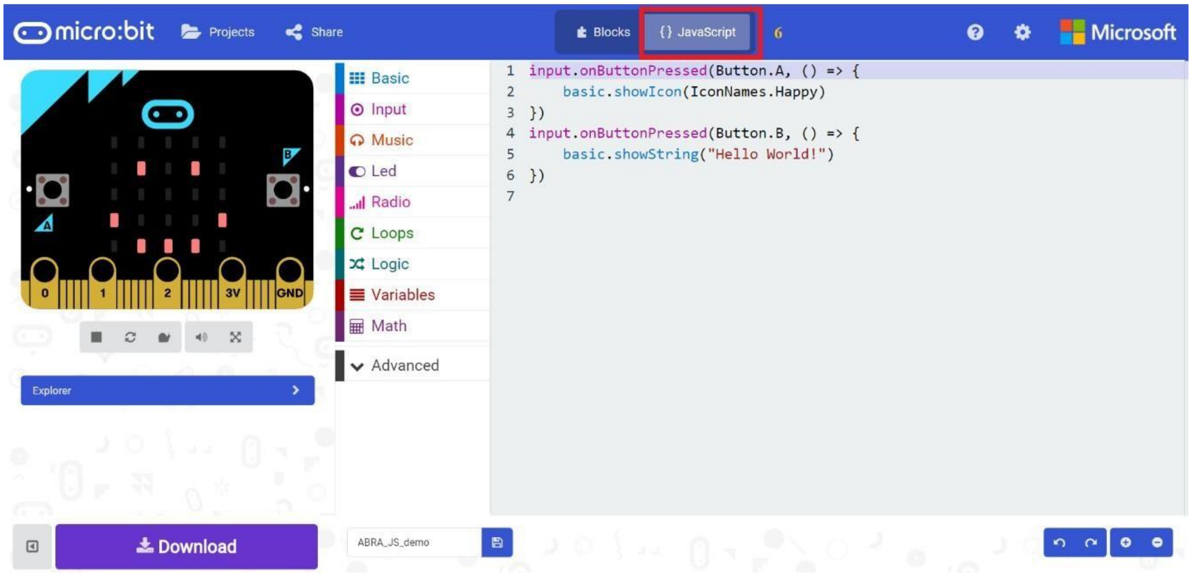
The *micro:bit v2* is unique in that it offers the possibility of programming in many different languages with many different environments. Beginner programmers can get the basics using a "block editor" by simply dragging and dropping segments of already written code. Experienced users can write bare-bone scripts.

Reference: https://www.microbit.co.uk/create-code#

1 – JavaScript Block Editor: [RECOMMENDED]

https://makecode.microbit.org/#
Sample projects and User Guide can be found here:
https://makecode.microbit.org/reference





1	Block mode
2	Code block selection menu
3	Program simulator
4	Name/Save file .js
5	Download hex file for uploading on board
6	JavaScript mode

Figure 4 – JavaScript

2 – Python Editor [ADVANCED]

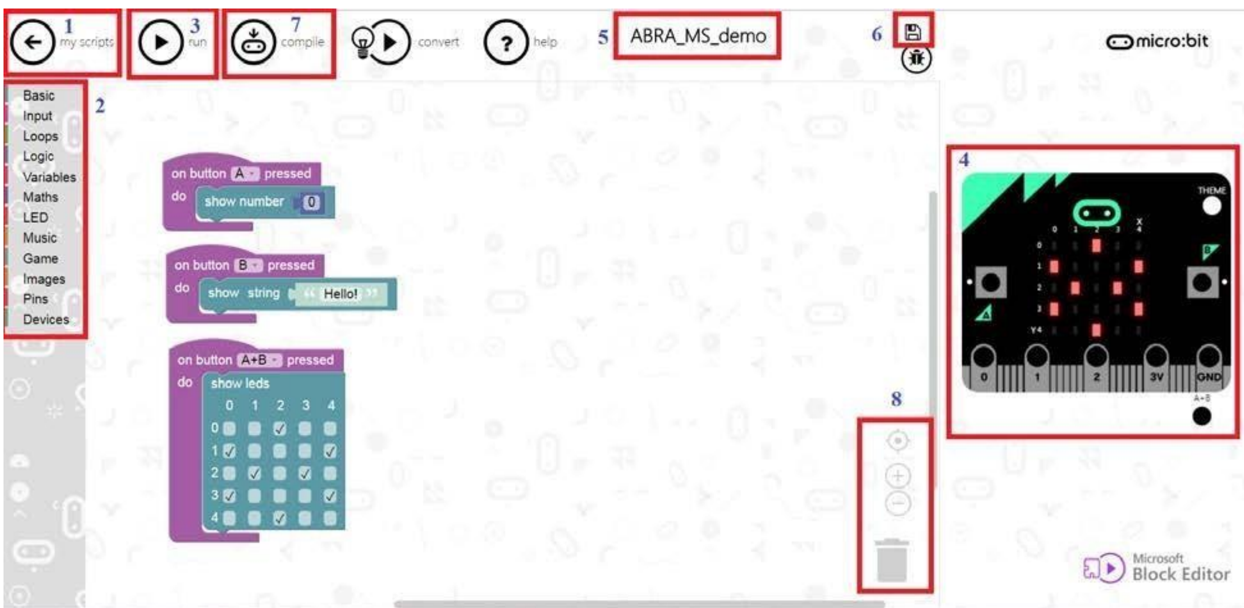
http://python.microbit.org/editor.html#

1	Script sample code
2	File name
3	Save .py file
4	Download hex file for uploading onto board

Figure 5 - Python

3 – Microsoft Block Editor [OLD]

https://www.microbit.co.uk/app/#



1	Load previously saved scripts
2	Block selection menu
3	Run script on simulator
4	Simulator
5	Name file
6	Save file locally
7	Download hex file for upload onto board
8	Screen navigator

Figure 6 - Microsoft

Running Programs:

Now that our script has been written and tested on the simulator, we are ready to download it and install it onto the *micro:bit v2*.

Reference: https://microbit.org/get-started/user-guide/web-usb/

Requirements: USB cable, Windows 7 (or later), MAC OS X 10.6 (or later), Internet

Procedure:

1. Connect the *micro:bit v2* into your computer USB. Your computer should recognize the device and create a MICROBIT drive
2. Compile the script (varies with each program editor). This creates a .hex file
3. Save file locally on your computer (ex: My Documents)
4. Locate the downloaded .hex file and folder and copy it (drag and drop) into the MICROBIT drive folder. This will compile the file onto the hardware. (You cannot do multiple files at a time)
5. The *micro:bit v2* LED will flash for a few seconds. The software has been incorporated into the flash memory. This means that even after unplugging your device your program will remain. It will execute next time the board is powered.

Figure 7 – Upload

Error Codes:

Programming can be tricky and often doesn't work on the first try. When you see the *micro:bit v2* frowny face, something is wrong. Here are a few error codes to look out for:

10	MICROBIT_I2C_LOCKUP	I2C bus is not working
20	MICROBIT_OOM	No free memory available
30	--	Heap space corruption
40	--	Uninitialized object type
41	--	Out of bounds
42	--	Cannot execute script

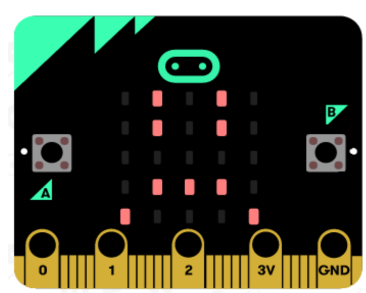


Figure 8 - Error Code

Reference: https://makecode.microbit.org/device/error-codes

Projects

*Other PROJECTS ideas can be found at: https://www.microbit.co.uk/blocks/lessons

1- Coin Toss

“This project helps you decide with a simple coin toss”

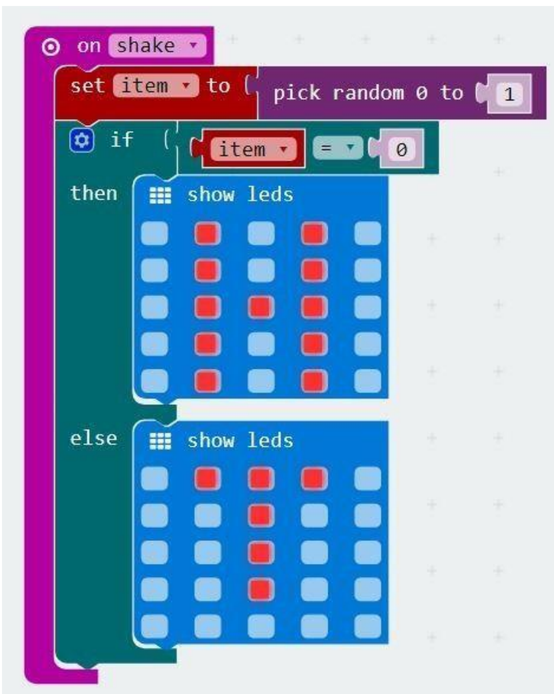
LEVEL: Beginner

MATERIALS: microbit, Battery, USB cable

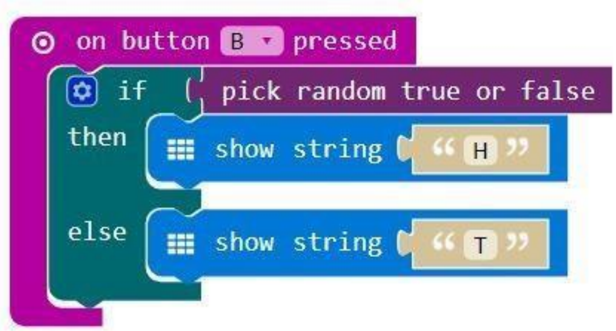
PSEUDO CODE:

1. When the device is **shook (or button pressed)**, do coin toss
2. Coin toss can have 1 of 2 **random** results
3. **Set** heads to **0** and tails to **1**
4. **If** the randomly generated toss is 0, **print** heads (H) on **LED screen**
5. **Else**, the toss must be 1, **print** tails (T) on **LED screen**

SAMPLE CODE:



ALTERNATE CODE:



2- Dice Roll

"This project creates a useful gadget for rolling dice and playing games"

LEVEL: Beginner

MATERIALS: microbit, Battery, USB cable

PSEUDO CODE:

1. When the device is **shook (or button is pressed)** roll dice,
2. Coin toss can have 1 of 6 **random** outcomes
3. **Set** result to random outcome
4. **If** result is **1, print** 1 on **LED screen**
5. **Else if** result is **2**, **print** 2 on **LED screen**
6. Repeat for all possible cases

SAMPLE CODE:

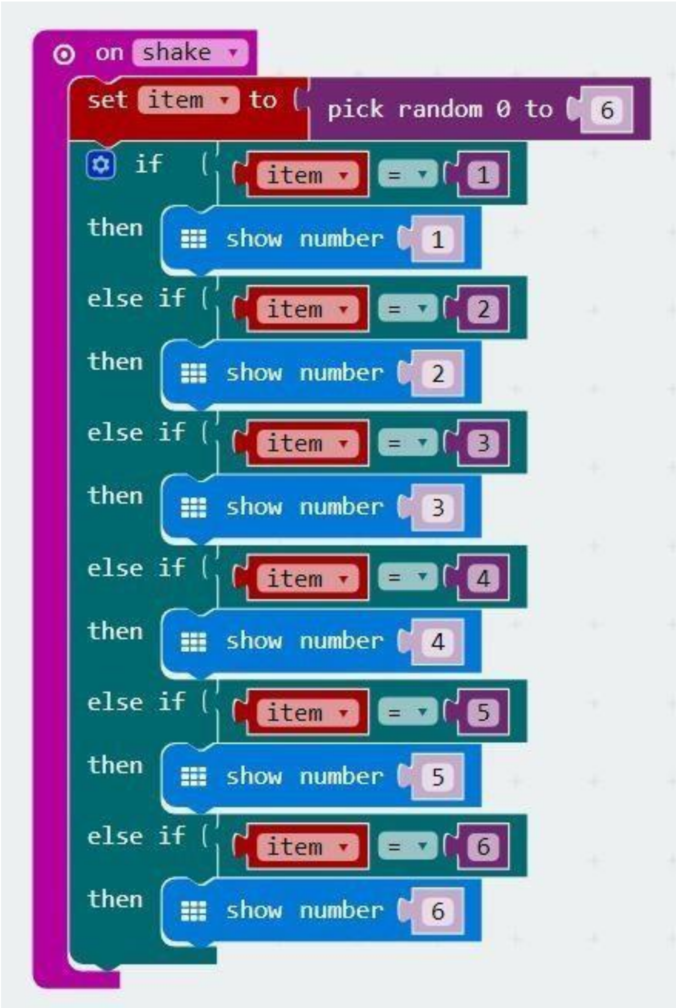


Figure 10 - Dice Roll

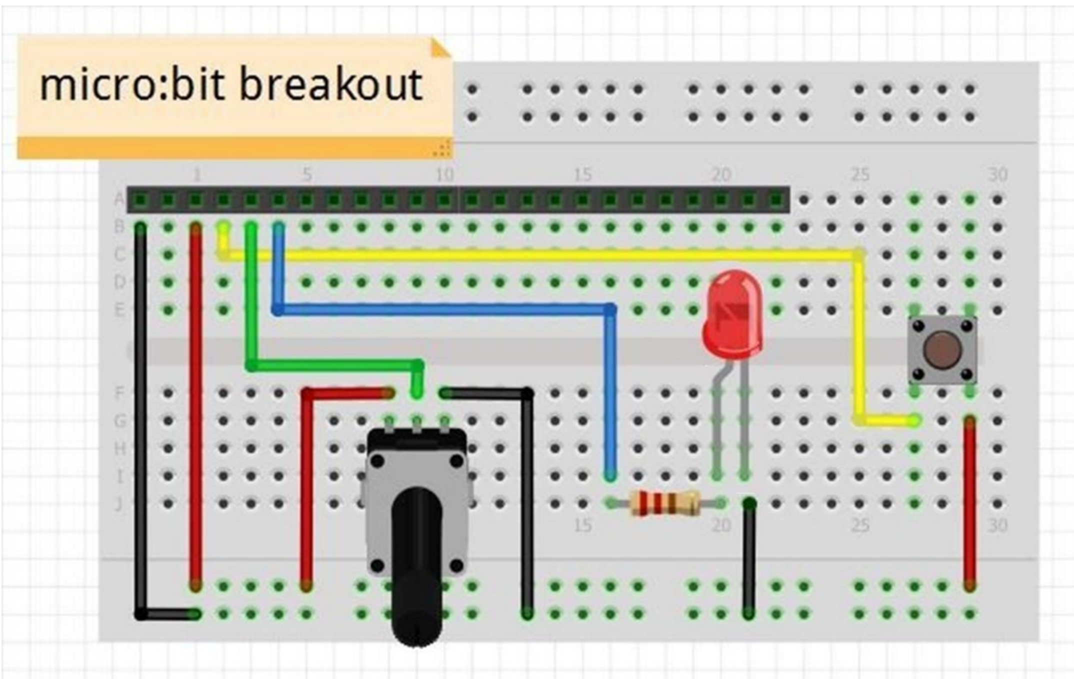
3- LED Control

"This project shows you how to turn an LED ON and OFF with pushbuttons and control its brightness with a potentiometer."

LEVEL: Intermediate

MATERIALS: LED, Resistor(150), Potentiometer, Pushbutton Jumper wire, Breadboard, microbit Breakout, Battery pack, USB cable

HARDWARE:



***LED:**
Longer leg is **+**
Shorter leg is **–**
(connect to black wire)

Figure 11 - LED Circuit

PSEUDO CODE:

1. Assign **button** to a **pin (P0)**
2. Check and update **light state** when button pin is **pressed**
3. **If** light state is **OFF (0),** change it to **ON (1)**
4. **Else**, change light state to **OFF (0)**
5. Check light state **forever**
6. **If** light state has been set to **ON(1)**, control LED brightness
7. LED brightness is controlled by **reading** the **analog** value of **potentiometer pin (P1)** and **analog writing** it on to **LED pin (P2)**
8. **Else,** light state is OFF, LED must be turned off (**digital write P2** to **0)**

SAMPLE CODE:

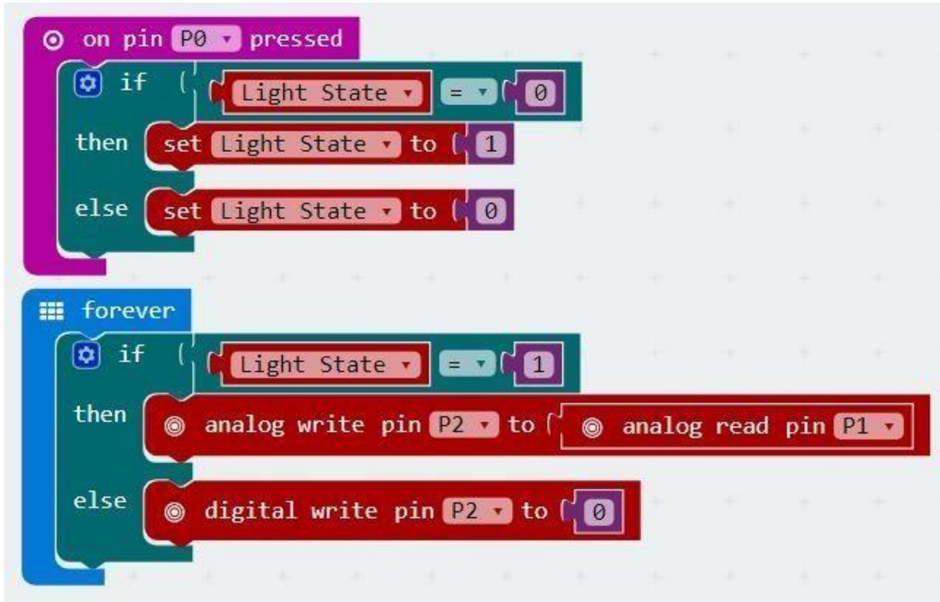


Figure 12 - LED Control

4- Light Sensing

"This project demonstrates how to measure light intensity with a sensor and use it for control (TIP: Try controlling an LED brightness with this technique from Project 3)"

LEVEL: Intermediate

MATERIALS: Photocell, Resistor (10k), Microbit breakout, Breadboard, Battery pack, USB cable

HARDWARE:

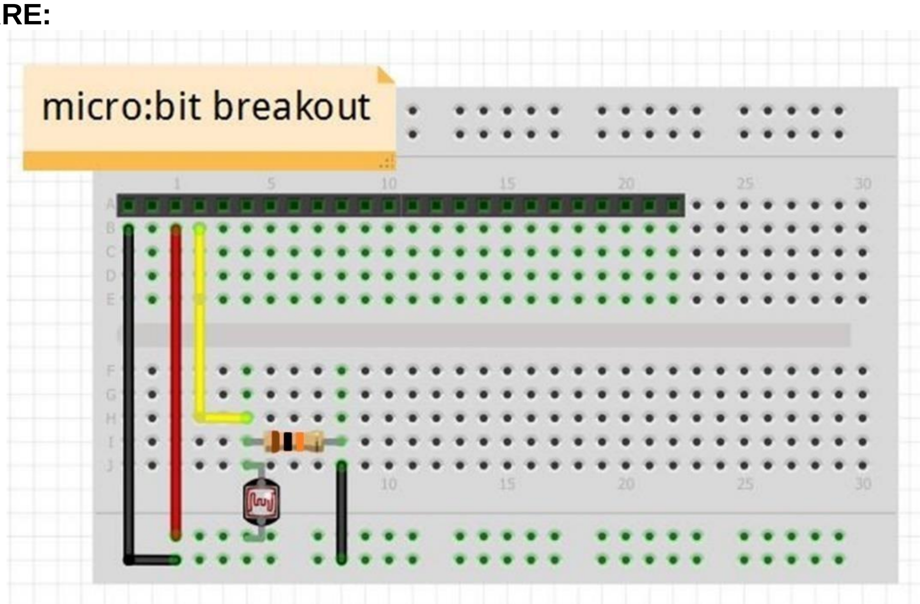


Figure 13 - LDR Circuit

PSEUDO CODE:

1. Check sensor reading **forever**
2. **Set** sensor value to variable **Light**
3. **Light** is **read** from **analog pin P0**
4. **Light** can have values 0 to 1024 (analog pin)
5. **If** light is **greater** than **512**, show SUN on **LED**
6. **Else**, show MOON on **LED**

SAMPLE CODE:

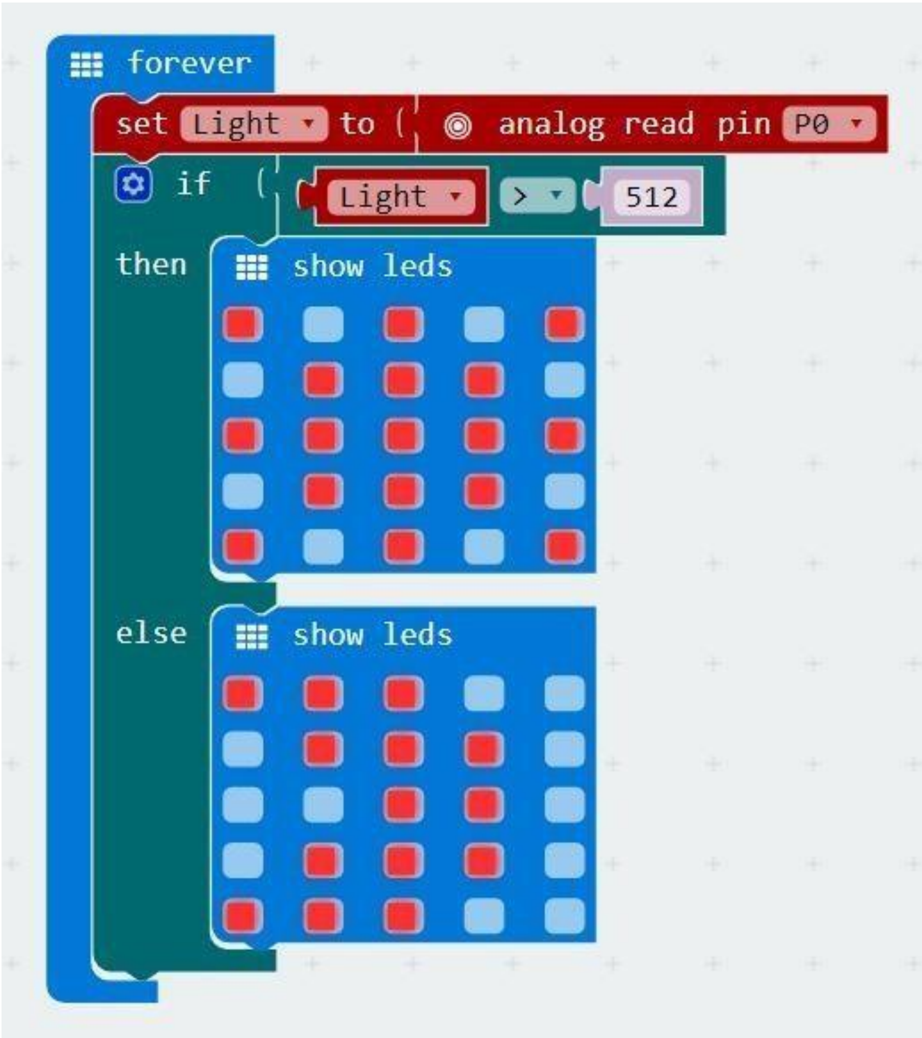


Figure 14 - LDR Control

5- Tone Control

"This project plays with sound and varies a tone using a piezo buzzer"

LEVEL: Intermediate

MATERIALS: Piezo buzzer, Microbit breakout, Breadboard, Battery pack, USB cable

HARDWARE:

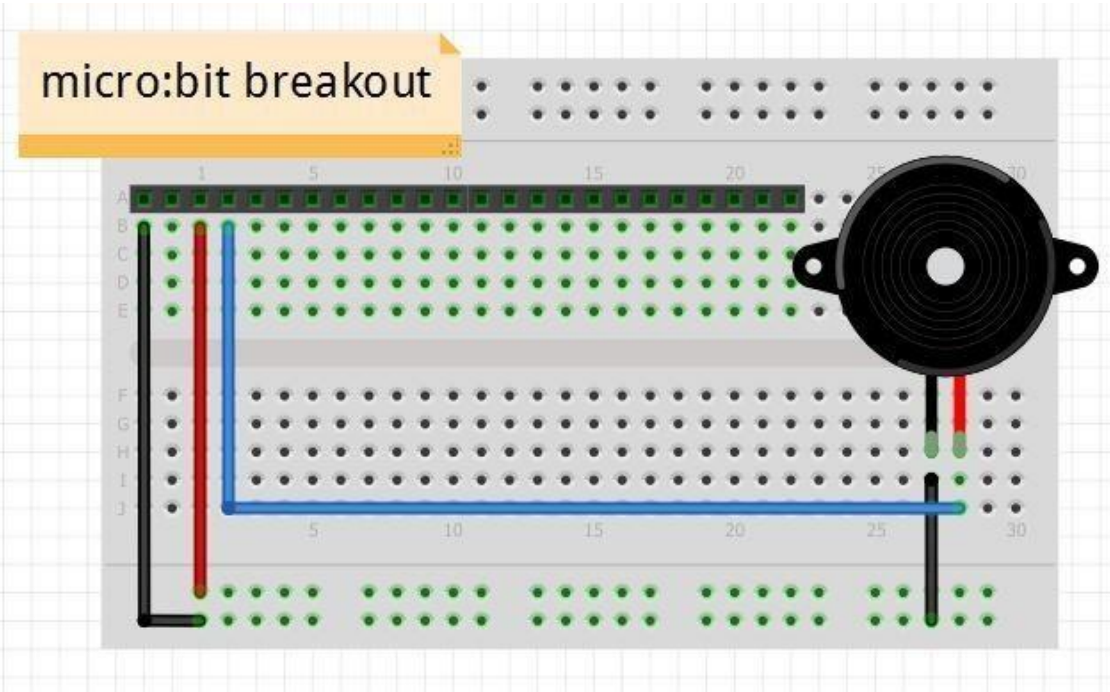


Figure 15 - Piezo Buzzer Circuit

PSEUDO CODE:

1. When **Button A** is pressed,
2. **Play tone (note) for (beat)**

SAMPLE CODE:

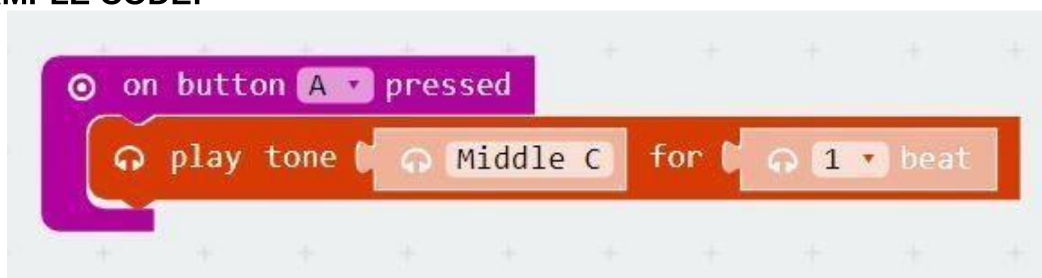


Figure 16 - Tone Control

6- RGB LED

“This project lets you manipulate light, change colors and patterns”

LEVEL: Intermediate

MATERIALS: RGB LED, 150Ω resistor, Microbit breakout, Breadboard, Battery pack, USB cable

HARDWARE:

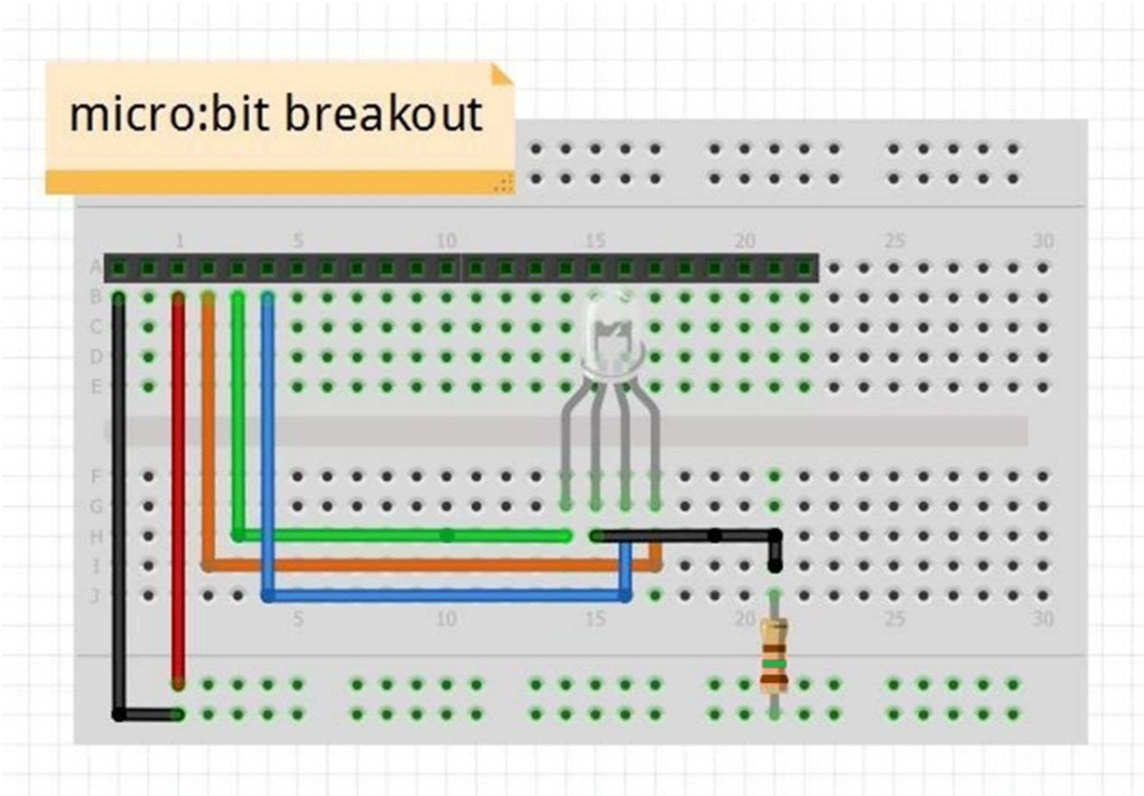


Figure 17 - LED RGB Circuit

PSEUDO CODE:

1. Keep LED running **forever**
2. **Assign analog write variables Red** to **P0**
3. **Assign analog write variables Green** to **P1**
4. **Assign analog write variables Blue** to **P2**
5. **If button A, increase** the level of **Green** by 10
6. **If Green surpasses 1020, reset to 0**
7. **If button B, increase** the level of **Red** by 10
8. **If Red surpasses 1020, reset to 0**
9. **If button A+B increase** the level of **Blue** by 10
10. **If Blue surpasses 1020, reset to 0**

SAMPLE CODE:

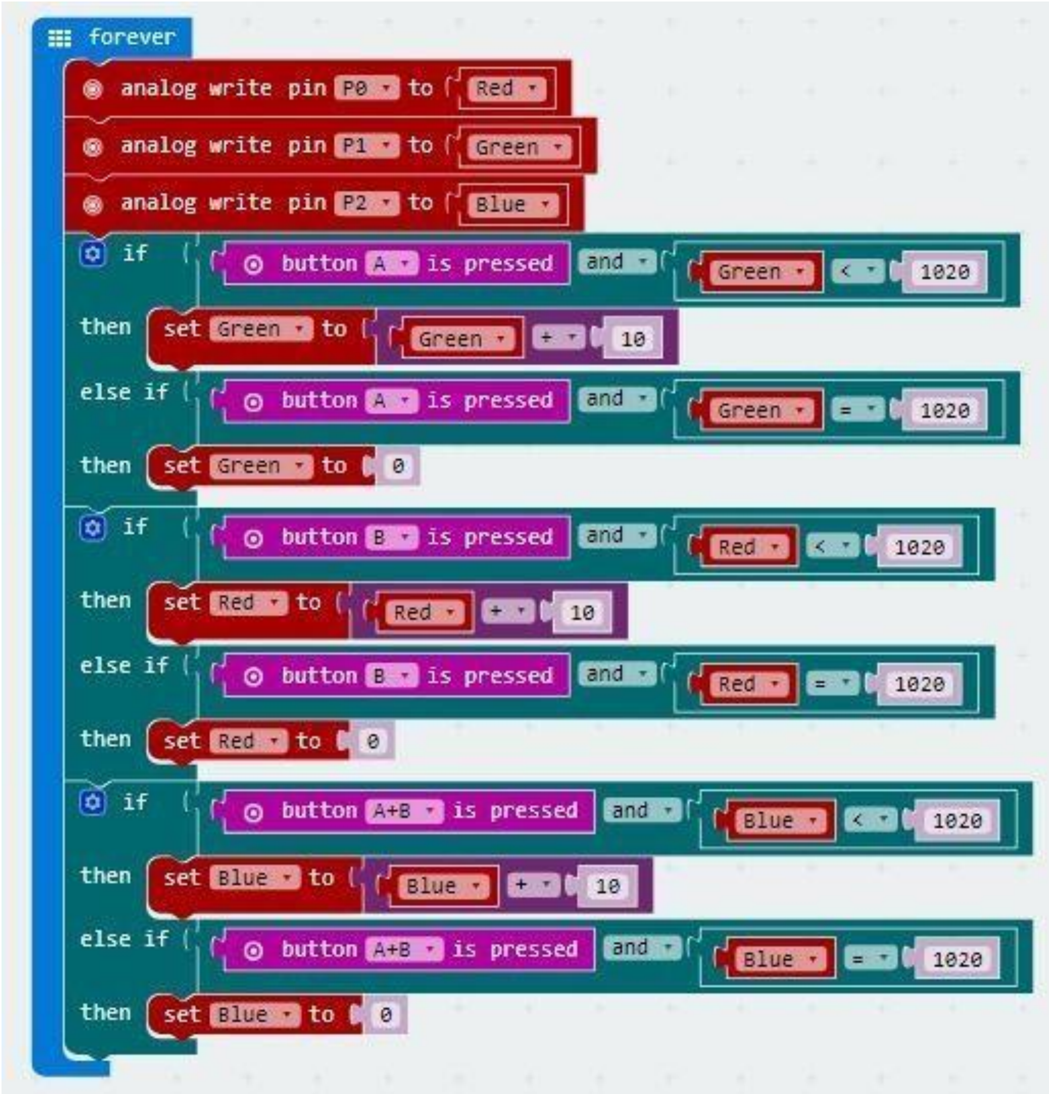


Figure 18 - LED RGB Control

7- Temperature Sensing

"This project creates a very accurate thermometer"

LEVEL: Intermediate

MATERIALS: TMP36, Microbit breakout, Breadboard, Battery pack, USB cable

HARDWARE:

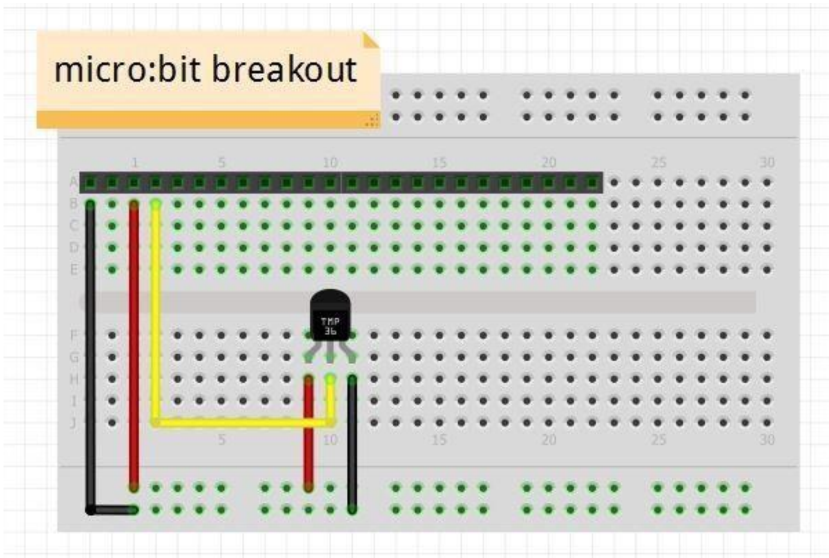


Figure 19 - TMP36 Temperature Circuit

PSEUDO CODE:

1- Check temperature sensor **forever**
2- Create **variable** to hold **sensor** value from **analog read pin P0**
3- Create **variable** to **map temperature** from lowest signed sensor input(124) and highest signed sensor input (496) to lowest temperature (-20) and highest temperature (100)
4- **Show number** corresponding to temperature

SAMPLE CODE:

Figure 20 - Temperature Control

8- Servo Control

"This project gets the gears rotating by controlling a servo motor"

LEVEL: Advanced

MATERIALS: Servo motor, Microbit breakout, Breadboard, Battery pack, USB cable

HARDWARE:

*****Note: In order to provide enough power to the servo motor, a separate breakout board/power supply can be used while the Microbit board is used to provide the control signal.*****

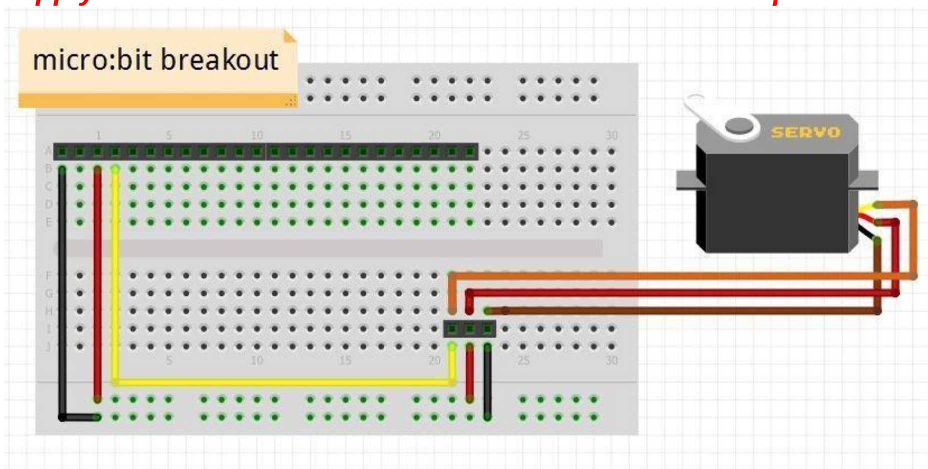


Figure 21 - Servo Motor Circuit

PSEUDO CODE:

1- When **Button A** is pressed
2- Command **servo** on **P0** to 180 degrees
3- **Pause** 1 second
4- When **Button B** is pressed
5- Command **servo** back to **0** degrees
6- **Pause** 1 second

SAMPLE CODE:

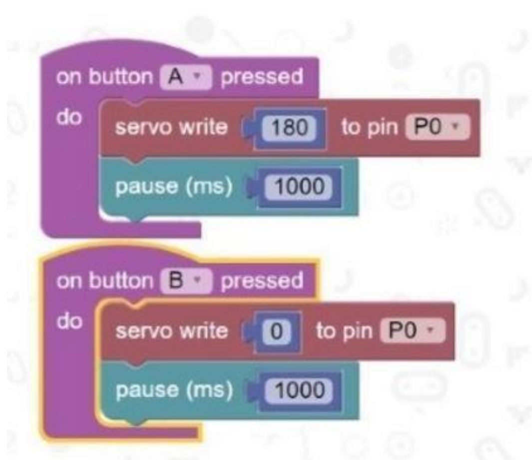


Figure 22 - Servo Control

9- Motor Control

"This project gets the wheels turning by controlling a motor"

LEVEL: Advanced

MATERIALS: DC motor, BC337 Transistor, Microbit breakout, Breadboard, Battery pack, USB cable

HARDWARE:

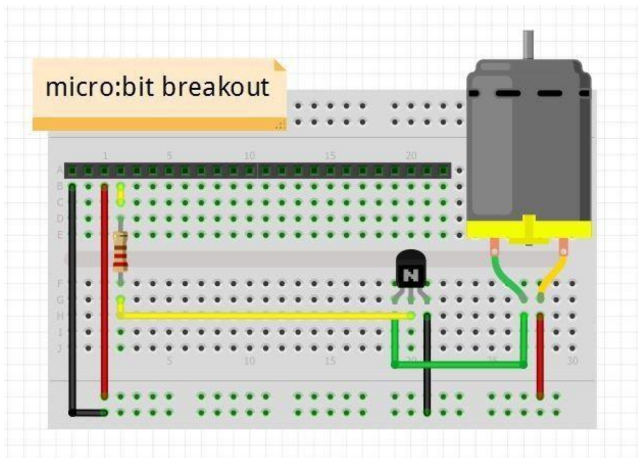


Figure 23 - Motor Circuit

PSEUDO CODE:

1- On start, create **variable** called **duty** and **set** it to **0**
2- Run motor **forever**
3- Ramp up motor speed by **analog write** the value of **duty** to **P0** until it reaches max value of **1023**
4- Ramp down motor speed until it reaches min value of **0**

SAMPLE CODE:

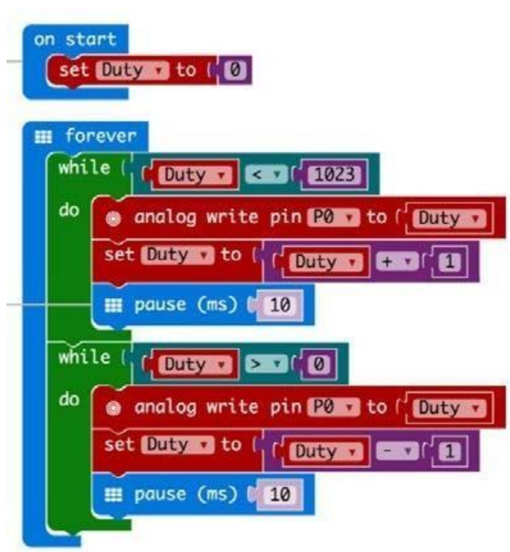


Figure 24 - Motor Control

10- Accelerometer Speed Control

"This project will get you accelerating motors with the built-in accelerometer"

LEVEL: Advanced

MATERIALS: DC motor, BC337 Transistor, Microbit breakout, Breadboard, Battery pack, USB cable

HARDWARE:

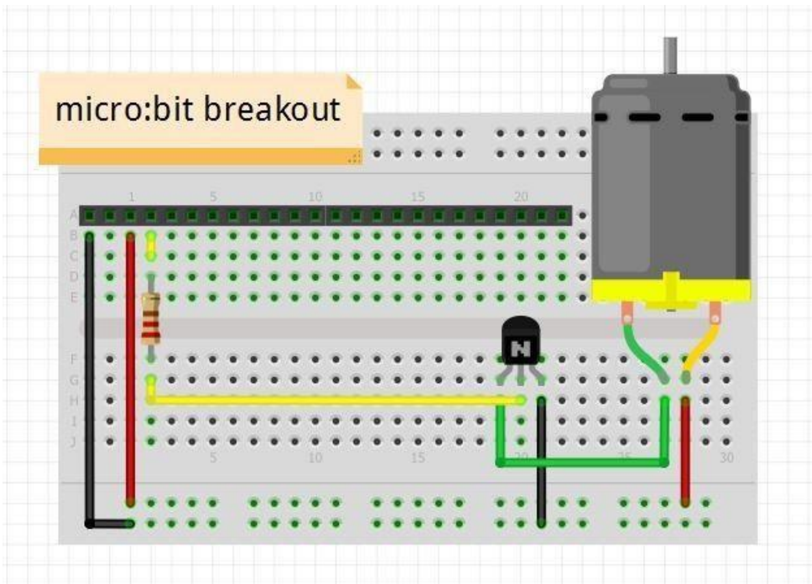


Figure 2 – Accelerometer Motor Circuit

PSEUDO CODE:

1- Run motor **forever**
2- **Analog write** the absolute value (positive values only) of the built-in **accelerometer** to **P0**

SAMPLE CODE:

Figure 25 - Accelerometer Motor Control