Machine Learning With Arduino

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In this learning book, learners use the Arduino Uno R3 and mBlock to create mini systems. Each activity focuses on an individual input or output, providing the foundation for building custom systems. The book includes three pre-designed systems and incorporates the use of Teachable Machine for training personalized data sets. mBlock simplifies the coding process, making it accessible to all learners. Throughout this journey, participants develop a range of skills, including AI literacy, circuitry, coding, and problem-solving.
Happy Innovating!

- Cora Yang, Alignment Edu

Basics

1. Arduino
2. Breadboard
3. Resistors

Outputs

1. LED
2. RGB LED
3. Micro Servo
4. Buzzer

Inputs

1. Button
2. LDR
3. Thermistor
4. Water Sensor
5. Ultrasonic Sensor

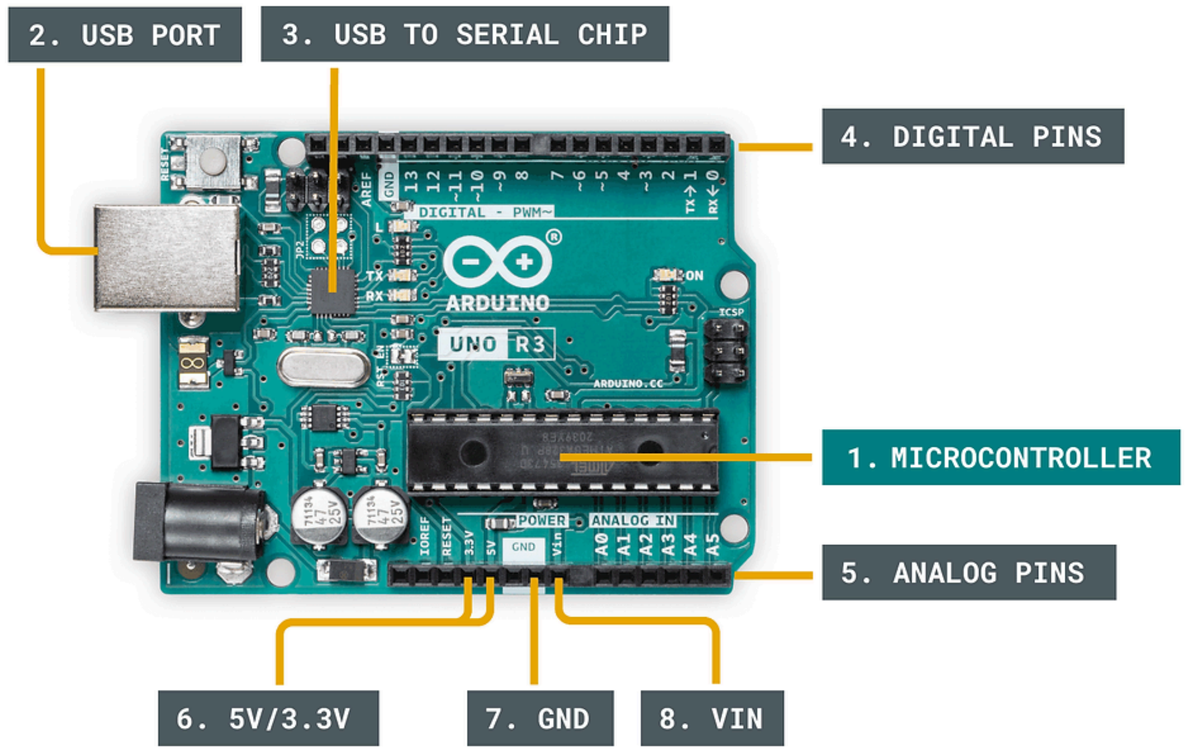
Systems

1. Auto Fan
2. Treasure Guard
3. Smart Home & Teachable Machine

More learning innovation and AI resources are available on ***alignmentedu.com***

What is Arudino Uno?

Arduino is a user-friendly electronics platform that is publicly accessible, meaning anyone can see, modify, and distribute the code as they see fit.
Arduino boards can read inputs such as light on a sensor or a finger on a button, and turn them into outputs that activate a motor and turn on an LED. The Arduino Uno is the standard version of Arduino that is commonly used.

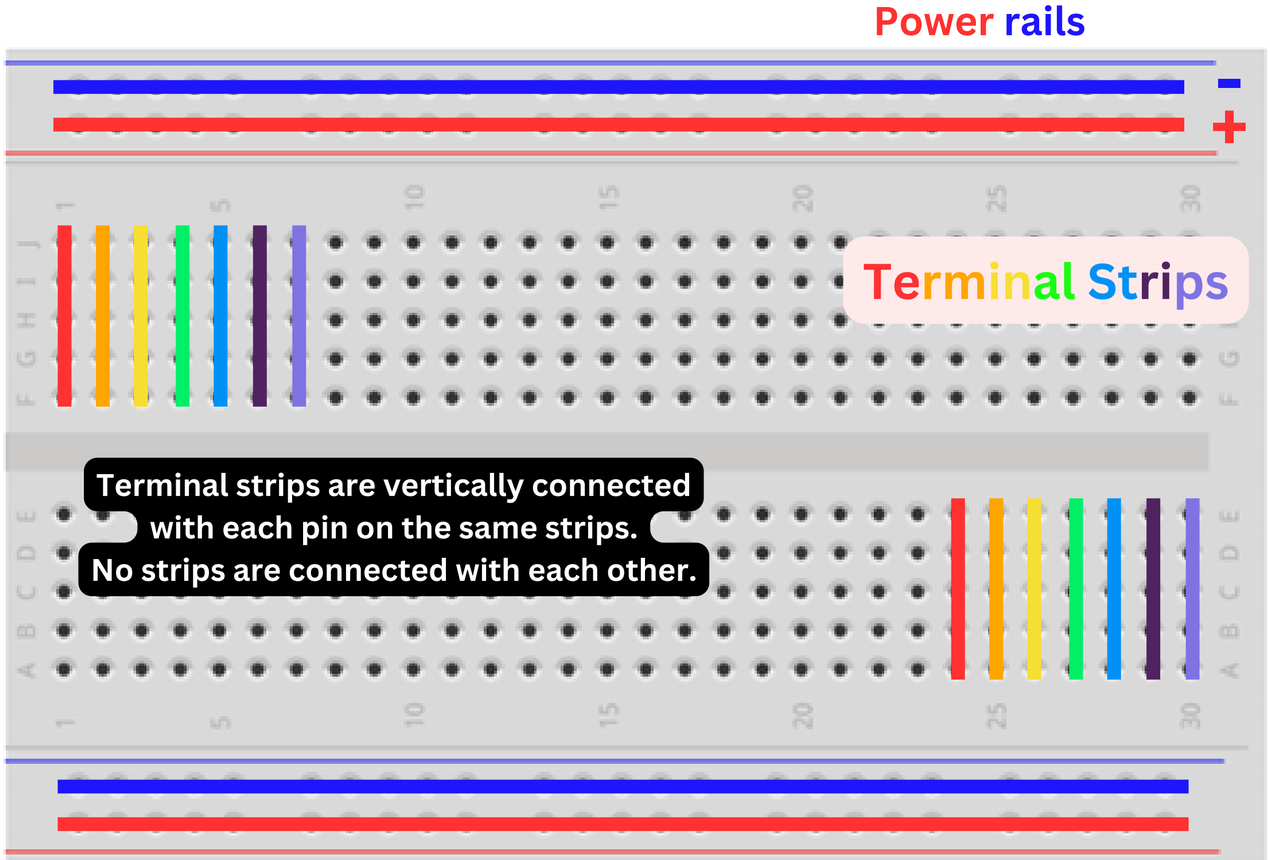


Credit: Key components of Arduino UNO Board (Söderby, 2023)

Arduino Uno Basic Components

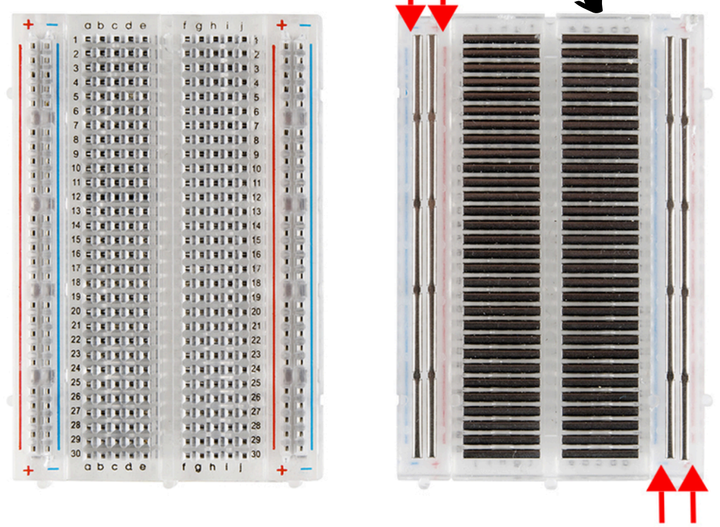
Breadboard

A breadboard is used to build and test circuits quickly before finalizing any circuit design. The breadboard has many holes into which circuit components like ICs (An integrated circuit (IC), sometimes called a chip, microchip or microelectronic circuit) and resistors can be inserted.



Two rails are not connected.

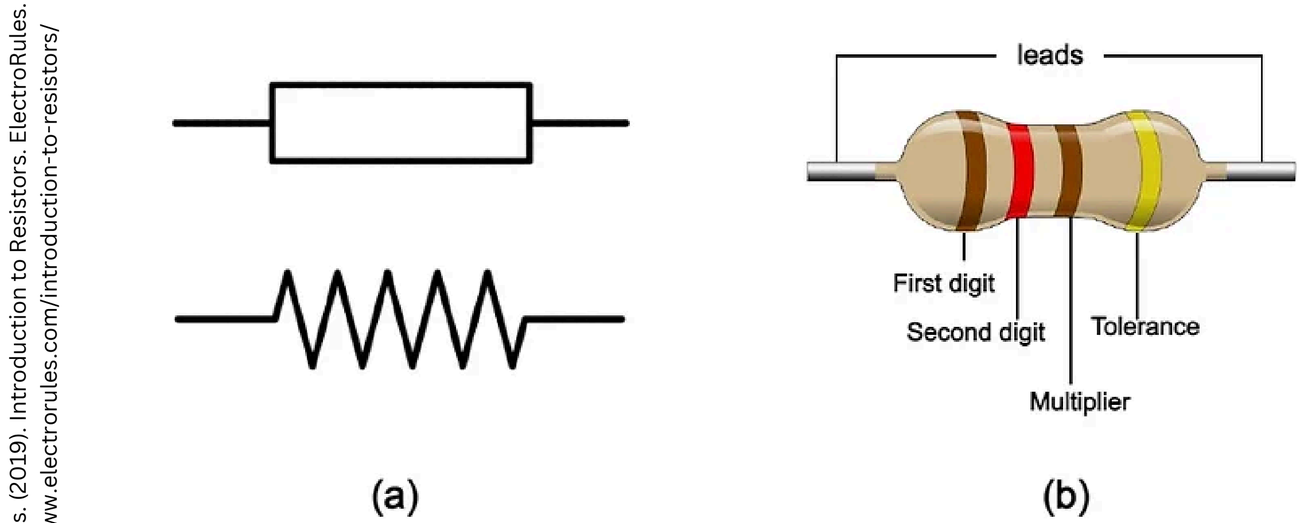
Individual rail is horizontally connected.



Breadboard Front & Back Sides

Resistors

As the name suggests, resistors resist the flow of electricity and the higher the value of the resistor, the more it resists and the less electrical current will flow through it.



ElectroRules. (2019). Introduction to Resistors. ElectroRules. https://www.electrorules.com/introduction-to-resistors/

(a) Representation of resistor in circuit diagram
(b) Resistor with color strips

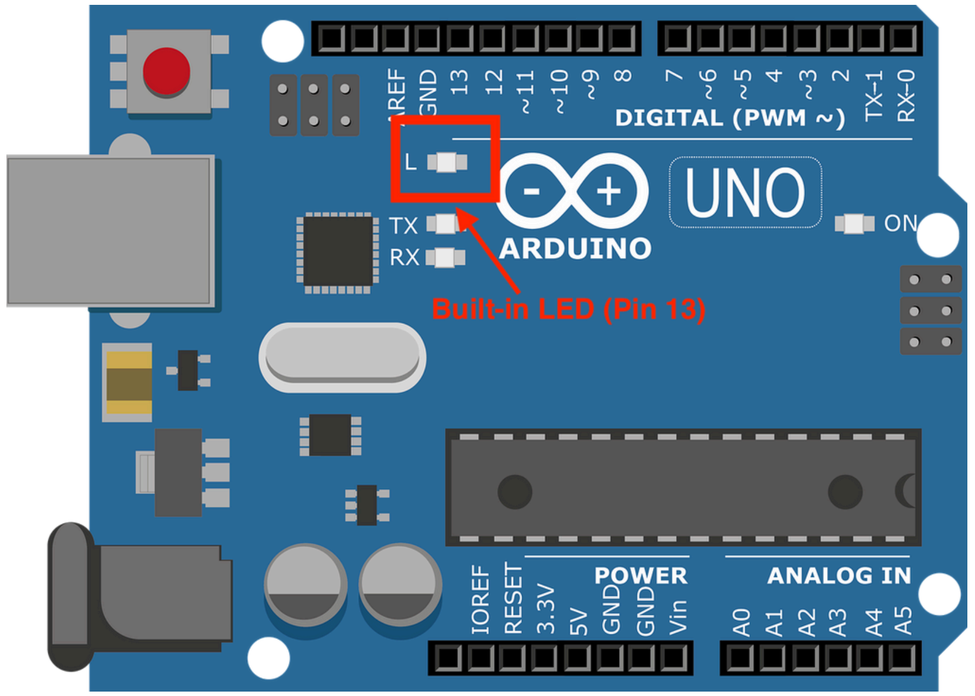
QUICK TIPS

LEDs have a voltage limit between 1.2V and 3.6V. Always include resistors in your circuits when using LEDs to prevent damage.

LED

An LED is a small light (it stands for "light emitting diode") that works with relatively little power.
The Arduino board has one built-in on digital pin 13.



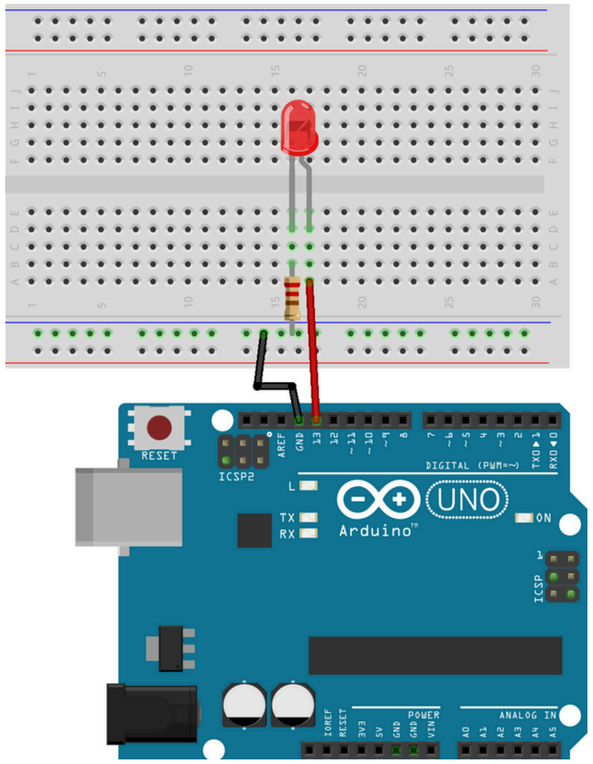


QUICK TIPS

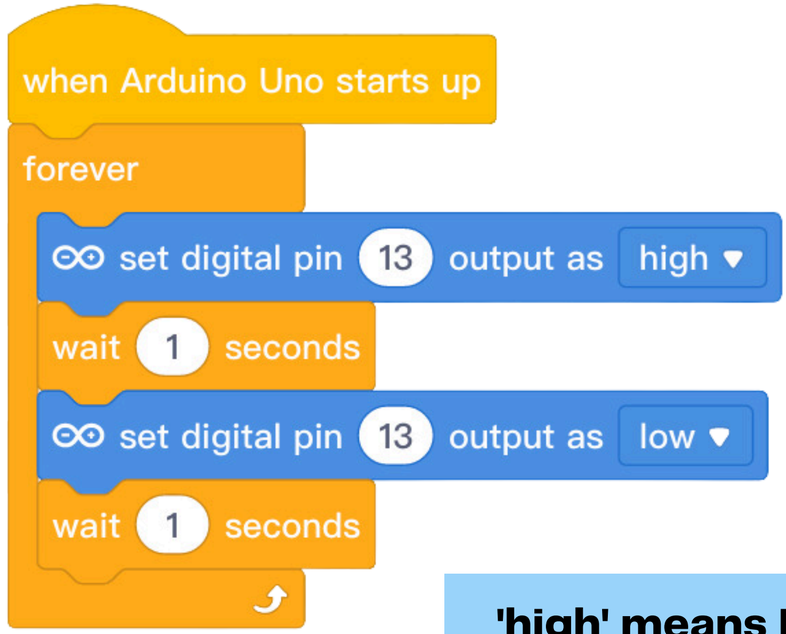
LEDs have a voltage limit between 1.2V and 3.6V. Always include resistors in your circuits when using LEDs to prevent damage.

Activity: LED Blink

In this activity, we will be connecting an LED to an Arduino board and programming it to blink. The blinking rate can be adjusted by altering the delay time in the code.



Circuit Connection

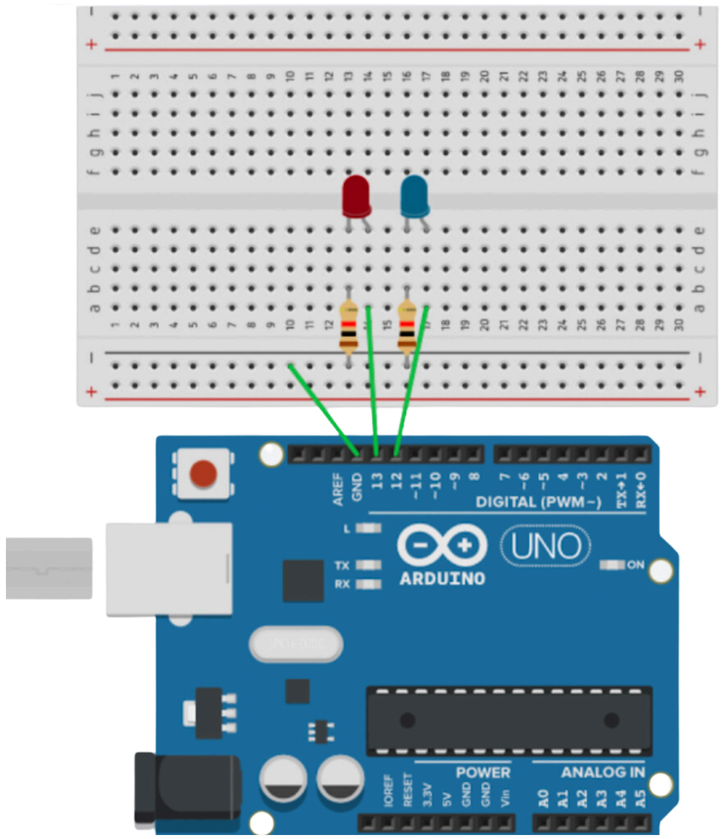


'high' means LED on;
'low' means LED off.

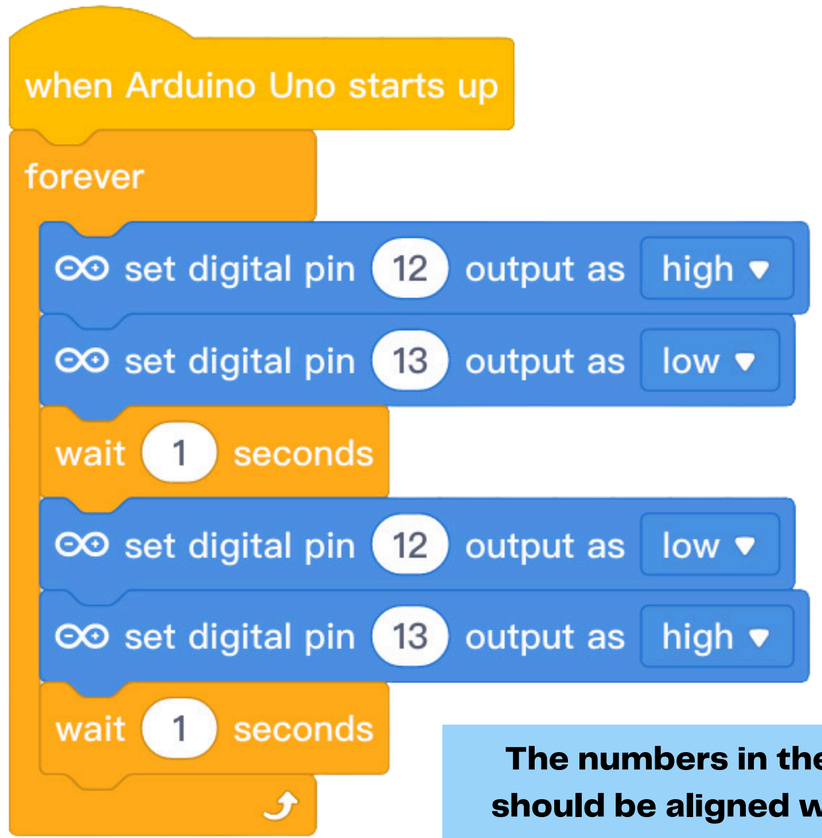
Block-based Code

Activity: LED Alternate Blink

This challenge requires us to create a parallel circuit to control two LEDs independently using an Arduino board.



Circuit Connection

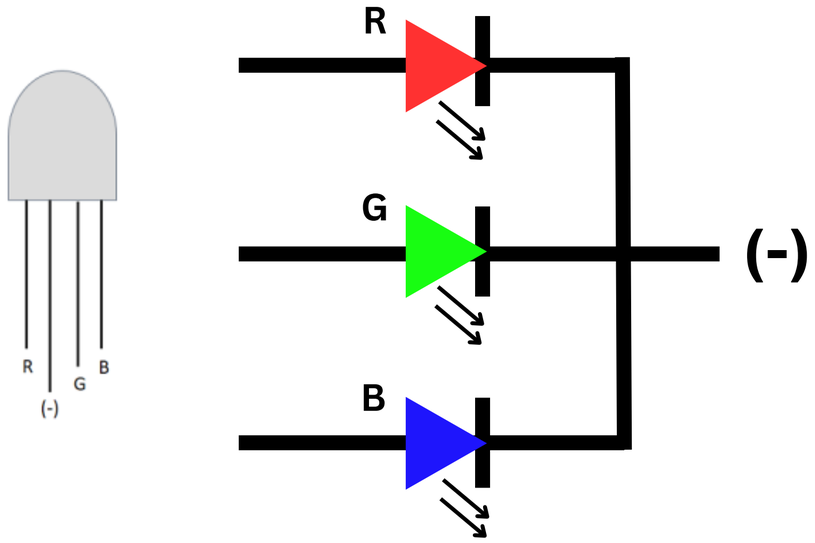


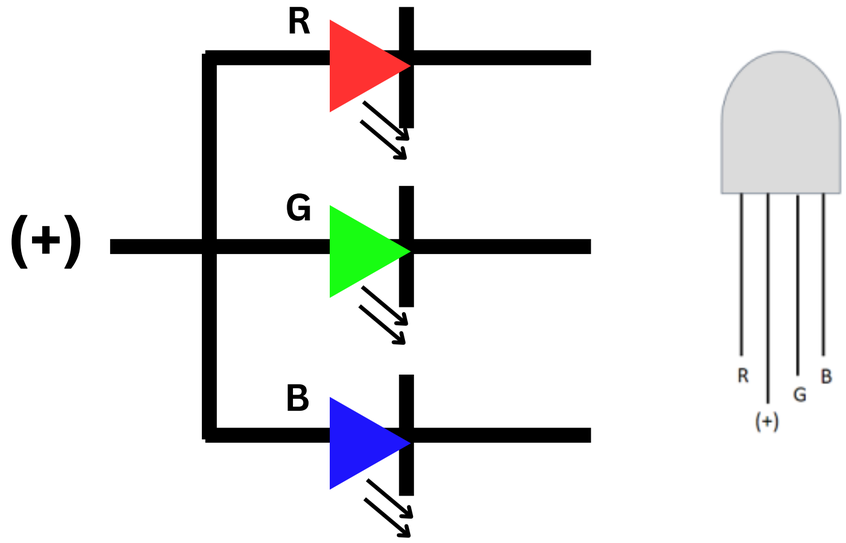
Block-based Code

The numbers in the code should be aligned with the circuit connection.

RGB LED

The RGB LED flashes in red, green and blue every second. This challenge is using upload mode.
There are two kinds of RGB LEDs: common anode LED and common cathode LED.
The figure below illustrates a common anode and a common cathode LED.

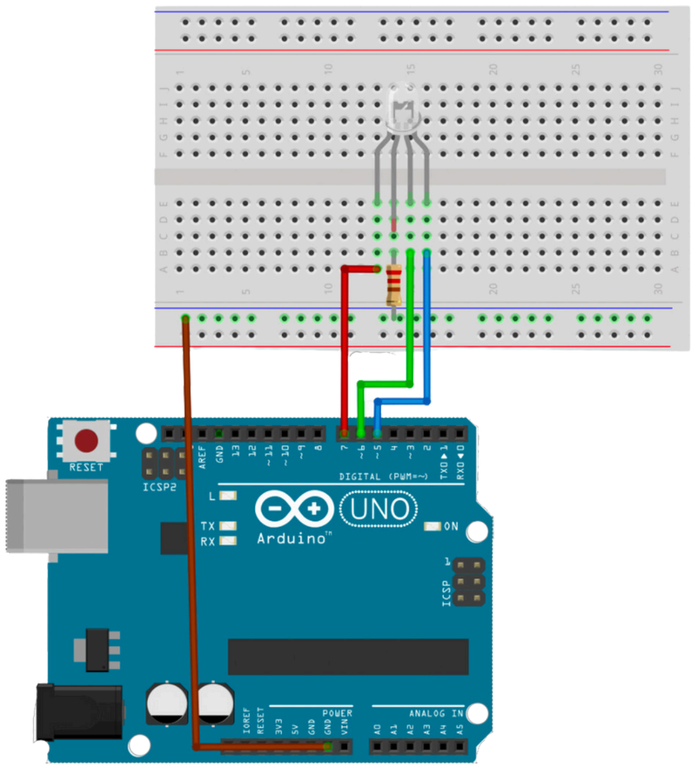




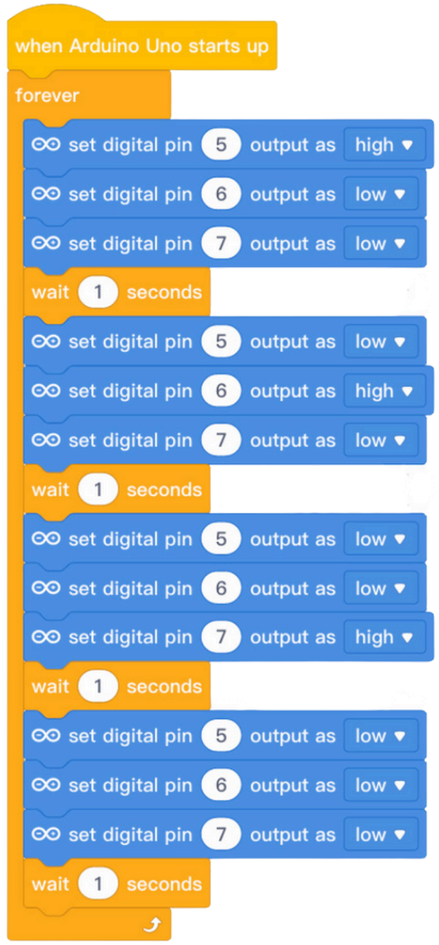
In a common cathode RGB LED, all three LEDs share a negative connection (cathode). In a common anode RGB LED, the three LEDs share a positive connection (anode).

Activity: Light In Colors

The RGB LED flashes in red, green and blue every second. This challenge is using upload mode.



Circuit Connection

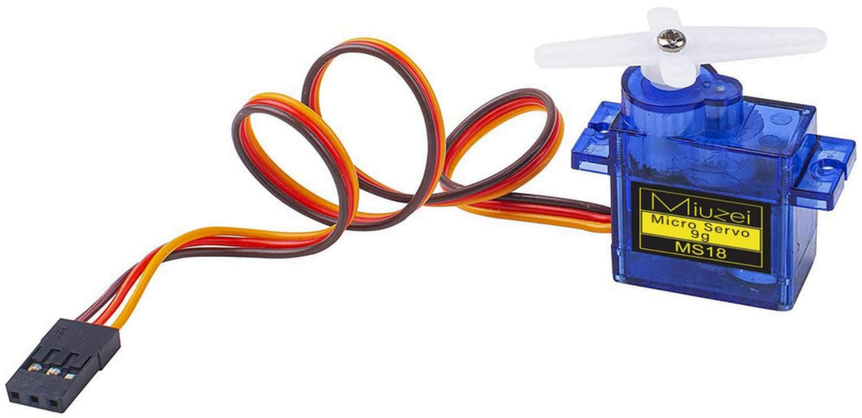


Block-based Code

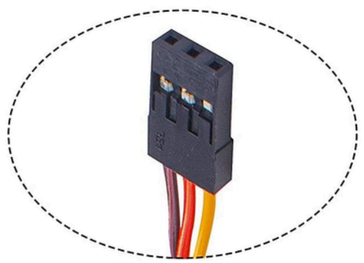
To display different colors on the RGB LED, turn on each color pin one at a time.

Micro Servo

Tiny little servo can rotate approximately 180 degrees (90 in each direction) or 360 degrees and works just like the standard kinds you're used to but smaller. You can use any servo code, hardware, or library to control these servos.



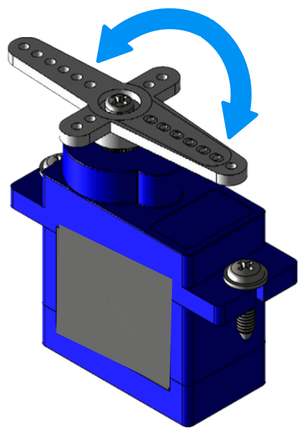
Braun	Minuspol
Rot	Pluspol
Gelb	Signa



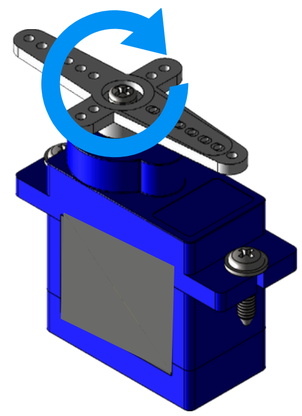
QUICK TIPS

There are two types of micro servo:

- A positional servo has a movement range of 90 or 180 degrees;
- A continuous servo only controls direction and speed, not position, moving in loops.



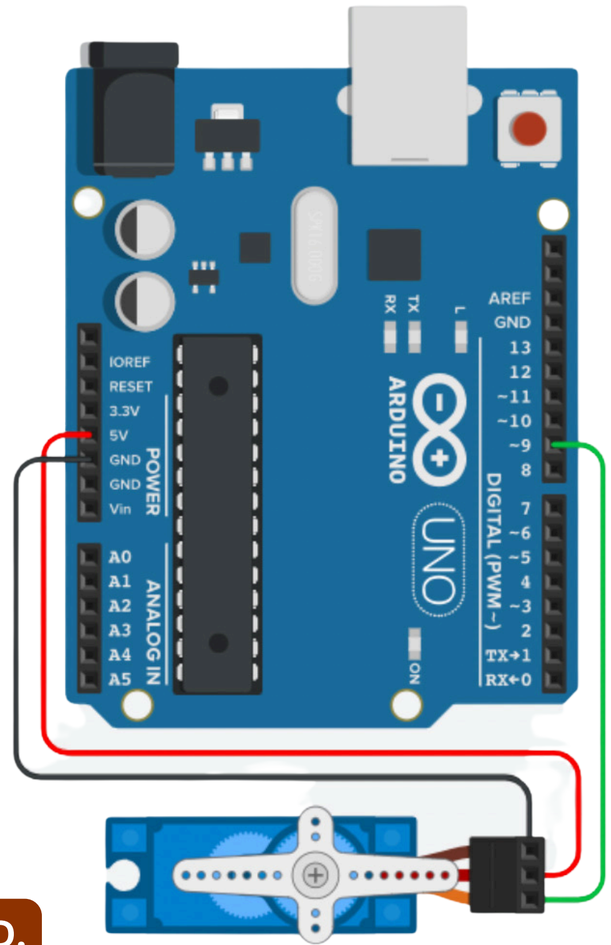
Positional Servo



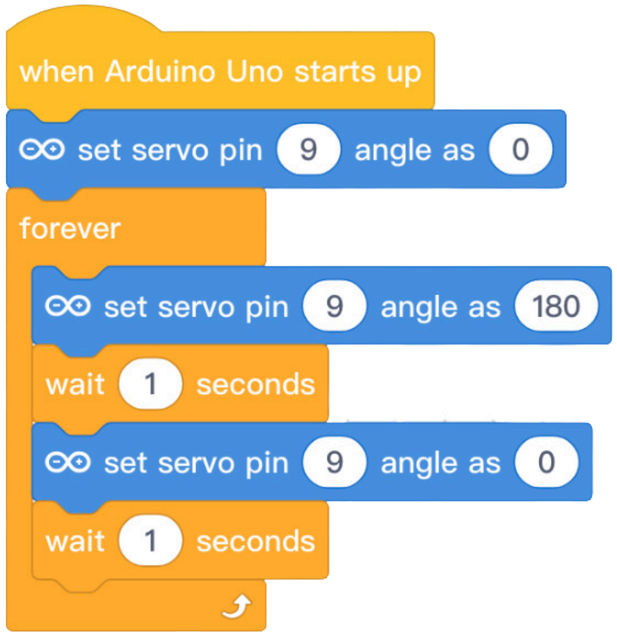
Continuous Servo

Activity: Servo Sweep

Connect micro servo with Arduino Uno and make it rotate.



Circuit Connection



Block-based Code

QUICK TIPS

Red wire goes to 5V.

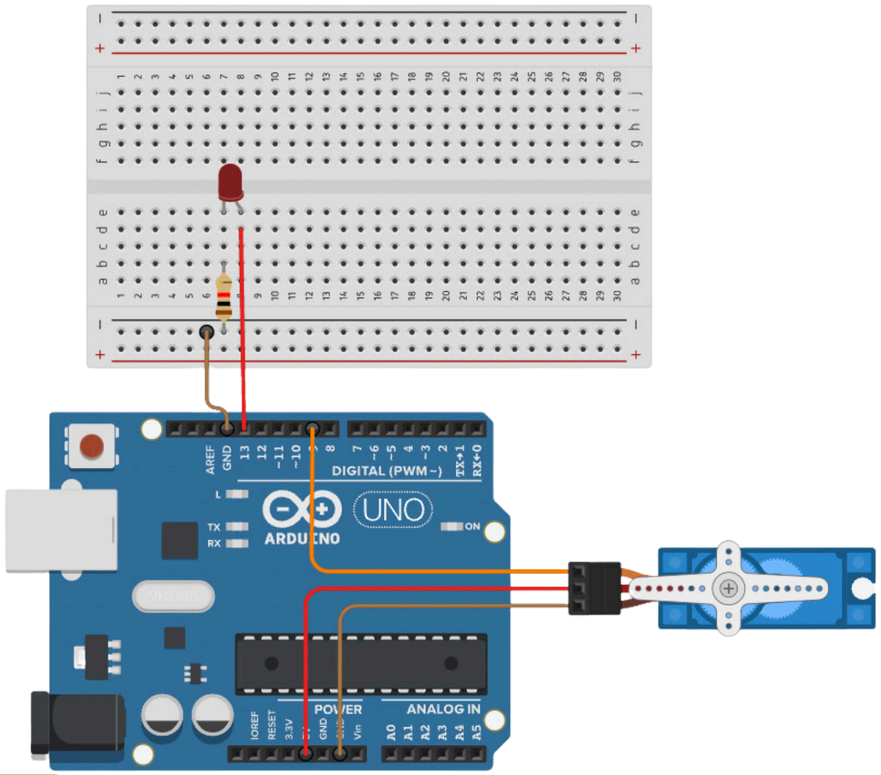
Brown wire goes to GND.

Orange wire goes to digital pin.

The micro servo in this project is positional one which can rotate with 180 degrees.

Activity: Servo Sweep and Blink

Use Arduino Uno to control both LED and micro servo, make them rotate and flash at the same time.



Circuit Connection



Block-based Code

QUICK TIPS

Red wire goes to 5V.

Brown wire goes to GND.

Orange wire goes to digital pin.

Activity: Make the Noise

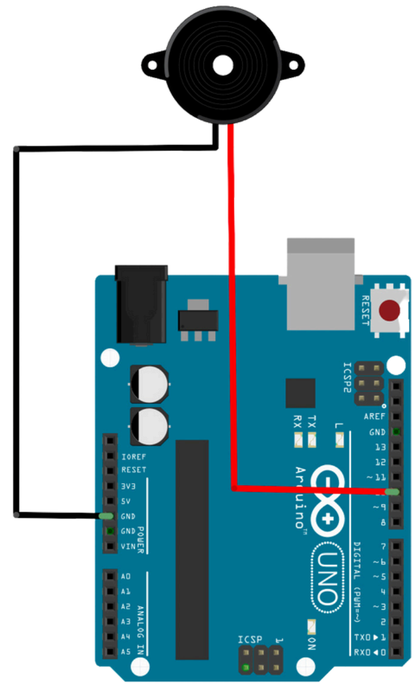
A buzzer or beeper is an audio signaling device. Typical uses of buzzers and beepers include alarm devices and timers. This challenge is to connect the buzzer with Arduino and make some noises!



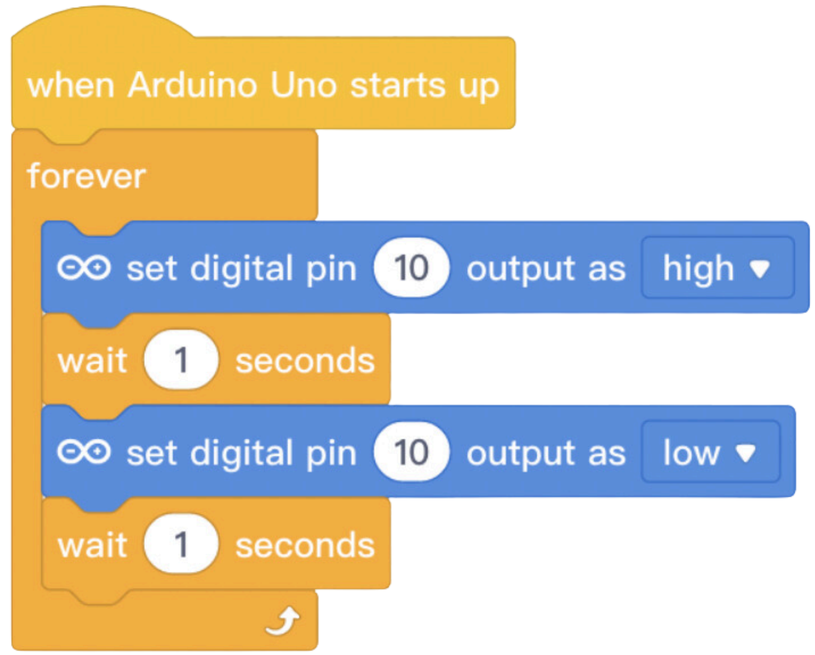
QUICK TIPS

Red wire goes to digital pins.

Black wire goes to GND.



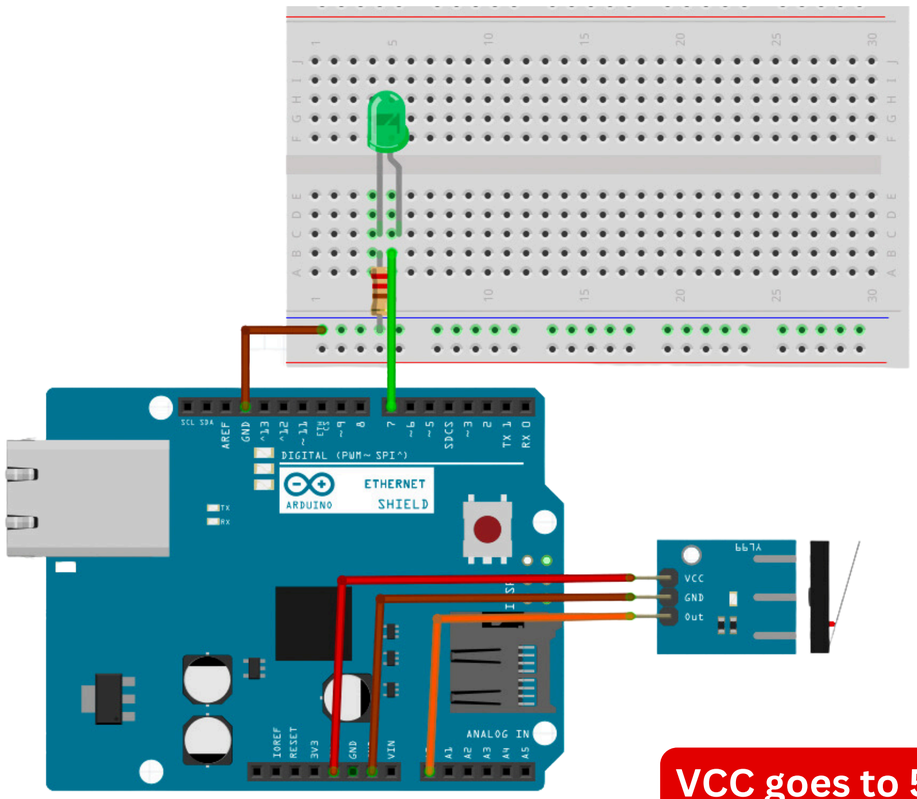
Circuit Connection



Block-based Code

Activity: Turn On the Light

Use the push button as the switch to turn on/off the LED.

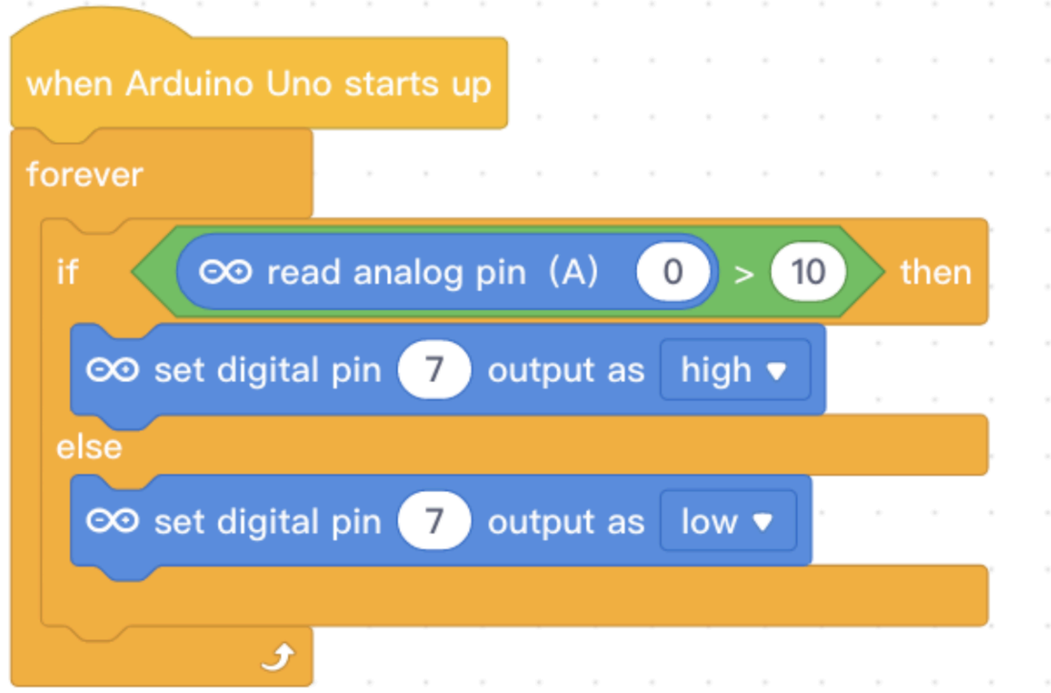


VCC goes to 5V.

GND goes to GND.

OUT goes to A0.

Circuit Connection

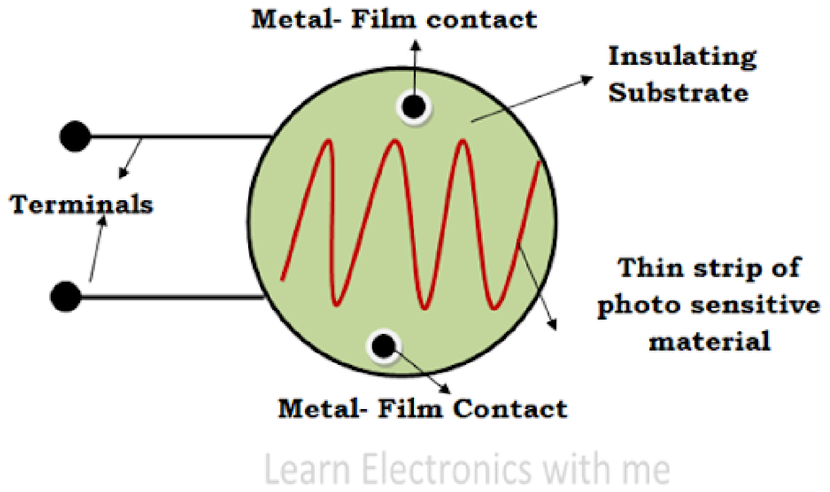


Block-based Code

Light Dependent Resistor

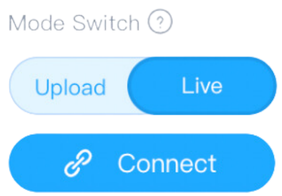
The LDR is a special type of resistor that allows higher voltages to pass through it (low resistance) whenever there is a high intensity of light, and passes a low voltage (high resistance) whenever it is dark.





Credits: Picture from https://www.learnelectronicswithme.com/





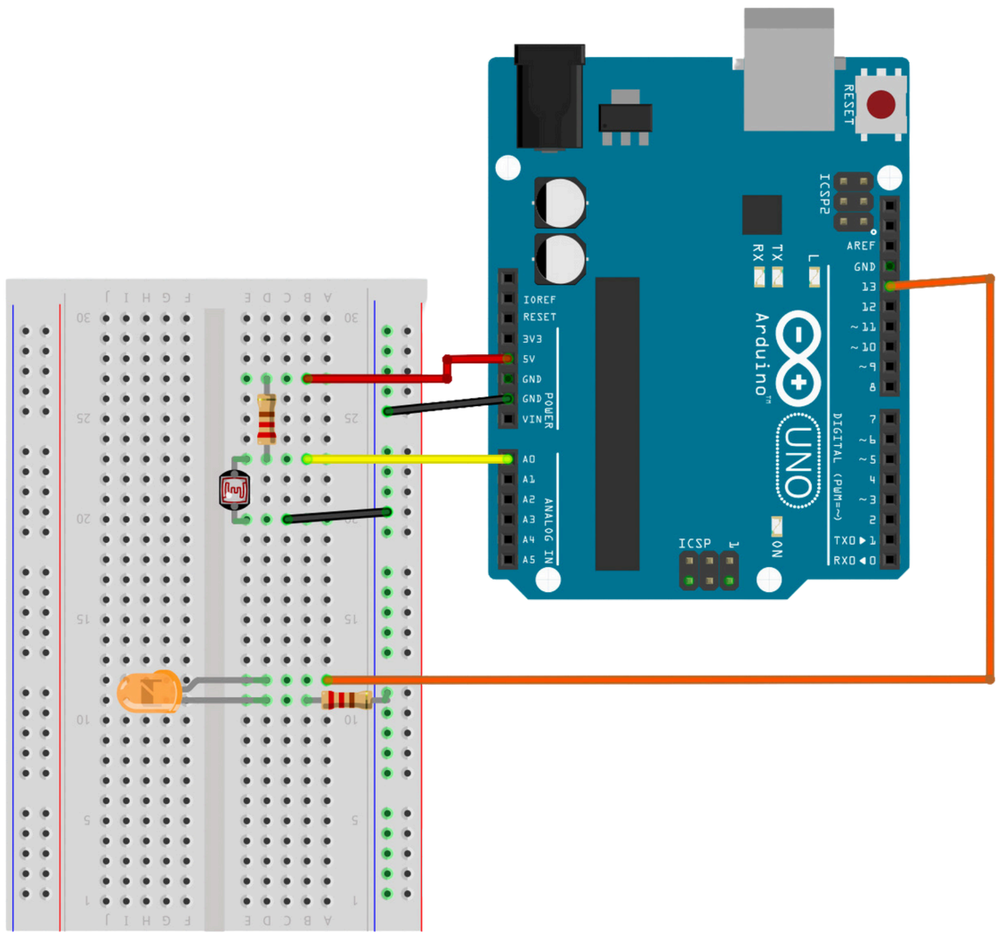
Please notice that this activity is in LIVE mode.



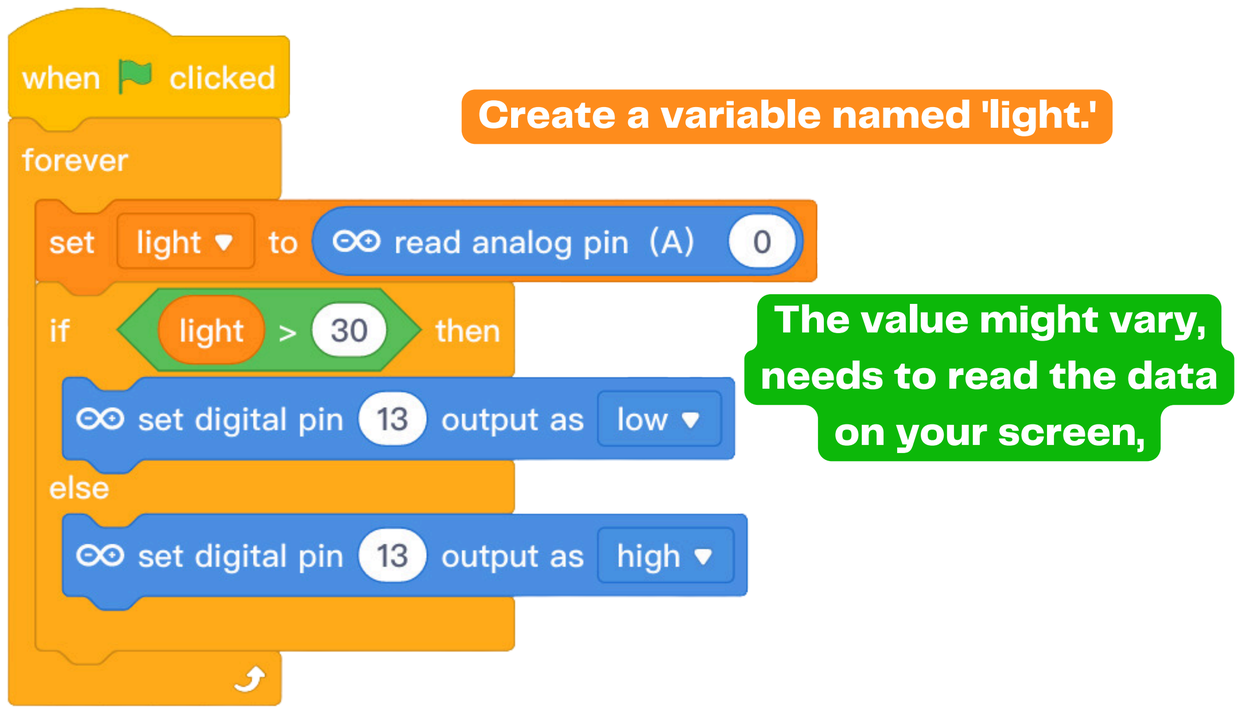
You need to click the green flag to start the activity.

Activity: Auto Light

Use LDR as ‘light sensor’ - when it’s dark, make the light on automatically; when it’s bright, the light is off.



Circuit Connection



Create a variable named 'light.'

The value might vary, needs to read the data on your screen,

Block-based Code

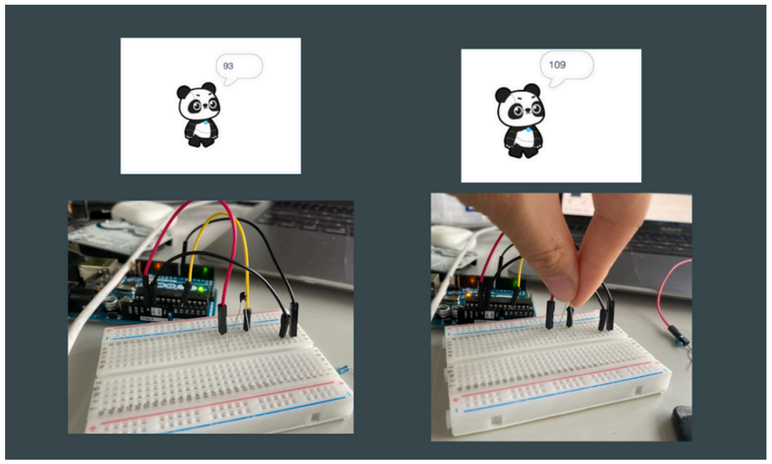
Activity: Temperature Teller



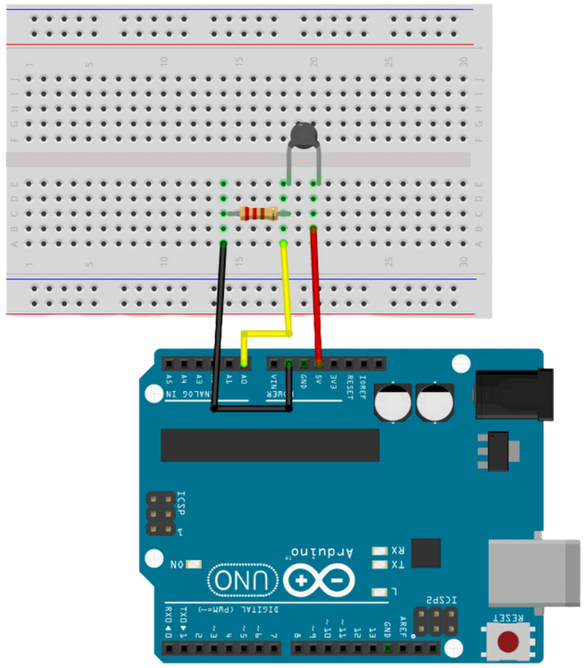
Please notice that this activity is in LIVE mode.



You need to click the green flag to start the activity.

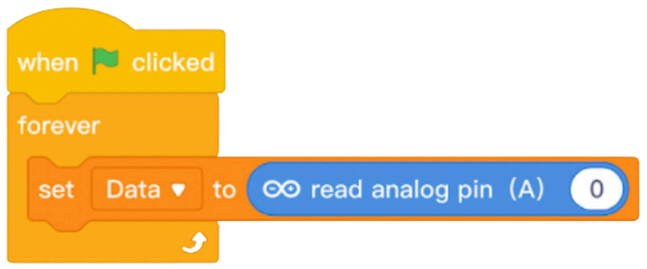


Use thermositor as a sensor to log the change of temperature.



Circuit Connection

Create a variable named 'data.'

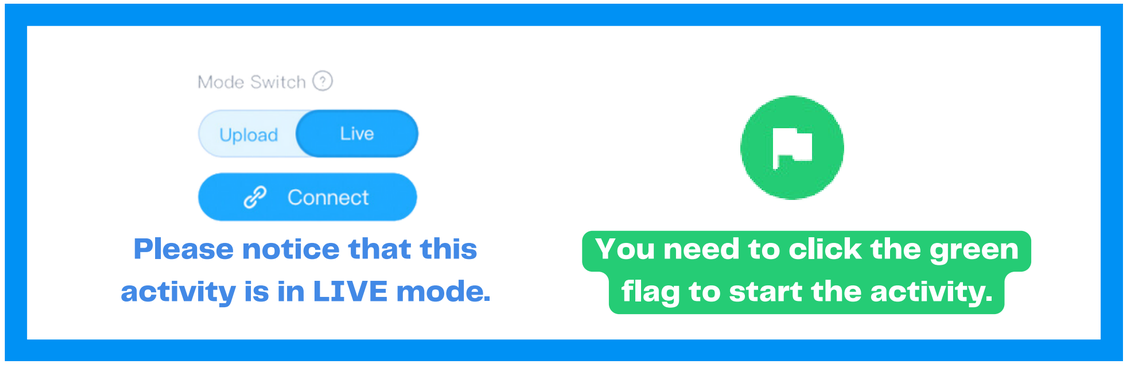


Code for device (Arduino)



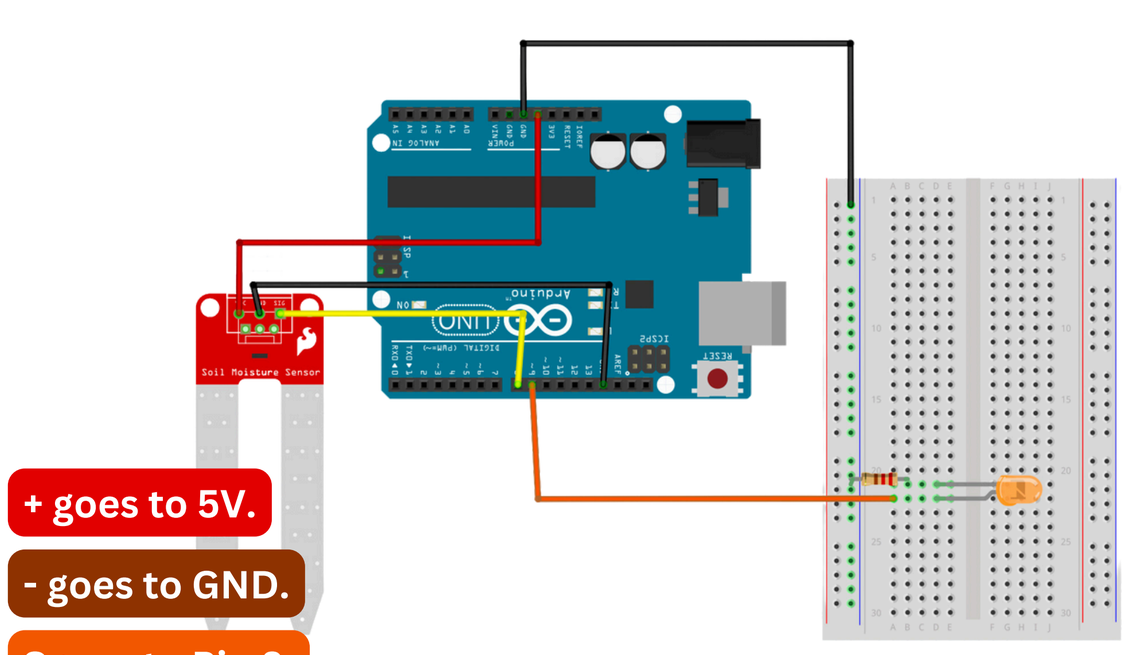
Code for Sprite(s)

Activity: Water Sensor

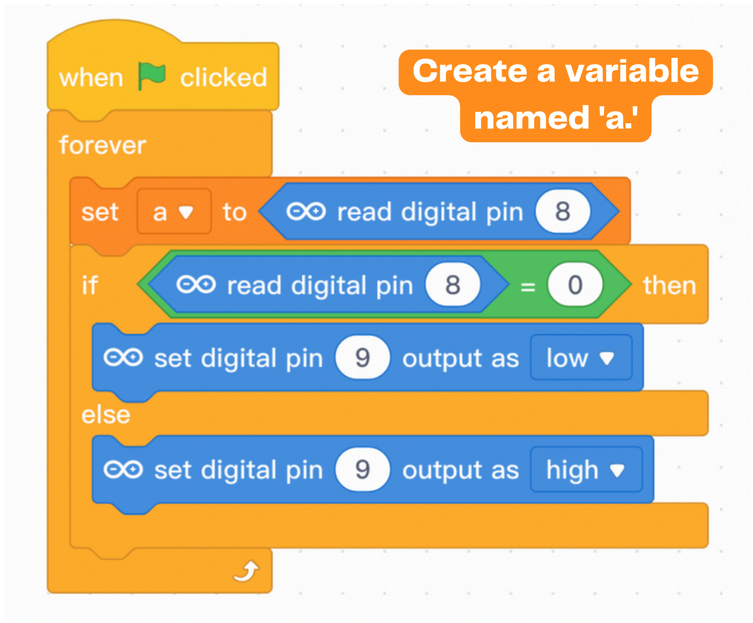




Code for Sprite(s)

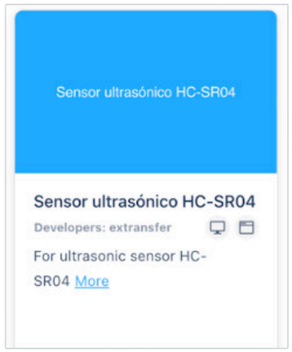


Circuit Connection



Code for device (Arduino)

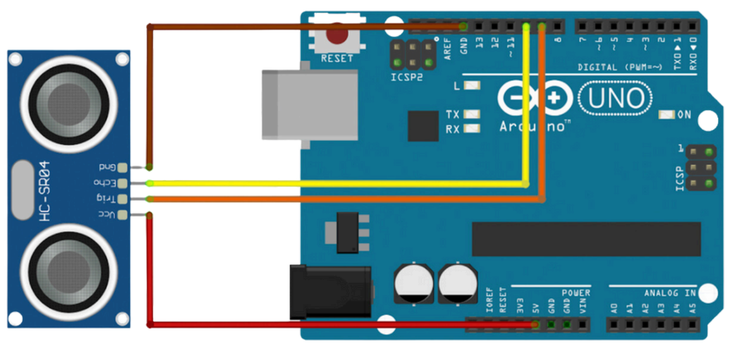
Activity: Ultrasonic Sensor



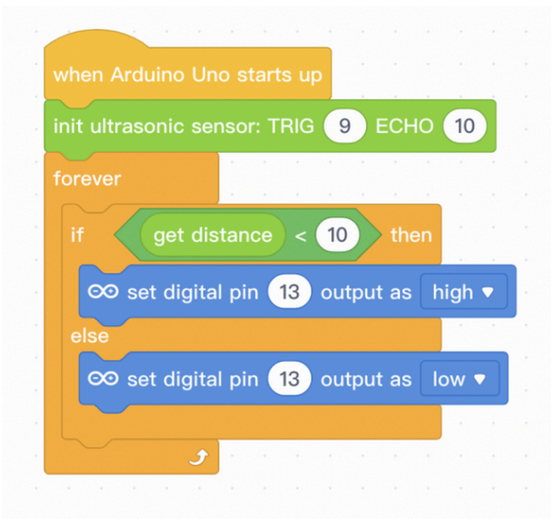




Add the extension (follow the correct name)



Circuit Connection



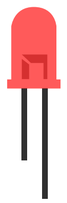
Block-based Code

Auto Fan

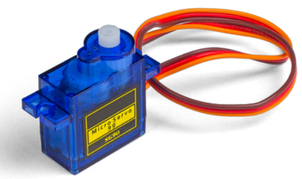
How can we save the energy by controlling the fan with temperature automatically?
The thermistor detects the temperature and control the fan.



Thermistor (Input)

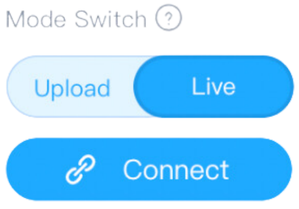


LED (Output)



Servo (Output)

In this project, we will use live mode to control the system because the value that the thermistor reads might vary, and we need to adjust the number based on the situation on a case-by-case basis.



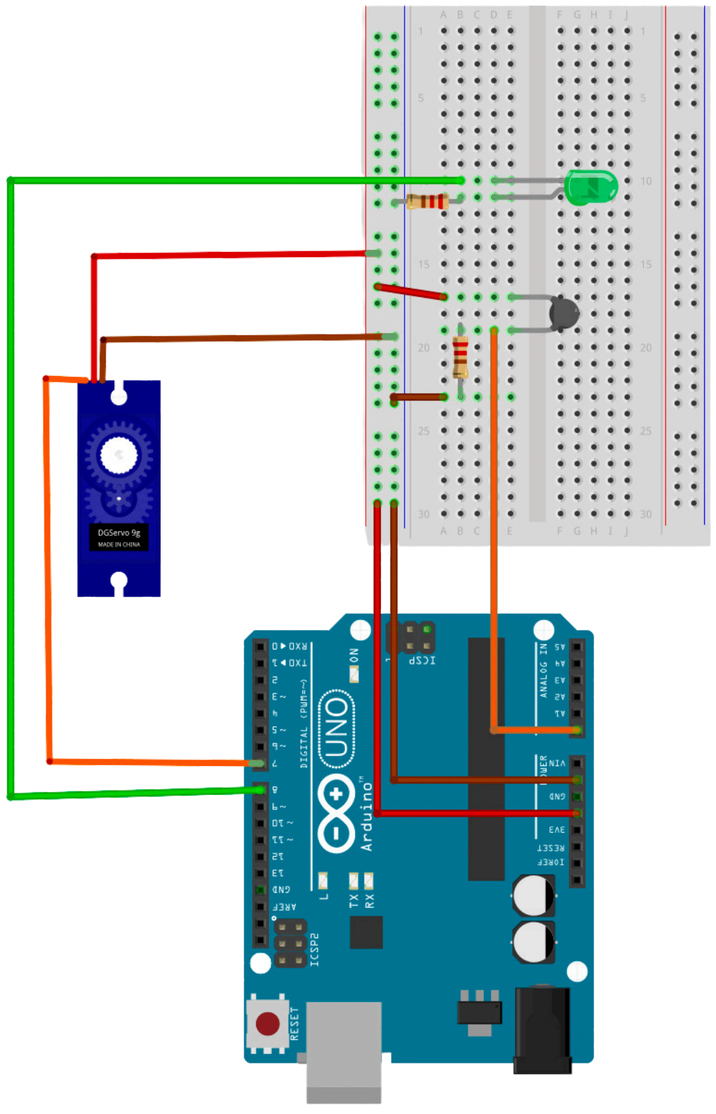
Please notice that this activity is in LIVE mode.



You need to click the green flag to start the activity.

Machine Learning With Arduino

Inputs



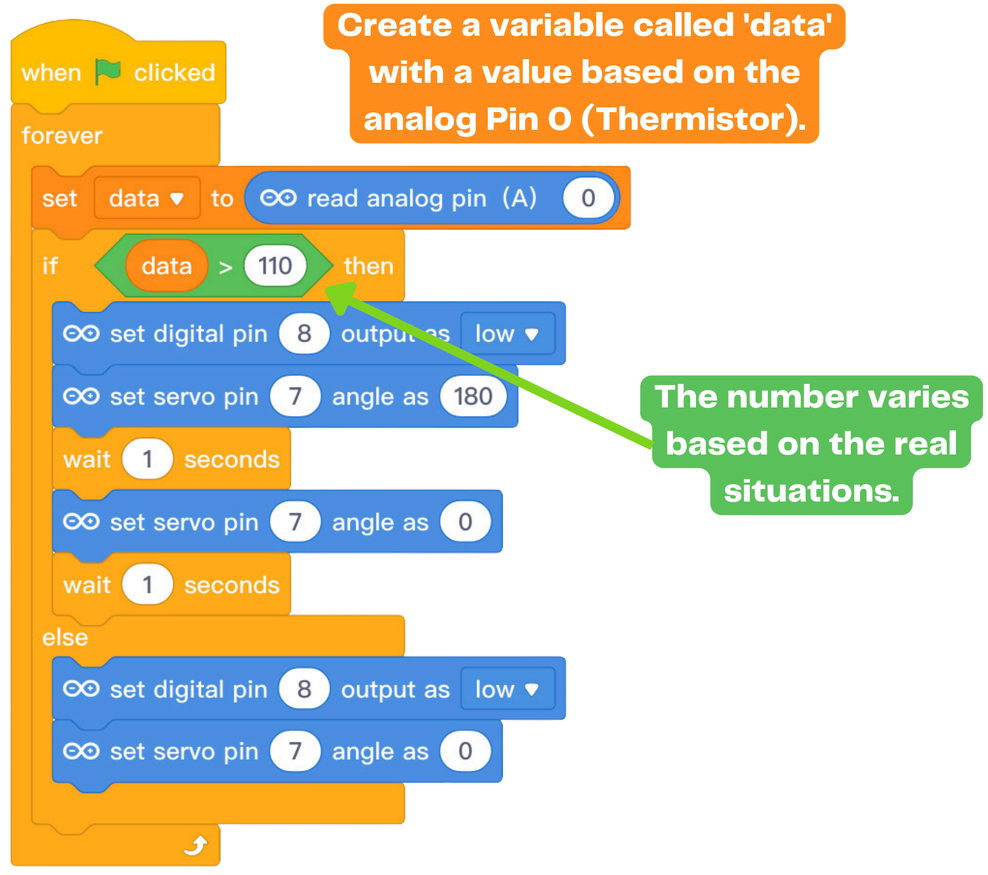
Circuit Connection



The sprite will read data (number)

Code for Sprite(s)

Create a variable called 'data' with a value based on the analog Pin 0 (Thermistor).



The number varies based on the real situations.

Code for device (Arduino)

Treasure Protection System

Do you have something valuable that you want to protect? How can we set up an alarm based on the distance of the object? We will use the ultrasonic sensor as the input to set up the system.



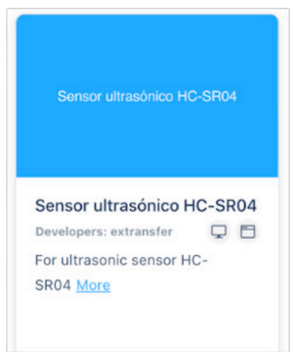
Camera (Input)



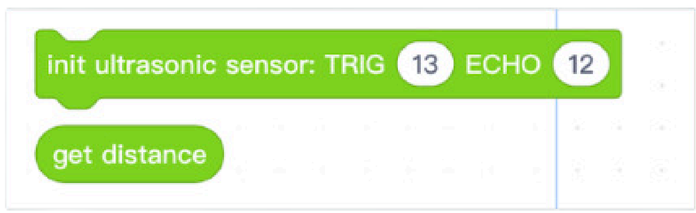
Buzzer (Output)



RGB LED (Output)



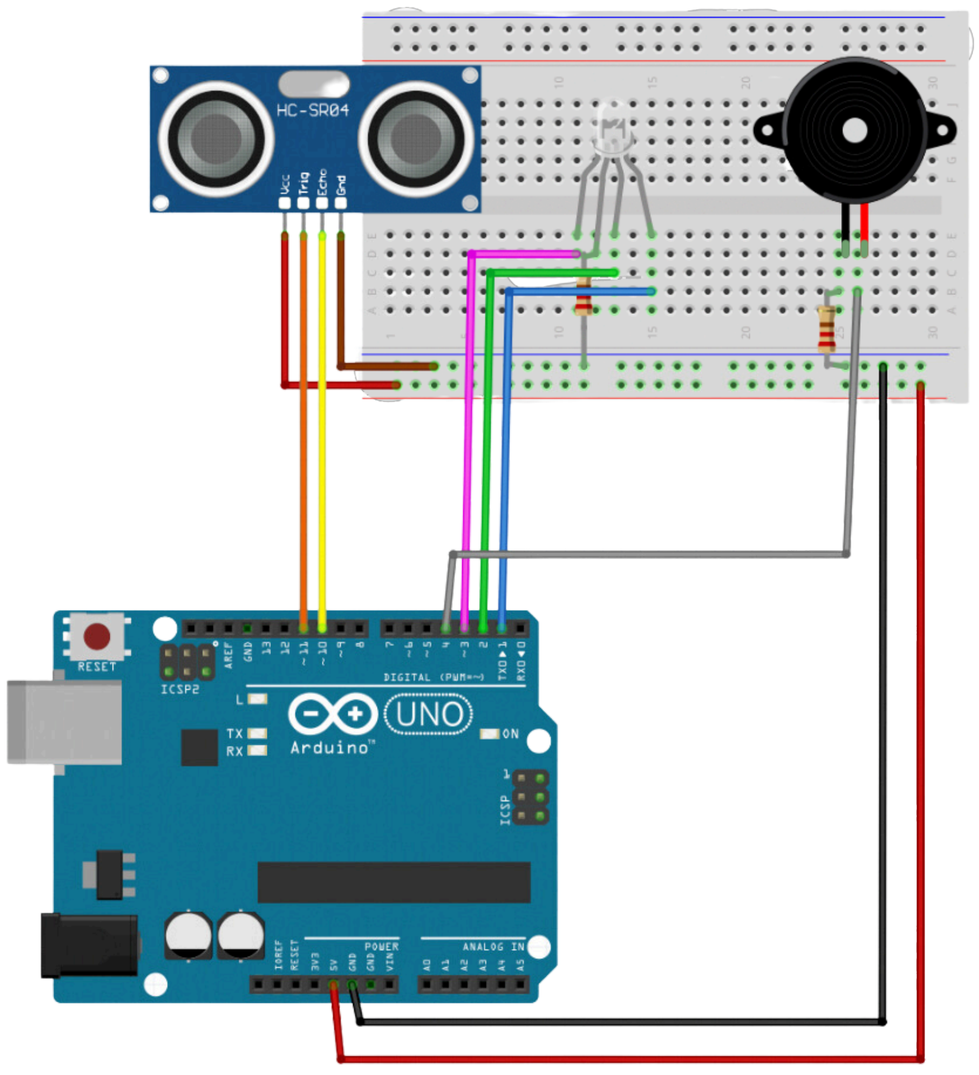




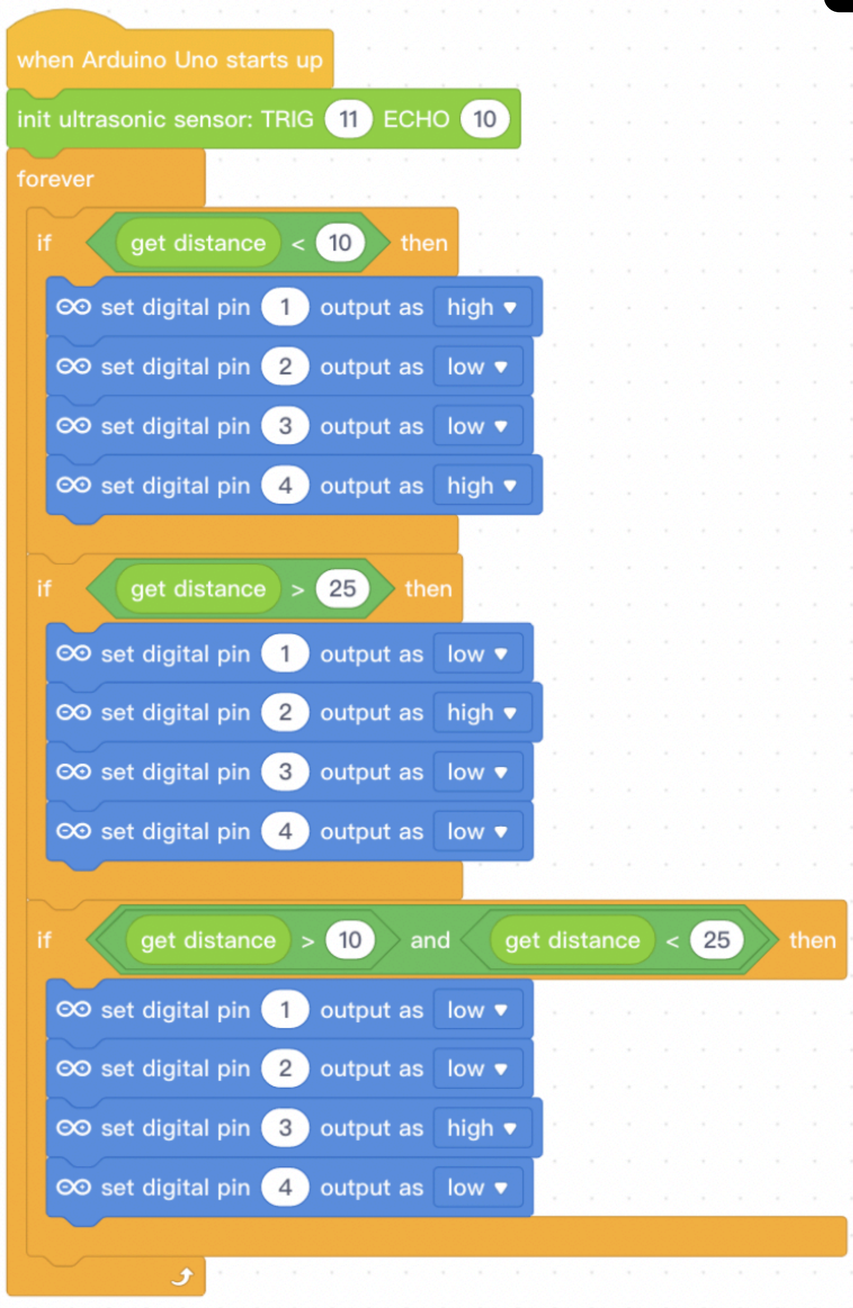
Add the ultrasonic extension (follow the correct name)

Machine Learning With Arduino

Inputs



Circuit Connection



Code for device (Arduino)

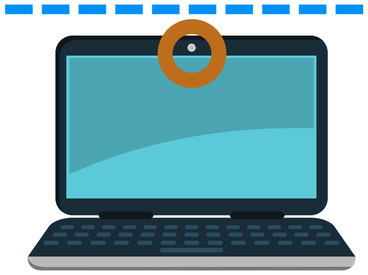
Machine Learning With Arduino

Inputs

Smart Home System

(With Machine Learning)

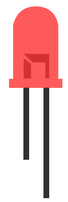
If the camera recognizes it's you, the servo (door) will open for the house owner.
If the camera recognizes it's someone else, the LED and the buzzer will be on to alert you.



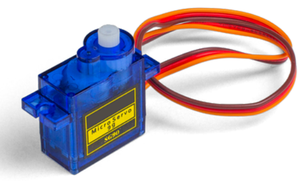
Camera (Input)



Buzzer (Output)

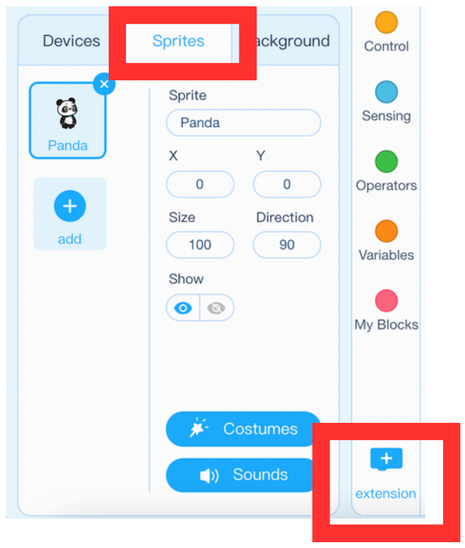


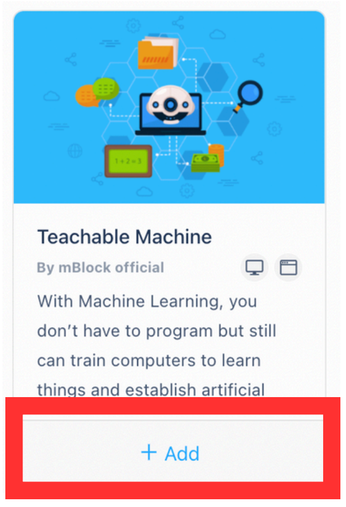
LED (Output)

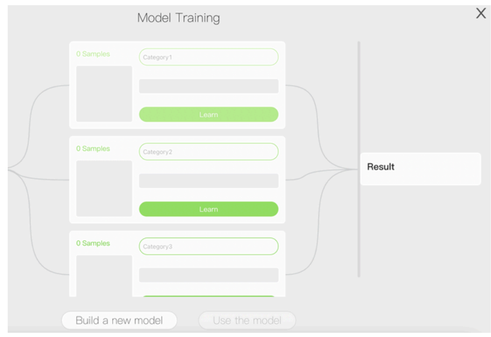


Servo (Output)

'Machine Learning' extension





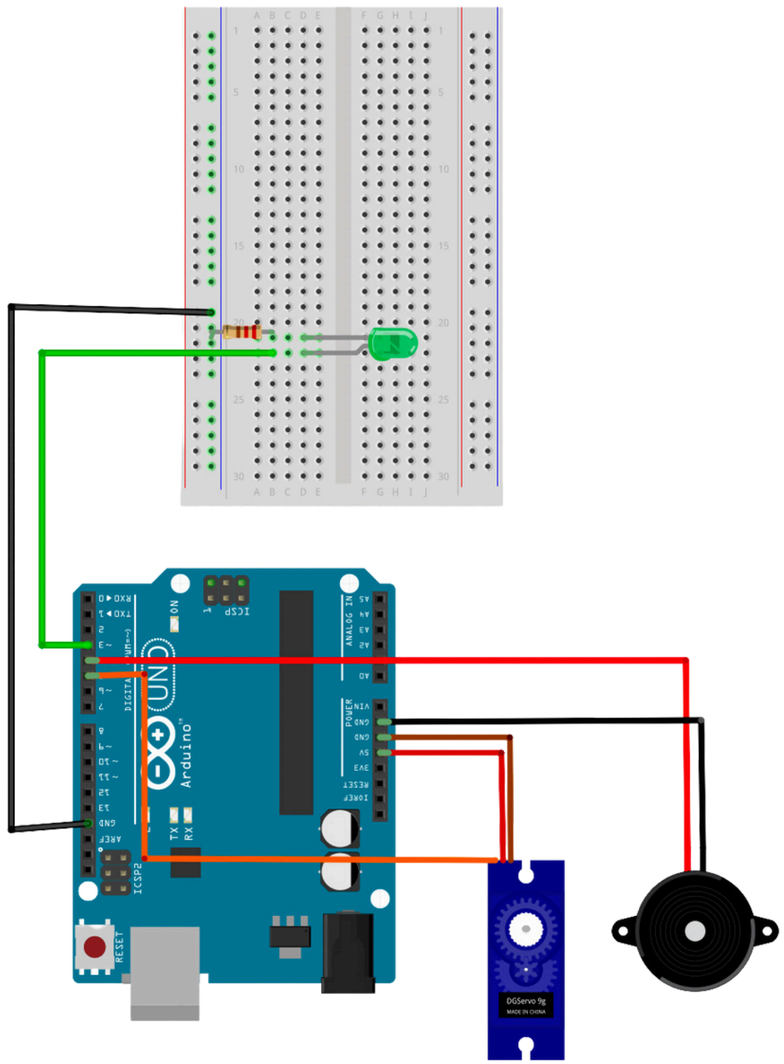


Train your data set with more pictures to improve accuracy.

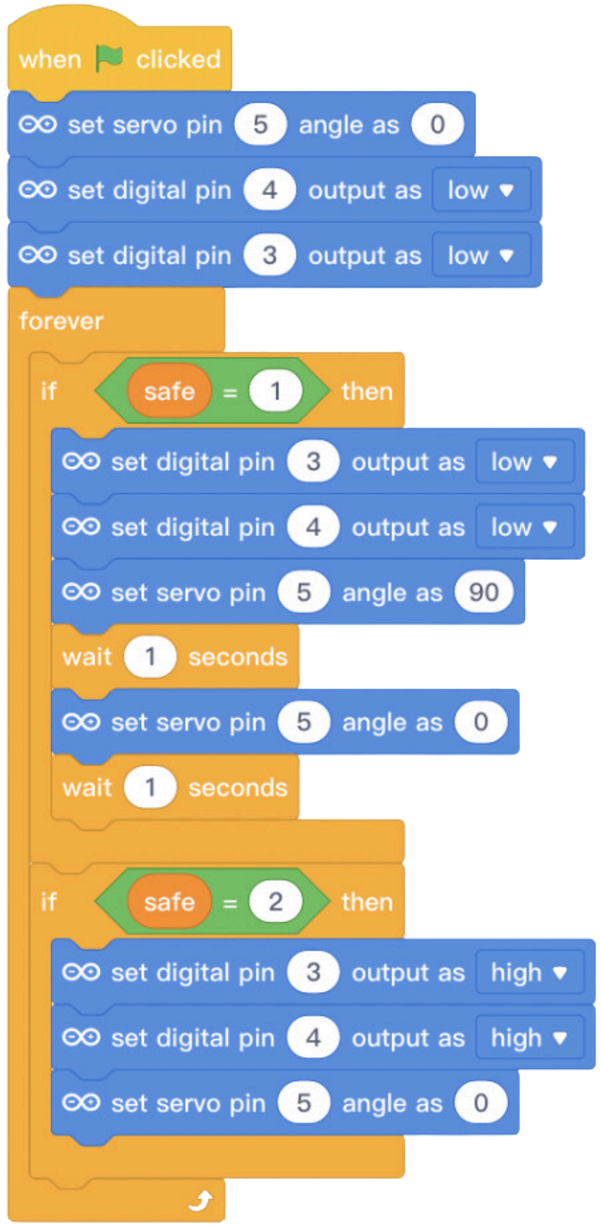
ALIGNMENT

Machine Learning With Arduino

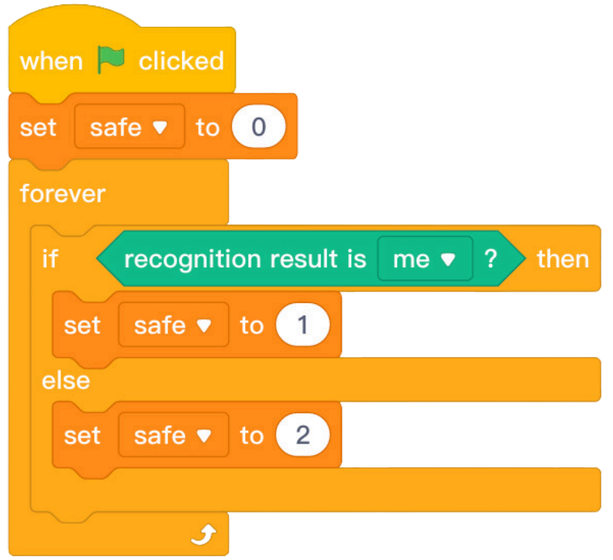
Inputs



Circuit Connection



Code for device (Arduino)



Code for Sprite(s)