Name: _____

An tSraith Shóisearach do Mhúinteoirí

Junior CYCLE for teachers

Elective 2019/2020

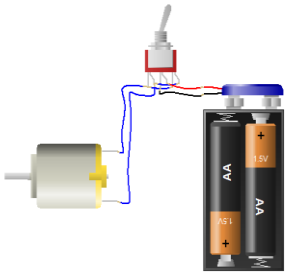
Problem solving through Coding, Applied Control and Mechatronics

Specification

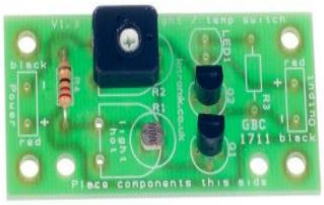
Ionad Oideachais Mhuineacháin

An Roinn Oideachais agus Scileanna
Department of Education and Skills

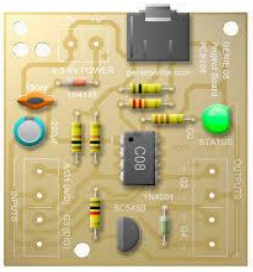
Using Control Technology to solve problems



Simple circuit



Easy build PCB kits

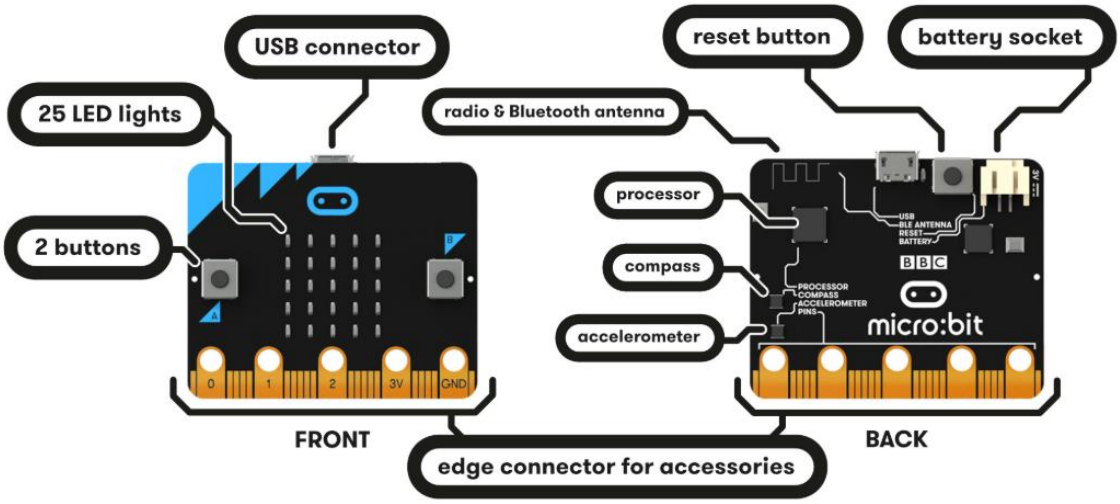


Microcontroller board

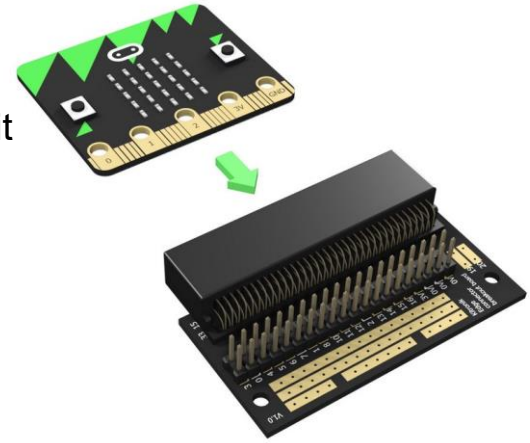
Micro:bit microcontroller board

What is it?

- Stimulus to drive learning
- It is a pocket-sized computer
- Pre-populated and pre-soldered
- Multiple inputs/outputs
- Options for break-out boards and additional soldering
- Free coding software
- Many students will have prior knowledge



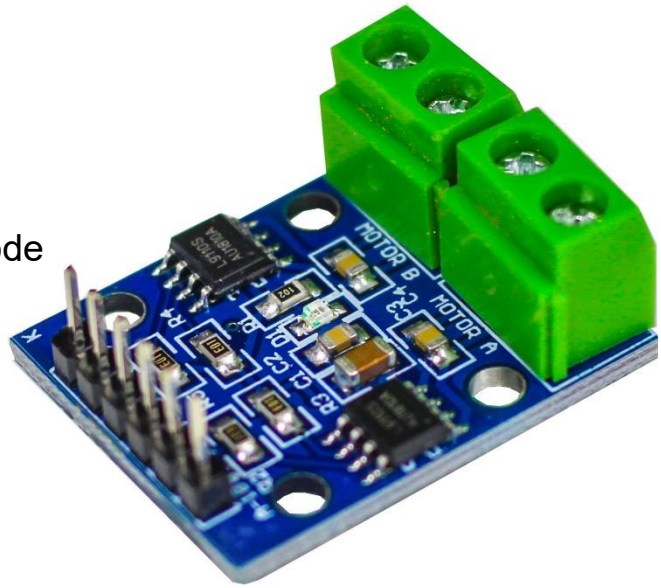
Micro:bit edge connector breakout board



- 21 pins available from the edge of the micro:bit
- External inputs/outputs can be soldered or connected using jumper wires.
- Additional expansion boards can be attached
- Relatively low cost

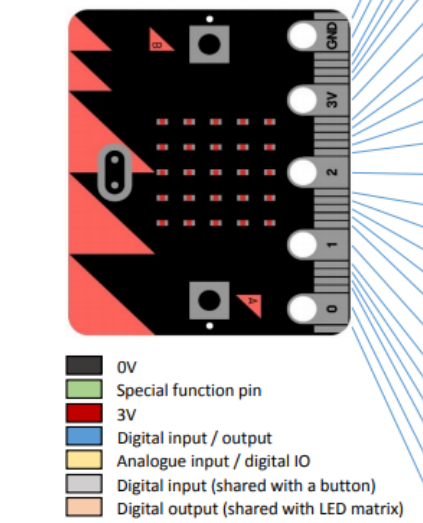
Video: https://youtu.be/bzm4zepbGAc

Two Channel Motor Driver Board L9110S



- Low cost motor driver board
- 2.5V to 12V DC supply
- drive either two DC motors or one 4 wire 2 phase stepper motor
- Motors controlled using program code
- Relatively low cost

Edge connector pin description

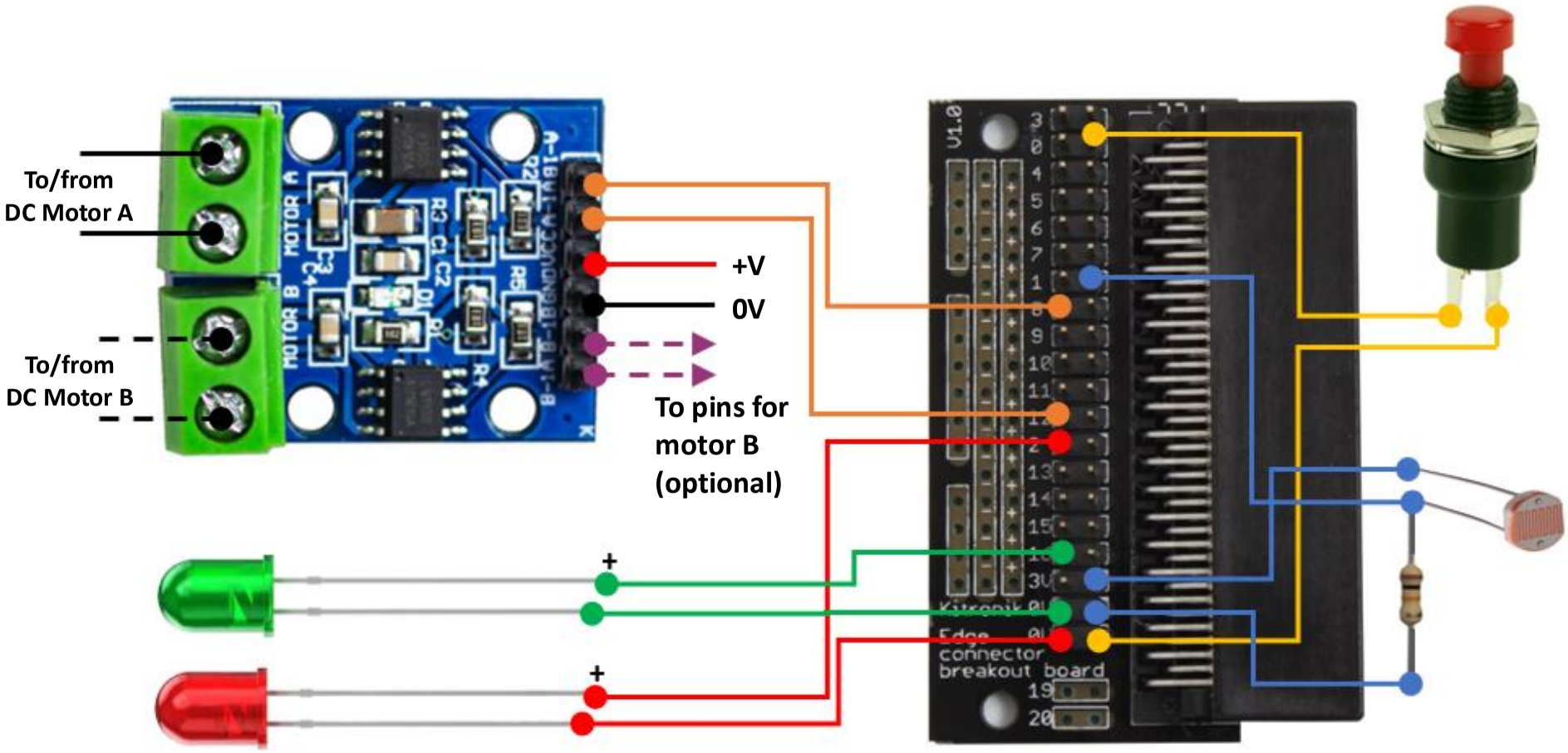


Breakout PCB Ref (if applicable)	Name	Description
22	0V	0V / ground
0V	0V	0V / ground
21	0V	0V / ground
20	SDA	Serial data pin connected to the magnetometer & accelerometer
19	SCL	Serial clock pin connected to the magnetometer & accelerometer
18	3V	3V / positive supply
3V	3V	3V / positive supply
17	3V	3V / positive supply
16	DIO	General purpose digital IO **(P16 in editors)**
15	MOSI	Serial connection - Master Output / Slave Input
14	MISO	Serial connection - Master Input / Slave Output
13	SCK	Serial connection - Clock
2	PAD2	General purpose digital / analogue IO **(P2 in editors)**
12	DIO	General purpose digital IO **(P12 in editors)**
11	BTN_B	Button B – Normally high, going low on press **(Button B in editors)**
10	COL3	Column 3 on the LED matrix
9	COL7	Column 7 on the LED matrix
8	DIO	General purpose digital IO **(P8 in editors)**
1	PAD1	General purpose digital / analogue IO **(P1 in editors)**
7	COL8	Column 8 on the LED matrix
6	COL9	Column 9 on the LED matrix
5	BTN_A	Button A – Normally high, going low on press **(Button A in editors)**
4	COL2	Column 2 on the LED matrix
0	PAD0	General purpose digital / analogue IO **(P0 in editors)**
3	COL1	Column 1 on the LED matrix

Connecting the motor driver board to the edge connector board (one solution)

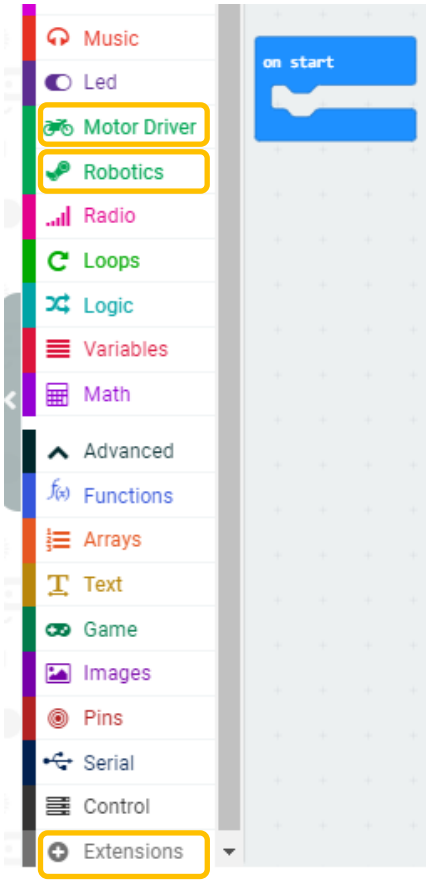
Component	Pin Identification
Push-to-make (PTM) switch	0 and 0V
Light Dependent resistor (LDR)/10K resistor potential divider	LDR- 3V 10K Resistor- 0V Combined- 1
Red light emitting diode (LED)	Anode- 2 Cathode- 0V
Green LED	Anode- 16 Cathode- 0V
DC Motor	8 and 12

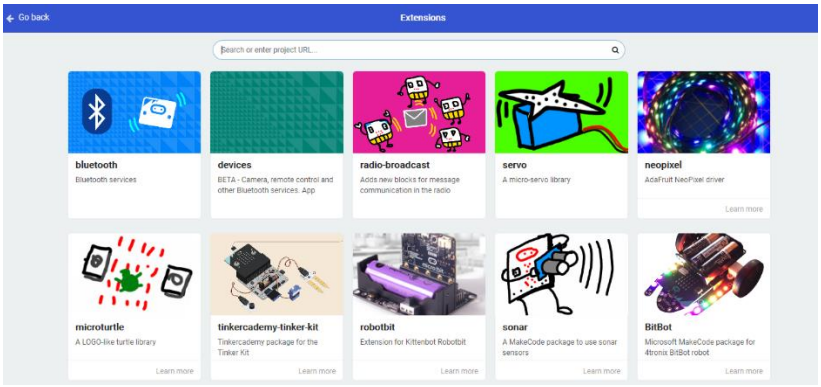
Connecting the motor driver board to the edge connector board

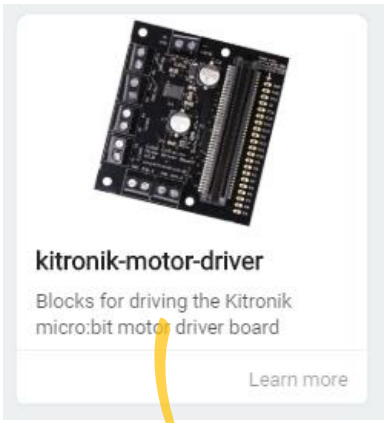


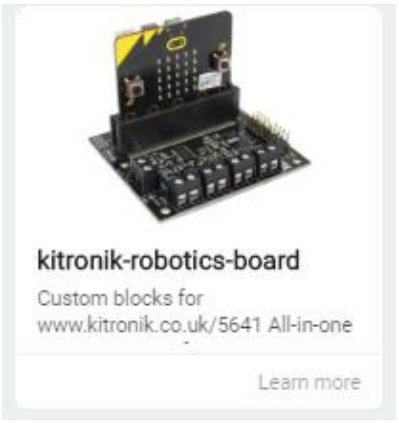
Adding Extensions

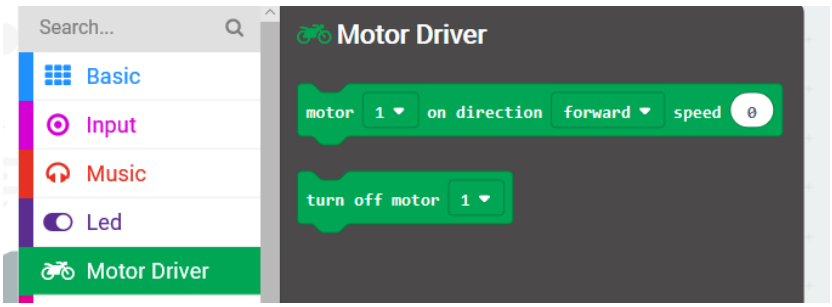
Additional extensions can be added to allow for the use of different breakout boards. Simply select extensions at the bottom of the block menu and search for the name of the extension you require.







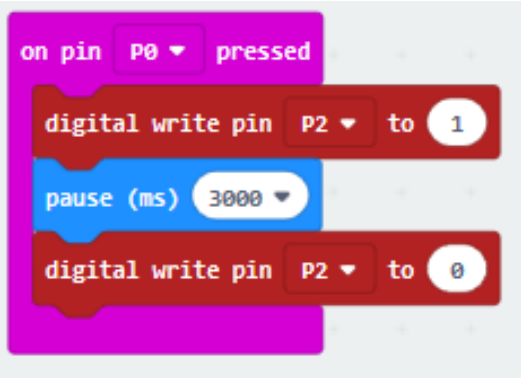




Developing creative thinking and problem-solving skills through coding.

micro:bit activity:

Introduction activity: Use pins to turn an LED on/off

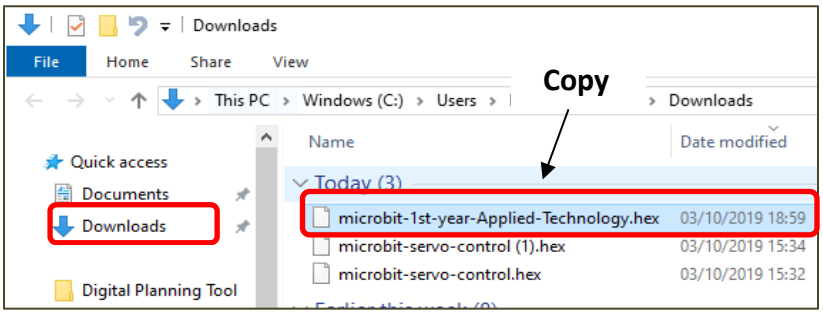


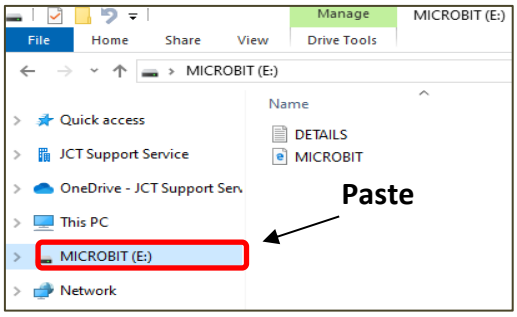
Steps

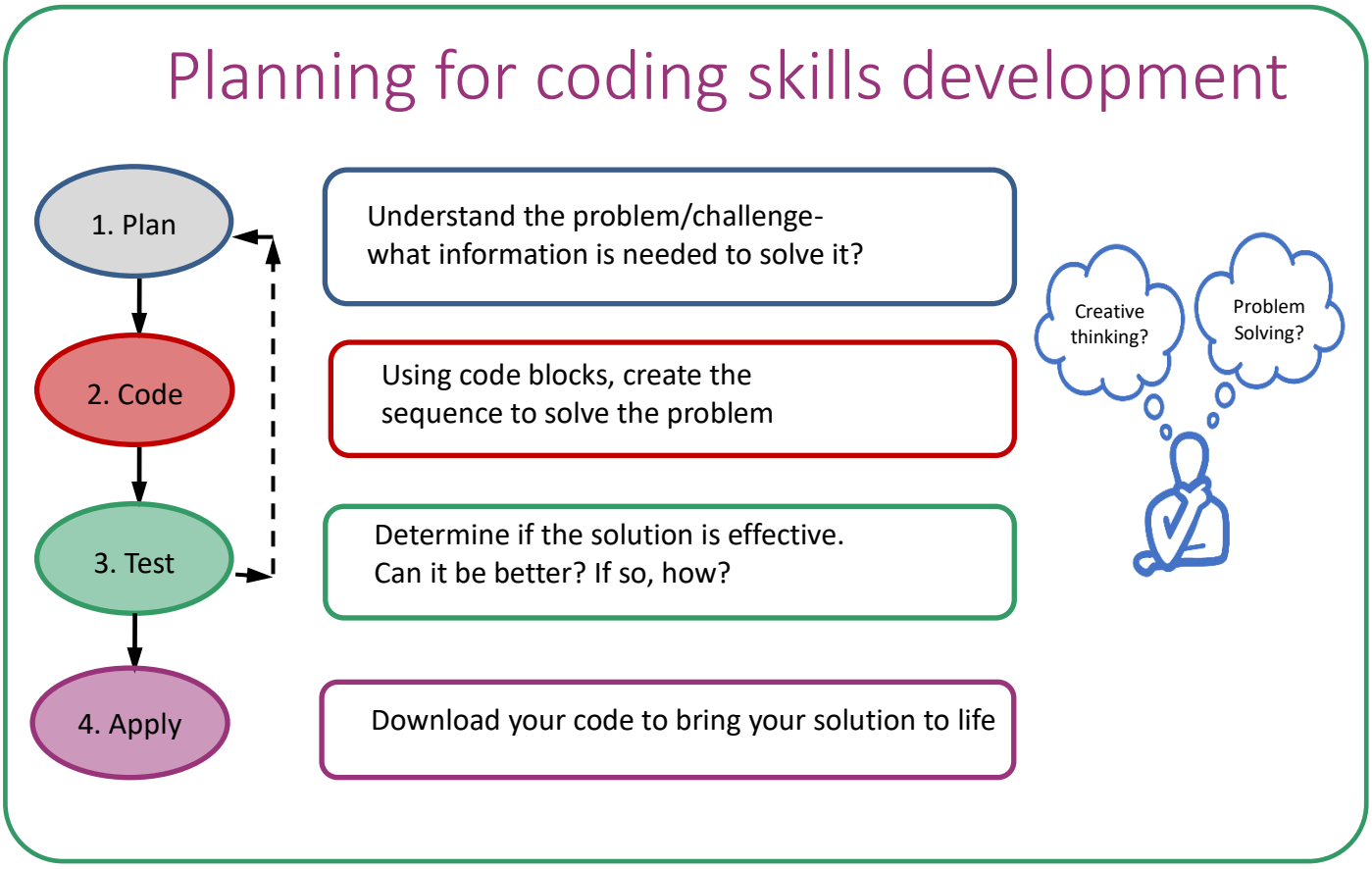
1. Place a on pin pressed block to run code when pin **0** (PTM switch) is pressed.
2. Place a digital write pin block inside on pin 0 pressed and set the pin to **P2** (the pin connected to the output component).
3. Set the connector value to **1 (high)** to activate the output (LED).
4. Place a pause block after the digital write pin block. Change the pause time as required.
5. Copy and paste the digital write pin block after the pause block.
6. Set the connector value to **0 (low)** to turn off the output (LED).
7. Use the simulator to ensure the code is effective.
8. With your micro:bit connected, click Download to transfer your code!

To transfer the HEX file to the micro:bit.

Once the file is downloaded, ‘copy’ the file from the Downloads folder and ‘paste’ it into the micro:bit drive.







A context for code challenges



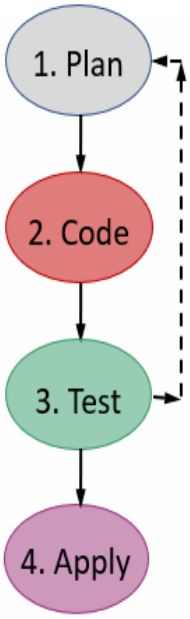
'More than 1 billion animals estimated dead in Australia wildfires' (ABC News, Jan 2020)

Notes:

Coding Challenge 1:

A student has decided to make a model on a circulating fan to comfort people during extreme heat conditions.
*Design code to turn on the fan (motor) for **five** seconds and then turn off the fan.*

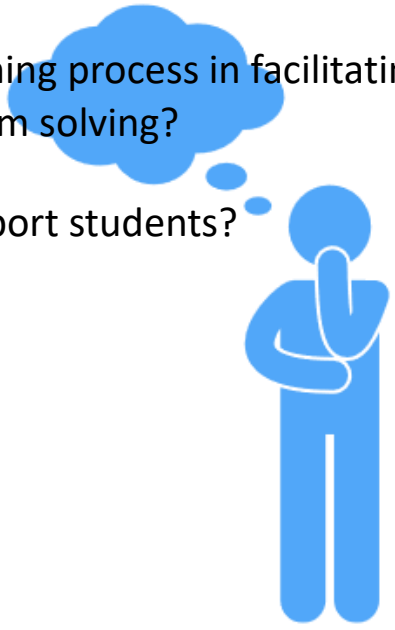
Planning Process



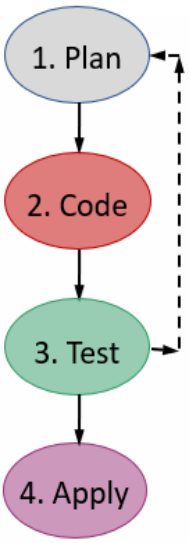
Pause and reflect

How effective was this planning process in facilitating creative thinking and problem solving?

How might this process support students?



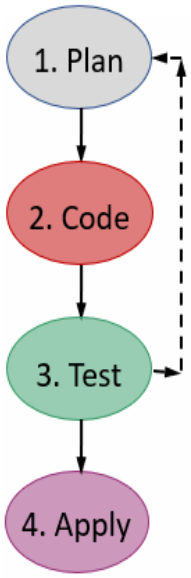
Planning Process



Coding Challenge 2:

An enclosure is to be used to care for wild animals affected by the wildfires. Design code to open and close the enclosure door using the motor with display LEDs.

Planning Process



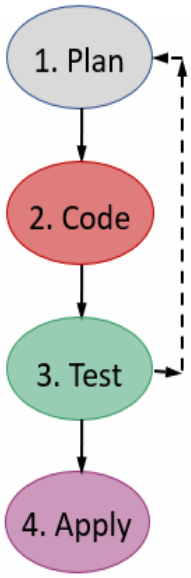
Pause and Reflect

Planning Process

Future extension challenge:

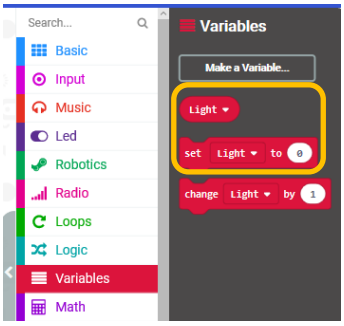
Limit switches are to be incorporated to stop the motor (door) when it is open and closed.

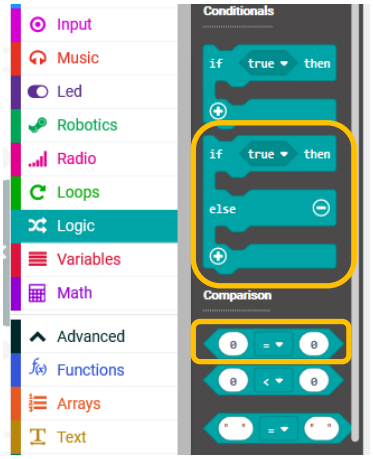
What code solution would you propose?

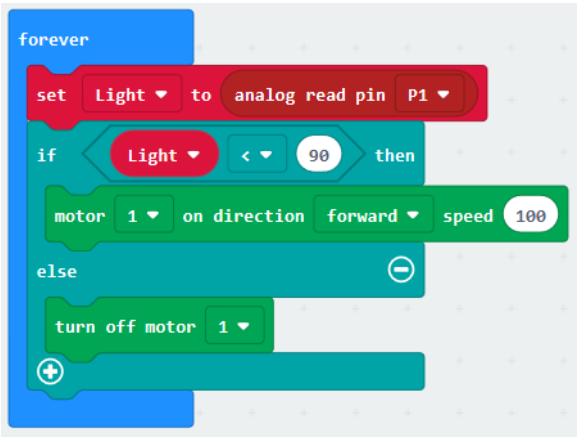


Micro:bit activity:

Introduction activity: Using a **light sensor** to activate an output.







Steps

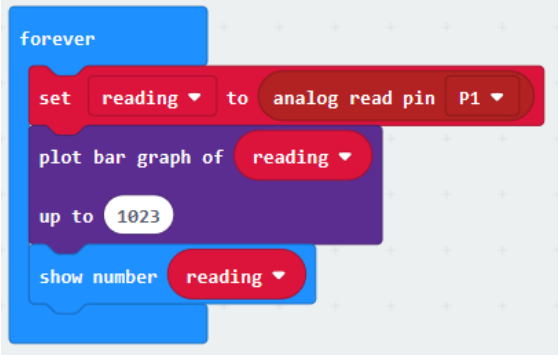
1. Make a new variable and call it **light**.
2. Place a set light to 0 block inside the forever block.
3. Place an analog read pin P1 block inside set light to 0 block. This code allows the micro:bit to read the digital light value associated with **P1** (using LDR/10k resistor).
4. Place an if, else logic block inside the forever block and after the set light to 0 block.
5. Insert a comparison block into the if, else logic block and set it to compare '**>**'.
6. Inside the comparison block, insert a light variable block on the left side of the equation.
   Set a digital light level of **90** on the right side of the equation. This code will compare the real LDR value against a threshold value of 90. The threshold value can be adjusted accordingly.
7. Place a motor block into the 'if' section of the if,else block. Set the motor block as follows; motor **1**, **forward** in direction and at full speed **100**.
8. Place a turn off motor block into the 'else' section of the if,else block. If the value is true, then the the motor block will activate rotating the motor at full speed. If the the value is false, then the turn off motor block will activate bringing the motor to a stop.
9. If you have a micro:bit connected, click Download to transfer your code!

Calibrating a Sensor

Use this code to measure and digitally display on your micro:bit the actual analogue reading of your sensor!

Knowing this value will allow you to plan for effective code solutions accordingly**.**

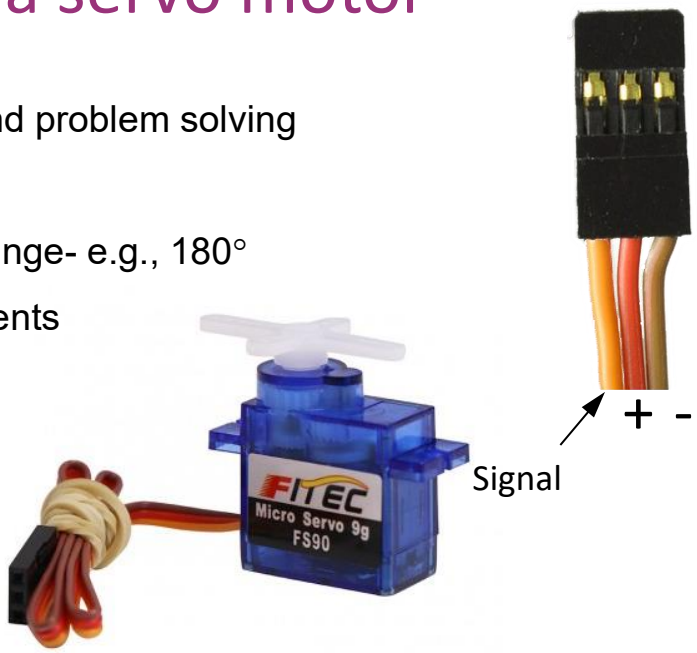
*Digital value **0** = **total darkness***
*Digital value **1023** = **total brightness***



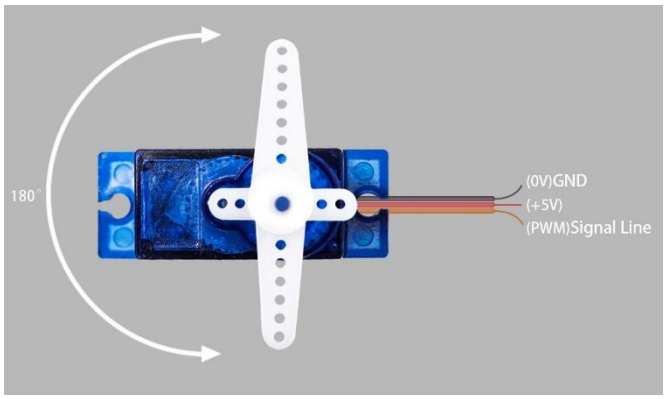
Using a servo motor

Why?

- Encourages creative thinking and problem solving
- High level of control
- Continuous rotation or limited range- e.g., 180°
- Safe failure experience for students



Angular Servo:
Set range, e.g. 0° to 180°



Continuous Servo:
variable speed in both directions

All for One Robotics Board

- It can drive 4 motors (or 2 stepper motors) and 8 servos.
- All the usable pins of the microbit are broken out to a 2.54mm link header.
- The 17 available I/O pins allow other input devices, such as sensors, or output devices, such as ZIP LEDs, to be added to the board.
- Power is provided via either a terminal block or servo-style connector.

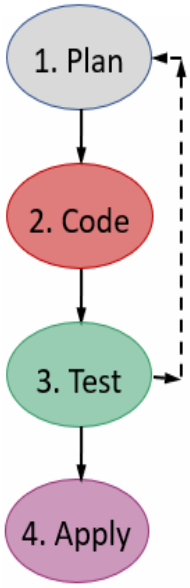
Video: https://youtu.be/EVowN8RN8nU

Coding Challenge 3:

Group Task:
In the context of the Australian wildfires, design a code solution that maximises the potential use of the robotics board.

Consider:
Your context, e.g., water distribution system, alert/alarm system?
Which inputs and outputs to use?

Planning Process



For further tutorials:

https://makecode.microbit.org/#

Opportunities for Future Learning

Using a micro:bit (or a similar stimulus) and with a focus on enhancing research skills; consider where the learning could go next for your students?

- Explore learning outcomes and key learning
- Consider assessment
- Develop experiences for students to engage in.

Microcontroller board

Research skills

What are my next steps?

Over the next couple of months…

What I must do?

What I could do?

What new strategies could I use in my classroom?

Software used during the day

Icon images – www.thenounproject.com

Images – www.unsplash.com | www.pixabay.com

QR codes – www.qrstuff.com

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