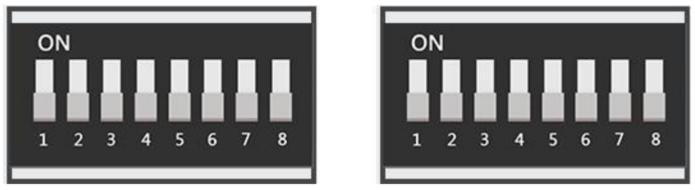
CrowPi Lessons with Scratch 3.0

Quick Start Guide（V2.2 2023.03）

CrowPi Lessons with Scratch 3.0

Switching between the modules

Understanding how to switch between the CrowPi sensors



The CrowPi board contains 2 “switches” each switch contains 8 pins, a total of 16 pins.

The switches enable us to change between the usage of sensors and modules, the Raspberry Pi supports only a limited number of GPIO pins but using those switches we can extend our capacity into much more.

Using those switches is pretty easy and will be required in some of the lessons above.

The following sensors require using switches and changing them accordingly:

* **Button array (the whole left switch is dedicated to the button array & independent button)**
* **Independent button (the whole left switch is dedicated to the button array & independent button)**
* **Vibration sensor (the right switch, first pin)**
* **Tilt sensor (the right switch, second pin)**
* **Step motor (the right switch, pins number: 3,4,5,6)**
* **Servos (the right switch, number 7,8)**

When you need to use one of those sensors, you’ll need to switch up using the switch associated with the right number, after the class or in case you don’t use that sensor it’s good practice to turn off the switch as some other sensors use those GPIO pins as well.

In the case that you don’t turn off unused pins and keep the switch on, this might cause conflict between sensors and the CrowPi might not work the way it should.

If you encounter any issue in following the tutorials - make sure that the switch is turned on or off accordingly.

Introduction - What is Scratch

Scratch is a free educational programming language that was developed by the lifelong kindergarten group at the Massachusetts institute technology (MIT) with over 27 million registered users and 31 million shared projects.

During this CrowPi manual we'll teach you the basics of scratch, how to get started and how to use the GPIO INPUT and OUTPUT in order to control various sensors - all this, through hands-on code samples and projects.

We at Elecrow think that Scratch is the way to go for total beginners that have never tried coding before.

Scratch can teach you the logic of coding by using blocks of:

Input > program > output

Learn through the process of gamification, a process that rewards learning with funny animations and even sounds.

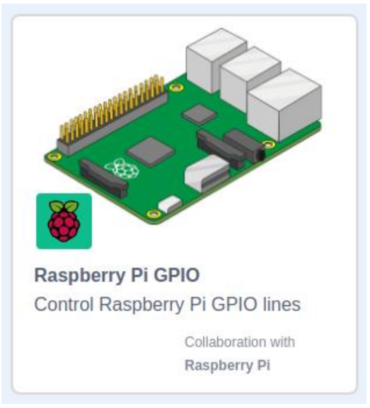
Scratch isn't just for kids but for anyone who willing to take the fist steps into learning code, and we hope you will enjoy it just as we do.

Scratch official website: https://scratch.mit.edu/

Introduction - Scratch with GPIOs

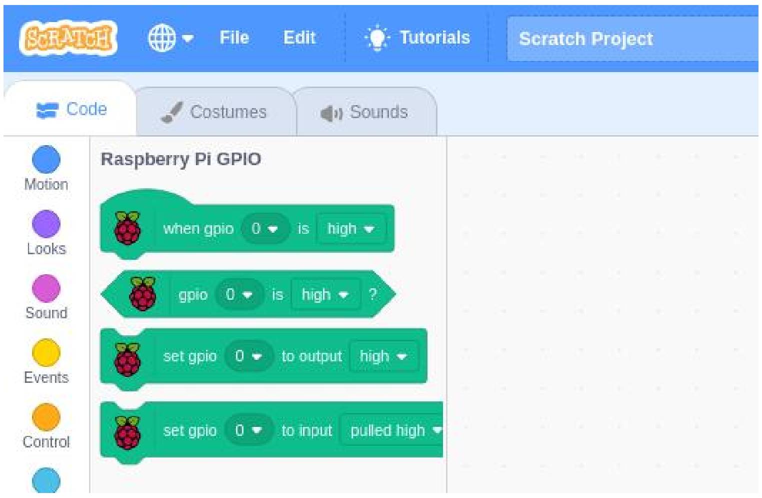
During this short introduction we'll explain how to open the scratch GPIO functionality inside the scratch software.

1. Inside scratch go to the "more blocks"section
2. Inside "more blocks" choose "add an extension"
3. Inside the extension choose "Raspberry Pi GPIO"



Raspberry Pi GPIO
Control Raspberry Pi GPIO lines
Collaboration with
Raspberry Pi

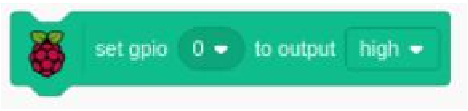
This should open a new sub group like in the picture above, called "Raspberry Pi GPIO" that contains **set GPIO … to …** and **GPIO … is high?** We will now learn how to use them right away.



Raspberry Pi GPIO

when gpio 0 is high
gpio 0 is high ?
set gpio 0 to output high
set gpio 0 to input pulled high

You can use these green blocks to control output pins or read input pins by entering the pin number into the field, or using a variable containing the pin number:

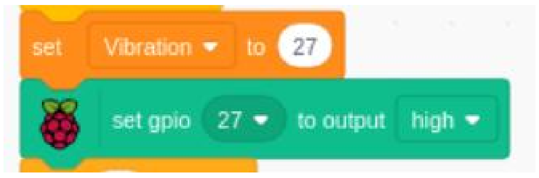


set gpio 0 to output high

This will set GPIO pin 0 to HIGH or you can change the OUTPUT to LOW and even make it as INPUT instead of output.

Note: Scratch **doesn't** support GPIO.BOARD like we use during our all Python lessons and during our drivers usage, make sure to note the GPIO pins as GPIO.BCMpins from 0 to 27.

You can create a new variable and give it a name for example "Vibration" which can active the vibration motor inside the CrowPi then you can use the "set" method to configure which pin the vibration is using, take a look at the example below:



set Vibration ▾ to 27
set gpio 27 ▾ to output high ▾

We've first set the variable name to vibration then configured the led to pin 27 (GPIO.BCM) afterwards we've set the GPIO led to OUTPUT.HIGH which means it will turn on.

If we would like to turn it off we would set it to GPIO.LOW as LED is an OUTPUT module we cannot set it as INPUT as we cannot get any data from it.

This is just an example and later on during our lessons we'll teach how to use various sensors combined with scratch files for better understanding.

Lesson 1 - Controlling buzzer

In this project we'll learn how to control the buzzer through scratch logic.

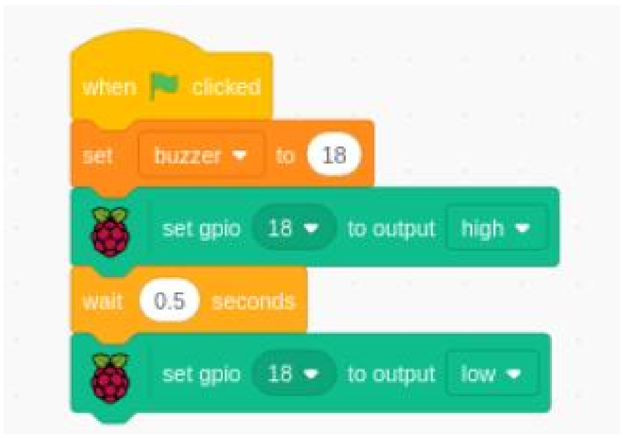
We'll use the buzzer which is on GPIO.BCM pin number 18 and we'll set its OUTPUT to **HIGH** so it can buzz loudly, then we'll wait 0.5 seconds and we'll set it **LOW** to turn off the buzzing sound.

In case you want to repeat the code forever, you can add "forever" logic within the events blocks and the program will stop only after clicking the **RED Circle** in the scratch software.

Block structure

Let's go step by step through the block structure:

1. When the green flag is clicked the software will run
2. Set buzzer to GPIO 18 (the buzzer GPIO location)
3. Set the buzzer to GPIO.HIGH and activate it
4. Wait 0.5seconds
5. Set buzzer to GPIO.LOW to shut it down.



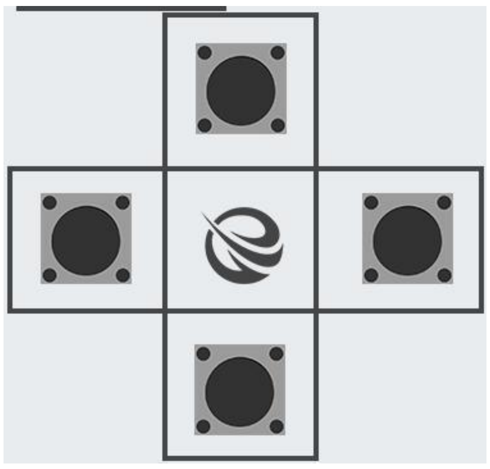
```
when [flag] clicked
set buzzer to 18
set gpio 18 to output high
wait 0.5 seconds
set gpio 18 to output low
```

Lesson 2 - Controlling buzzer using button

In this project we’ll learn how to control the buzzer by clicking the button.

We’ll use the buzzer which is on GPIO.BCM pin number 18 and the button which is on GPIO 26 and we’ll set its OUTPUT to **HIGH** when button is pressed so the buzzer can buzz loudly then we’ll wait 0.5 seconds and we’ll set the buzzer to **LOW** to turn off the buzzing sound.

We’ll use the **UP** button on top of the independent buttons:



Note: in the CrowPi circuit board pressing the button will release GPIO.LOW instead of GPIO.HIGH and un-pressing it will release GPIO.HIGH instead of GPIO.LOW. Make sure to note it ifyou want to you write your own code using scratch.

Requires switching modules using the switch

*the left switch - turn ALL the pins ON by turning them UP

Block structure

Let’s go step by step through the structure:

1. When the green flag is clicked the software will run

2. Set buzzer to GPIO 18 (the buzzer GPIO location)

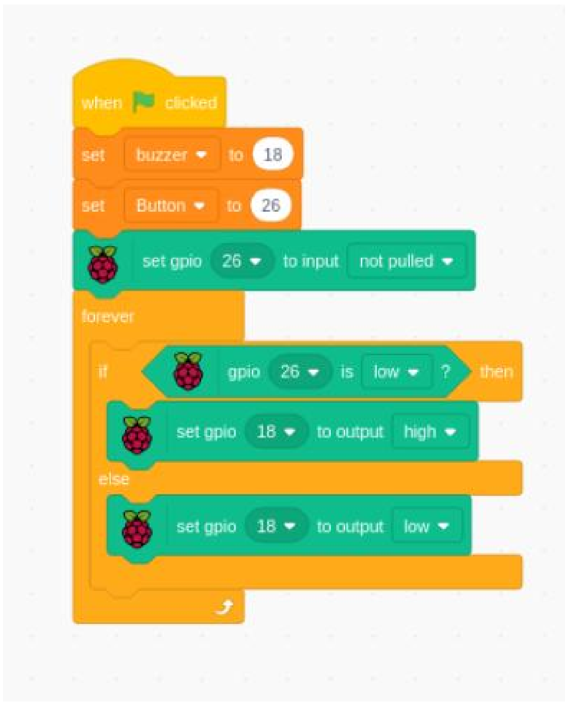
3. Set button to GPIO 26 (the button GPIO location

4. Set the button to INPUT

5. Do the next following actions forever

6. If (button pressed) then (output GPIO LOW)

7. Else (if button unpressed) then (output GPIO HIGH)

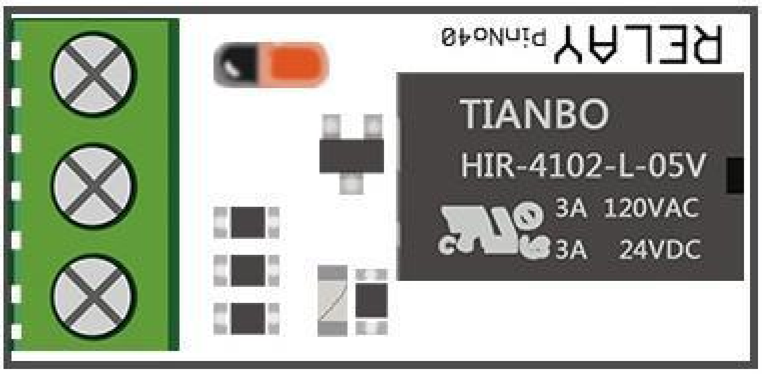


```
when 🏴 clicked
set buzzer to 18
set Button to 26
set gpio 26 to input not pulled
forever
    if gpio 26 is low ? then
        set gpio 18 to output high
    else
        set gpio 18 to output low
```

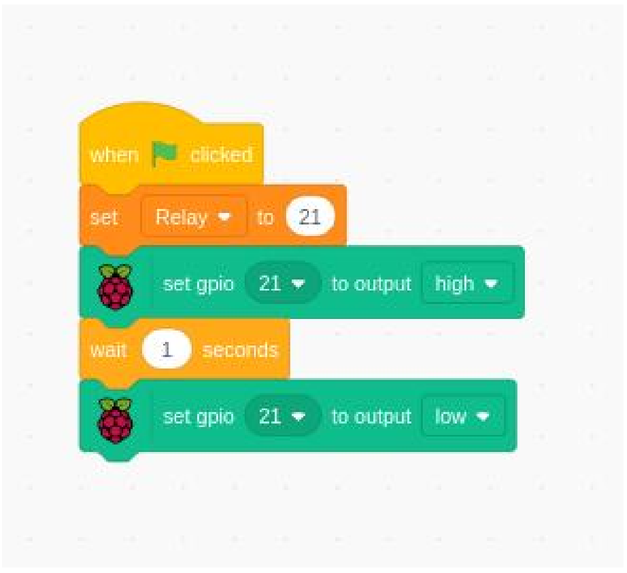
Lesson 3 - Controlling relay

In this project we'll learn how to control the relay through scratch.

We'll use the relay which is on GPIO.BCM pin number 21 and we'll set its OUTPUT to **HIGH** so it can open, then we'll wait 1second and we'll set it **LOW** to close the relay.



Block structure



```
when [flag] clicked
set Relay to 21
set gpio 21 to output high
wait 1 seconds
set gpio 21 to output low
```

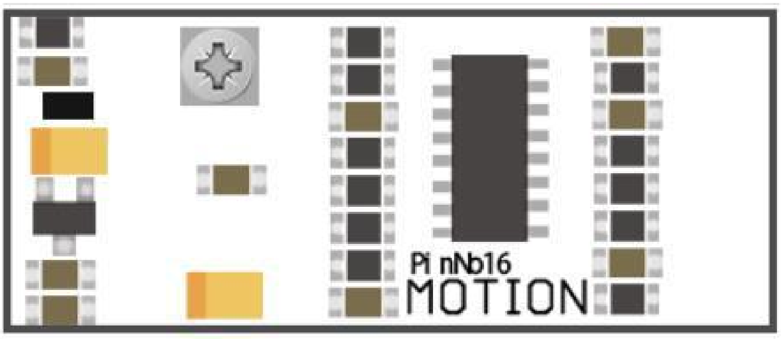
Let's go step by step through the structure:

1. When the green flag is clicked the software will run
2. Set relay to GPIO 21 (the relay GPIO location)
3. Set the relay to GPIO.HIGH in order to open it
4. Wait one second
5. Set the relay to GPIO.LOW in order to close it.

Lesson 4 - Controlling motion

In this project we'll learn how to control and detect motion through scratch.

We'll use the motion sensor which is on GPIO.BCM pin number 23 and we'll set it to INPUT as we'll get data from it and won't give it data like we did with the other sensors before.



The motion sensor works normally where HIGH means something is moving and LOW means nothing is moving …

We'll use it to detect if something moves and let the cat bubble-tell us "Motion Detected!" Or "Nothing moves …".

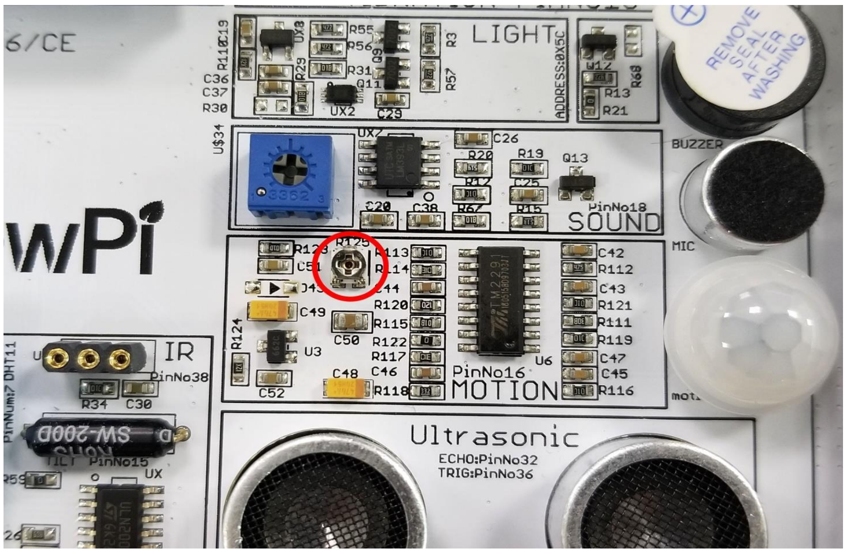
Configuring the motion sensitivity

The motion sensor includes a tiny screw right under the sound sensor potentiometer (the blue thing to configure the sound sensitivity)

We'll use that tiny potentiometer in order to adjust the sensitivity of the motion sensor.

By adjusting the sensitivity of the motion sensor we'll be able to let the motion sensor know in

what distance



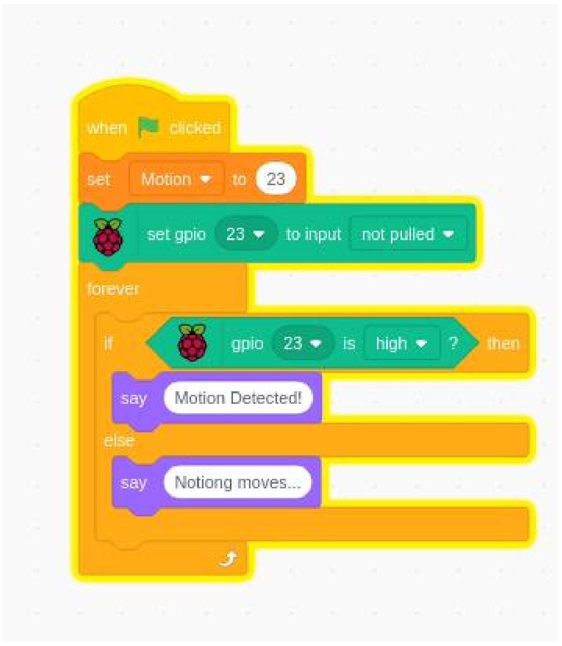
we would like to detect a motion (far distance or close distance) and that would allow us to have better control over our application.

By using a standard flat head Philips screwdriver, rotate the screw to the right or to the left when running the motion example script in order to find the suitable distance of the motion sensor.

Block structure

Let’s go step by step through the structure:

1. When the green flag is pressed the program starts
2. Set the motion sensor to GPIO PIN number23
3. Set the motion sensor to INPUT
4. Keep doing the following actions forever
5. If (motion detected { means its high })then
6. Make the cat say “motion detected!”
7. Else (if motion not detected {means it’s low})
8. Make the cat say “Nothing moves…"

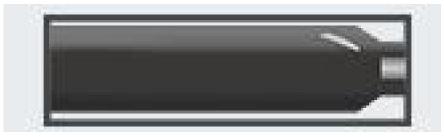


```
when clicked
set Motion to 23
set gpio 23 to input not pulled
forever
    if gpio 23 is high ? then
        say Motion Detected!
    else
        say Notiong moves...
```

Lesson 5 - Controlling the tilt

In this project we'll learn how to control and detect the tilt direction through scratch.

We'll use the tilt sensor which is on GPIO.BCM pin number 22 and we'll set it to INPUT as we'll get data from it and won't give it data.



We'll know to which side the tilt sensor is tilting by the HIGH / LOW reading.

If the tilt sensor gives us GPIO.HIGH it means it tilts LEFT if it gives us GPIO.LOW it means it tilts RIGHT.

We can use this data and information to change the cat's direction based on the tilt position!

Block structure

Let's go step by step through the structure:

1. When the green flag is clicked start the program

2. Set the tilt sensor to GPIO.BCM pin number 22

3. Set the tilt sensor as INPUT

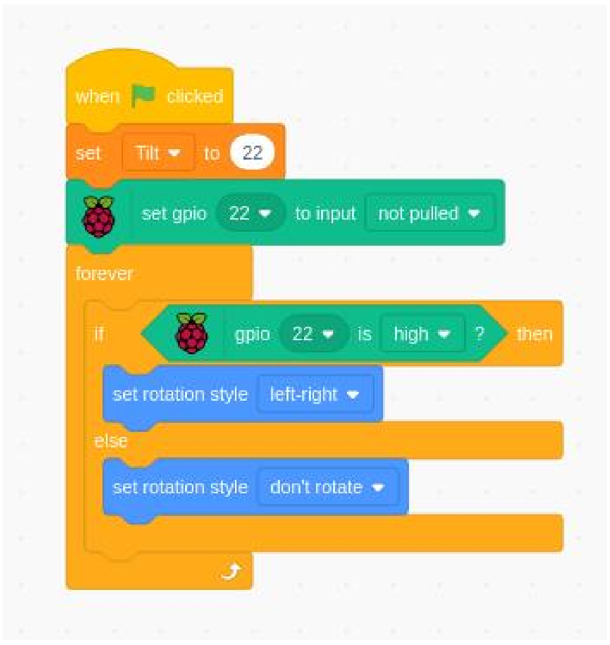
4. Do the following actions forever

5. If (tilt is GPIO.HIGH { tilt left })then

6. Set the rotation style of the cat to left-right which means he will look to the left side

7. If (tilt is GPIO.LOW { tilt right })then

8. Set the rotation of the cat to default which is the cat looking to the right side.



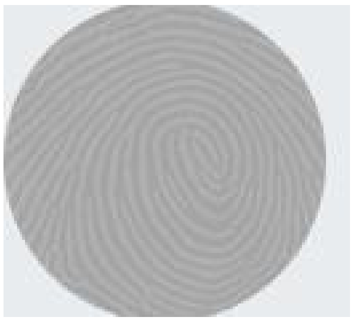
```
when [flag] clicked
set Tilt to 22
set gpio 22 to input not pulled
forever
    if gpio 22 is high ? then
        set rotation style left-right
    else
        set rotation style don't rotate
```

Lesson 6 - Controlling the touch

In this project we'll learn how to control and detect a touch over the touch sensor through scratch.

We'll use the touch sensor which is on GPIO.BCM pin number 17 and we'll set him to INPUT as we'll use him to get data whenever touch occurs or not.

We'll make it more interesting by turning on a buzzer whenever touch has been detected and turning off when nothing is touching the touch sensor.



The touch sensor operates like any other button which can be pressed but instead of pressing we actually touch it and it close a circuit. The buzzer is set up as we already used it, but this time will be activated by closing the circuit, then making a loud alarm noise!

Block structure

Let's go step by step through the structure:

1. When the green flag clicked start the program

2. Set the buzzer to GPIO.BCM18

3. Set the touch to GPIO.BCM 17

4. Set the touch as an GPIO.INPUT

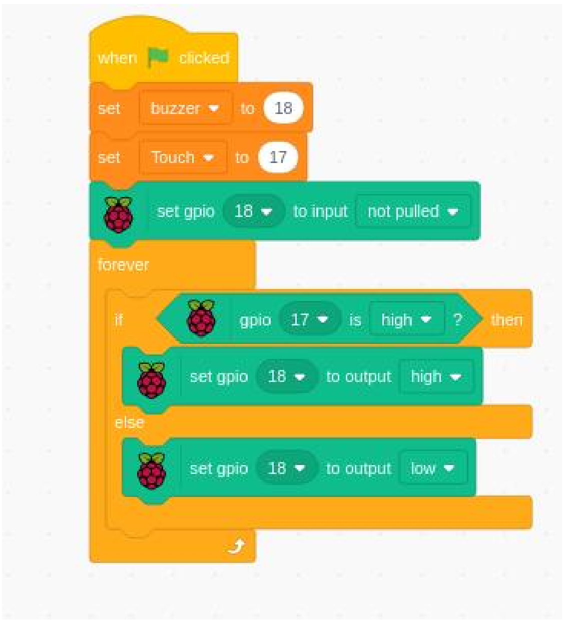
5. Do the next steps forever till the program ends:

6. If (touch detected {GPIO.HIGH})then

7. Set buzzer to GPIO.HIGH

8. Else (if touch not detected {GPIO.LOW}) then

9. Set the buzzer to GPIO.LOW(quite)



```
when ⚑ clicked
set buzzer to 18
set Touch to 17
set gpio 18 to input not pulled
forever
    if gpio 17 is high ? then
        set gpio 18 to output high
    else
        set gpio 18 to output low
```

Lesson 7 - Controlling vibration

In this project we'll learn how to control and activate the vibration module through scratch.

We'll use the vibration module which is on GPIO.BCM pin number 27 and we'll set it to OUTPUT as we'll send HIGH signal to shake and LOW signal to stop shaking.

We'll not use forever but instead we'll run it once when the green button pressed, turn on the vibration, wait half a second and turn off the vibration.

Perfect for notifications or reminders if you need anything and afraid you might forget it.

note: for the vibration sensor we need to set the right switch **UP**, we'll explain how to do so in the next page.

Requires switching modules using the switch

*The Right Switch, Pin number 1 - Make sure it's on by switching it UP

Block structure

Let's go step by step through the structure:

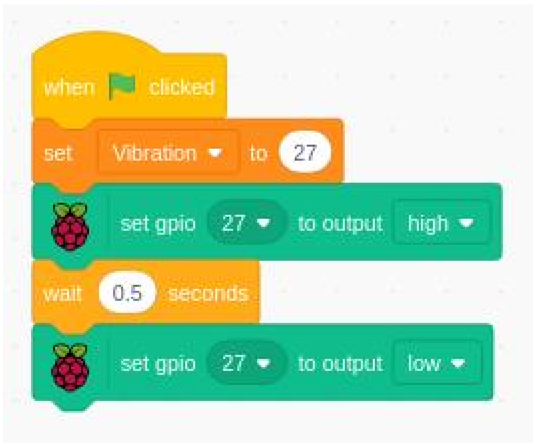
1. When the green flag pressed, start the program

2. Set the vibration module to GPIO.BCM pin number 27

3. Turn on the vibration by setting it to GPIO.HIGH (makes it vibrate)

4. Wait 0.5seconds

5. Turn off the vibration by sending GPIO.LOW



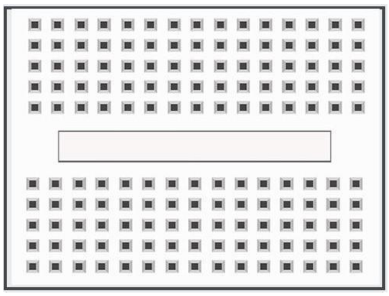
```
when [flag] clicked
set Vibration to 27
set gpio 27 to output high
wait 0.5 seconds
set gpio 27 to output low
```

Lesson 8 - Controlling blinking LED

In this project we'll learn how to make a basic electronic circuit to control an LED and make it blink! We'll first learn how to make the basic circuit and afterwards how the scratch code works.

We'll use one of the GPIO pins that belongs to the servo motor originally and the bread board to create a circuit with LED and resistor in order not to burn it up, then we'll code it to send GPIO.HIGH in order to turn on the LED and GPIO.LOW in order to turn it off.

We'll also need to turn on the right switch in order to make those GPIO work, so we'll also explain how to do that part.



Requires switching modules using the switch

* We'll use the servo pins to make custom circuits, pins numbers 7,9 turn them ON by switching it UP

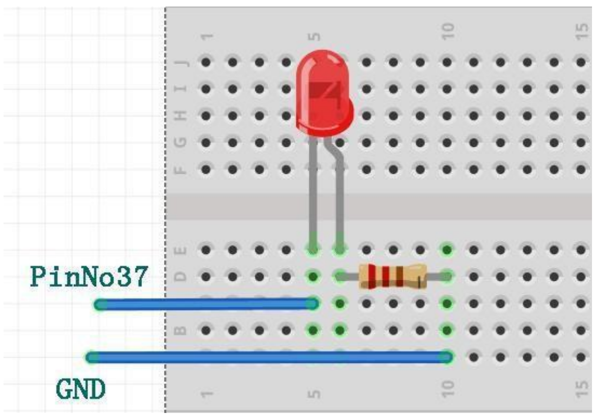
The "Blinking LED" circuit

We'll be making a custom circuit whose function will literally be blinking an LED.

Before we start make sure to switch the right switch properly !

In order to do that we'll need to use GPIO as output and GND as we did before in our previous lessons. We'll use the servo interface (specifically SERVO1 Interface) on GPIO 37.

The first thing will be to create the custom circuit, take a look at the following picture:



You can refer to this picture to make your circuit on the breadboard.

Don’t forget that PinNo37 is located on the SERVO1 Interface GPIO port.

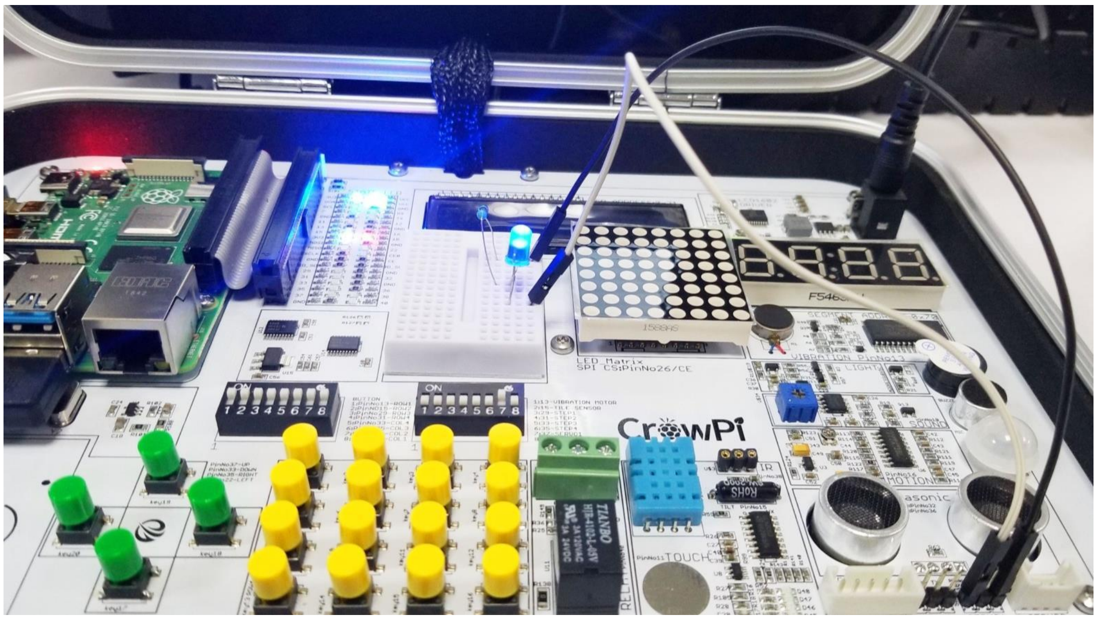
The GND is located on the SERVO1 Interface as well on the GND port.

We’ll need to take one resistor that comes with the CrowPi package and wire it to the negative side of the
LED **(the negative side of the LED is the shorter leg between the 2 LED legs)**

From the other side of the resistor we’ll wire it directly with jumper to the GND pin on the SERVO1 interface.

The other LED leg would be the positive pin which we’ll wire it directly into the GPIO37 pin on SERVO1 to be able to control it and make it blink!

The final result should look similar to this:



Block structure

Let’s go step by step through the structure:

1.When the green flag clicked, start the program

2. Set the LED to GPIO.BCM pin number26

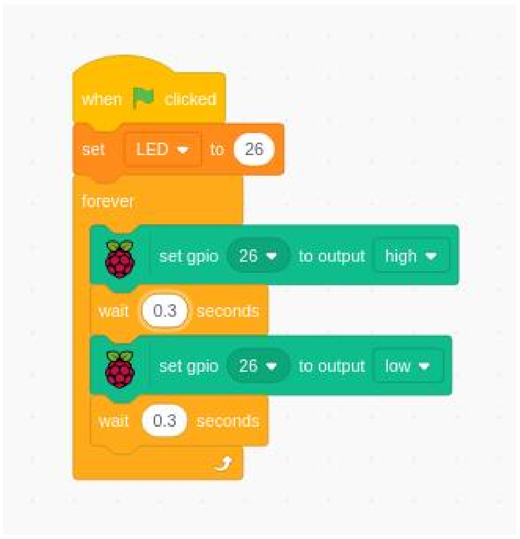
3. Do the following steps forever

4. Turn on the LED by sending GPIO.HIGH signal

5. Wait for 0.3seconds

6. Turn off the LED by sending GPIO.LOW signal

7. Wait 0.3seconds



```
when [flag] clicked
set LED to 26
forever
    set gpio 26 to output high
    wait 0.3 seconds
    set gpio 26 to output low
    wait 0.3 seconds
```

By applying the 0.3 seconds waiting it make the LED turn on and off quickly which makes the blinking effect!

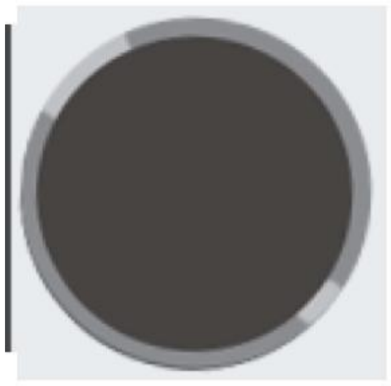
Try to play with the timing and add more objects and see what you can do!

Lesson 9 - Controlling sound

In this project we'll learn how to detect sound using the sound sensor and then make the cat say if sound been detected or not!

We'll use the sound sensor which is located on GPIO.BCM pin number 24 as INPUT to detect if loud noise heard around.

If loud noise is detected, the INPUT would be GPIO.HIGH and if no noise at all the INPUT would be GPIO.LOW



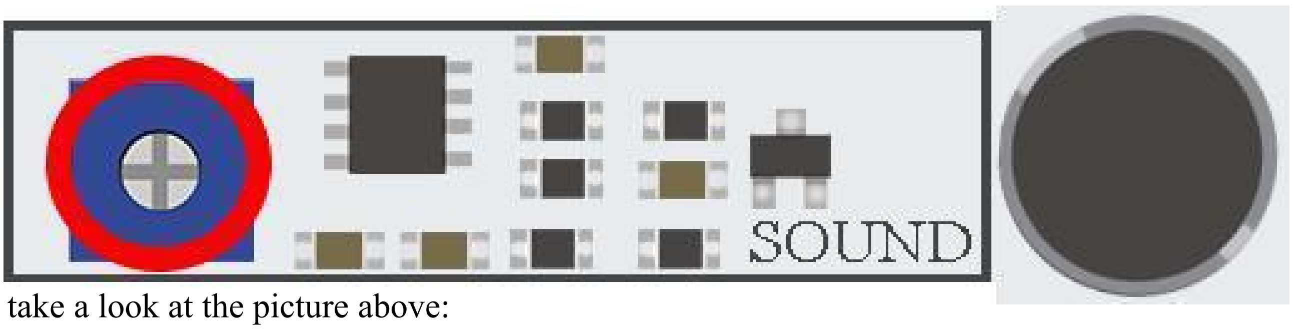
We'll also teach how to configure the sensitivity of the sound sensor to be able to recognize louder or quieter sounds …

This module doesn't require any changes to the switches.

Configuring the sound sensitivity

Our sensor contains a small controller that allows us to manually control the sensitivity of the noise for sounds that are too quiet or too loud.

In order to make our script work we first must learn how to control that sensitivity option …



take a look at the picture above:

We'll need to spin the little blue square that is rounded with red oval (in the picture) for either left or right in order to control its sensitivity.

Spinning the sensitivity controller can be done by simply using any Phillips flat head screw driver.

The best way to know what sensitivity level is suitable for you is by running the script and clapping your hands once in a while or shout so you can see if there is an INPUT reaction from the sensor which means he detects the loud noise.

If the sensor doesn't detect the loud noise it means the sensitivity is too low and it won't react to it.

Increasing the sensitivity by spinning the blue square will solve this issue immediately.

Block structure

Let's go step by step through the structure:

1. When the green flagged is clicked we start the program

2. Set the sound sensor to GPIO.BCM pin number 24

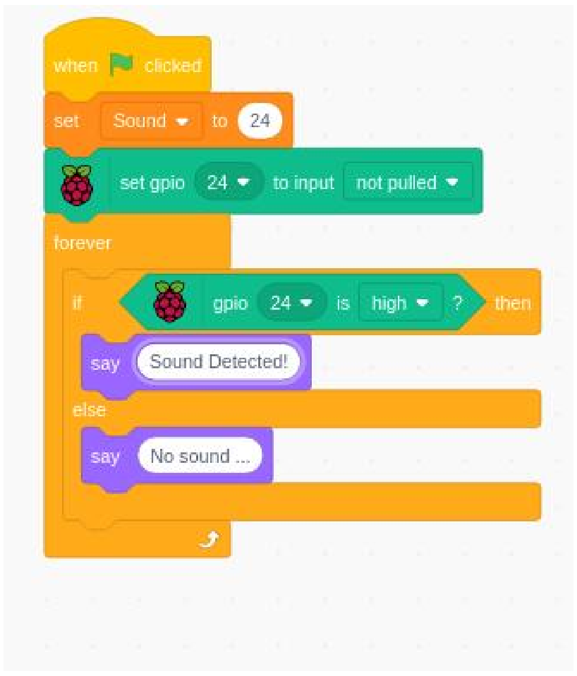
3. Do the following actions forever

4. If (sound detected {GPIO.HIGH}) then

5. Make the cat say "Sound detected!" + wait for 1 second.

6. Else (sound not detected {GPIO.LOW})

7. Make the cay say "No sound …"



```
when 🏴 clicked
set Sound ▾ to 24
set gpio 24 ▾ to input not pulled ▾
forever
    if gpio 24 ▾ is high ▾ ? then
        say Sound Detected!
    else
        say No sound ...
```

By applying the 1 second waiting, it won't make the cat change from detected to not detected so quickly and make the animation of the cat look more smoothly.

Try to change your own parameters or maybe make the cat do some other actions!