Learning Programming Through Sensor and Scratch

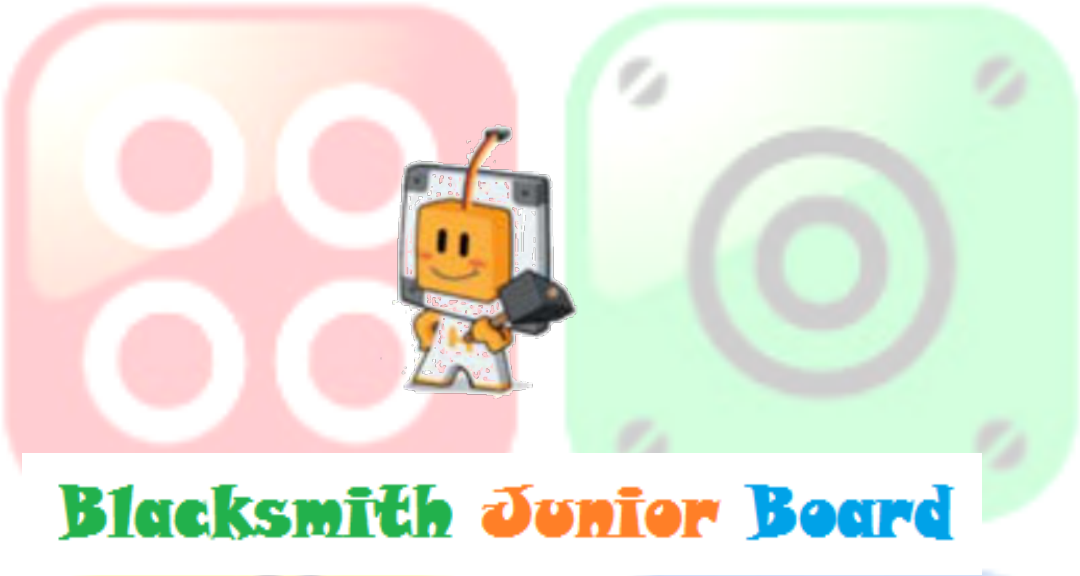
Blacksmith Junior Board

Student Name	
Student ID	
Start Date	

Lesson	Theme	Date	Remarks
1	Introduction		
2	Controlling LED with Starfish		
3	Making Doorbell with Buzzer		
4	Give a Present to Ballerina with Gyro Sensor		
5	Using Touch Switch To Play Game With Butterfly		
6	Using Cds to Make An Automated Street Light		

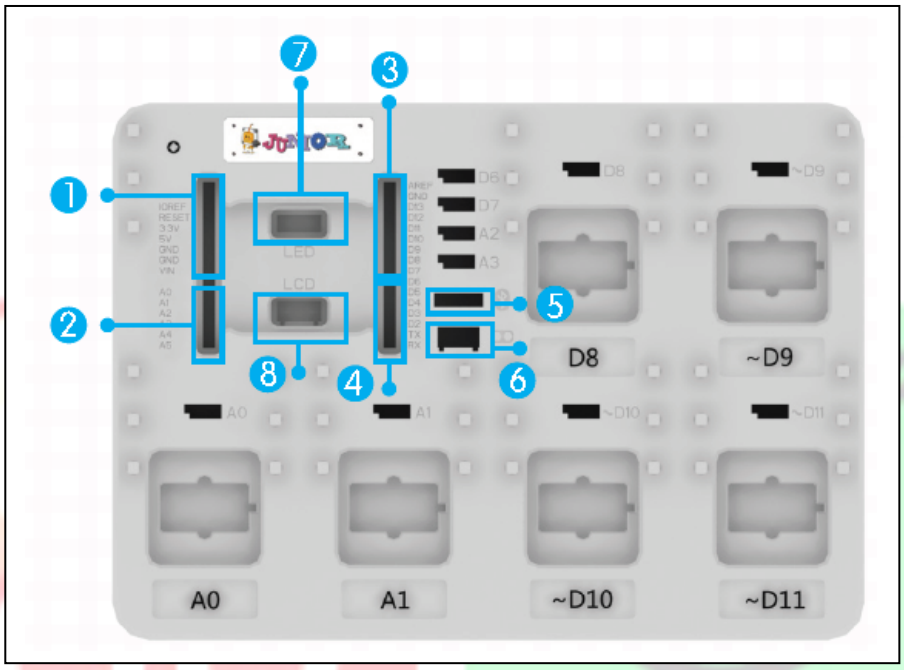
Lesson	Theme	Date	Remarks
7	Getting To Know About Variable		
8	Using Magnetic Sensor To Launch A Rocket		
9	Using NTCT Sensor To Determine Hot and Cold		
10	Using LM35 to Play A Game with Butterfly		
11	Using Potentiometer To Control Penguin		
12	Using Rain to Measure Water Level		
13	Using Rain To Make A Water Level Gauge		

Lesson	Theme	Date	Remarks
14	Using Buzzer To Play A Song		
15	Using IR Sensor To Make a Game		
16	Using Servo Motor To Prevent Insect		
17	Using Ultrasonic Sensor To Keep Princess Safe		
18	Using Ultrasonic Sensor To Ensure Safety		



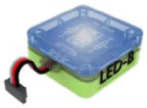
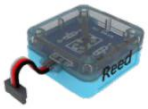
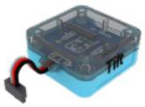
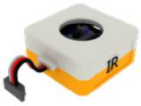
Blacksmith Junior Board

Introduction



1	Power pin (5V, 5V, GND, GND, 3.3V, VIN)	**Extension pin for Arduino**
2	Analog in-put pins (A0~A5)	
3	Digital in-put and out-put pins (7~13)	
4	Digital in-put and out-put pin (0 ~ 6)	
5	Bluetooth pin (combined with pin 2, 3)	**Exclusive port**
6	Ultra-sensor pin (combined with pin 4, 5)	
7	O-LED Port	
8	LCD Port	
USB Port	Connect to computer with USB cable	
Power Plug	9V(1A) adaptor or batteries can be used as power supply if necessary	

Blacksmith board sensors

			
Red LED	Green LED	Blue LED	Yellow LED
			
White LED	Buzzer	Touch switch	Reed (Magnetic Sensor)
			
Tilt sensor	CdS (Light sensor)	NTCT (Temperature Sensor)	LM35 (Temperature Sensor)
			
Volume (Potentiometer)	Servo	Rain sensor	IR sensor
		Ultrasonic sensor	

Difference between Analog and Digital Sensor

Digital Sensor

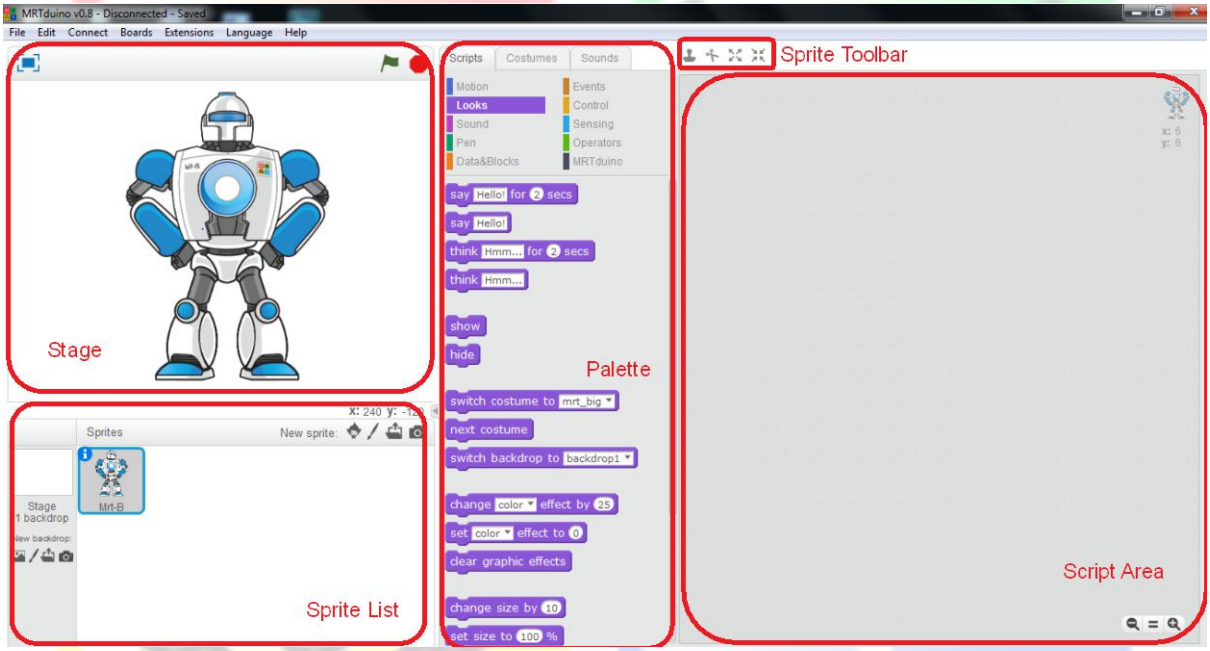
- It gives only “High” and “Low” output, similar to the binary digit 0 and 1 which symbolize “On” and “Off”.
- For example, the LED can only give two output, either “On” and ‘”Off” output.
- Digital sensor including:
  - LED
  - Buzzer
  - Touch Switch
  - Reed
  - Tilt Sensor

Analog Sensor

- Analog sensor will not only give “High” and “Low” signal but it will give you numerical feedback according to change in the surrounding.
- The value given by sensor is ranged between 0-1023 and unit-less.
- Analog sensor including:
  - Cds
  - NTCT
  - LM35
  - Volume
  - Rain sensor
  - IR sensor
  - Ultrasonic sensor

Getting to know MRTScratch

MRTScratch is designed based on Scratch. Scratch is a free visual programming developed by MIT (Massachusetts Institute of Technology) Media Lab. MRTScratch is a stepping stone to advance programming as it can help student to build up programming logic and their interest towards programming.



To Begin

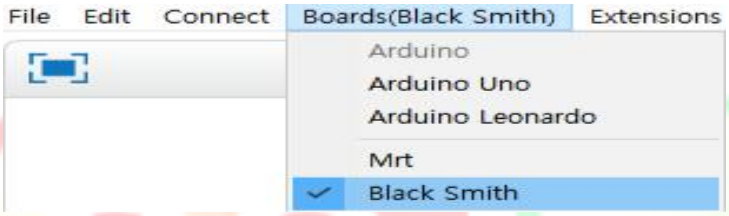
1. Connect Blacksmith board to a computer with USB cable to set up the hardware.
2. LCD window will be on if the power is on. If you want to turn off the Blacksmith board, just disconnect the USB cable from the computer.
3. Use pins D6~D11 for digital sensors.
4. Use pins A0~A5 for analog sensors.
5. For Arduino sensor, please use extended pins. Arduino pins 0~13, A0~A5 are compatible with Blacksmith board 0-13, A0-A5.

Connecting hardware

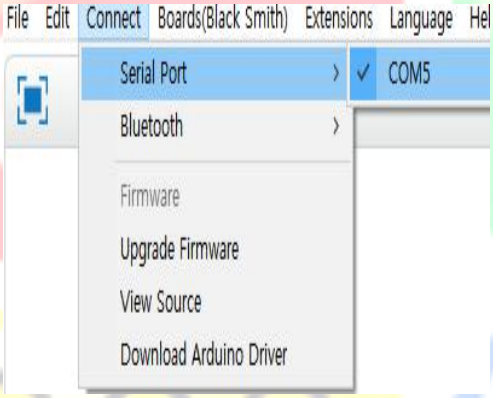
①Install MRTScratch S/W.

② Connect Blacksmith board to a computer with USB cable.

Select [Boards-Black Smith] on top.

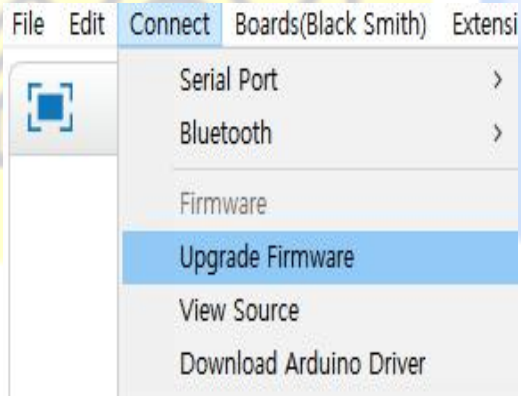


③ Select [Connect-Serial Pin-Black Smith board number] to connect Black Smith and Scratch.



④ Select [Connect-Upgrade Firmware] to upgrade firmware.

*If you used other software, not MRTScratch, you must upgrade firmware.



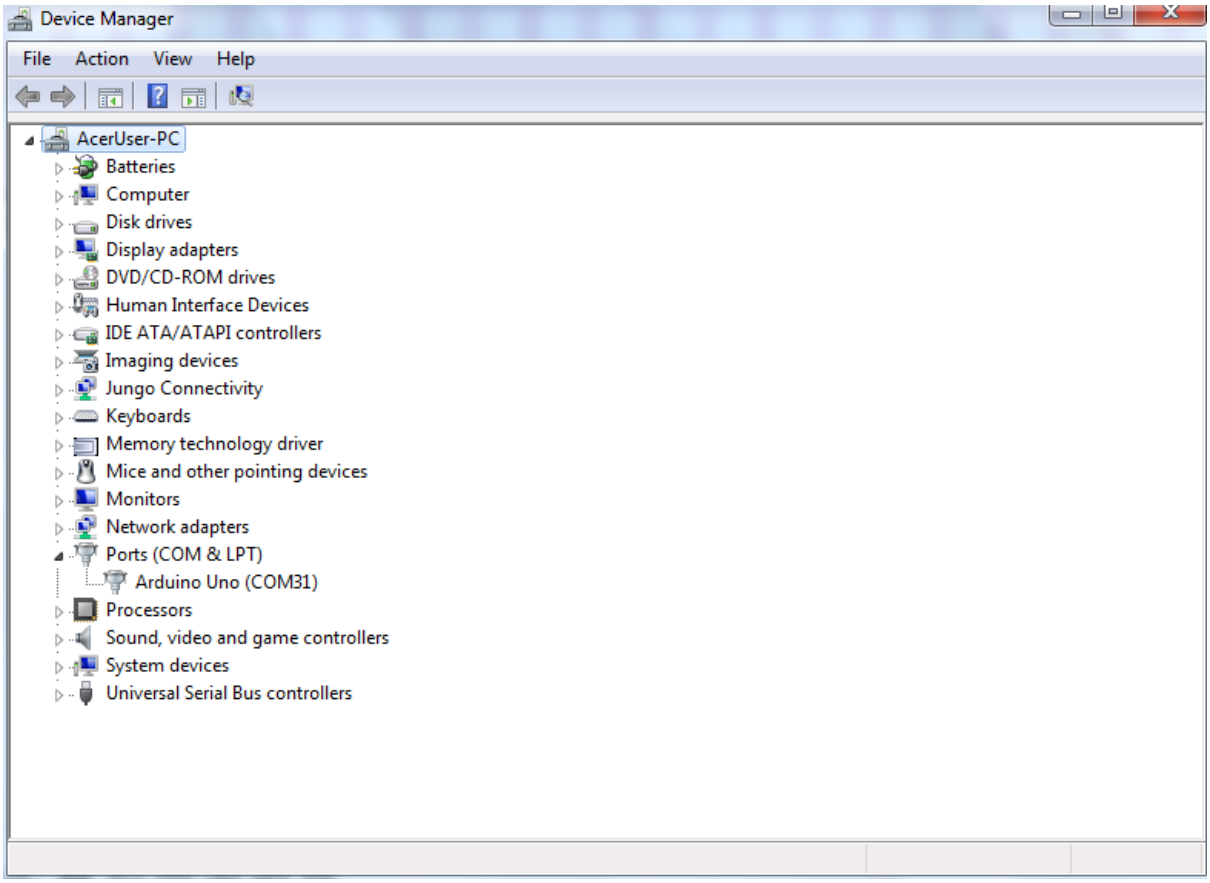
⑤ Select [MRTScratch] tap on Scripts. Check if circle on the right turns green.

	
Not connected	Connected

el

How to determine your MRTScratch COM Port ?

1. Open the "Run" dialog box by pressing and holding the Windows key, then press the R key ("Run").
2. Type “devmgmt.msc” and enter.
3. You’ll now see a window similar to the following :



4. Click on “Ports (COM & LPT), you’ll see “Arduino Uno” with a COM Port attached to it at behind. This is the port number that Blacksmitch Junior is connected to your PC.

Controlling LED with Starfish

Introduction: In this lecture, we will learn how to control LED by using Blacksmith Junior board and MRTScratch. You should understand the basics of interaction between software and hardware through the changes of size of starfish and LED on the Blacksmith Junior board.

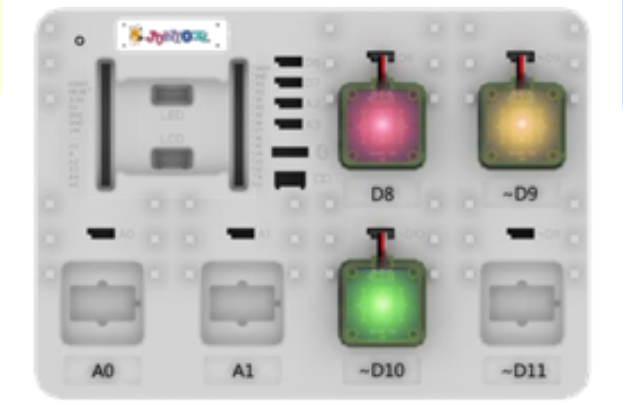
Hardware Introduction : What is LED ?

Stands for "Light-Emitting Diode" An LED is an electronic device that emits light when an electrical current is passed through it. Early LEDs produced only red light, but modern LEDs can produce several different colors, including red, green, and blue (RGB) light. Recent advances in LED technology have made it possible for LEDs to produce white light as well.

Lean new Scratch Block

when this sprite clicked	Run the command script that attached to it below
switch costume to starfish-a	Changes sprite's appearance by switching to different costume.
set size to 150 %	Sets sprite's size to specified % of original size.
set color effect to 0	Sets a visual effect to a given number. (Most visual effects range from 0 to 100.)
set digital pin 9 output as HIGH	Send signal to digital output pin 9.
set digital pin 9 output as LOW	Do not send signal to digital output pin 9
wait 0.5 secs	Wait for 0.5 second.

Hardware preparation: Connect red, yellow, green LED to D8, D9 & D10.

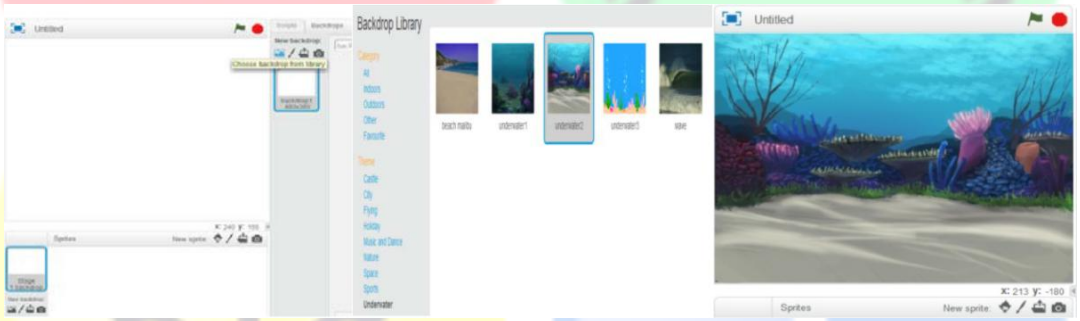


Connect Blacksmith board

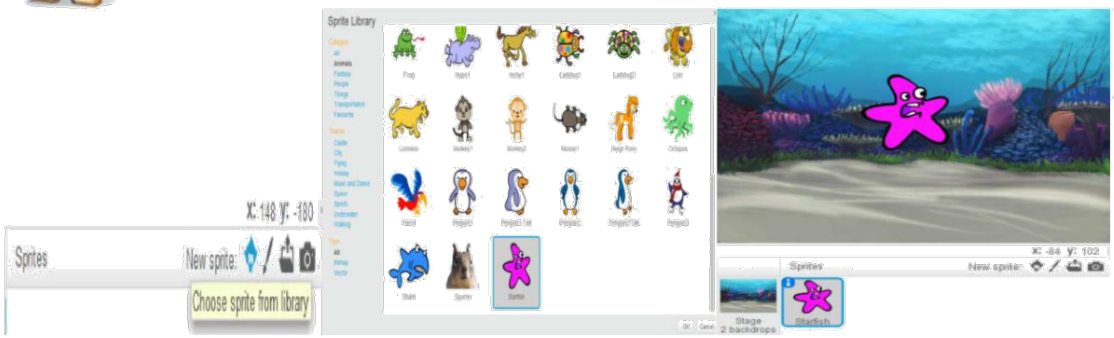
Software preparation: Set “Underwater2” as a backdrop and place 3 starfishes on the backdrop.

① Delete the robot in the original sprite.

② Select [Stage backdrop]. Select [Backdrops] on the right side of Scripts and click [New backdrop-Choose backdrop from library].Select [Underwater-underwater2] and apply.



③ Click [New sprite-Choose sprite from library] on sprite to open the library Select [Animals-Starfish] and apply.



Coding

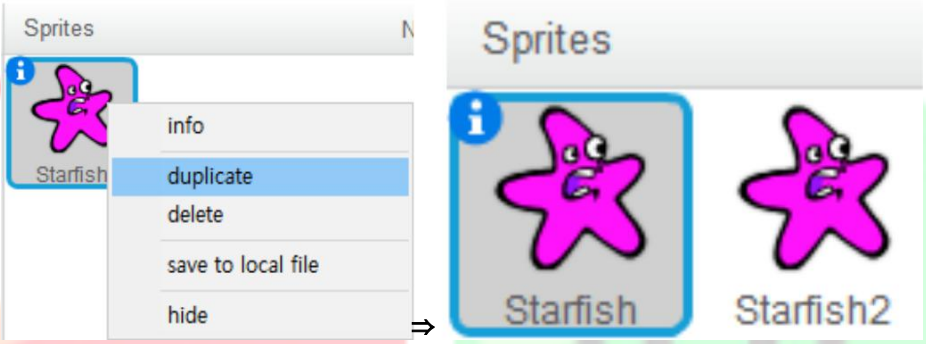
Starfish1 

[Algorithm] When click “Starfish1” it changes “Starfish-a”, change the size by 150% and color to red (40).At the same time red LED (D8) will be on for 0.5 sec and then return to its original color (purple) and size.

Coding	Location	Explanation
	Events	Click sprite
	Looks	Change shape to starfish-a
	Looks	Enlarge the size by 150%
	Looks	Change color to red (=40)
	MRTduino	Send signal to D8 (on)
	MRTduino	Do not send signal to D9,
	MRTduino	and D10 (off)
	Control	Wait for 0.5 sec
	Looks	Return to starfish-b and size
	Looks	down to 100%.
	Looks	Color back to original

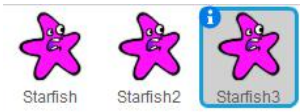
Starfish2 

Duplicate "Starfish" sprite by clicking right mouse. If you duplicate sprite by clicking right mouse, you can copy commend in sprite too.



[Algorithm] When click "Starfish2" it changes "Starfish-a", change the size by 150% and color to yellow (60). At the same time hardware D9 (yellow LED) will be on for 0.5 sec and the sprite return to its original color (purple) and size.

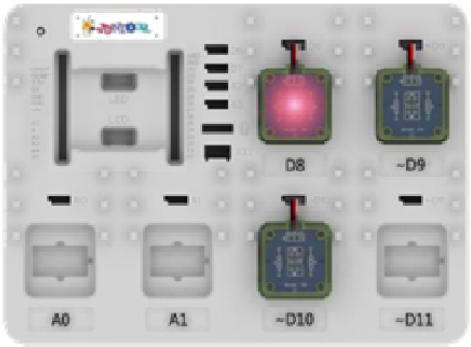
Coding	Location	Explanation
	Events	Click sprite
	Looks	Change shape to starfish-a
	Looks	Enlarge the size by 150%
	Looks	Change color to yellow (=60)
	MRTduino	Do not send signal to D8 (off)
	MRTduino	Send signal to D9 (on)
	MRTduino	Do not send signal to D10 (off)
	Control	wait for 0.5 sec
	Looks	Return shape to starfish-b and
	Looks	size down to 100%.
	Looks	Color back to original

Starfish 3 

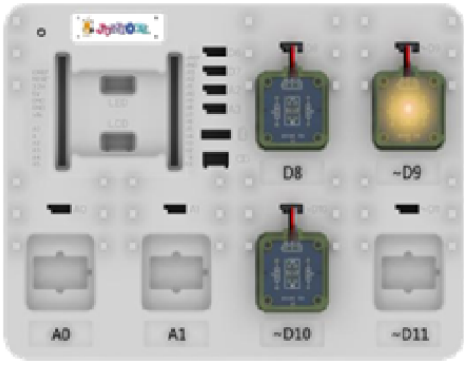
[Algorithm] When click “Starfish3” it changes “Starfish-a”, change the size by 150% and color to green (100). At the same time hardware D10 (green LED) will be on for 0.5 sec and return to its original color (purple) and size.

Coding	Location	Explanation
	Events	Click sprite
	Looks	Change shape to starfish-a
	Looks	Enlarge the size by 150%
	Looks	Change color to Green (=100)
	MRTduino	Do not send signal to D8(off)
		Do not send signal to D9(off)
		Send signal to D10 (on)
	Control	Wait for 0.5 sec
	Looks	Return to starfish-b
	Looks	Size down to 100%.
	Looks	Color back to original

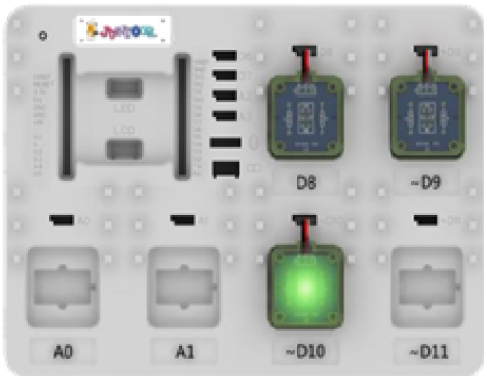
Practice



Clicked Starfish 1 Blacksmith board



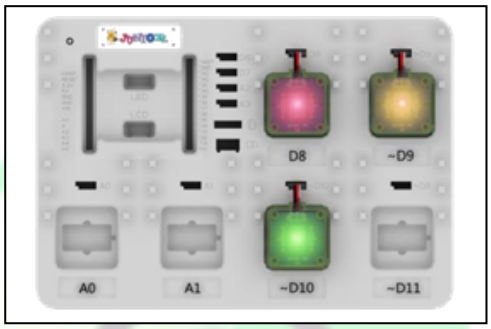
Clicked Starfish 2 Blacksmith board



Clicked Starfish 3 Blacksmith board

Mission

Make a Christmas tree that the LED will light up accordingly.



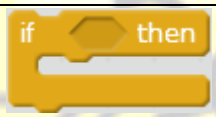
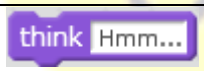
Making doorbell with LED and buzzer

Introduction: In this lecture we will make doorbell with switch, LED and buzzer. When we pressed the touch switch on Blacksmith board, the buzzer will make sound and LED will light up. There will be some changes in the MRT Scratch when we pressed the switch. Through this exercise we can understand that hardware can control software just like we can create documents with keyboard and mouse.

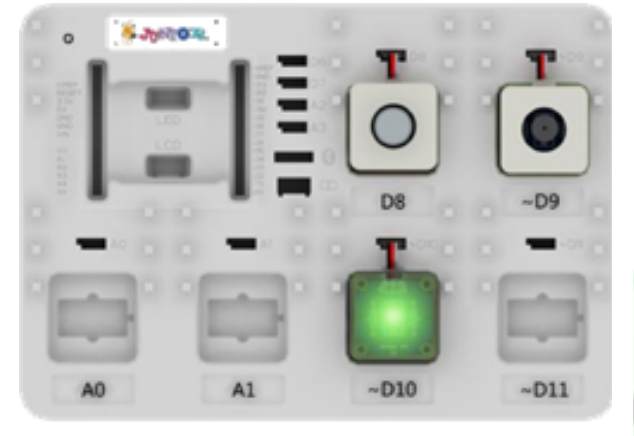
Hardware Introduction : What is Buzzer ?

A buzzer is an electrical device that is used to make a buzzing sound for example, to attract someone's attention. Typical uses of buzzers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Learn new Scratch Block

	Run script attached below when green flag is clicked.
	Moves sprite to specified x and y position on Stage.
	If condition is true, run the scripts inside.
	Run the scripts inside over and over.
	Display sprite's thought bubble.
	Read digital input signal from pin 9.
	Rotates sprite clockwise according to the degrees.
	Rotates sprite counterclockwise according to the degrees.

Hardware preparation: Connect switch to D8, buzzer to D9 and green LED to D10..

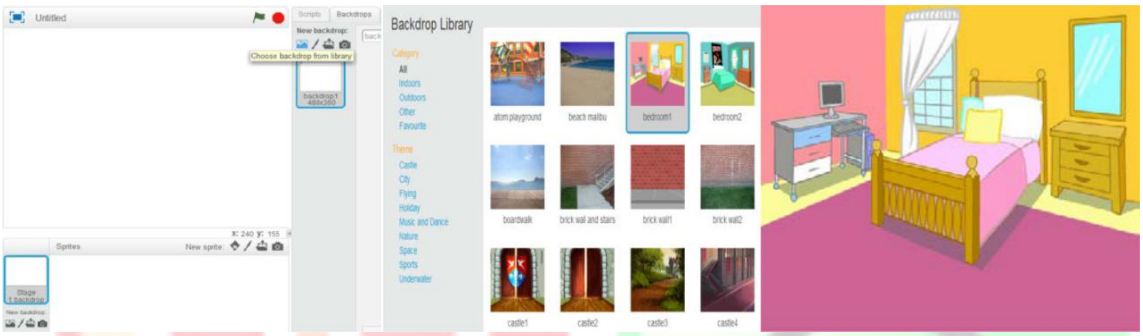


Connect Blacksmith board

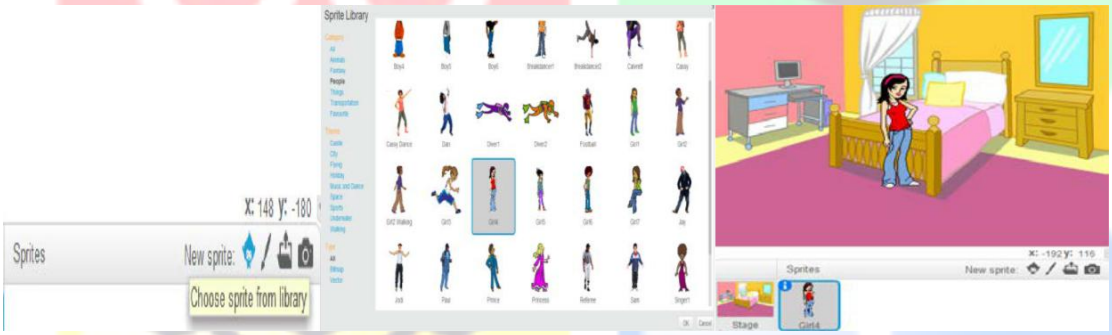
Software preparation: Set “Bedroom1” as the backdrop and select “Girl-4” and “Bell” as the sprite.

① Delete the robot in the sprite.

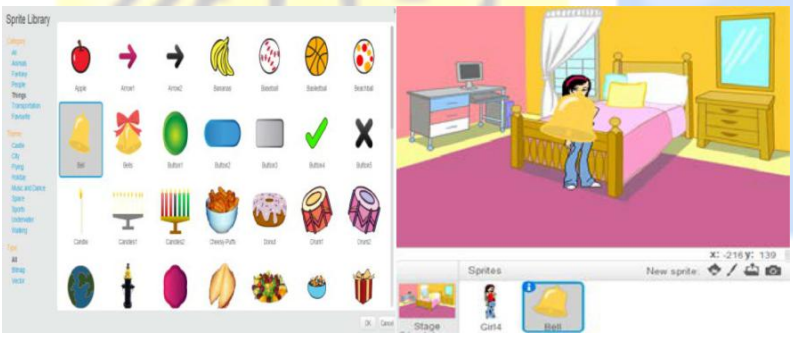
② Select [Stage backdrop]. Click [Backdrops] on the scripts and click [New backdrop-Choose backdrop from library]. Select [bedroom1] and apply.



③ Click [New sprite-Choose sprite from library] from sprite to open library. Select [People–Girl4] and apply.



④ Click [New sprite-Choose sprite from library] again and select [Things-Bell] from the library.



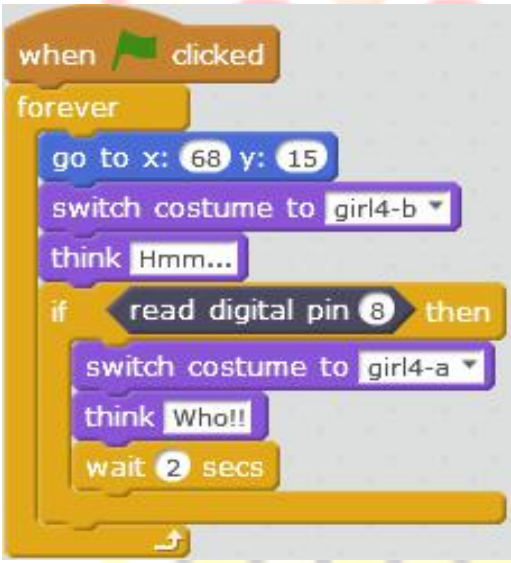
⑤ Move “Bell” and place it on left down side corner on the screen.

⑥ Click costumes tab on the right side of the scripts and change “Girl4-a” to “Girl4-b”.

Coding

Girl4 sprite 

[Algorithm] When click the flag, place “Girl-4” on the bed and apply costume to “Girl4-b”. “Girl-4” will sit and thinks “Hmm..” and when the switch is pressed (signal is received from D8), her costume changes to “Girl4-a” ,thinks “Who!” and waits for 2 sec. The process continues.

Coding	Location	Explanation
	Events	When click the flag
	Control	Endless loops
	Motion	Move to X:68, Y:15
	Looks	Change to “Girl4-b”
	Looks	Think “Hmm…”
	Control\MRTduino	When received signal from D8 (switch pressed)
	Looks	Change to “Girl4-a”
	Looks	Think “Who!!”
	Control	Waits 2 sec

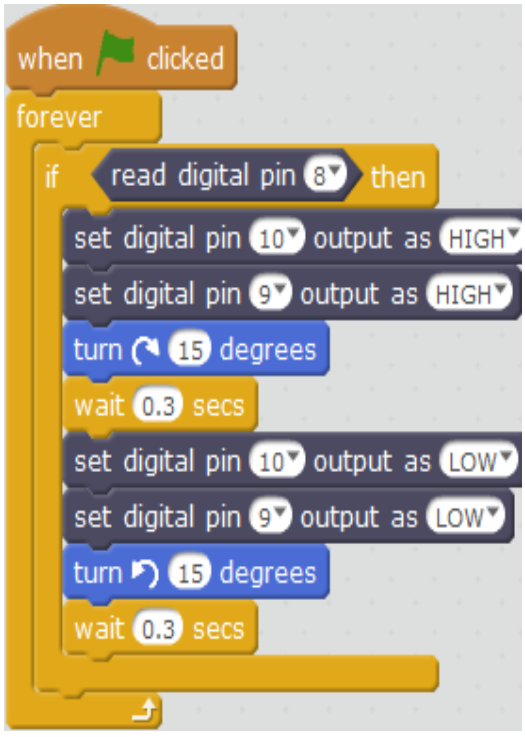
Bell sprite 

[Algorithm] When the flag is clicked and when switch is pressed (signal is received from digital pin 8), digital pin 6 and pin 9 will activate to light up LED and Buzzer will make sound. At the same time the bell will turn 15 degrees right for 0.3 sec. LED light and buzzer sound will stop because there is no signal from digital pin 6 and 9. The bell will turn 15 degree left to return to its original position.

Before switch is pressed.

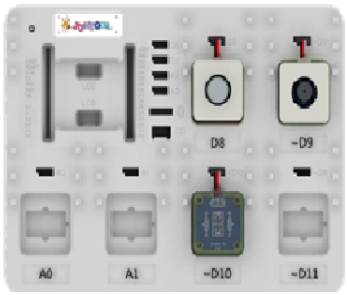
After switch is pressed 0 – 0.3 sec.

After 0.3 sec to 0.6 sec.

Coding	Location	Explanation
	Events	When click flag
	Control	Endless loops
	Control	When D8 received signal
	Control\MRTduino	D6 and D9 works
	Motion	Tilt 15 degrees to right
	Control	Wait 0.3 sec
	MRTduino	Stop send signal to pin 6 and
	MRTduino	pin 9 (off)
	Motion	Tilt 15 degrees to left
	Control	Wait 0.3 sec

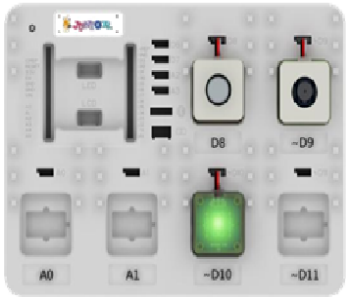
Practice

Before switch is pressed



Blacksmith board

After switch is pressed



Blacksmith board

Mission

The buzzer and LED is on if and only if the switch is pressed and not released.	

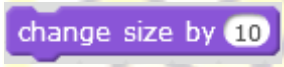
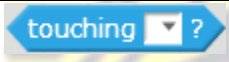
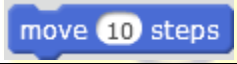
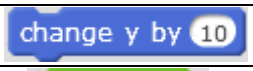
Give a present to ballerina with tilt sensor

Introduction: During the past lecture, we have practiced controlling software and hardware with input sensor “Switch”. In this lecture, we will make simple game with input sensor “Tilt sensor”. Tilt sensor cannot measure how tilt the object is. Hence, it can be only used as switch to determine whether the object is tilt or not. When tilt sensor is tilted, the dove will drop a gift from the top. If the gift touches the dancing ballerina or the floor, the buzzer will make a sound.

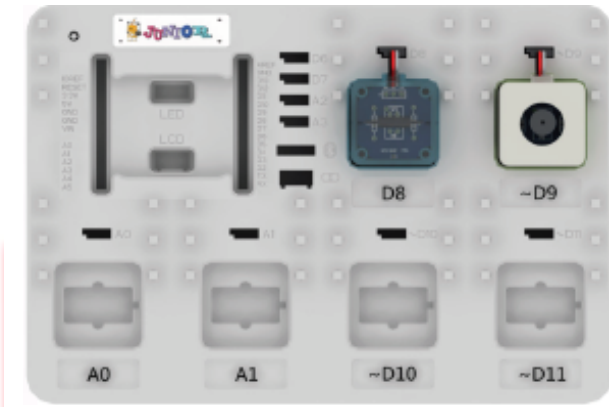
Hardware Introduction : What is tilt sensor ?

A tilt sensor is an instrument that is used for measuring the tilt in multiple axes of a reference plane. Tilt sensors measure the tilting position with reference to gravity, and are used in numerous applications. They enable the easy detection of orientation or inclination.

Learn new Scratch Block

	Changes sprite’s size by specified amount.
	Changes sprite’s costume to next costume in the costume list.
	Reports true if sprite is touching specified sprite, edge, or mouse-pointer. (Select from pull-down menu.)
	Move to the set direction 10 steps
	Bounce if sprite touches the edge of stage
	There are three options for this block: all around, left-right, and do not rotate.
	Changes sprite’s y-position by specified amount.
	Reports true if either condition is true.
	Run the blocks inside the repeat loop until the condition met.

Hardware Preparation: Connect tilt sensor to D8 and buzzer to D9.

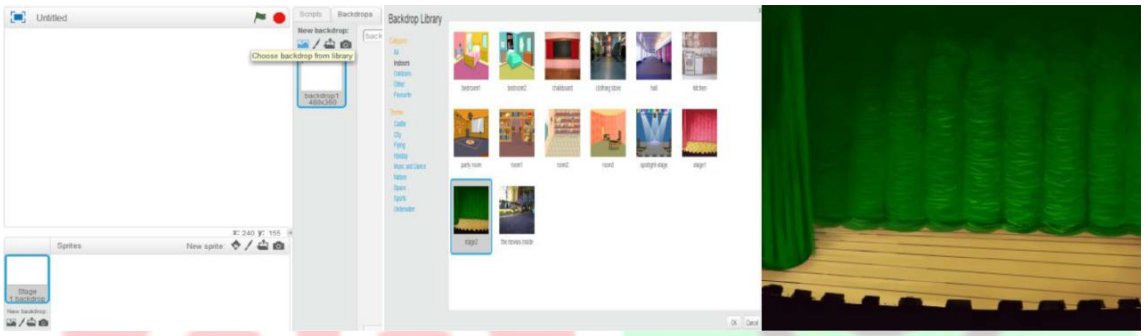


Connect Blacksmith board

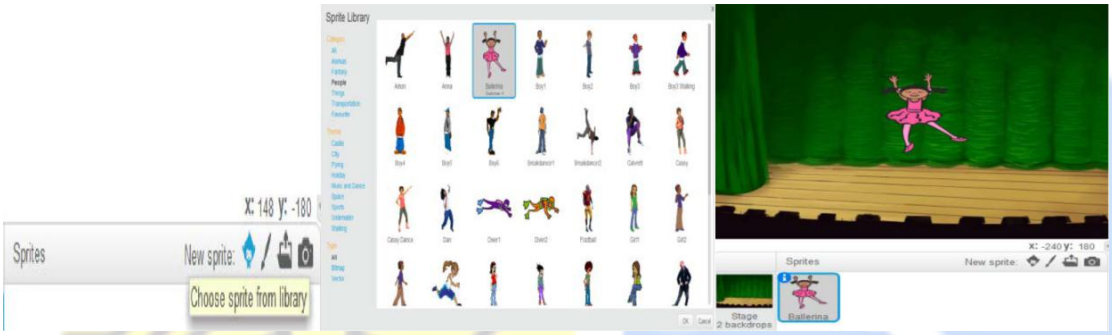
Software Preparation: Set “Indoors-stage2” as a backdrop. Select “Ballerina“, “Dove1”, “Gift” from the sprite and apply.

① Delete the robot from the sprite.

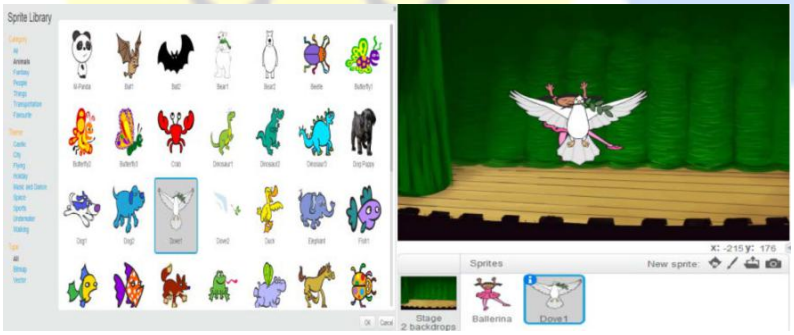
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Indoors-stage2] and apply.



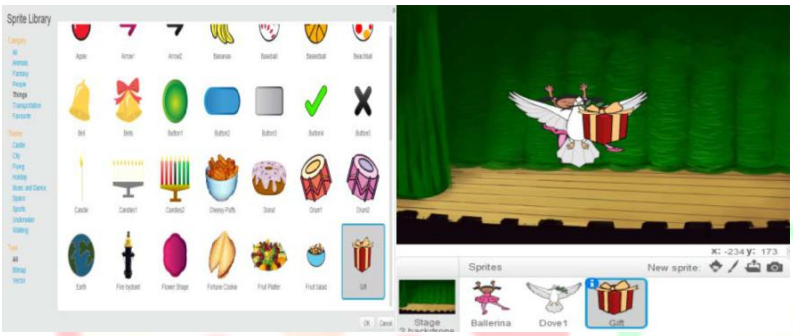
③ Click [New sprite-Choose sprite from library] from sprite to open the library. Select [People–Ballerina] and apply.



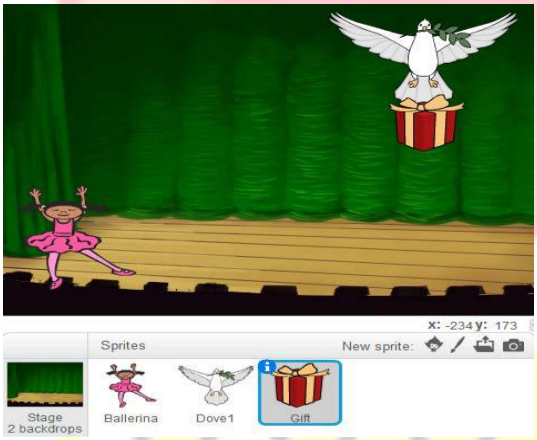
④ Click [New sprite-Choose sprite from library] again and select [Animals-Dove1] from the library and apply.



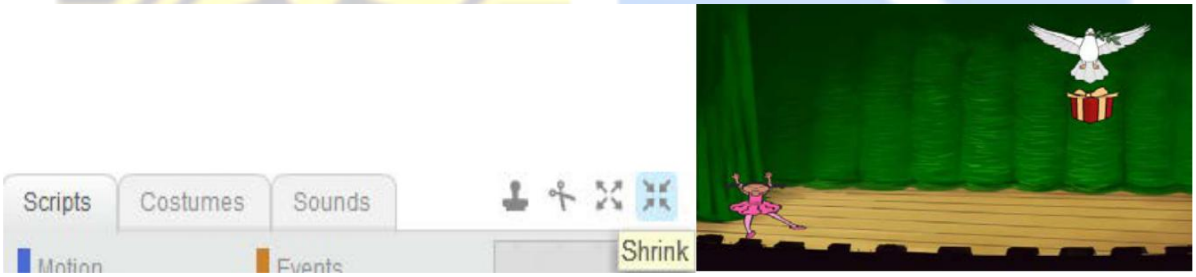
⑤ Click [New sprite-Choose sprite from library] from the sprite to open the library and select [Things-Gift] and apply.



⑥ Move “Ballerina” sprite to bottom left, “Dove 1” to top right and “Gift” to right below “Dove 1”



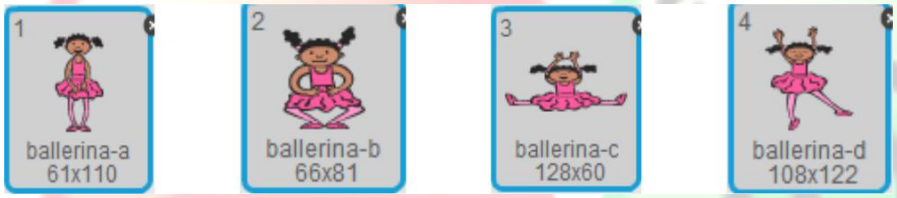
⑦ Find Shrink and de-size click “Ballerina”, “Dove1” and “Gift” by clicking as desired.



Coding

Ballerina sprite 

[Algorithm] When the flag is clicked, “Ballerina” will move 10 steps and changes her move. When she hits the edge wall, it bounces (change its direction) When “Ballerina” changes her direction, you must set rotation style to make sure that “Ballerina” changes its direction left- right, NOT up-down. If “Ballerina” is hit by “Gift” she de-sized by 20.

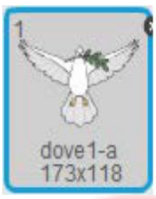


Ballerina 1 Ballerina 2 Ballerina 3 Ballerina 4

Coding	Location	Explanation
	Events	When click the flag
	Looks	Set size to 100%
	Control	Endless loops
	Motion	Move 10 steps
	Looks	Change to next costume
	Control	Wait 0.2 sec
	Motion	Bounce when on the edge
	Motion	Rotate left - right
	Control(Sensing)	When touches “Gift”,
	Looks	reduce size by 20

Dove1 Stripe 

[Algorithm] Make the Dove flies.



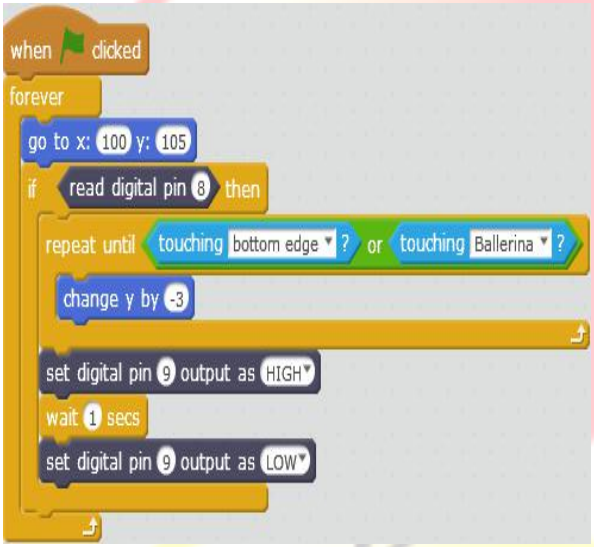
Dove 1

Dove 2

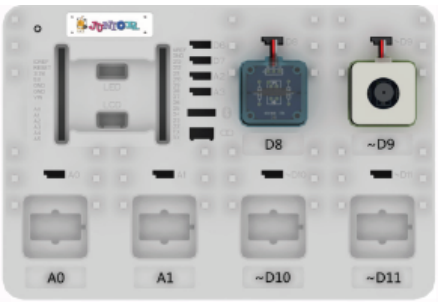
Coding	Location	Explanation
	**Events** **Motion** **Control** **Looks** **Control**	**When click the flag** **Move to X:100, Y:130** **Endless loops** **Changes to next costume** **Wait 0.3 sec**

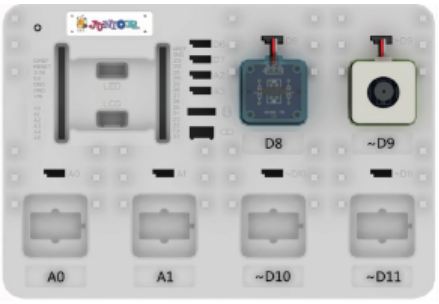
Gift Sprite 

[Algorithm] “Gift” stays in the position until when tilt sensor (pin 8) is tilted. Once tilt sensor is tilted, move by 3 until it hits the “Ballerina” or the bottom. Once it touches “Ballerina” or bottom, buzzer (pin 9) will make sounds for 1 second.

Coding	Location	Explanation
	Events Control Motion MRTduino Control/Sensing /Operation Motion MRTduino Control MRTduino	When flag is clicked Endless loops Move to X:100, Y:105 When Pin8 sends signal Repeat until it touches the bottom or “Ballerina” Move by -3 Buzzer is on Wait 1 second Buzzer is off

Practice





Mission

Make a game that the robot need avoid the enemy through tilt sensor when the enemy attack him suddenly	

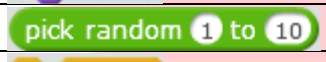
Using Touch Switch To Play Game with Butterfly

Introduction: In this lecture, we will learn how to use touch switch to make a game. Player controls a butterfly to avoid the coming bat. When the touch switch is pressed, the butterfly will move upwards. Otherwise, the butterfly will move downwards. Once the butterfly touches the edge or touches the bat, it is considered a game over for the player.

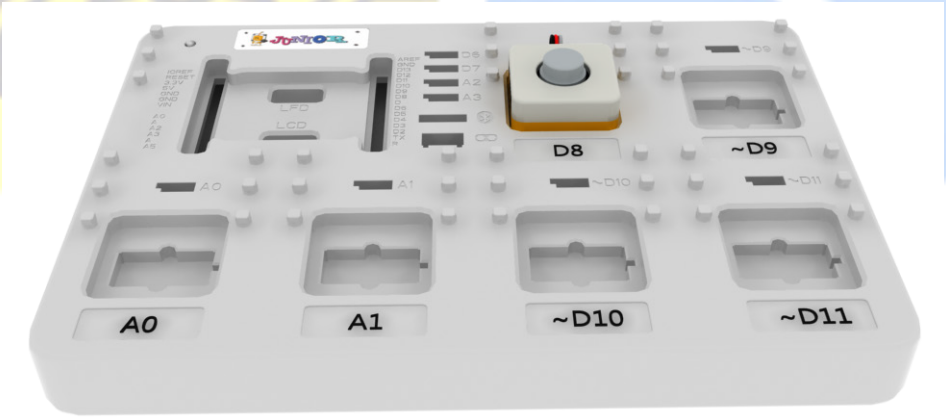
Hardware Introduction : What is Touch Switch ?

A touch switch is a type of switch that only has to be touched by an object to operate. It is used in many lamps and wall switches that have a metal exterior as well as on public computer terminals.

Learn new Scratch Blocks

	Display sprite's speech bubble.
	Picks a random integer within the specified range.
	Stop all scripts for the sprite.
	If condition is true, runs the blocks inside the **if** portion; if not, runs the blocks inside the **else** portion.

Hardware preparation: Connect touch switch to D8.

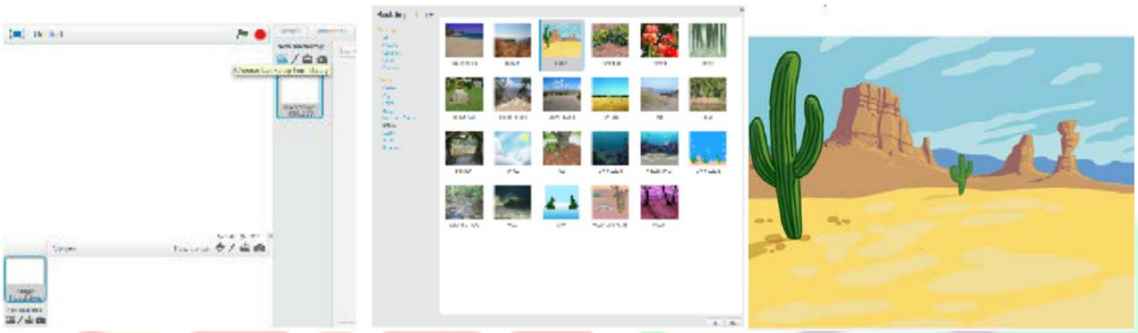


Touch Switch (D8)

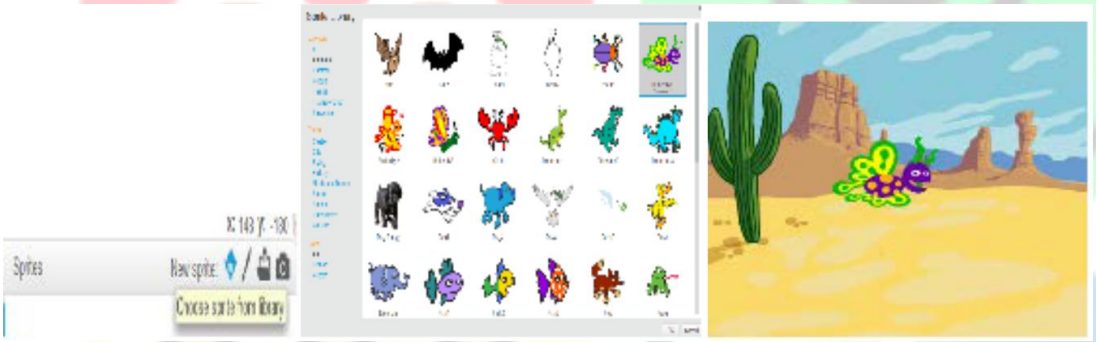
Software Preparation: Set desert as the backdrop. Select “Butterfly 1” and

① Delete the robot from the sprite.

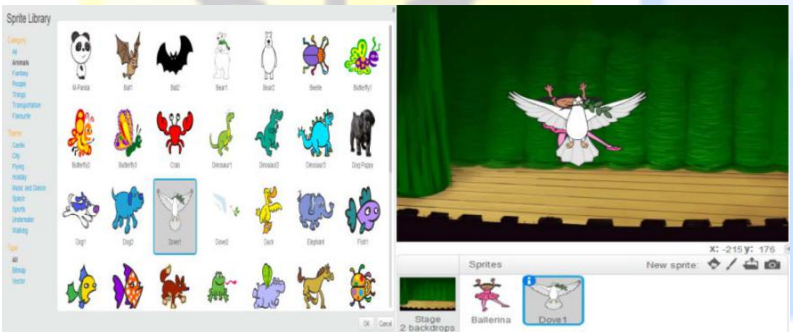
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Nature-desert] and apply. “Bat2” from the sprite and apply.



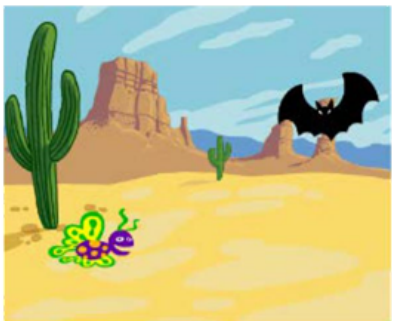
③ Click [New sprite-Choose sprite from library] from sprite to open the library. Select [Animals-Butterfly1] and apply.



④ Click [New sprite-Choose sprite from library] again and select [Animals-Bat2] from the library and apply.



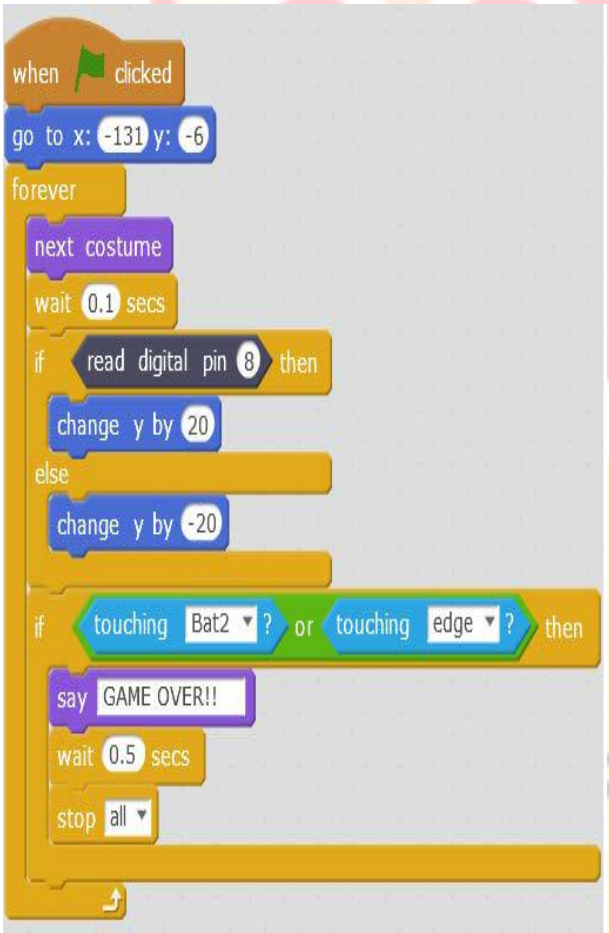
⑤ Move “Butterfly1” sprite to the bottom left and “Bat2” to the upper right corner.



Coding

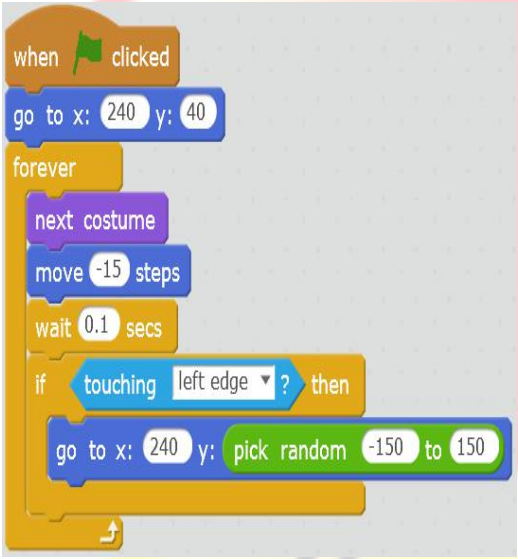
Butterfly sprite 

[Algorithm] When the flag is clicked, the butterfly start moving (switching to next costume) and continue moving downwards unless the touch switch is pressed (read digital pin 8) and it will move upwards. If the butterfly touches "Bat2" and it will say "GAME OVER!!" and stop all.

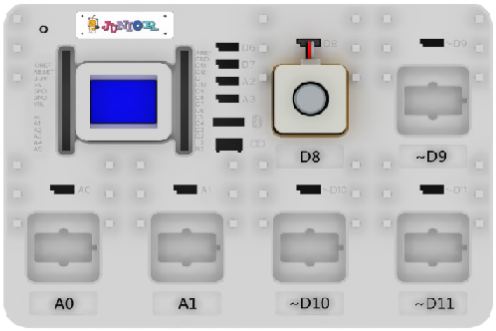
Coding	Location	Explanation
	Events	When flag is clicked
	Motion	Move to X:-131,Y:-6
	Control	Endless loops
	Looks	Switch to next costume
	Control	Waits 0.1 sec
	Control\MRTduino	When D8 sends signal
	Motion	Move along the y-axis by 20
	Control	When pin 8 does not send signal
	Motion Control\Sensing\ Operator	Move along the y-axis by 20 When touching bat 2 or edge
	Looks	Say "GAME OVER"
	Controls	Waits 0.5 sec
	Control	Stop all

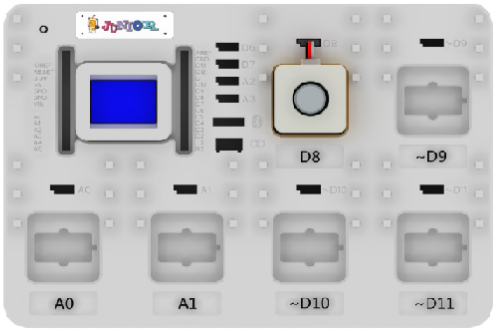
Bat2 sprite 

[Algorithm] When the flag is clicked, it moves to x: 240,y: 40. It starts moving towards butterfly (switching to next costume and move -15 steps for every 0.1 seconds). If it touches the left edge of the backdrop, it will moves to X: 240 and pick a random position at y-axis.

Coding	Location	Explanation
	Events Motion Control Looks Motion Control Control Motion\ operator	When the flag is clicked Move to X:240, Y:40 Endless loops Change to next costume Moves -15 steps Waits 0.1 sec When it touches left edge Moves to X:240 and pick random from -150 to 150 at Y

Practice





Mission

Make a program that the butterfly will make sound and change its color when touch switch is pressed.	

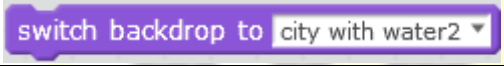
Using Cds Sensor to Make an Automated Street Light

Introduction: In this lecture, we will use Cds sensor to control LED. Cds sensor can detect light ambient and it is widely used in our life. For example, it can be used to control street light since we only need the street light during the night. The resistance of Cds sensor change according to the surrounding light ambient and it acts like the eyes of the computer. It is a good example of that how sensor helps computers to detect the change in the surrounding.

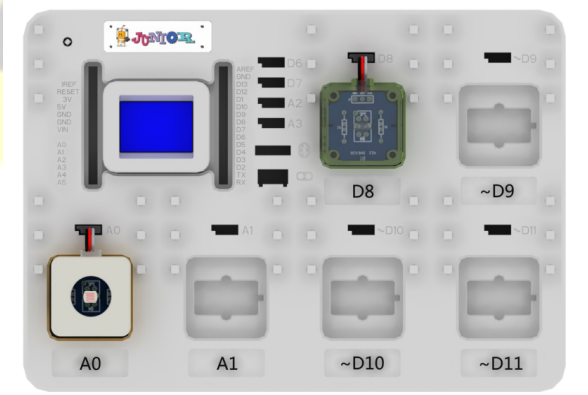
Hardware Introduction : What is CDS (Cadmium Sulfide cells) Sensor ?

It is a photo resistor a device or you can call it as photocell that changes its resistance depending on the light intensity. It's often used in street lights and as an electric eye.

Learn new Scratch Blocks

	Reports true if first value is greater than second.
	Change the backdrop to “city with water2”
	Get the reading from pin A0.

Hardware preparation: Connect LED to D8 and Cds sensor to A0.



Connect Blacksmith Board

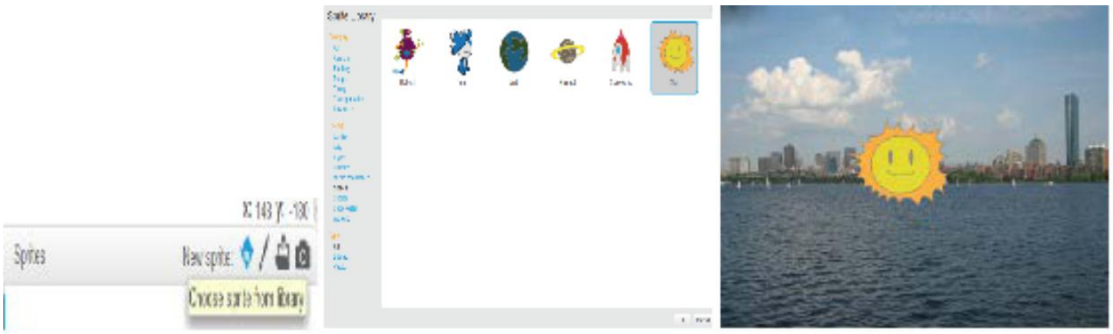
Software Preparation: Set “city with water” and “city with water 2” as the

① Delete the robot from the sprite.

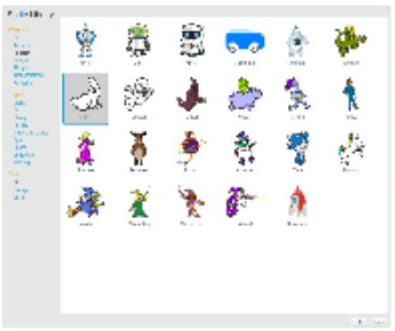
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Outdoors-city with water] and apply backdrop. Select “Ghost 1” and “Sun” from the sprite and apply.

③ Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Outdoors-city with water2] and apply.

④ Click [New sprite-Choose sprite from library] and select [Space – Sun] from the library and apply.



⑤ Click [New sprite-Choose sprite from library] again and select [Fantasy-Ghost1] from the library and apply.

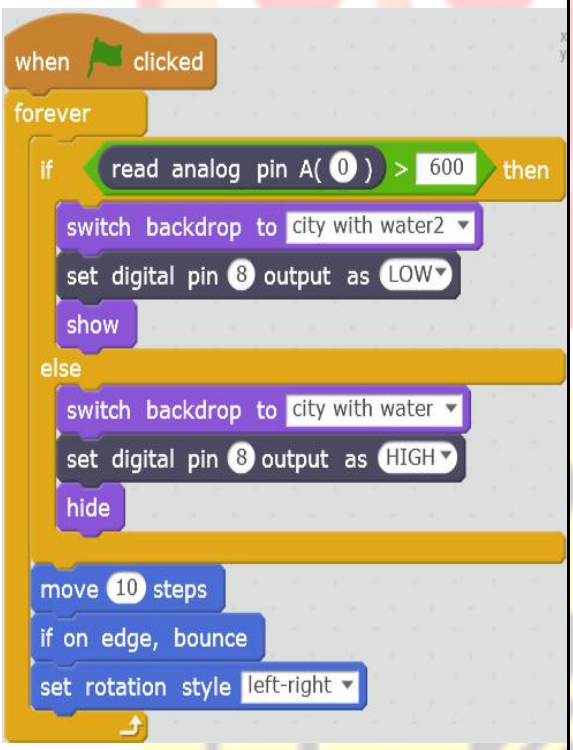


⑥ Move all the sprite to the position as shown in the figure below.

Coding

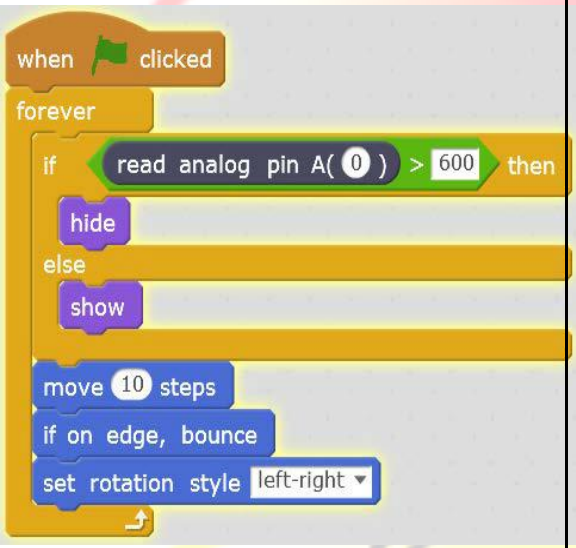
Sun sprite 

[Algorithm] When the flag is clicked, if it the condition is bright (reading of Cds greater than 600), the backdrop is switched to “city with water2”, LED is off (D8 is set as low) and the sun is shown. If the condition is dark (reading of Cds less than 600), the backdrop is switched to “city with water”, LED is on (D8 is set as high) and the sun is hidden. The sun will keep moving and rotate in left-right direction if it touches the edge.

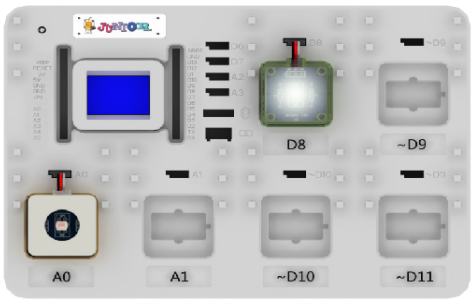
Coding	Location	Explanation
	Events	When the flags is clicked
	Control	Endless loop
	Control\operator\ MRTduino	If value of A0 greater than 600
	Looks	The backdrop is switched
	MRTduino	D8 is set as low (LED off)
	Looks	The sun is shown
	Control	If value of A0 lower than 600
	Looks	The backdrop is switched
	MRTduino	D8 is set as high (LED on)
	Looks	The sun is hidden
	Motion	The Sun moves 10 step
	Motion	Bounce if touching edge
	Motion	Rotate in left-right direction

Ghost1 sprite 

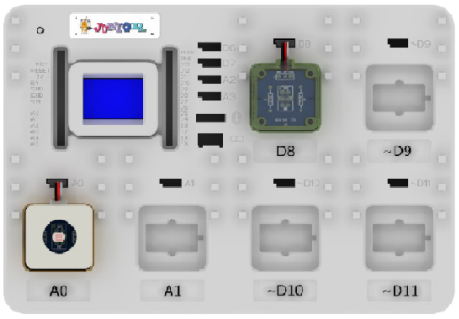
[Algorithm] If it is in bright condition (reading of Cds greater than 600), the ghost is hidden and if it is in dark condition (reading of Cds less than 600), the ghost is shown. The ghost1 will keep moving and rotate in left-right direction if it touches the edge.

Coding	Location	Explanation
	Events Control Control\Operator\MRTduino Looks Control Looks Motion Motion Motion	When the flags is clicked Endless loop If value of A0 greater than 600 The ghost is hidden If value of A0 lower than 600 The ghost is shown The ghost moves 10 step Bounce if touching edge Rotate in left-right direction

Practice

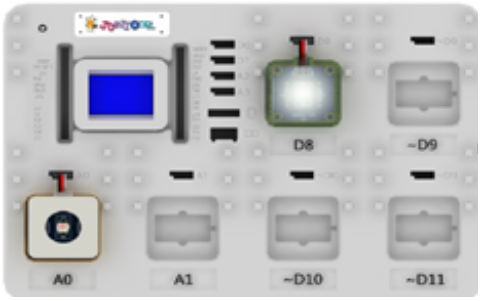


When Cds is in light condition



When Cds is in dark condition

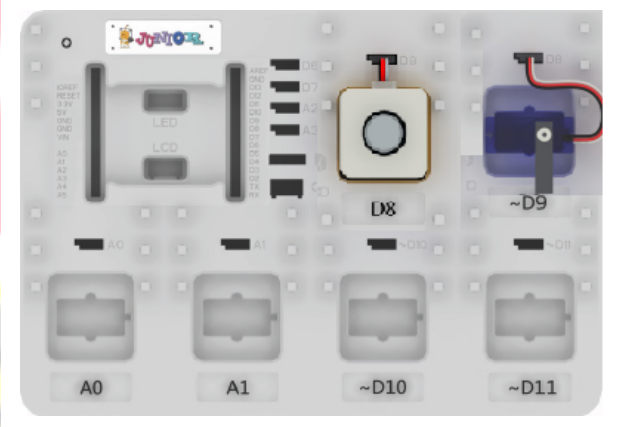
Mission

Do a program that the intensity of LED changes according to the surrounding light intensity.	

Getting to know about variable

Introduction: In programming, a variable is a placeholder for some value, much like x and y are the popular variables in algebra. In Scratch, variables are represented by elongated circle block and it is uniquely labeled by user. Variables can be local or global. In Scratch, a local variable can be used by just one sprite and a global variable can be used by all of the sprites. In this lecture we will use variable to control a servo motor.

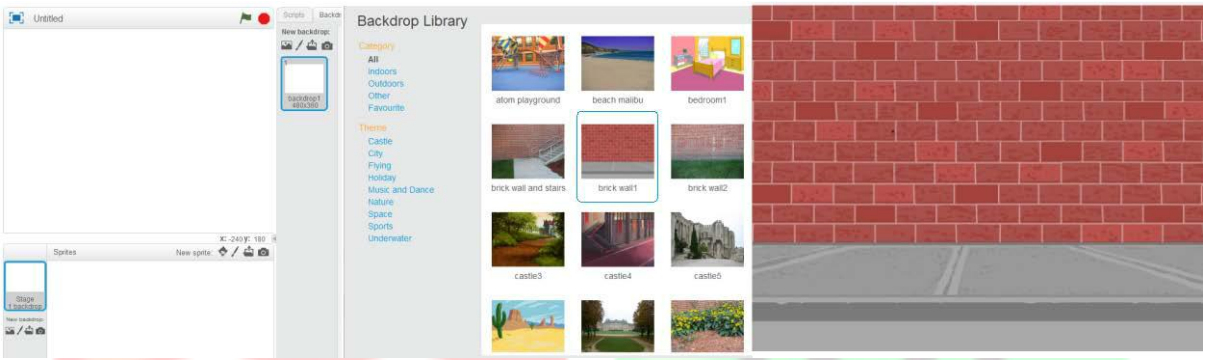
H/W Preparation: Connect touch switch and servo to D8 and D9.



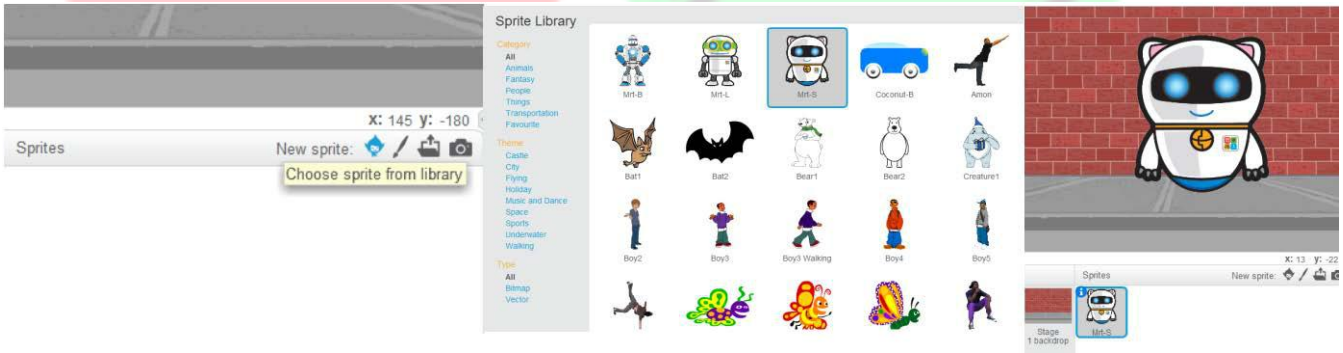
S/W Preparation: Set “Brick Wall 1” as the backdrop and place “Mrt-S” and “Arrow 2”.

① Delete the robot in the original sprite.

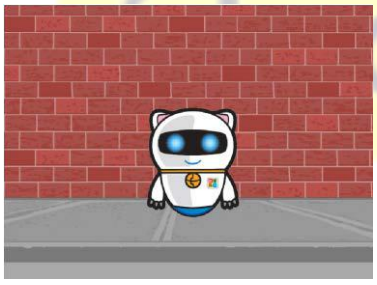
② Select [Stage backdrop]. Select [Backdrops] on the right side of Scripts and click [New backdrop-Choose backdrop from library].Select [Brick Wall 1] and apply.



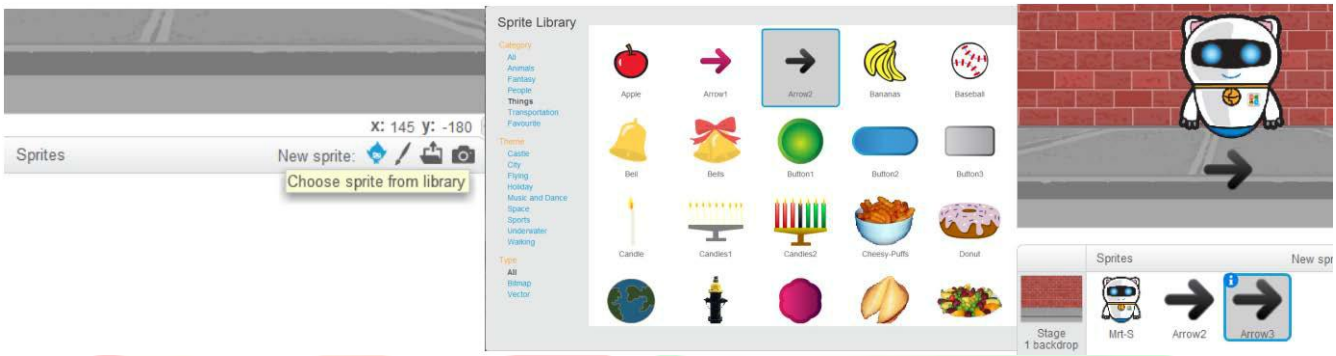
③ Click [New sprite-Choose sprite from library] from sprite to open library. Select [Mrt-S] and apply.



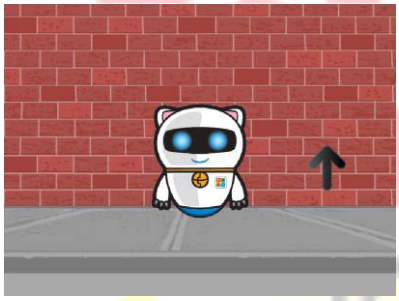
④ Move “Mrt-S” and place it on the middle on the screen.



⑤ Click [New sprite-Choose sprite from library] from sprite to open library. Select [Arrow 2] and apply.



⑥ Move arrow to the left of [Mrt-S] and make sure the arrow point in upward directions.



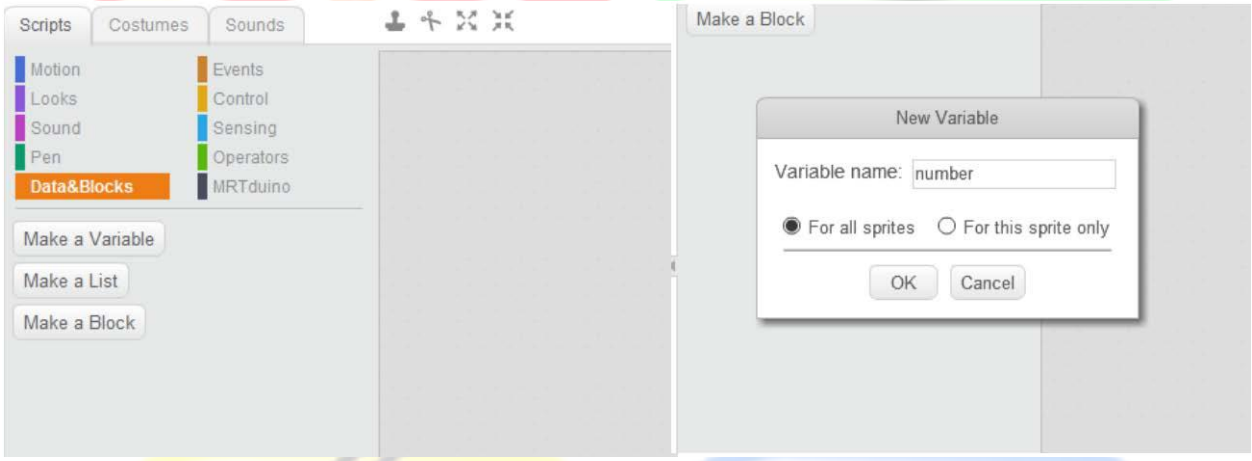
Coding

Mrt-S Sprite 

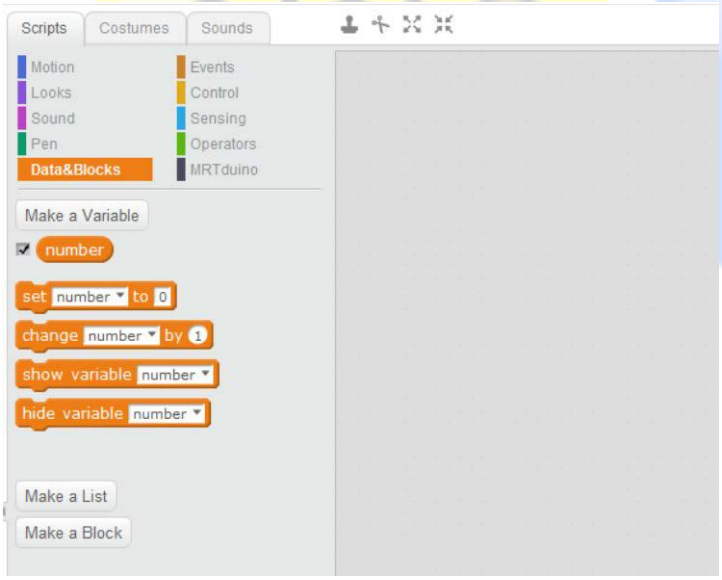
[Algorithm] When the flag is clicked, [Mrt-S] will count the number from 0. The number will increase by 1 if the touch sensor (pin 8) is pressed.

How to make a variable

① Click [Script]. Select [Data&Blocks] and select [Make a Variable].



② The variable can be anything that you like. Here we take the variable name as “number” for easier understanding.



③ While using variable for counting, there are two things that we need to do

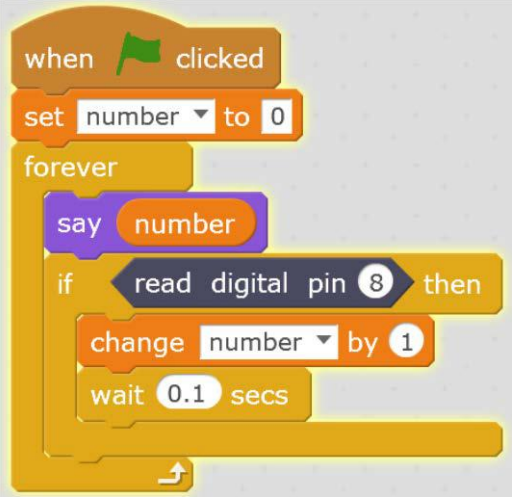
I) **Initialization** – Initialize the value to the assigned value
II) **Increment** – Increase the value when certain conditions are met

Initialization

Initialize the value of number to 0 (number = 0)

Increment

Increase the value of number by 1 (number = number+1)

Coding	Location	Explanation
	Events	When flag is clicked
	Data & Block	Initialize variable "number" to 0
	Control	Endless Loop
	Looks	Say the current value of "number"
	Mrtduino	If D8 received signals
	Data & Block	Increase the value of "number" by 1
	Control	Wait 0.1 sec

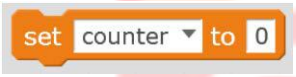
Arrow 2 

[Algorithm] When the flag is clicked, the arrow will start spinning slowly according to the change of the variable "counter". The servo will start spinning in the direction of the arrow until the value of "counter" is greater than 90.

This kind of programming is known as **counter-controlled loop**. There are three essential elements in counter-controlled loop.

I) Initialization- Initialize the value to the assigned value
II) Condition- Condition to terminate the loop
III) Increment- Increase the value when certain conditions are met

Initialization

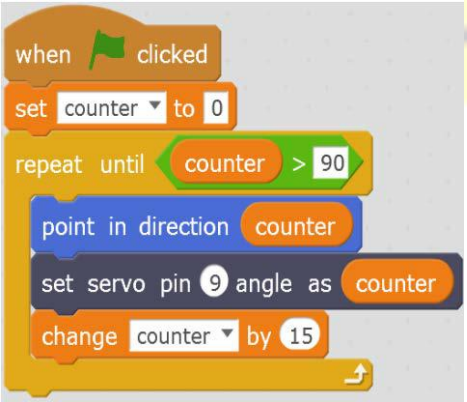


Initialize the value of variable "counter" to 0 (counter = 0)

Condition

The loop will continue until the value of variable "counter" greater than 90. **Increment**

Increase the value of counter by 15. (counter = counter +15)

Coding	Location	Explanation
	**Events**	**When flag is clicked**
	Data & Block	**Initialize variable "counter" to 0**
	Control\Operators	**Conditional loop**
	Motion	**Point in the direction of "counter"**
	Mrtduino	**Servo point in direction of "counter"**
	Data & Block	**Increase the value of "counter" by 1**

To understand the counter-controlled loop better, we can use a counter-loop table to get a clear picture of the logic of the programming.

counter	counter>90	Arrow 2 direction	Servo direction	counter=counter+15
0	False	0	0	15
15	False	15	15	30
30	False	30	30	45
45	False	45	45	60
60	False	60	60	75
75	False	75	75	90
90	False	90	90	105
105	True		Loop Terminate	

Mission

Try to make the “Arrow 2” and servo to rotate in anticlockwise direction with the aid of counter-loop table below.

counter	counter<0	Arrow 2 direction	Servo direction	counter=counter-15

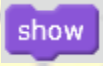
Using Magnetic Sensor to Launch a Rocket

Introduction: During the past lecture, we have learned using touch switch to control a butterfly. In this lecture, we will learn how to use a magnetic sensor (Reed) to launch a rocket to the sun or the beach ball. When the magnet is near to the magnetic sensor (Reed), the rocket will move upward until it hits the sun, beach ball, or the top of the backdrop. When there is no magnet around the magnetic sensor, the rocket will remain at the ground and find a suitable position.

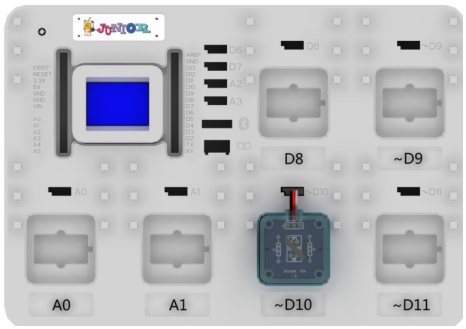
Hardware Introduction : What is Magnetic sensor ?

Magnet sensor works as a switch based on the presence or absence of a magnet field. When there is magnet present, it means ON else OFF.

Learn new Scratch Blocks

	Reports sprite's y-position. (Ranges from -180 to 180)
	Reports true if condition is false; reports false if condition is true.
	Reports true if first value is less than second.
	Makes sprite disappear from the Stage.
	Makes sprite appear on the Stage.

Hardware preparation: Connect magnetic sensor to D10.

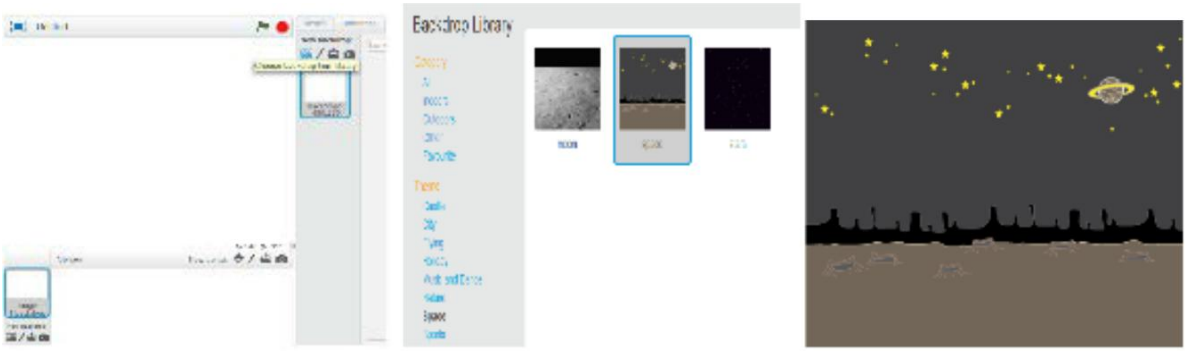


Connect Blacksmith Board

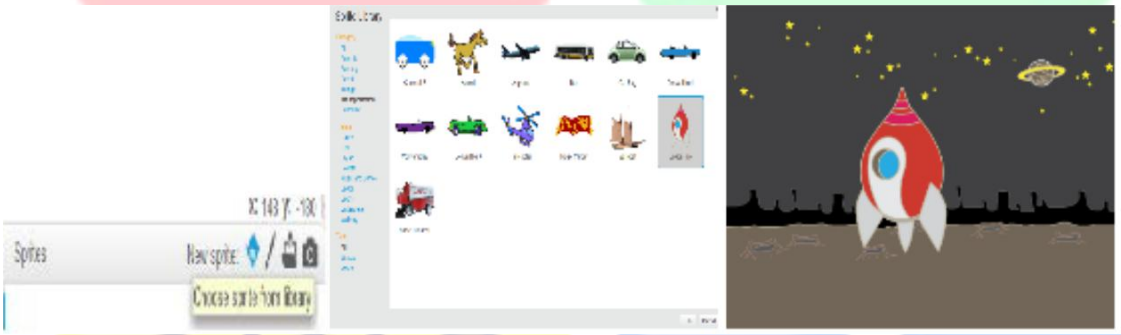
Software Preparation: Set “Space as the backdrop. Select “Spaceship”,

① Delete the robot from the sprite.

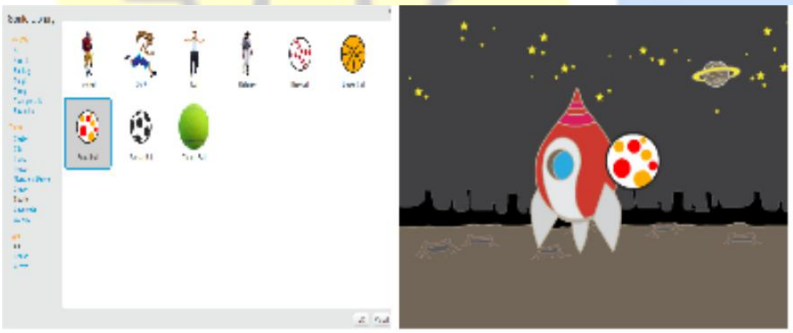
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Space-space] and apply. “Beachball” and “Sun” from the sprite and apply.



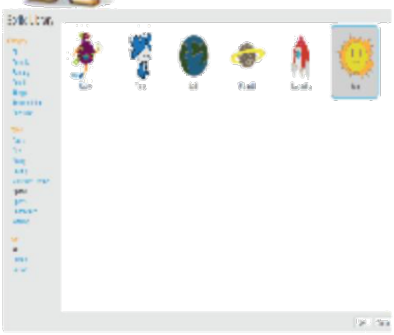
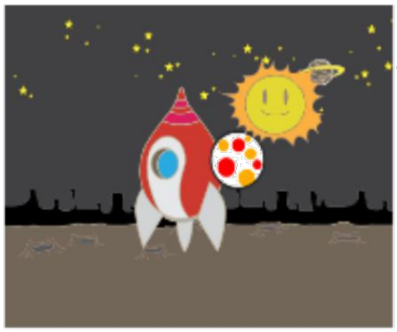
③ Click [New sprite-Choose sprite from library] from sprite to open the library. Select [Transportation – Spaceship] and apply.



④ Click [New sprite-Choose sprite from library] again and select [Space-Beachball] from the library and apply.



⑤ Click [New sprite-Choose sprite from library] again and select [Sports-Sun] from the library and apply.

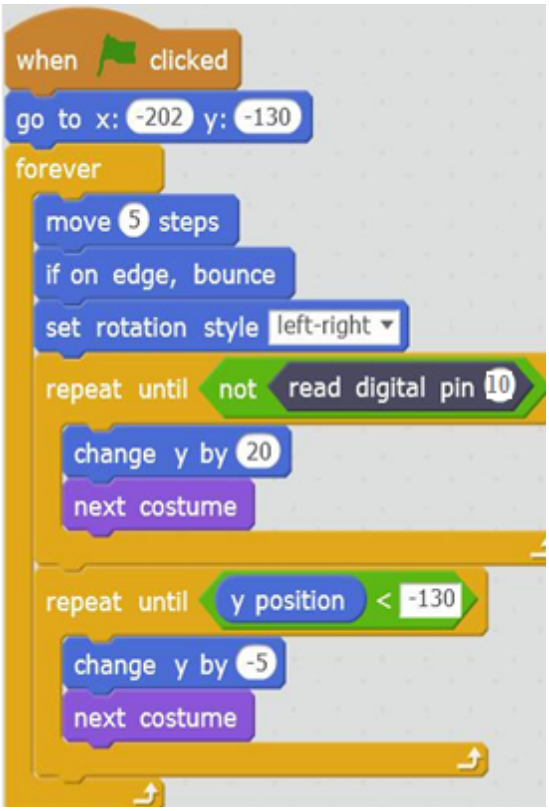



⑥ Move “Beachball” sprite and “Sun” sprite to 130 position at y-axis. Move “Spaceship” to -130 position at y-axis. Pick a random position at x-axis for all sprites.

Coding

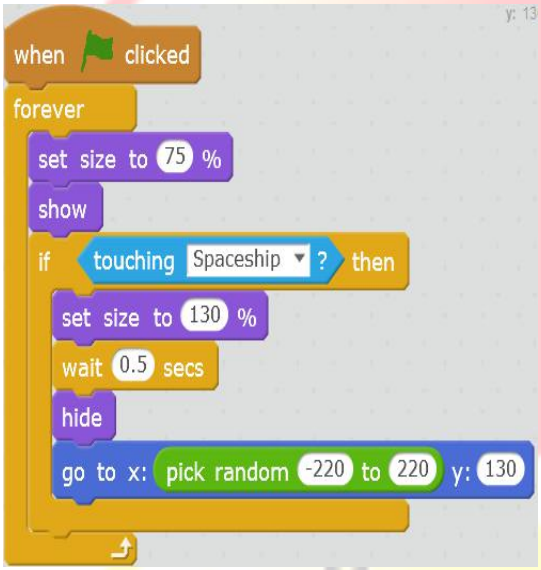
Spaceship sprite 

[Algorithm]When the flag is clicked, “Spaceship” will move to x: 202, y: -130. “Spaceship” will move at the bottom of the backdrop and if it touches the edges, it will bounce in left-right direction. When the magnet is near to the Reed (D10 send signal), the rocket will start moving upwards. When the magnet is removed, the rocket will start moving downwards.

Coding	Location	Explanation
	Events Motion Control Motion Motion Motion Control\Operator\MRTduino Motion Looks Motion Motion Looks	When flag is clicked Move to X:-202,Y:--130 Endless loops Moves 5 step Bounce if touches the edge Bounce in left-right direction Repeat until D10 does not send signal Moves along y-axis by 20 Change to next costume Repeat until y<-130 Moves along y-axis by-5 Change to next costumes

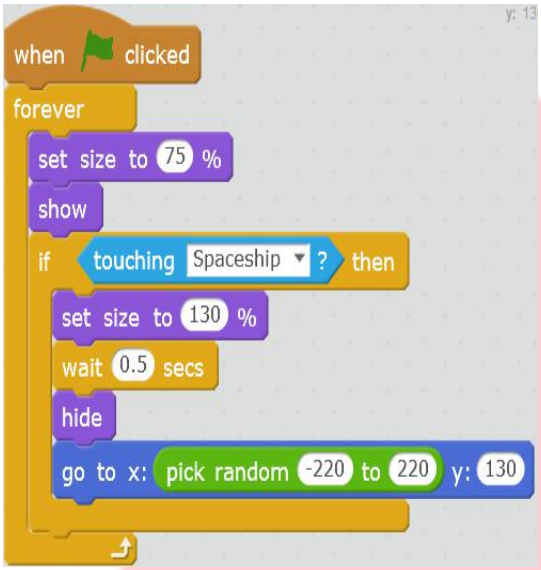
Beach ball sprite 

[Algorithm] When the flag is clicked, “Beach ball” is set to its 75% of its original size. When the “Spaceship” touches the “Beach ball”, it is set to its 130% of its original size. After 0.5sec, it will hide and the pick a random position at x-axis. The loop repeats forever.

Coding	Location	Explanation
	Events	When the flag is clicked
	Control	Endless loops
	Looks	Set sprite size to 75%
	Looks	Show the sprite
	Control\Sensing	When sprite touches spaceship
	Looks	Set sprite size to 130%
	Control	Waits 0.5 sec
	Looks	Hide the sprite
	Operator	Moves to y:130 and pick random position at x-axis

Sun sprite 

[Algorithm] “Sun” runs the same program as the “Beach ball”.

Coding	Location	Explanation
	Events	When the flag is clicked
	Control	Endless loops
	Looks	Set sprite size to 75%
	Looks	Show the sprite
	Control\Sensing	When sprite touches spaceship
	Looks	Set sprite size to 130%
	Control	Waits 0.5 sec
	Looks	Hide the sprite
	Operator	Moves to y:130 and pick random position at x-axis

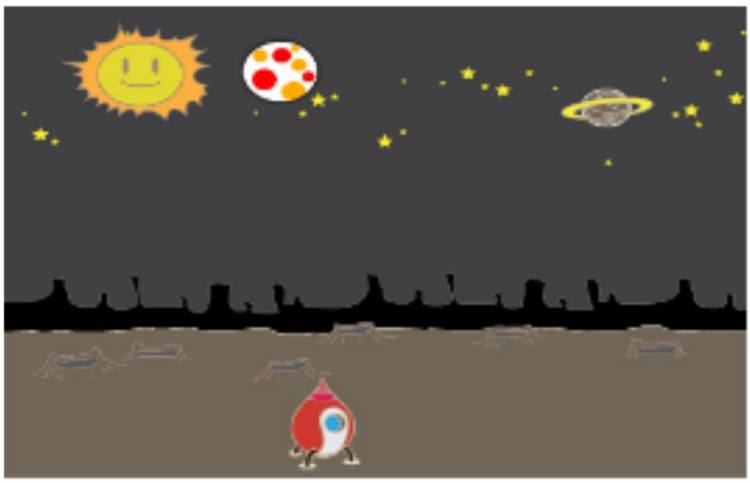
Practice

When there is no magnet

When there is magnet near Sensor

When spaceship touches “Sun” or “Beachball”

Mission

Use the concept of variable to count the times of spaceship touching sun and beach ball.	

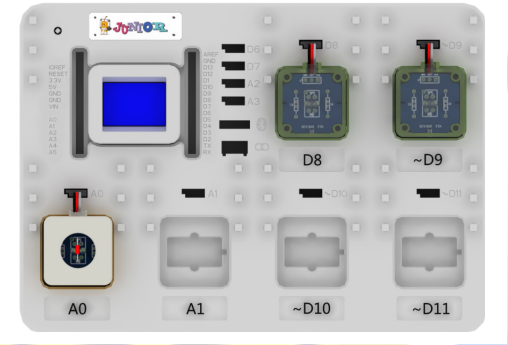
Using NTCT Sensor to determine Hot or Cold

Introduction: During the past lecture, we have learned how to use Cds sensor to detect light ambient. There are many sensors that can detect change in the surrounding. One of those sensors is NTCT sensor. NTCT sensor can detect surrounding temperature. There are many uses of NTCT sensor in real life. In this lecture, we will learn how to use NTCT sensor to write a program that can determine whether the weather is hot or cold.

Hardware Introduction : What is NTCT sensor ?

NTC is an acronym for Negative Temperature Coefficient. An NTC thermistor is a temperature sensor that uses the resistance properties of ceramic/metal composites to measure the temperature.

Hardware preparation: Connect LED-Y to D8, LED-B to D9 and NTCT sensor to A0.

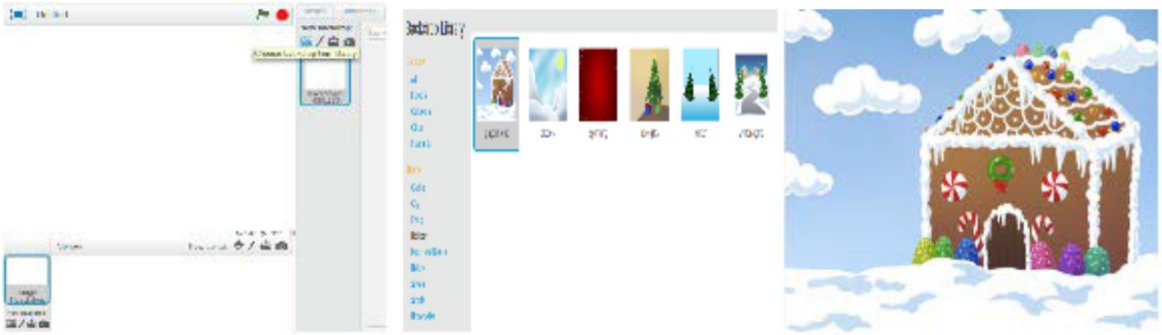


Connect Blacksmith Board

Software Preparation: Set “Gingerbread” and “desert” as the backdrop. Select

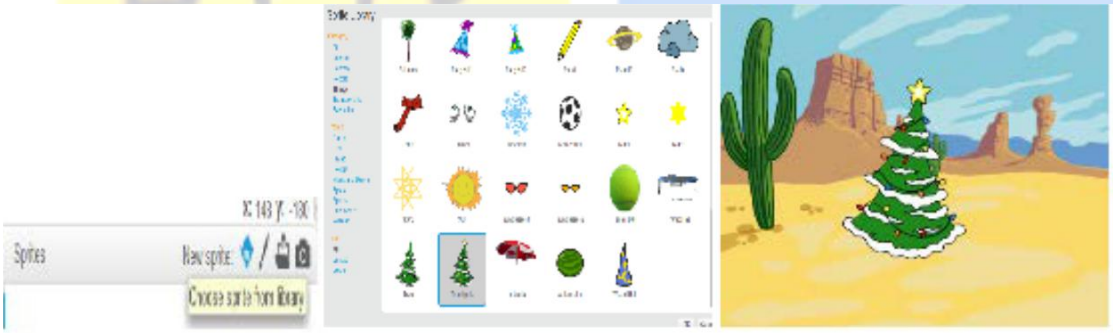
① Delete the robot from the sprite.

② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Holiday-gingerbread] and apply. “Tree-lights” and “Lion” from the sprite and apply.

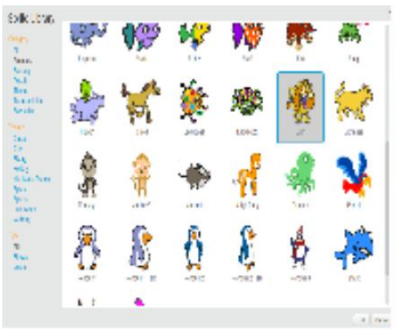


③ Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Nature–desert] and apply.

④ Click [New sprite-Choose sprite from library] and select [Things-Tree-lights] from the library and apply.



⑤ Click [New sprite-Choose sprite from library] again and select [Animals-Lion] from the library and apply.

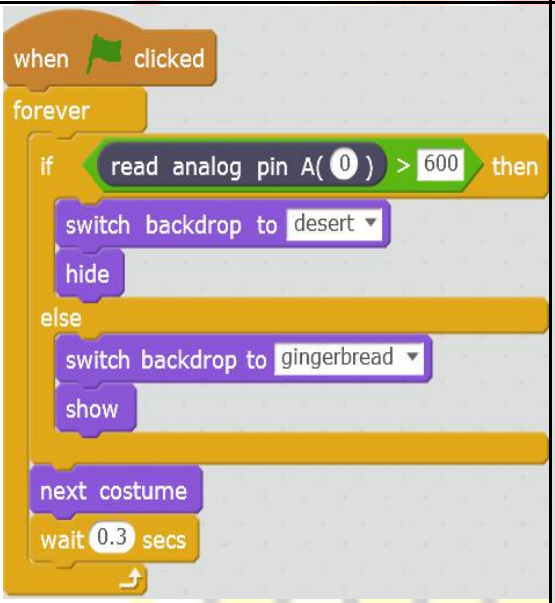



⑥ Move all the sprite to the position as shown in the figure below.


Coding

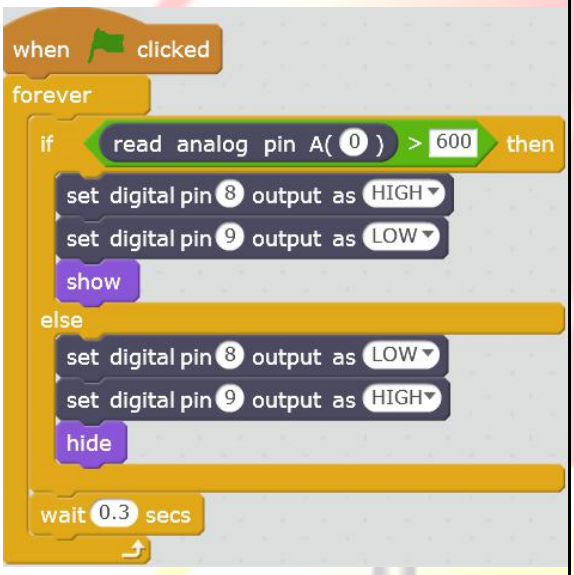
Tree-lights sprite 

[Algorithm] When the flag is clicked, if it is hot (value of NTCT>600), the backdrop is switched to desert and the "Tree-lights" is hidden. If it is cold (value of NTCT<600), the backdrop is switched to gingerbread and the "Tree-lights" is shown. It will change to next costumes for every 0.3 sec

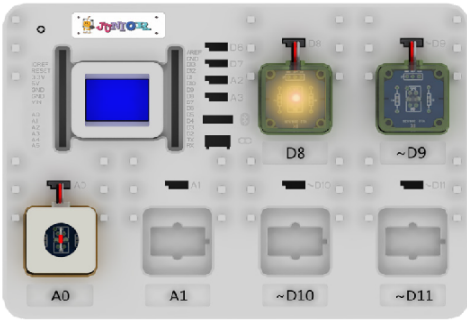
Coding	Location	Explanation
	Events Control Control\Operator\MRTduino Looks Looks Control Looks Looks Looks Control	When the flags is clicked Endless loop If value of A0 greater than 600 The backdrop is switched "Tree-lights" is hidden. If value of A0 lower than 600 The backdrop is switched. "Tree-lights" is shown. Switched to next costume Waits for 0.3 sec

Lion sprite 

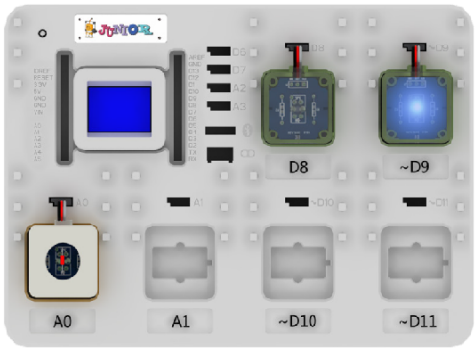
[Algorithm] When the flag is clicked, if it is hot (value of NTCT>600), LED-Y is on and LED-B is off (D8 is on and D9 is off). The lion is shown. If it is cold (value of NTCT<600), LED-Y is off and LED-B is on (D8 is on and D9 is off). The lion is hidden. The costume is switched for every 0.3 sec

Coding	Location	Explanation
	Events Control Control\Operator \MRTduino MRTduino MRTduino Looks MRTduino MRTduino Looks Control	When the flags is clicked Endless loop If value of A0 greater than 600 Set D8 as high (LED-Y is on) Set D9 as low (LED-B is off) The lion is shown Set D8 as low (LED-Y is off) Set D9 as high(LED-B is on) The lion is hidden. Waits for 0.3 sec

Practice

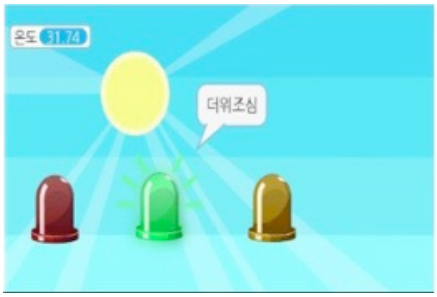


When it is hot



When it is cold

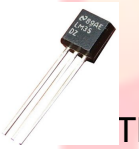
Mission

Use LED and buzzer to make a device that will give you a warning if the temperature is too high.	

Using LM35 to Play a Game with Butterfly

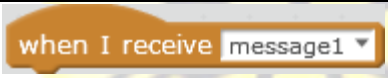
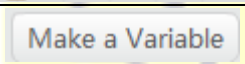
Introduction: LM35 is a thermistor with higher accuracy. Unlike the NTCT which can only determine the relative hot and cold, the voltage of LM35 will increase by 10mV with the rise of 1 degree Celsius of surrounding temperature. Hence, the voltage difference can be changed into a value when LM35 is connected to analog pin. LM35 is capable of measuring temperature ranged between 0-150 degree Celsius.

Hardware Introduction : What is LM35 sensor ?

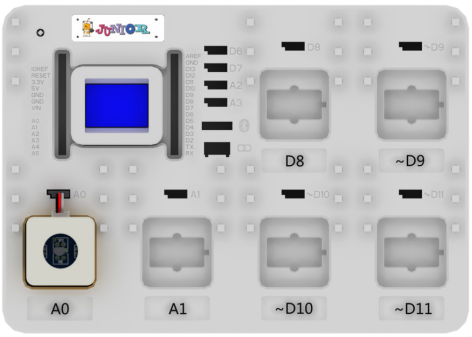


The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

Learn new Scratch Block

	Multiplies two numbers.
	Divides first number by second number.
	Create a copy of current sprite
	Run the scripts attached below if received “message 1”
	Broadcast the “message 1” to all sprite
	Click to create and name a variable. When you create a variable for the first time, the variable blocks will appear. You choose whether the variable is for all sprites (global) or just for one sprite (local).
	Sets the variable to specified value.
	Changes the variable by specified amount.

Hardware preparation: Connect LM35 to A0.

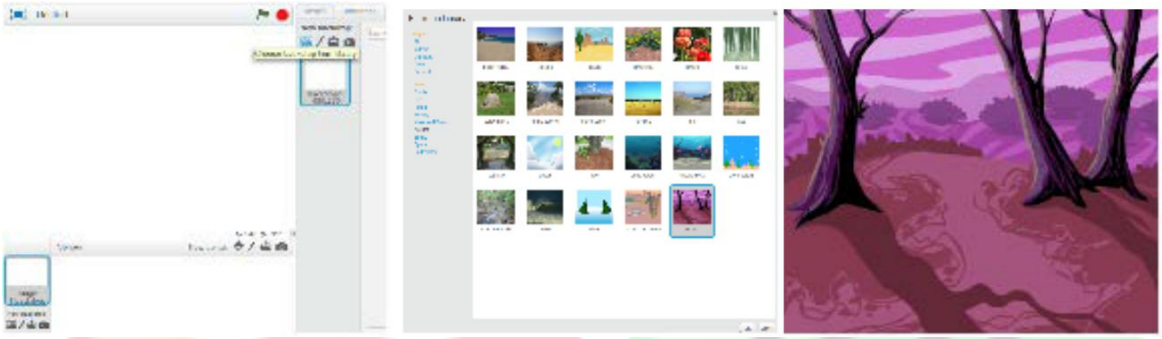


Connect Blacksmith Board

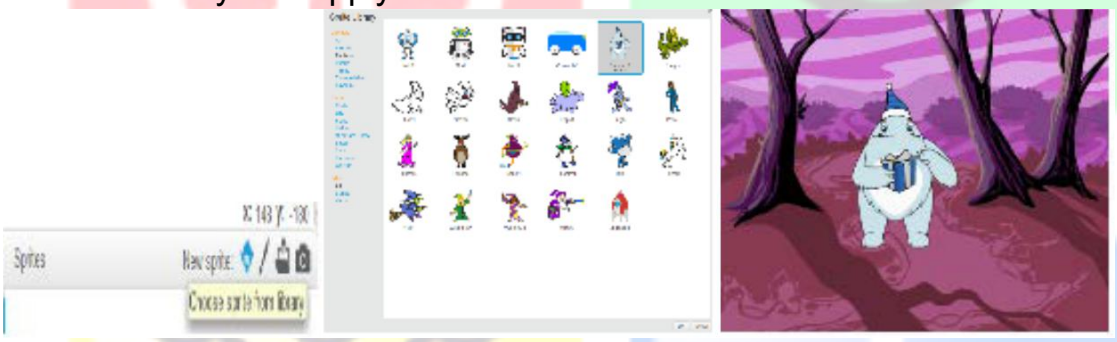
Software Preparation: Set “Woods” as the backdrop. Select “Creature 1” and

① Delete the robot from the sprite.

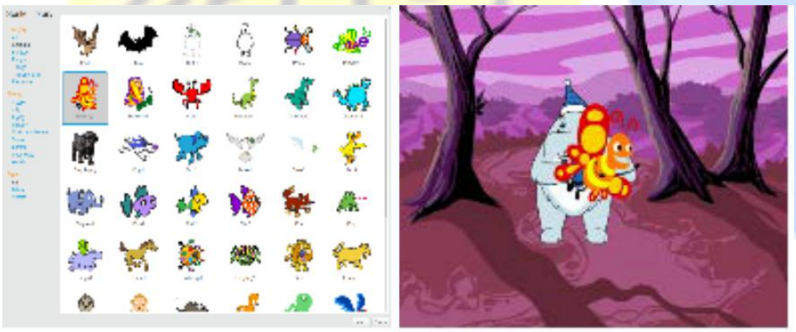
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Nature-woods] and apply. “Butterfly 2” from the sprite and apply.



③ Click [New sprite-Choose sprite from library] and select [Fantasy-Creature1] from the library and apply.



④Click [New sprite-Choose sprite from library] again and select [Animals-Lion] from the library and apply.

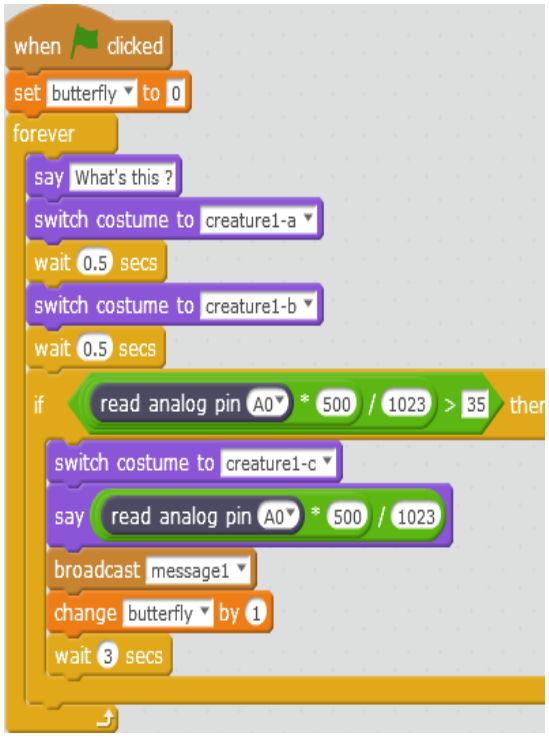


⑤ The position of the sprite will be determined by the program.

Coding

Creature 1 sprite 

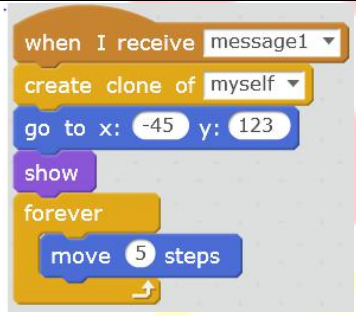
[Algorithm] When the flag is clicked, the variable “butterfly” is set to 0. It will says “What’s this?” and switch costume to “creature1-a” for 0.5 second .After that, it will switched costume to “creature1-b” for 0.5 second. If the surrounding temperature is greater than 35 degree Celsius, it will switch costume to “creature 1-c” and says the surrounding temperature. It will broadcast message 1, increase the variable “butterfly” by 1 for 3 seconds

Coding	Location	Explanation
	Events Data & Blocks Control Looks Looks Control Looks Control MRTduino Looks MRTduino Events Data&Blocks Control	When the flags is clicked Initialize the variable. Endless loop Says “What’s this?” The costume is switched. Waits 0.5 seconds The costume is switched. Waits 0.5 seconds Determine the surrounding temperature for the value returned The costume is switched. Says the surrounding temperature Sends out message 1 Increase the variable by 1 Waits 3 seconds

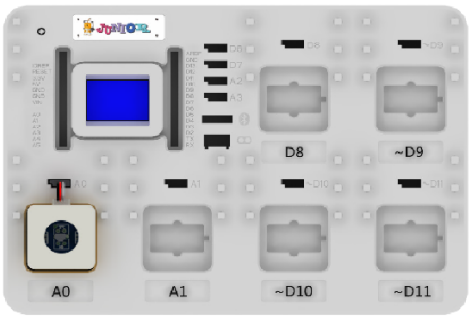
Butterfly sprite 

[Algorithm] When the flag is clicked, it will be hidden. When it receives message 1, it will create a clone, go to position of x: -45, y: 123 and be shown. It will move 5 steps continuously.

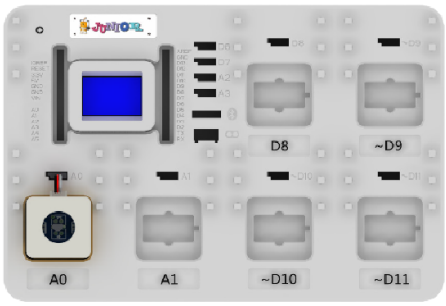
Coding	Location	Explanation
	Events Control	When the flags is clicked Butterfly is hidden

Coding	Location	Explanation
	Events Control Motion Looks Control Looks	When it receives message 1 The butterfly is duplicated Go to x:-45 y:123 The butterfly is shown. Endless Loop Moves 5 steps to right.

Practice

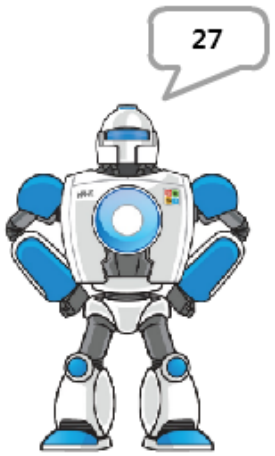


When temperature is less than 35 degree Celsius



When temperature is less than 35 degree Celsius

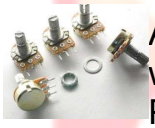
Mission

Find the hottest place in your classroom or your room.	

Using Potentiometer to Control Penguin

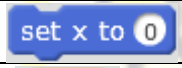
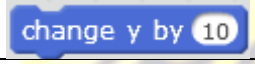
Introduction: In this lecture, we will learn how to use a potentiometer to control a sprite. Potentiometer is a type of variable resistor which we can use it to regulate the voltage of the Blacksmith Junior Board. The change of the voltage can be simulated to 0-1023 unitless value in MRTScratch. Hence, we will use the change of the potentiometer value to control the penguin's x-axis position through some calculation of the potentiometer value.

Hardware Introduction : What is potentiometer ?

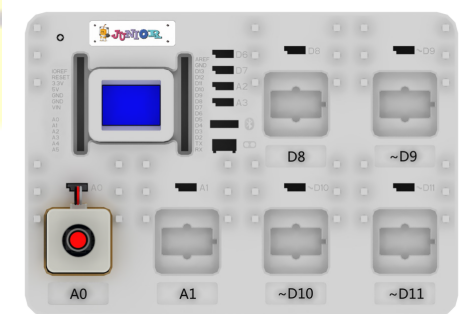


A potentiometer is a simple knob that provides a variable resistance, which we can read an analog value from 0 -1023 unitless. Potentiometers are used to control volume in audio equipment, frequency attenuation, changing loudness, and changing other characteristics of audio signals. Potentiometers are used to control volume in audio equipment, frequency attenuation, changing loudness, and changing other characteristics of audio signals.

Learn new Scratch Block

	Subtract second number from first number.
	Sets sprite's x-position to specified value.
	Variable "Score"
	Changes sprite's y-position by specified amount.

Hardware preparation: Connect potentiometer to A0.

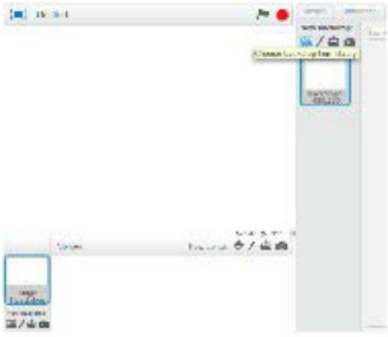
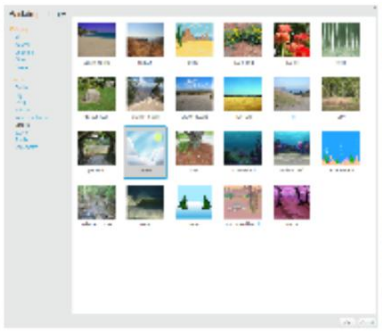


Connect Blacksmith Board

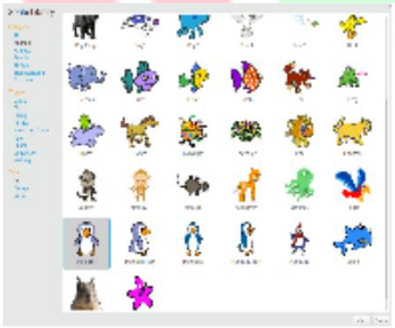
Software Preparation: Set “Slopes” as the backdrop. Select “Tree-lights” and

① Delete the robot from the sprite.

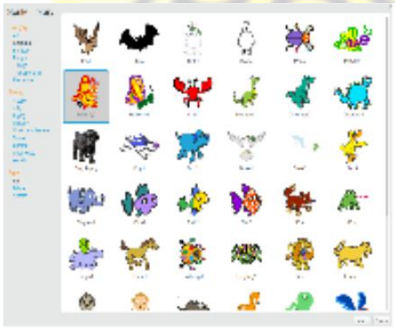
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Nature-slopes] and apply. “Lion” from the sprite and apply.

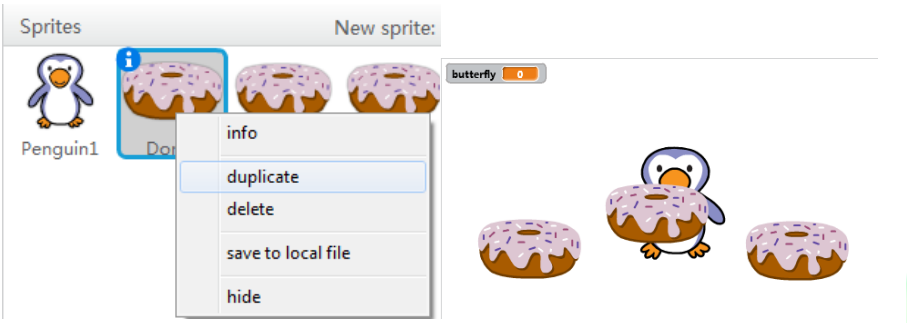

③ Click [New sprite-Choose sprite from library] and select [Animals–Penguin1] from the library and apply.




④ Click [New sprite-Choose sprite from library] and select [Things-Donut] from the library and apply.




⑤Right click and duplicate two donuts.



⑥Set the penguin and donut to its suitable size.

⑦Move the “Penguin1” to close to the ground and the position of “Donut” will be determined through the program.

Coding

Penguin sprite 

[Algorithm] When the flag is clicked, the variable “score” will be initialized to 0. The penguin will be controlled by the student to move left or right according to the input of the potentiometer and say the current score.

Coding	Location	Explanation
	Events Data & Blocks Control Motion\Operator\ MRTduino Looks	When the flags is clicked Initialize “score” to 0 Endless loop Move penguin along x-axis according to the potentiometer Say the current score

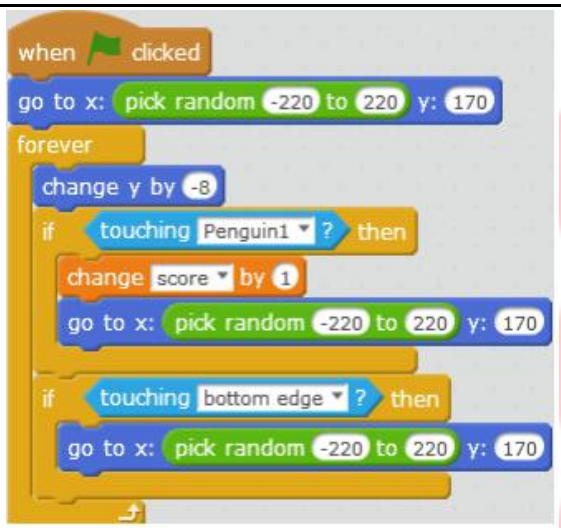
Donut sprite 

[Algorithm] When the flag is clicked, it will go to y: 170 and pick a random position at x-axis. It will move downwards continuously. When it touches "Penguin 1", the variable "score" will be increased by 1 and the "Donut" will go to y: 170 and pick a random position at x-axis again. When it touches the bottom of the backdrop, the "Donut" will go to y: 170 and pick a random position at x-axis again.

Coding	Location	Explanation
	Events	When the flags is clicked
	Operators	Go to y:170 and random at x-axis
	Control	Endless loop
	Motion	Move along the y-axis by -10
	Sensing	When it touches "Penguin 1"
	Data&Blocks	"score" increases by 1
	Motion	Go to y:170 and random at x-axis
	Sensing	When it touches bottom edge
	Motion	Go to y:170 and random at x-axis

Donut2 sprite 

[Algorithm] “Donut2” has similar program as “Donut” with slower speed of -8.

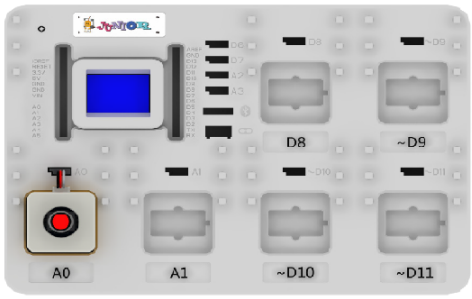
Coding	Location	Explanation
	Events Operators Control Motion Sensing Data&Blocks Motion Sensing Motion	When the flags is clicked Go to y:170 and random at x-axis Endless loop Move along the y-axis by -10 When it touches “Penguin 1” “score” increases by 1 Go to y:170 and random at x-axis When it touches bottom edge Go to y:170 and random at x-axis

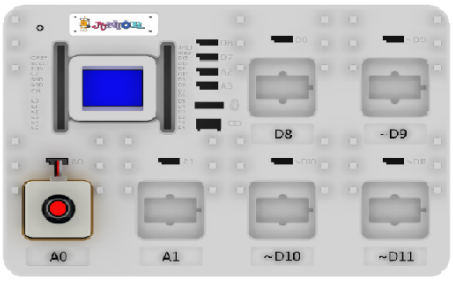
Donut3 sprite 

[Algorithm] “Donut2” has similar program as “Donut” with the slowest speed of -5.

Coding	Location	Explanation
	Events Operators Control Motion Sensing Data&Blocks Motion Sensing Motion	When the flags is clicked Go to y:170 and random at x-axis Endless loop Move along the y-axis by -10 When it touches “Penguin 1” “score” increases by 1 Go to y:170 and random at x-axis When it touches bottom edge Go to y:170 and random at x-axis

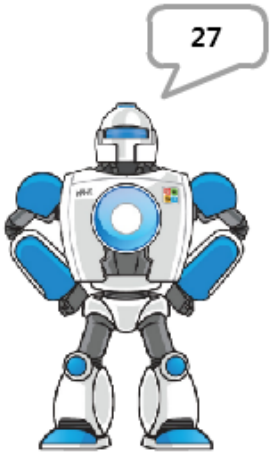
Practice





Score will increase when “Penguin” eats donuts

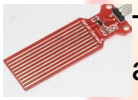
Mission

The higher the score, the faster the speed of donut moving downwards.	

Using Rain to Measure Water Level

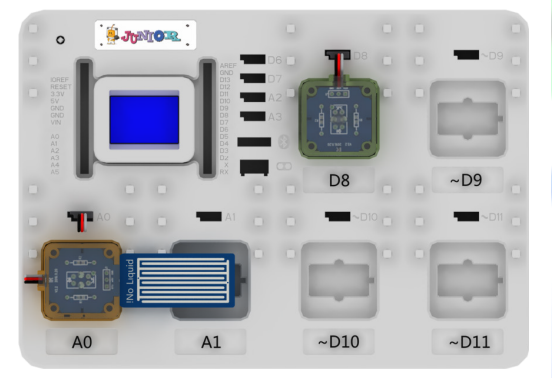
Introduction : Rain sensor is one type of sensor to measure water level. It is so sensitive that even one water droplet can affect its reading. In this lecture, we will learn how to use rain sensor to measure water level and make a game between a shark and a fish. The scenario will change according to the water level.

Hardware Introduction : What is rain sensor ?



The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. It can be used to measure water level.

Hardware preparation: Connect LED-R to D8 and Rain sensor to A0.

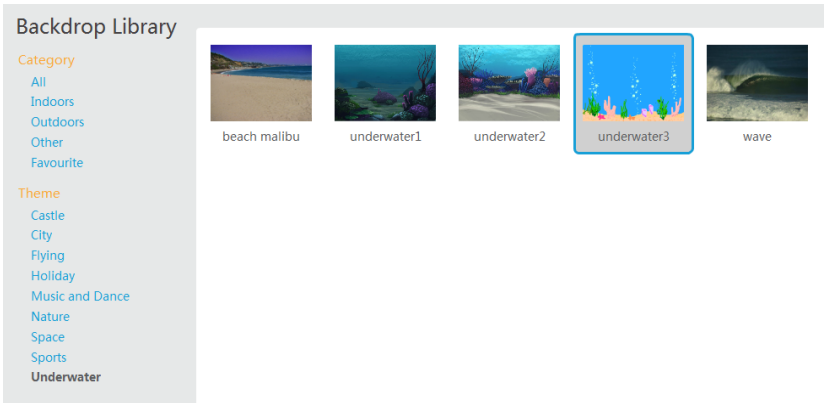


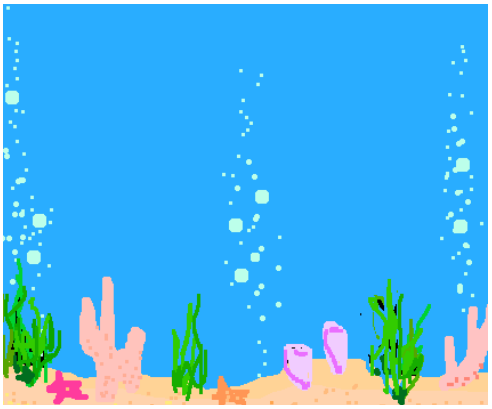
Connect Blacksmith Board

Software Preparation: Set “Underwater3” as the backdrop. Select “Shark” and “Fish 3” from sprite and apply.

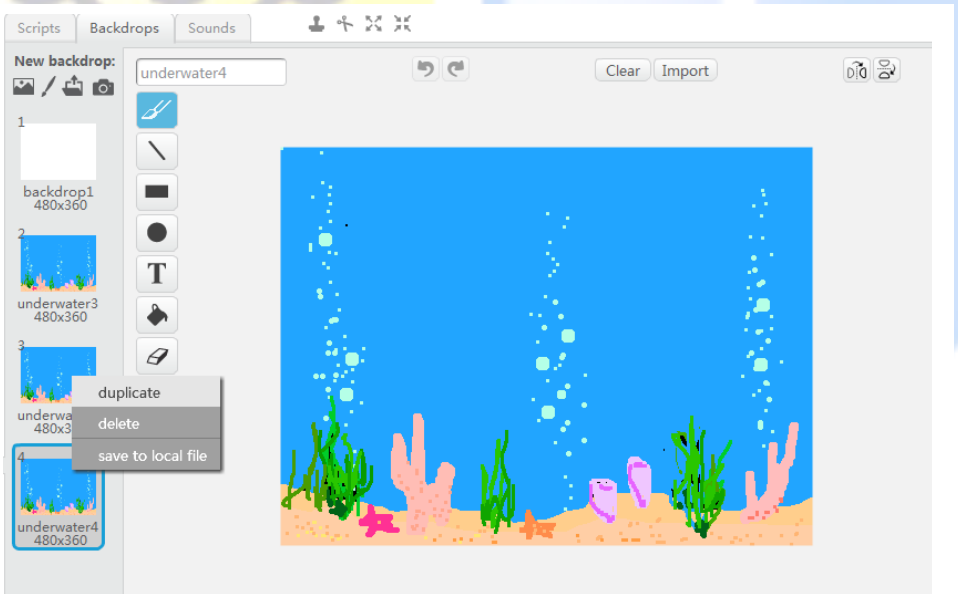
① Delete the robot from the sprite.

② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Nature-underwater3] and apply.

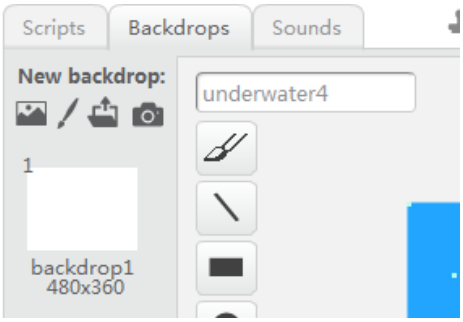


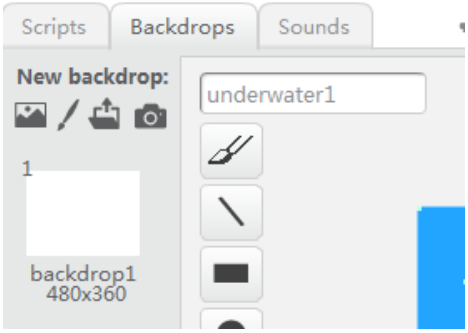


③ Right click the “underwater3” to duplicate two more backdrop.

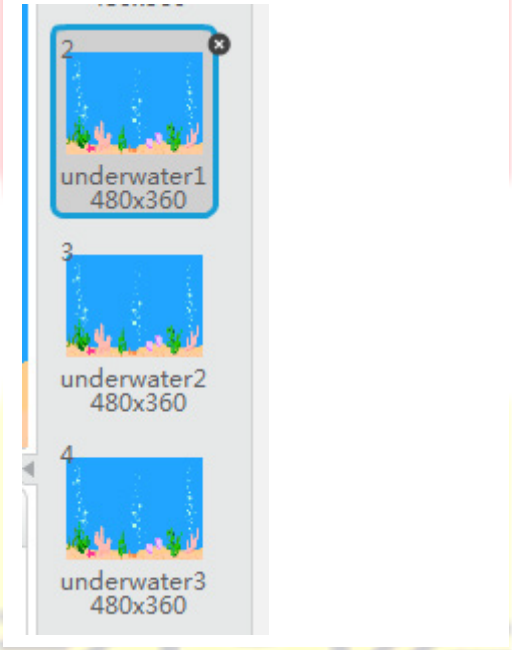


④ Change “underwater4” to “underwater1”.

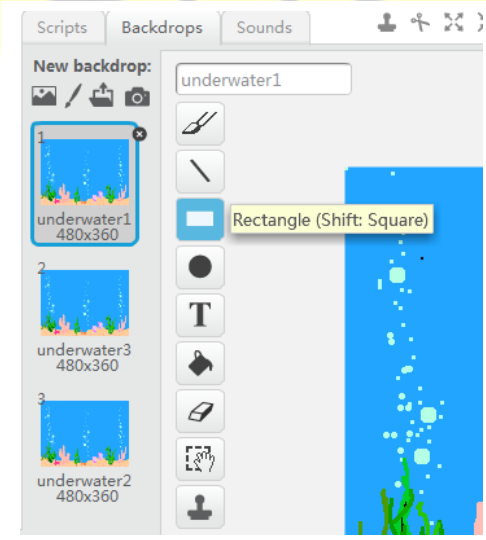


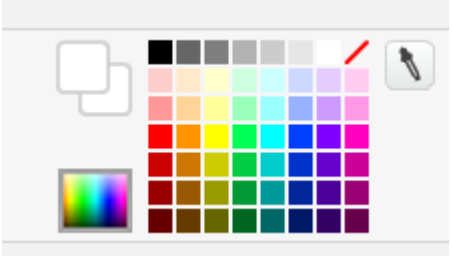


⑤ Rearrange the sequence of backdrop as below.

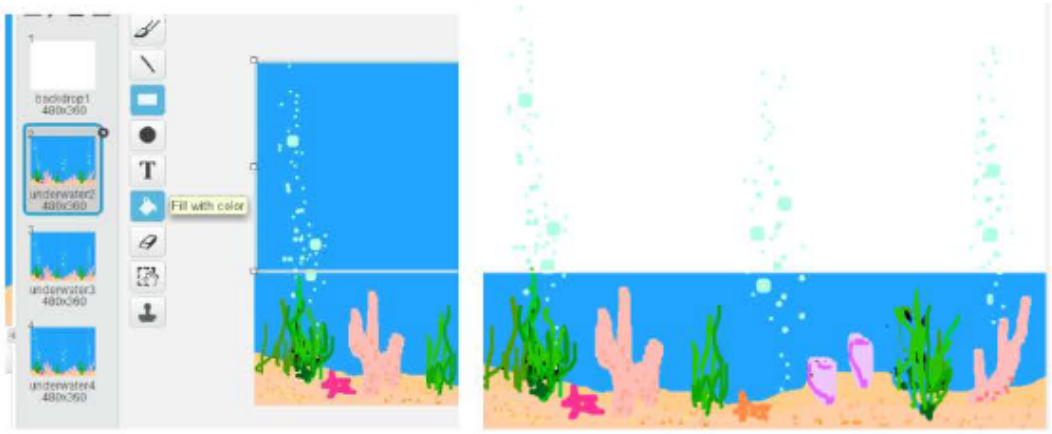


⑥ Select “underwater1”, select the rectangle tool and select white color.



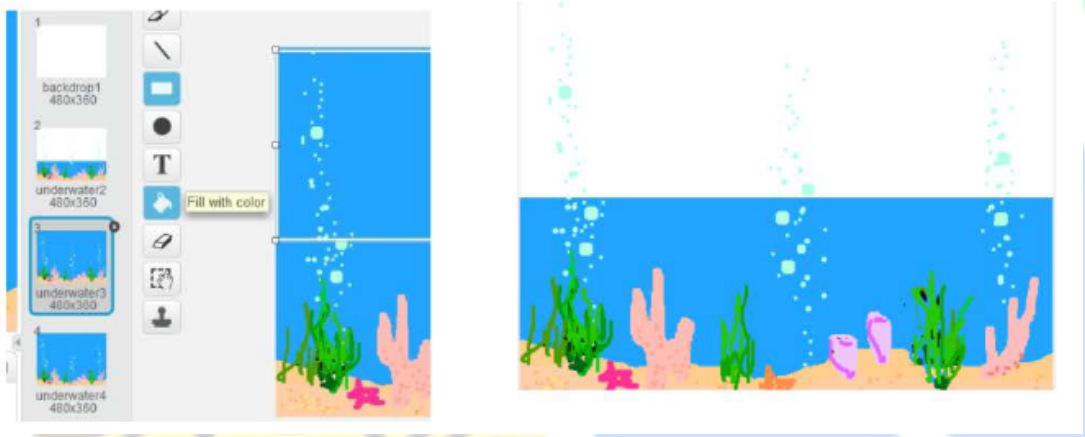


⑦ Fill 70% of the background to white as shown in figure.

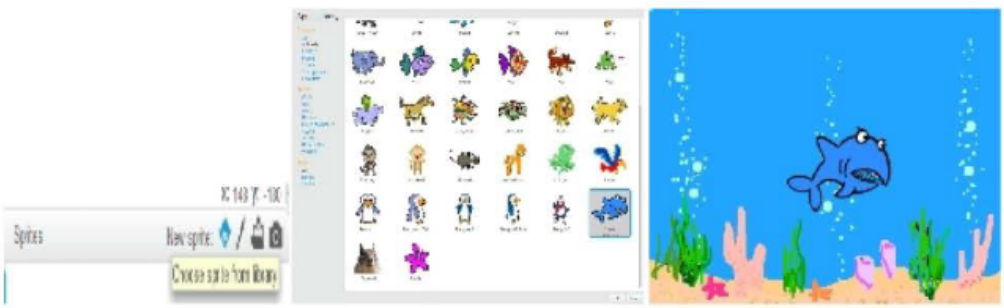


⑧ Select “underwater2”, select the rectangle tool and select white color.

⑨ Fill 50% of the background to white as shown in figure.



⑩ Click [New sprite-choose sprite from library] and select [Animal – Shark] from the library and apply.



⑪ Click [New Sprite – Choose sprite from library] again and select [Animals – Fish3] from the library and apply.

⑫ Set the sprite position as shown in figure.

Coding

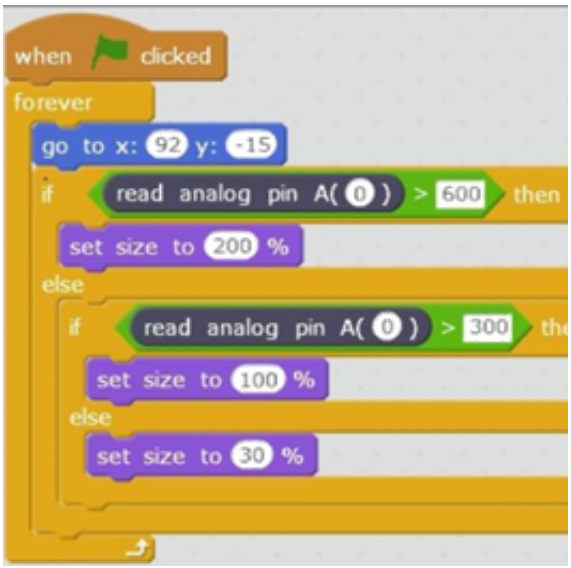
Shark sprite 

[Algorithm] When the flag is clicked, if the water level is high (reading of rain sensor greater than 600), the backdrop will change to “underwater3”. Shark will change its costume to “shark-c”, move to x : -75, y : -120 and LED is on. If the water level is at middle level (reading of rain sensor greater than 300), the backdrop will change to “underwater2”. Shark will change its costume to “shark-b”, move to x : -75, y : 15 and LED is off. If the water level is low (reading of rain sensor less than 300), backdrop will change to “underwater1”. Shark will change its costume to “shark-a”, move to x : -75, y : -72 and LED is off.

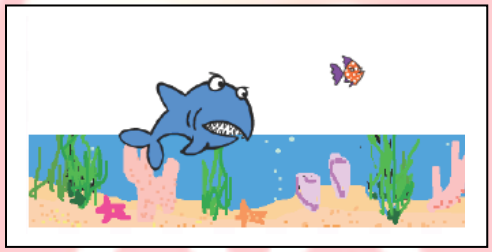
Coding	Location	Explanation
	vent ontrol RTDuino ooks ooks lotion RTDuino ontrol RTDuino ooks ooks lotion RTDuino ontrol ooks ooks lotion RTDuino	When the flag is clicked Endless Loop If the water level is high Backdrop is changed Costume is changed Move to x : -75, y : 120 LED on If the ware level is middle Backdrop is changed Costume is changed Move to x : -75, y : 15 LED off If the ware level is low Backdrop is changed Costume is changed Move to x : -75, y : -72 LED off

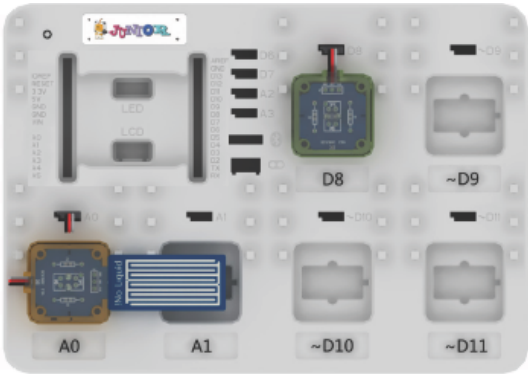
Fish3 sprite 

[Algorithm] When the flag is clicked, it will move to x: -92, y: -15. If the water level is high, it will become larger and if the water level is low, it will become smaller.

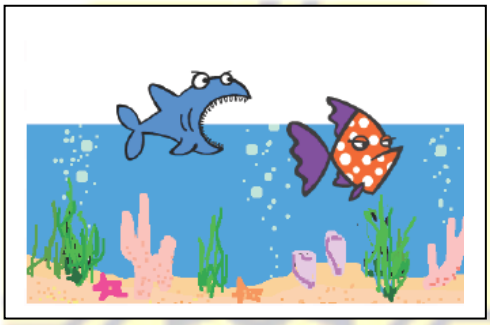
Coding	Location	Explanation
	:vent Control Motion MRTDuino ook MRTDuino ook ook	When the flag is clicked Endless Loop Move to x : 92, y : -15 If water level is high The fish become larger If water level is at middle level The fish is original size If water level is low The fish become smaller

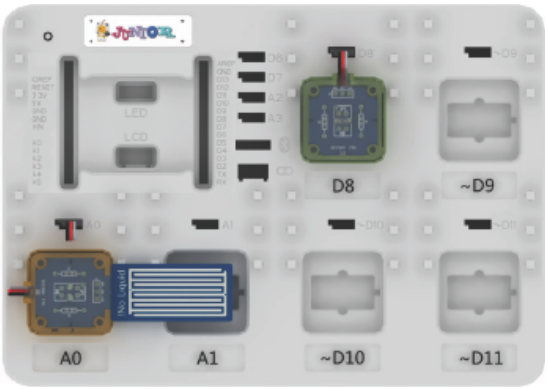
Practice :



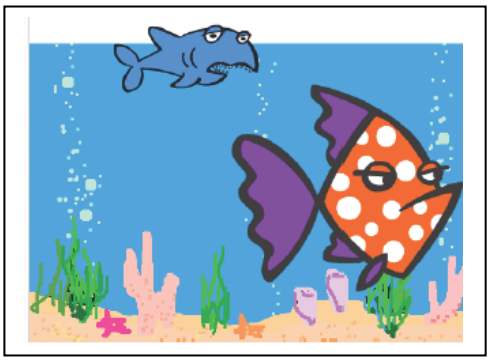


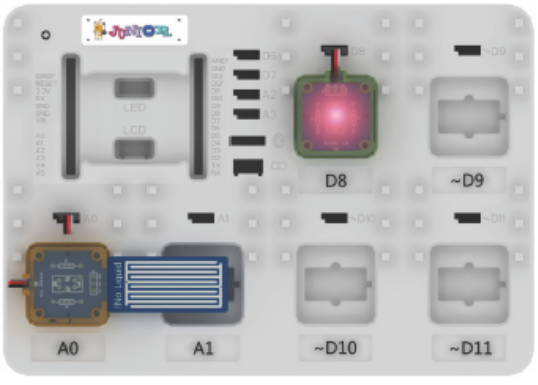
Water Level < 300 (Low)





Water Level >300 (Middle)





Water level > 600 (High)

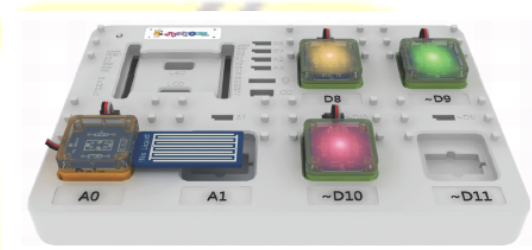
Using Rain To Make a Water Level Gauge

Introduction: In this lecture, we will learn how to make a water level gauge using rain sensor with the help of scratch and a sprite. Through some calculation on the reading of rain sensor, we can actually control sprite position in the scratch to indicate the water level.

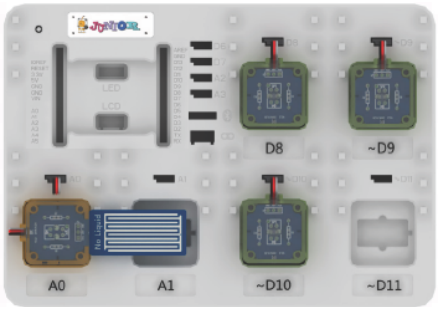
Learn new Scratch Blocks

	Reports true if both conditions are true.
	Sets sprite's y-position to specified value.

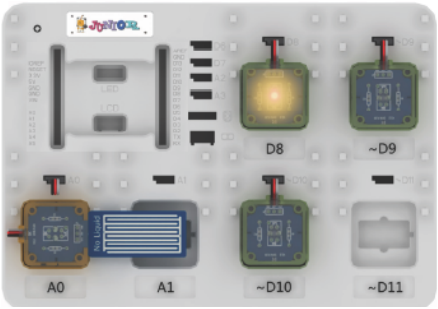
Hardware preparation: Connect Rain sensor to A0, LED-Y to D8, LED-G to D9 and LED-R to D10.



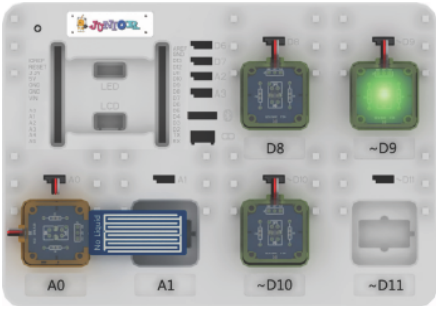
Connect Blacksmith Board



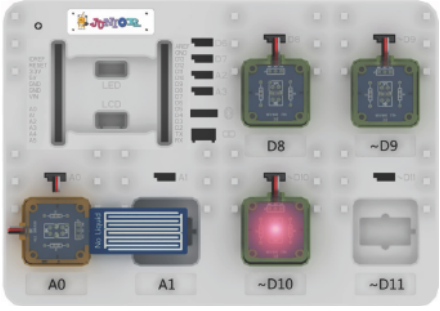
Rain Sensor (A0)



LED-Y (D8)



LED-G (D9)

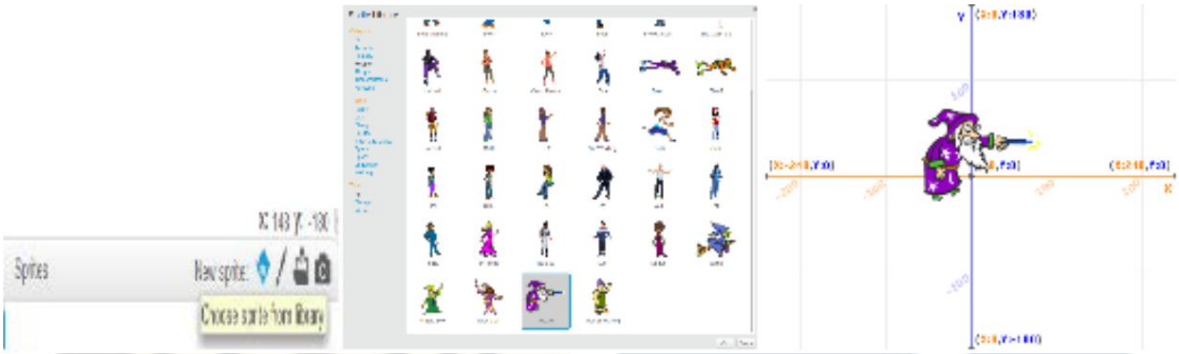


LED-R (D10)

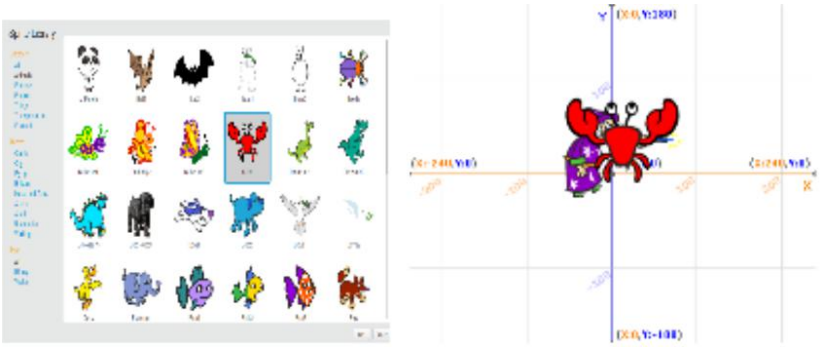
Software Preparation: Set “xy-grid” as the backdrop. Select “Wizard” and ① Delete the robot from the sprite.

② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Other-xy-grid] and apply. “Crab” from the sprite and apply.

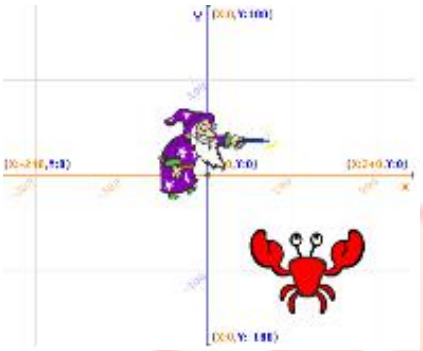
③ Click [New sprite-Choose sprite from library] and select [People-Wizard] from the library and apply.



④Click [New sprite-Choose sprite from library] again and select [Animals-Crab] from the library and apply.”



⑤ Move the crab sprite to the position as shown in the diagram.



⑥ Move the wizard sprite so that the wizard's rod touches the y-axis as shown in figure.

Coding

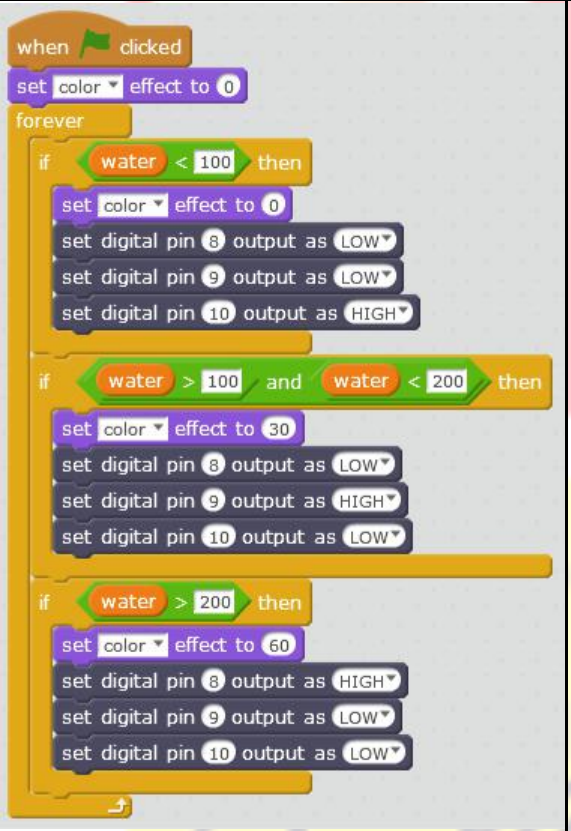
Wizard sprite 

[Algorithm] When the flag is clicked, it moves to x:-64 and y:-110. The variable "water" is set to the reading of rain sensor divided by 4. The wizard y-axis position is set to the value of variable "water'' minus 110.

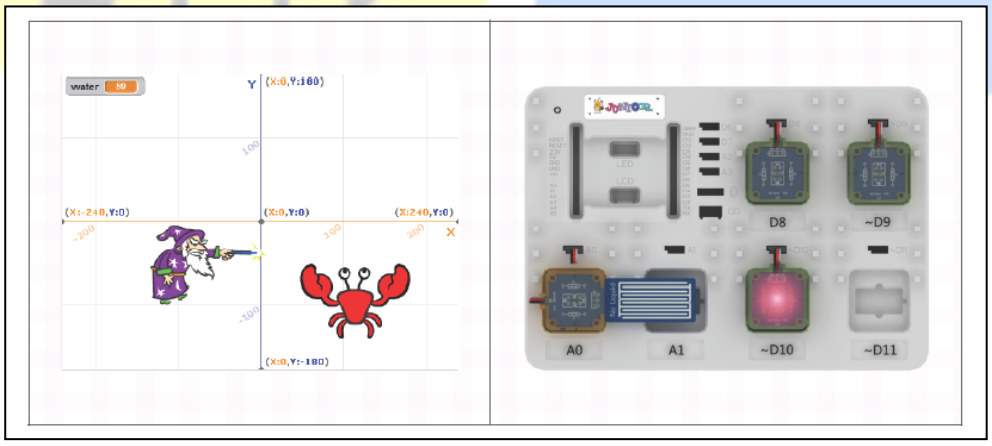
Coding	Location	Explanation
	**Events** **Motion** **Control** **Data/Operator/MRTduino** **Motion**	**When the flags is clicked** **Move to x:-64, y:-110** **Endless Loop** **Set value of variable "water"** **Set y-axis position**

Crab sprite

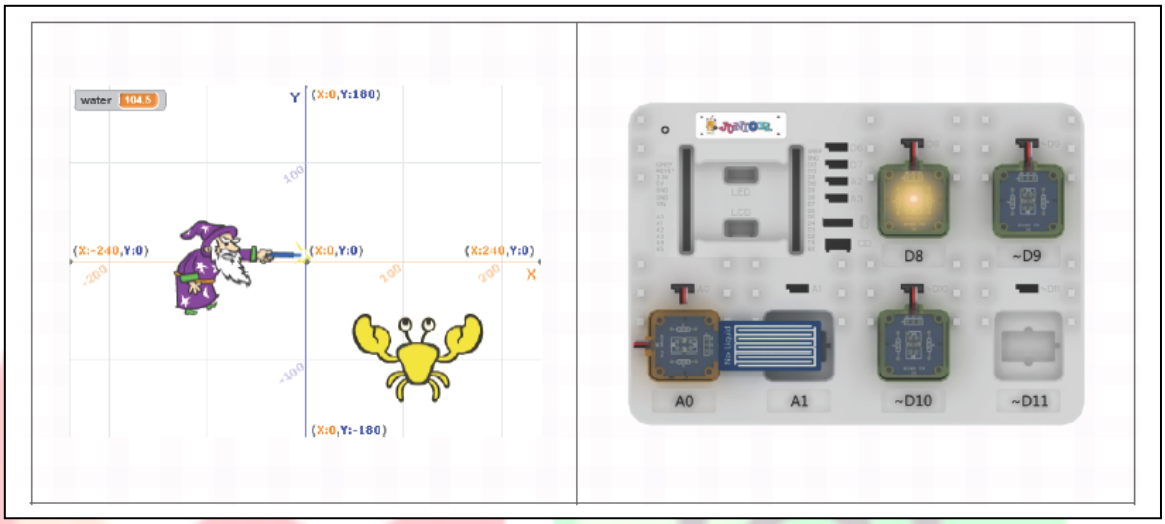
[Algorithm] When the flag is clicked, it is set to its original color. If water level is low (variable “water” is less than 100), it will show its original color and LED-R is on. If water level is at its middle level (variable “water” is more than 100 and less than 200), it will change color and LED-G is on. If water level is high (variable “water” is more than 200), it will change color and LED-Y is on.

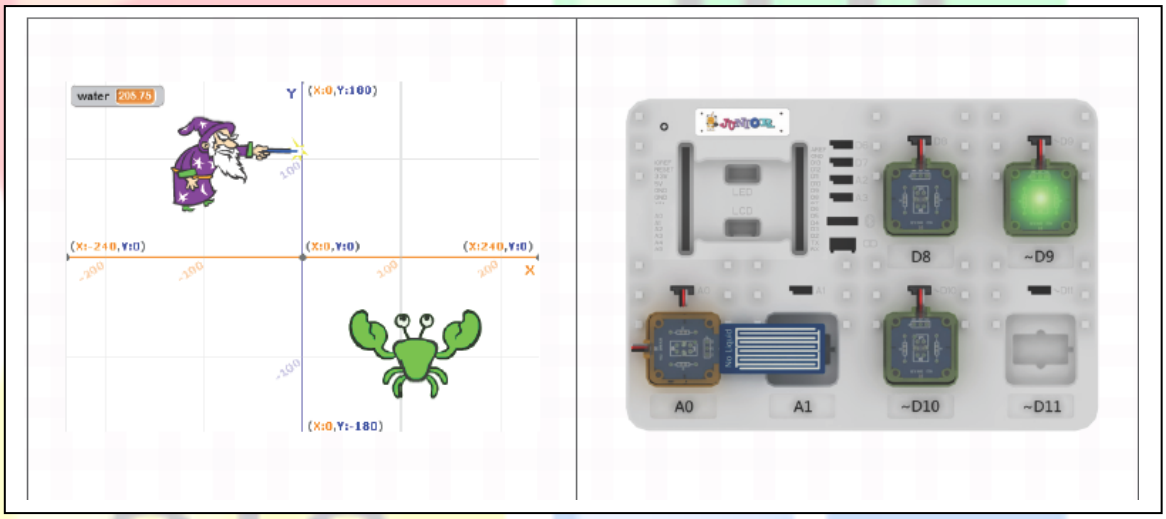
Coding	Location	Explanation
	Events Looks Control Control/Operator/Data & Blocks Looks MRTduino MRTduino MRTduino Control/Operator/Data&Blocks Looks MRTduino MRTduino MRTduino Control/Operator/Data&Blocks Looks MRTduino MRTduino MRTduino	When the flags is clicked Show original color Endless loop If water level is low Show original color LED-Y is off LED-G is off LED-R is on If water level is at its middle level Show yellow color LED-Y is off LED-G is on LED-R is off If water level is high Show green color LED-Y is on LED-G is off LED-R is off

Practice

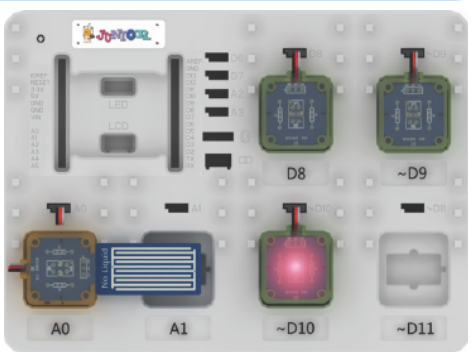


Variable “water” is less than 100





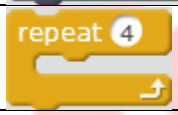
Mission

Make a program that will make a warning when the water exceeds certain level.	

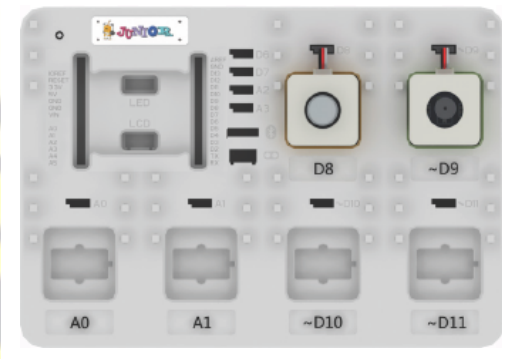
Using Buzzer To Play a Song

Introduction: In this lecture, we will learn how to program a buzzer to play a song with the help of scratch. Buzzer is an audio signaling device which is always used for alarm devices, timers and confirmation of user input such as a mouse click or keystroke. We can program buzzer to make any sound we want even a song. Today, let's try to program a famous song named "Twinkle Twinkle Little Star".

Learn new Scratch Blocks

	Play note C4 for half beat
	Runs the blocks inside a specified number of times.

Hardware preparation: Connect Rain sensor to analog pin 0, LED-Y to digital pin 8, LED-G to digital pin 9 and LED-R to digital pin 10.

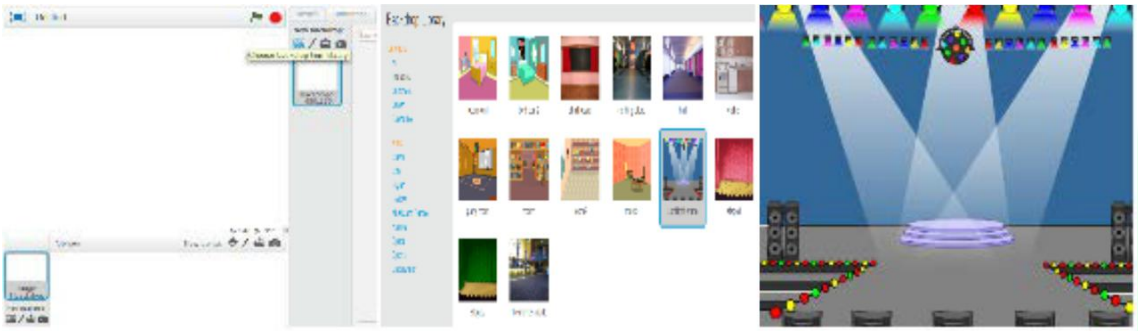


Connect Blacksmith Board

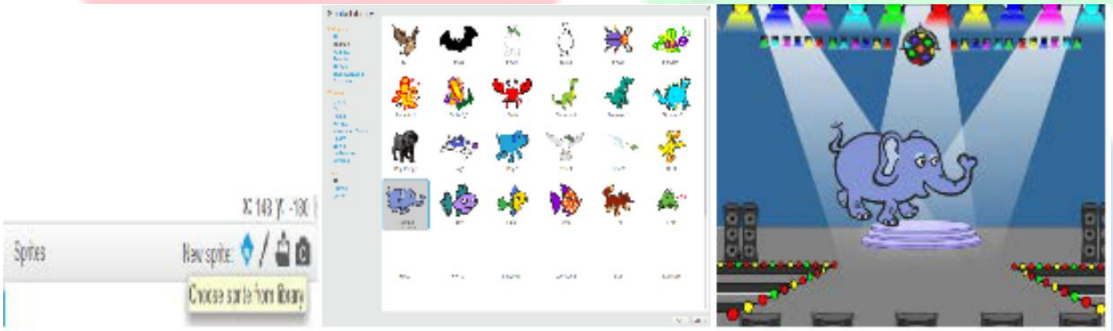
Software Preparation: Set “Spotlight-Stage” as the backdrop. Select “Elephant”

① Delete the robot from the sprite.

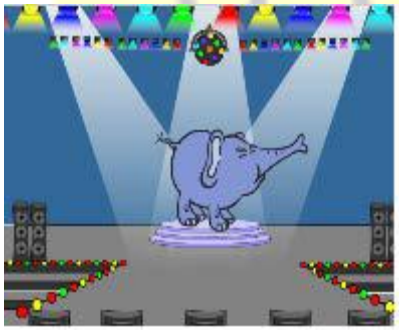
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Indoors-spotlight-stage] and apply.



③ Click [New sprite-Choose sprite from library] and select [Animals-Elephant] from the library and apply.



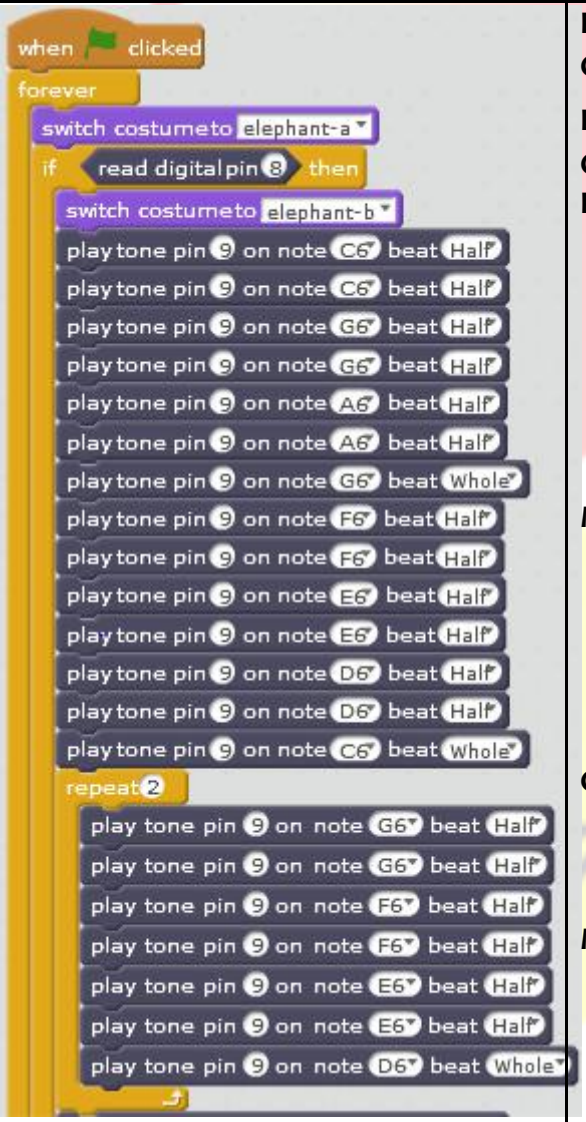
④ Move the elephant to the stage as shown in figure.

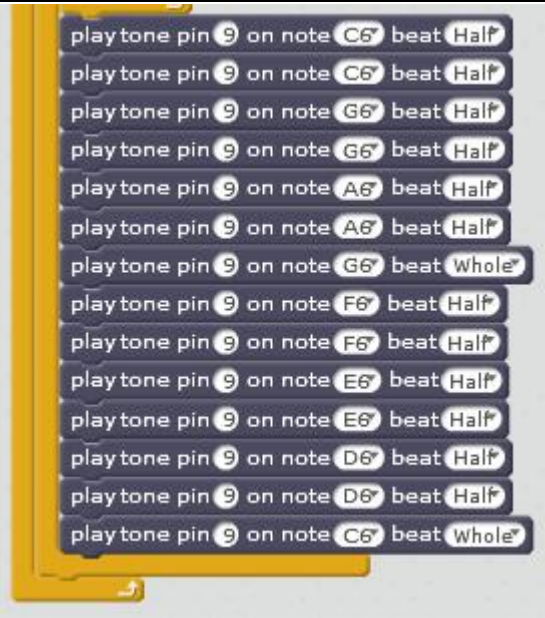


Coding

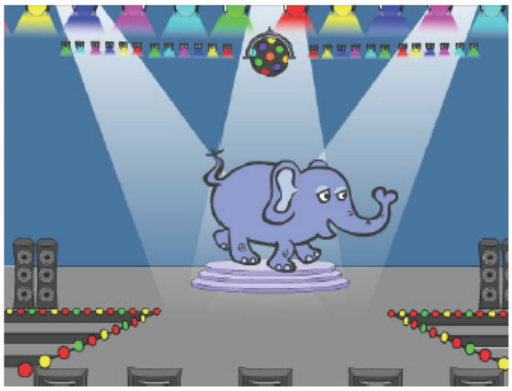
Elephant sprite 

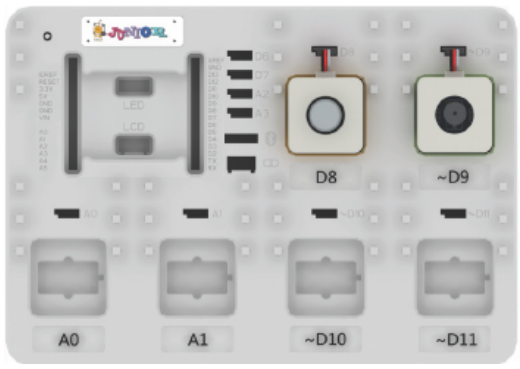
[Algorithm] When flag is clicked, it will change costume to “elephant- a”. If touch switch is pressed, it will change costume to “elephant-b” and start playing “Twinkle Twinkle Little Star”.

Coding	Location	Explanation
	Events	When the flags is clicked
	Control	Endless Loop
	Looks	Costume is changed
	Control\MRTduino	When touch sensor is pressed
	Looks	Costume is changed
		Play do6 for half beat
		Play so6 for half beat
		Play la6 for half beat
		Play so6 for half beat
	MRTduino	Play fa6 for half beat
		Play mi6 for half beat
		Play re6 for half beat
		Play do6 for half beat
	Control	Loop for twice only
		Play so6 for half beat
		Play fa6 for half beat
	MRTduino	Play mi6 for half beat
		Play re6 for half beat

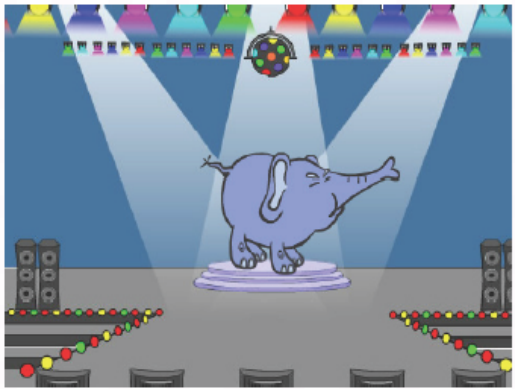
Coding	Location	Explanation
	MRTduino	Play do6 for half beat Play so6 for half beat Play la6 for half beat Play so6 for half beat Play fa6 for half beat Play mi6 for half beat Play re6 for half beat Play do6 for half beat

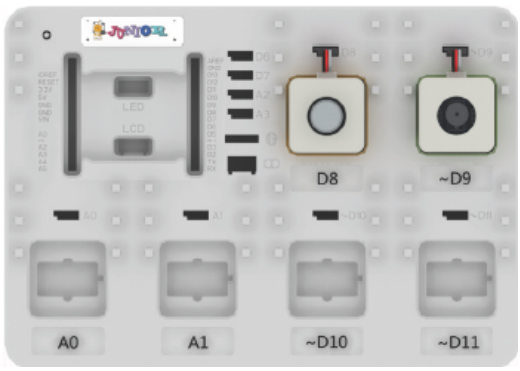
Practice





Before pressing the touch switch





After pressing the touch switch

Mission

Use buzzer to play “London Bridge is Falling Down”.	

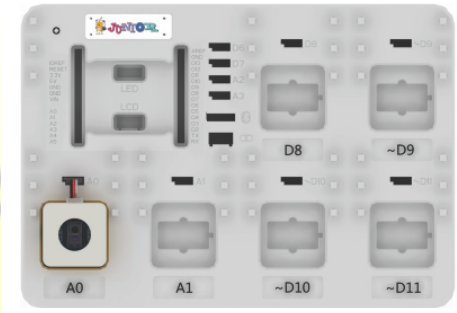
Using IR Sensor to Make a Game

Introduction: In this lecture, we will use IR sensor to control a sprite and avoid all obstacle coming to it. An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. IR sensor is usually used in remote control for electrical appliances such as television and air-conditioner. IR sensor can also be used for line tracing.

Hardware Introduction : What is IR (Infrared) sensor ?

Received infrared (IR) light radiating from objects in its field of view. Usually this radiation isn't visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

Hardware preparation: Connect IR sensor to A0.

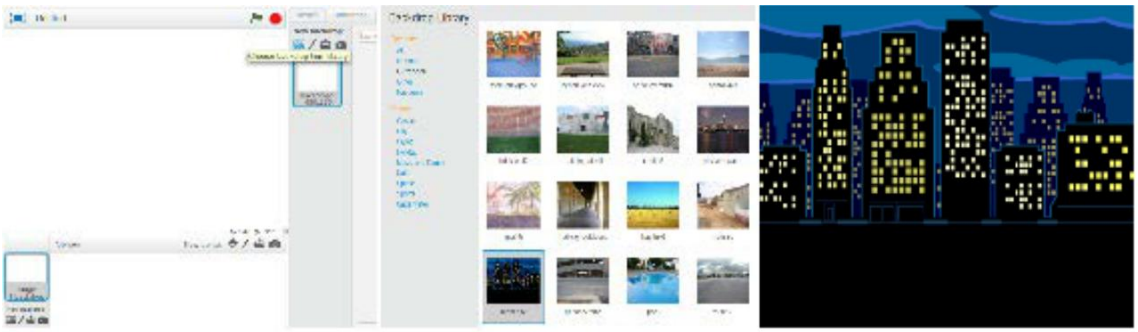


Connect Blacksmith Board

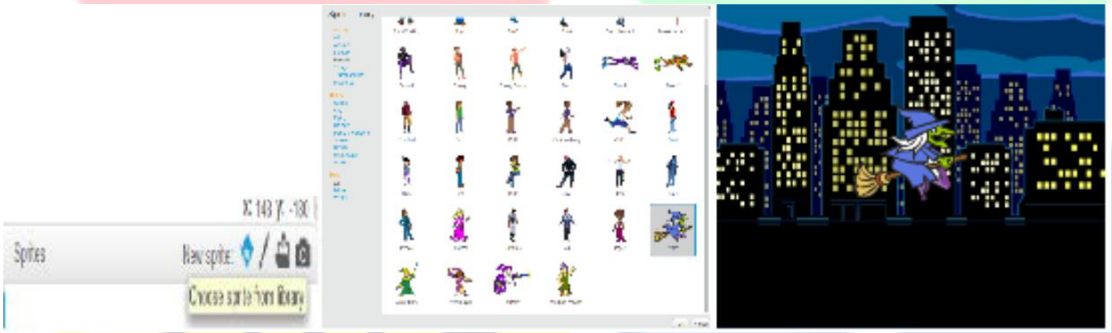
Software Preparation: Set “night city” as the backdrop. Select “Witch”,

① Delete the robot from the sprite.

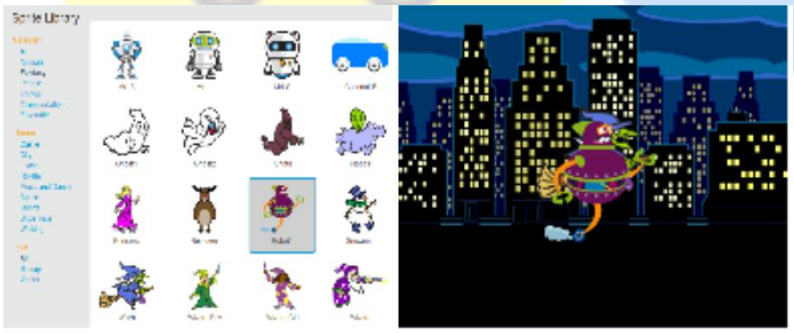
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Indoors-night city] and apply. “Robot1”,“Helicopter” and “Soccer Ball” from the sprite and apply.



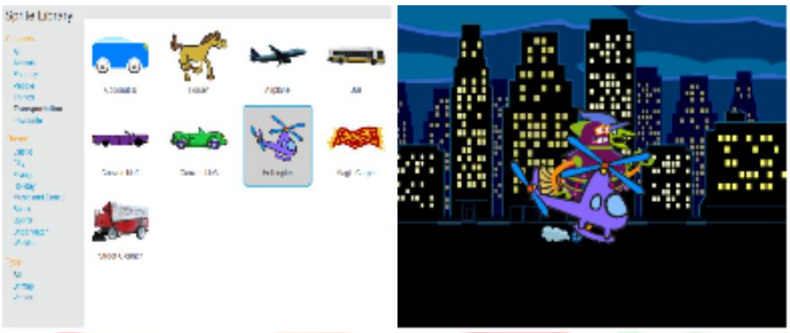
③ Click [New sprite-Choose sprite from library] and select [People-Witch] from the library and apply.



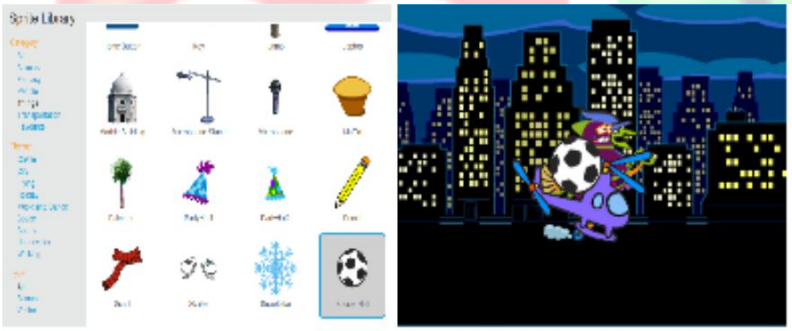
④ Click [New sprite-Choose sprite from library] again and select [Fantasy-Robot1] from the library and apply.



⑤ Click [New sprite-Choose sprite from library] again and select [Transportation-Helicopter] from the library and apply.



⑥ Click [New sprite-Choose sprite from library] again and select [Things-Soccer ball] from the library and apply.



Coding

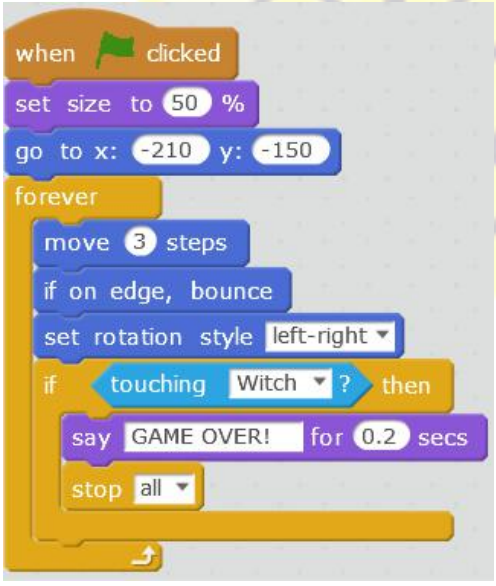
Witch sprite 

[Algorithm] When flag is clicked, it will become smaller and move to x:-10, y:-140.Its y-axis position is set to than it is controlled by IR reading (IR reading/3 - 170).

Coding	Location	Explanation
	Events Looks Motion Control Motion	When the flags is clicked Size become smaller Moves to x:-10, y:-140 Endless Loop Set y-axis position changed according to IR reading

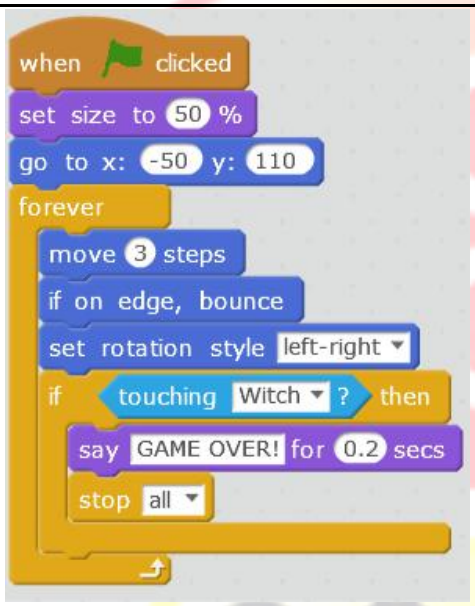
Robot1 sprite 

[Algorithm] When flag is clicked, it will become smaller and move to x:-210, y:-150.It will always move 3 steps to the right. When it touches edges, it will move in opposite direction and rotate in left-right direction. When it touches witch, it will say “Game Over” for 0.2 seconds and all activity will be stopped.

Coding	Location	Explanation
	Events Looks Motion Control Motion Motion Motion Control\Sensing Looks Control	When the flags is clicked Size become smaller Moves to x:-210, y:-150 Endless Loop Moves to the right Moves in opposite direction when it touches edge Rotate in left-right direction When it touches “Witch” Say “Game Over” Stop all activity

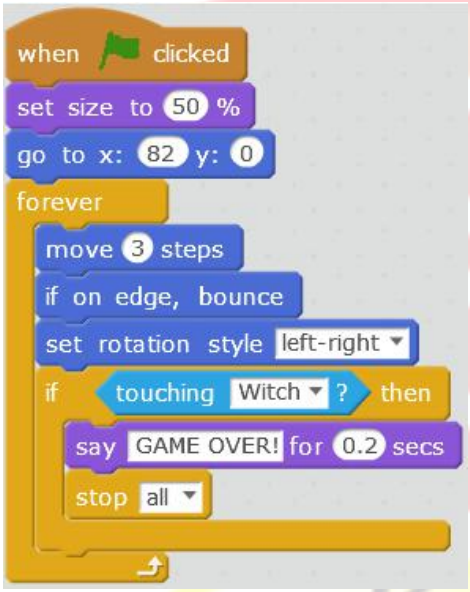
Helicopter sprite 

[Algorithm] When flag is clicked, it will become smaller and move to x: -50, y: 110. It will always move 3 steps to the right. When it touches edges, it will move in opposite direction and rotate in left-right direction. When it touches witch, it will say “Game Over” for 0.2 seconds and all activity will be stopped.

Coding	Location	Explanation
	Events	When the flags is clicked
	Looks	Size become smaller
	Motion	Moves to x:-50, y:110
	Control	Endless Loop
	Motion	Moves to the right
	Motion	Moves in opposite direction when it touches edge
	Motion	Rotate in left-right direction
	Control\Sensing	When it touches “Witch”
	Looks	Say “Game Over”
	Control	Stop all activity

Soccer ball sprite

[Algorithm] When flag is clicked, it will become smaller and move to x: 82, y: 0. It will always move 3 steps to the right. When it touches edges, it will move in opposite direction and rotate in left-right direction. When it touches witch, it will say “Game Over” for 0.2 seconds and all activity will be stopped.

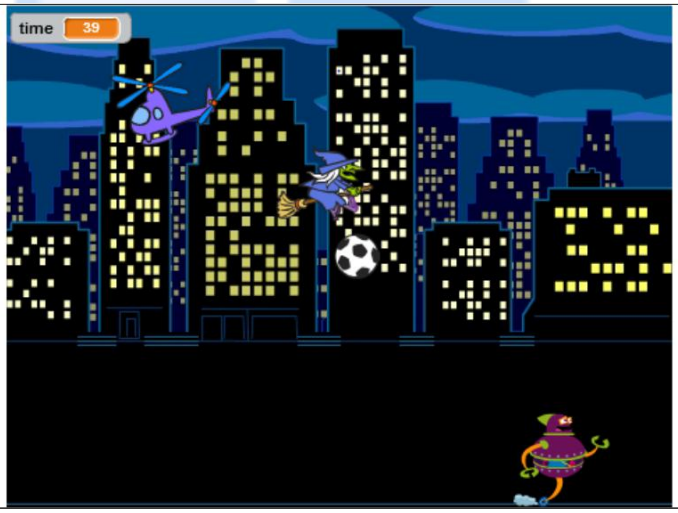
Coding	Location	Explanation
	Events	When the flags is clicked
	Looks	Size become smaller
	Motion	Moves to x: -82, y: 0
	Control	Endless Loop
	Motion	Moves to the right
	Motion	Moves in opposite direction when it touches edge
	Motion	Rotate in left-right direction
	Control\Sensing	When it touches “Witch”
	Looks	Say “Game Over”
	Control	Stop all activity

Practice

When it does not touch Witch Sprite

When it touch Witch Sprite

Mission

Make a timer and record your best time	

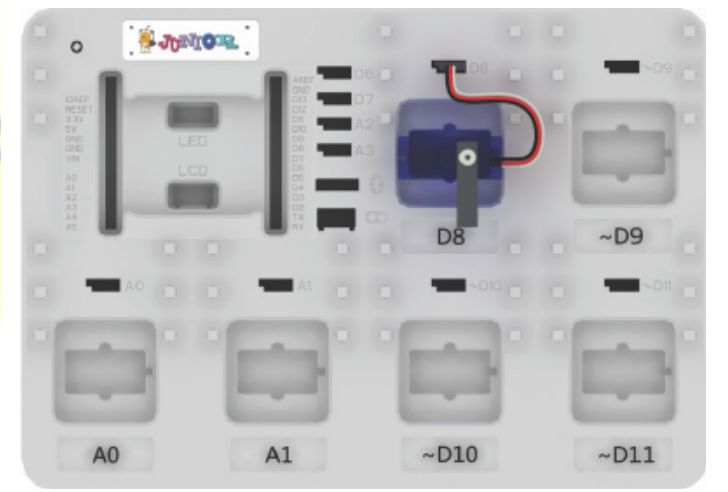
Using Servo Motor to Prevent Insect

Introduction: Servo motor is used in various ways in our daily life. Servo motor is basically a DC motor with a set of gear and a circuit board to control the DC motor in a way that it can rotate from 0-180 degree. Servo motor is always used in robotic industry for various purposes such as opening the door or act as the joint of a humanoid. Be noted that a battery case might be needed for this lecture as the power supply from the USB port might not be enough.

Hardware Introduction : What is servo motor ?

Unlike dc motors, with servo motors you can position the motor shaft at a specific position (angle from 0 – 180 degrees) using control signal. The motor shaft will hold at this position as long as the control signal not changed. This is very useful for controlling robot arms, unmanned airplanes control surface or any object that you want it to move at certain angle and stay at its new position.

Hardware preparation: Connect servo motor to D8.

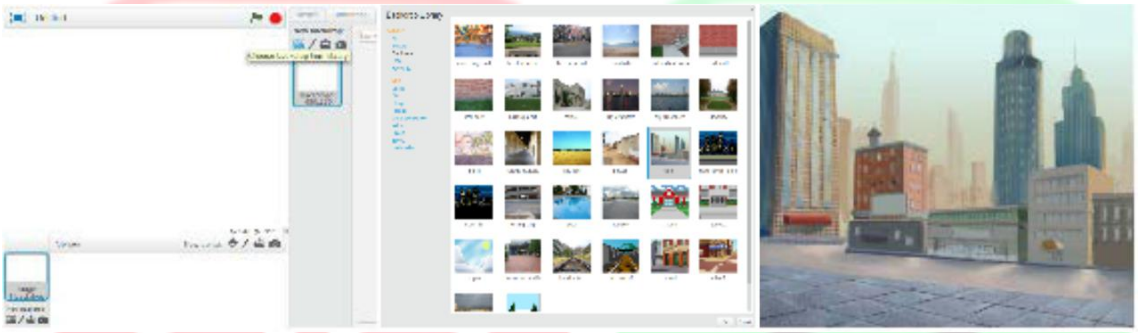


Connect Blacksmith Board

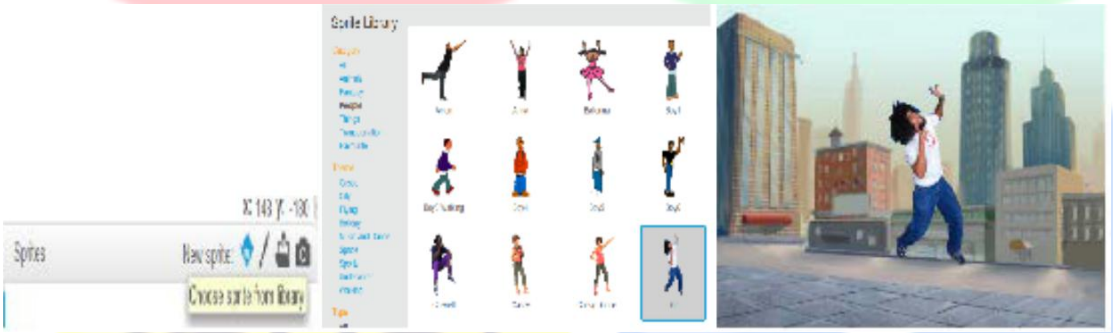
Software Preparation: Set “metro1” as the backdrop. Select “Dan” and

① Delete the robot from the sprite.

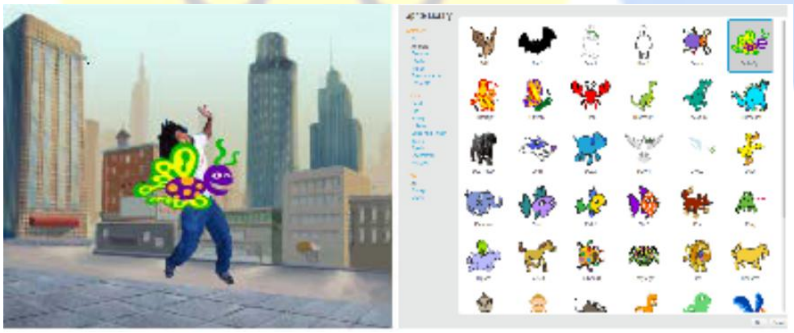
② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Outdoors-metro1] and apply. “Butterfly1”, from the sprite and apply.



③ Click [New sprite-Choose sprite from library] and select [People-Dan] from the library and apply.



④ Click [New sprite-Choose sprite from library] again and select [Animals-Butterfly1] from the library and apply.

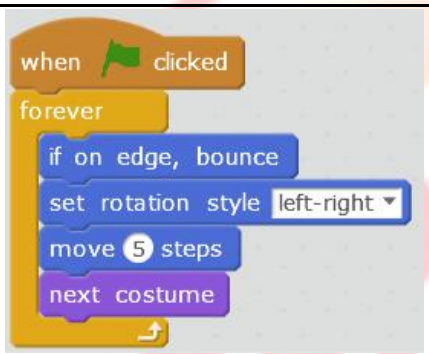


⑤Sprite position will be determined by program.

Coding

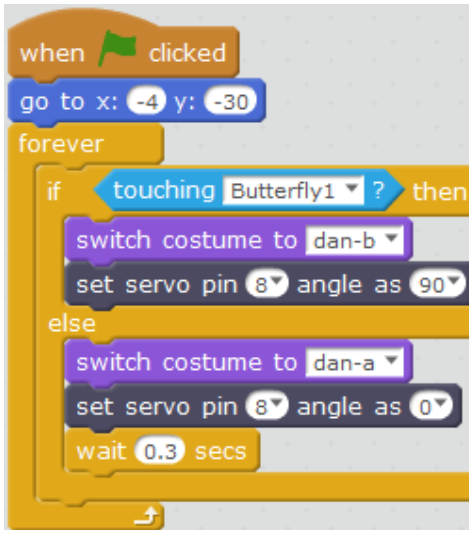
Butterfly1 sprite 

[Algorithm] When flag is clicked, it will move 5 steps to the right continuously and bounce when it touches the edges. Its will rotate in left-right direction and always change its costume

Coding	Location	Explanation
	Events	When the flags is clicked
	Looks	Endless Loop
	Motion	Bounce when it touches edge
	Control	Rotate in left-right direction
	Motion	Moves 5 steps to the right
	Looks	Change to next costume

Dan sprite 

[Algorithm] When flag is clicked, it will move to x:-4, y: -30.When it touches "Butterfly1", it will switch its costume to "dan-b" and servo at D8 will turn to 90 degree. Else, it will switch costume to "dan-a" and servo at D8 will turn to 0 degree for 0.3 seconds.

Coding	Location	Explanation
	Events	When the flags is clicked
	Motion	Move to x:-4, y:-30
	Control	Endless Loop
	Control/Sensing	When it touches "Butterfly1"
	Looks	Costume is changed
	MRTduino	Move servo at D7 to angle 90
	Control	When it does not touch "Butterfly1"
	Looks	Costume is changed
	Looks	Move servo at D7 to angle 0
	Control	Waits 0.3 second

Practice

When it does not touch Butterfly1 Sprite

When it touch Butterfly1 Sprite

Mission

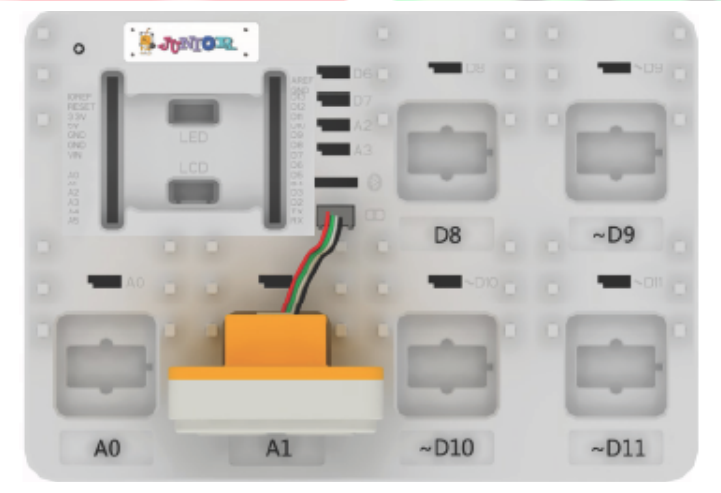
Butterfly1 sprite will disappear shortly after it touches Dan!	

Using Ultrasonic Sensor to Keep Princess Safe

Introduction: In this lecture we will learn how to use and how to program an ultrasonic sensor. Ultrasonic sensor is usually used for detect the obstacle in front of it and its range is much wider than IR sensor. Unlike IR sensor, ultrasonic sensor sends out a high frequency sound pulse and records the times taken for the echo of the sound to reflect back. As speed of sound is always constant (343m/s in the air), the distance travelled by the sound can be calculated by using formula:

Distance Travelled = (speed of sound × time travelled) ÷ 2

Hardware preparation: Connect Ultrasonic sensor to ultra-sensor pin.

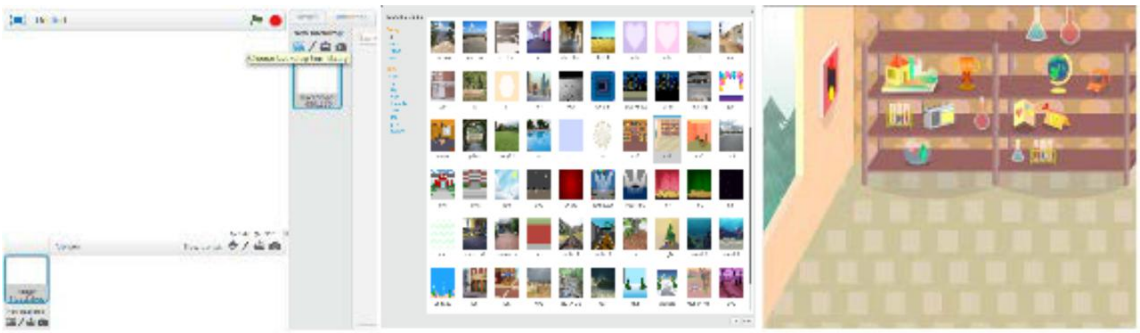


Connect Blacksmith Board

Software Preparation: Set “Room2” as the backdrop. Select “Princess” ,

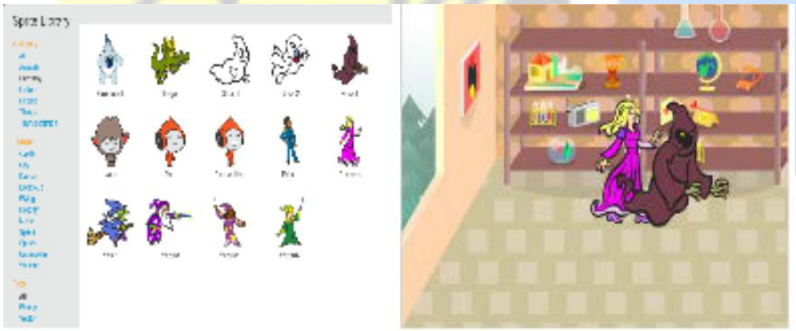
① Delete the robot from the sprite.

② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Indoors-Room2] and apply. “Ghoul” and “Apple” from the sprite and apply.

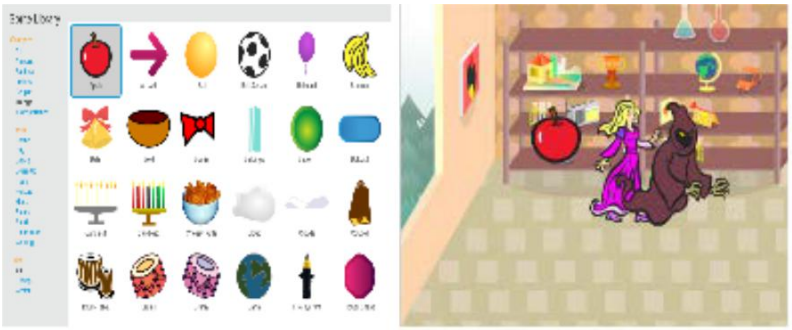


③ Click [New sprite-Choose sprite from library] and select [People-Princess] from the library and apply.

④ Click [New sprite-Choose sprite from library] again and select [Fantasy-Ghoul] from the library and apply.



⑤ Click [New sprite-Choose sprite from library] again and select [Fantasy-Apple] from the library and apply.

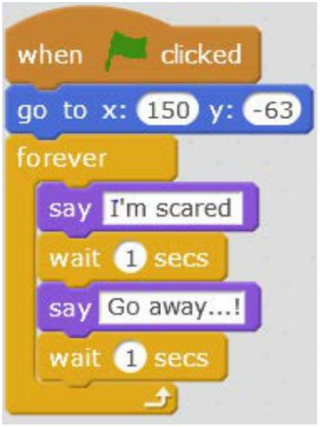


⑥ Sprite position will be determined by program.

Coding

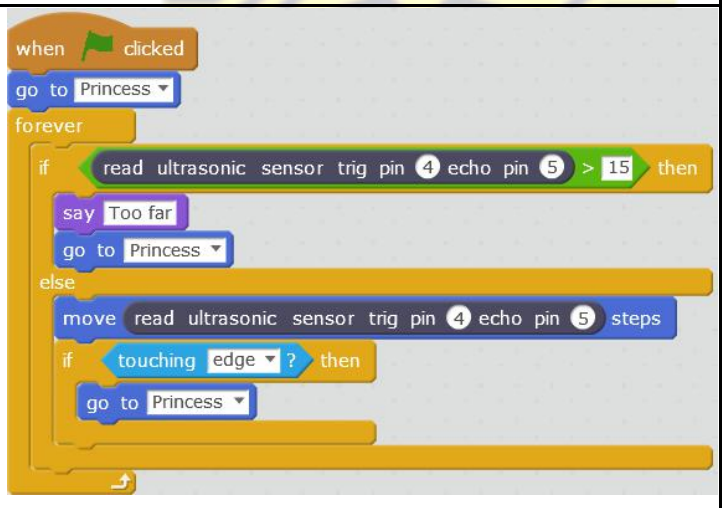
Princess sprite 

[Algorithm] When flag is clicked, it will move to x:150,y:- 63.It will always say "I'm scared" and "Go away…!" at an interval of 1 second.

Coding	Location	Explanation
	Events Motion Control Looks Controls Looks Control	When the flags is clicked Moves to x:150, y:-63 Endless Loop Say "I'm scared" Waits 1 second Say "Go away…!" Waits 1 second

Apple sprite 

[Algorithm] When flag is clicked, it will move to princess. When the distance is too far (Ultrasonic reading greater than 15), it will say "Too far" and move to princess. When the distance is suitable, it will move in step of ultrasonic reading. When it touches edges, it will move to princess again.

Coding	Location	Explanation
	Events Motion Control Control\Operator\MRTduino Looks Motion Motion\MRTduino Control\Sensing Motion	When the flags is clicked Move to princess Endless Loop When distance is too far Says "Too far" Move to Princess Move steps to the right When it touches edges Move to princess

Ghoul sprite 

[Algorithm] When flag is clicked, it will move to x:-120, y:-47.It will always think of “My princess…” and move 20 steps to the right. After 0.1 second, it will change to next costume. When it touches Apple, it will move 30 steps to the left. When it touches princess, it will move 50steps to the right, say “I got it” for 2 seconds and stop all activity.

Coding	Location	Explanation
	Events Motion Control Looks Motion Control Looks Control\Sensing Motion Control\Sensing Motion Looks Control	When the flags is clicked Move to x:-4, y:-30 Endless Loop Think of “My princess…” Move 20 steps to the right Waits 0.1 second Costume is changed When it touches “Apple” Move 30 steps to the left When it touches princess Move 50 step to the right Say “I got it” for 2 seconds Stop all activity

Practice

When Ghoul Sprite cannot catches Princess

When Ghoul Sprite catches Princess

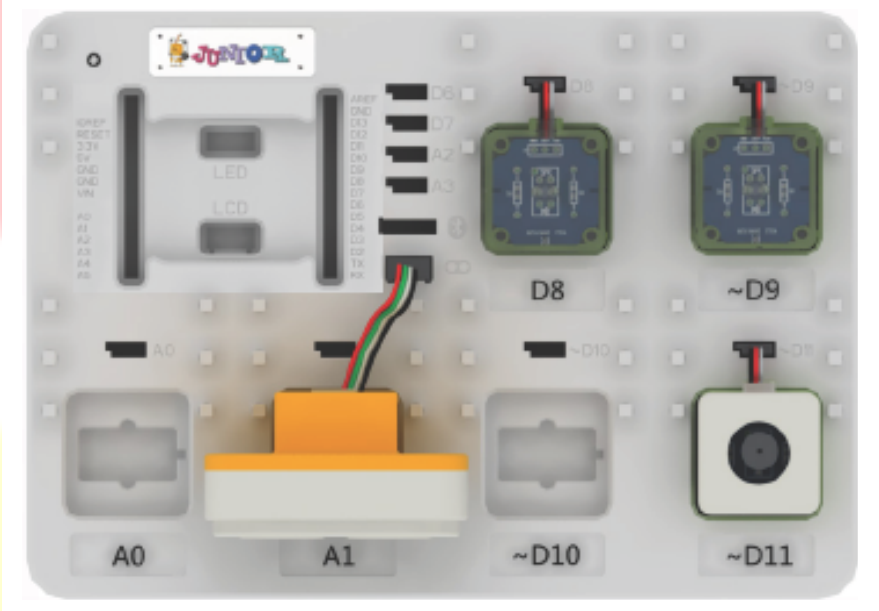
Mission

Ghoul will disappear after 1 minutes !	

Using Ultrasonic Sensor to Ensure Safety

Introduction: In past lecture, we have learned how to use and program ultrasonic sensor. Ultrasonic sensor is widely used in different fields and one of the fields is autonomous car. Ultrasonic sensor is the eyes of the autonomous car and it helps detect obstacle in front of the car. With the help of scratch, we will do a program that will alert us when the obstacle is too near with the car.

Hardware preparation: Connect Ultrasonic sensor to ultra-sensor pin, LED-R to D8, LED-G to D9 and Buzzer to D11.

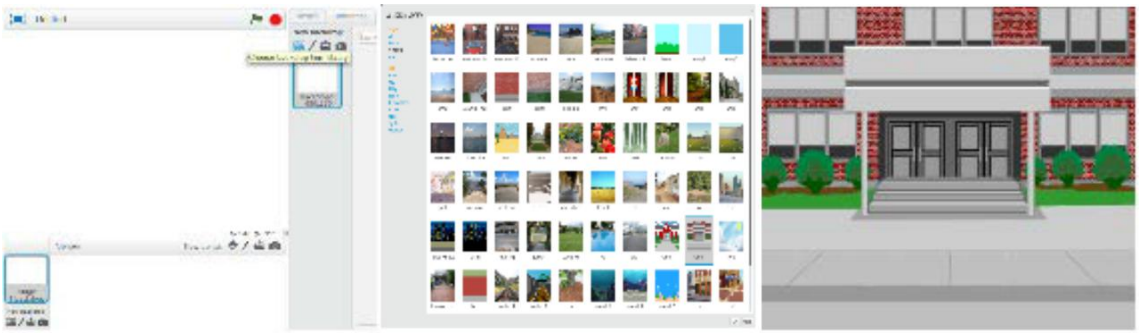


Connect Blacksmith Board

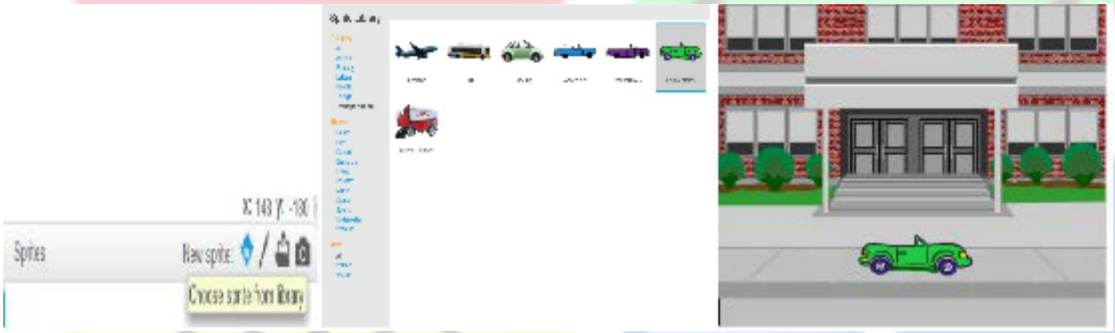
Software Preparation: Set “School2” as the backdrop. Select “Convertible3”

① Delete the robot from the sprite.

② Select [Stage backdrop]. Click [Backdrops] from the right side of stripe and click [New backdrop-Choose backdrop from library]. Select [Outdoors-School2] and apply. “Star2” from the sprite and apply.

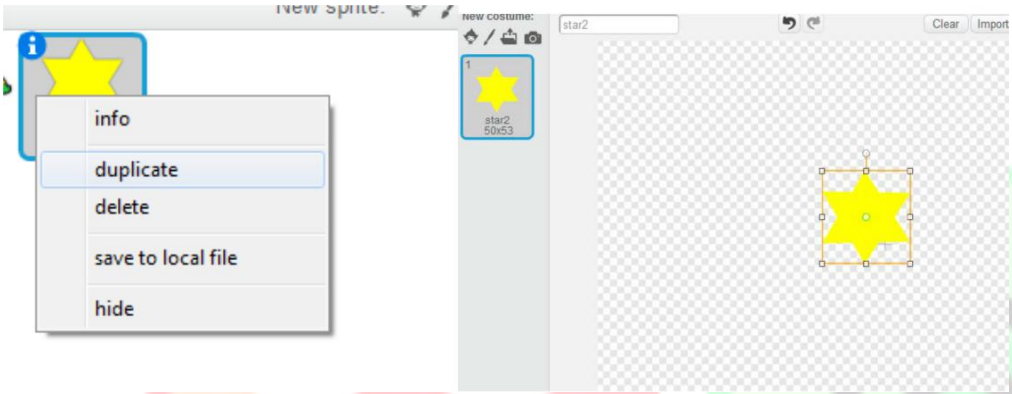


③ Click [New sprite-Choose sprite from library] and select [Transportation-Convertible3] from the library and apply.



④ Click [New sprite-Choose sprite from library] again and select [Things-Star2] from the library and apply.

⑤ Duplicate “Star2” and rename it to “Star3.Resize it to 50*53.

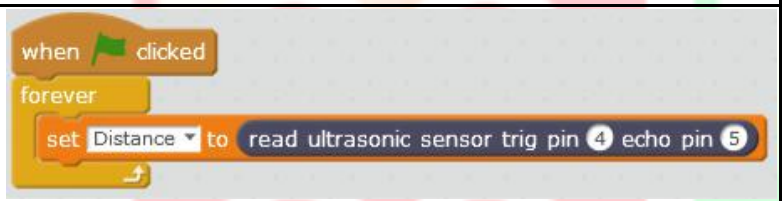


⑥ Sprite position will be determined by program.

Coding

Convertible3 sprite 

[Algorithm] When flag is clicked, the variable “Distance” is set to the reading of ultrasonic sensor

Coding	Location	Explanation
	Events Control Data&Blocks \MRTduino	When the flags is clicked Endless Loop Set “Distance” to ultrasonic reading

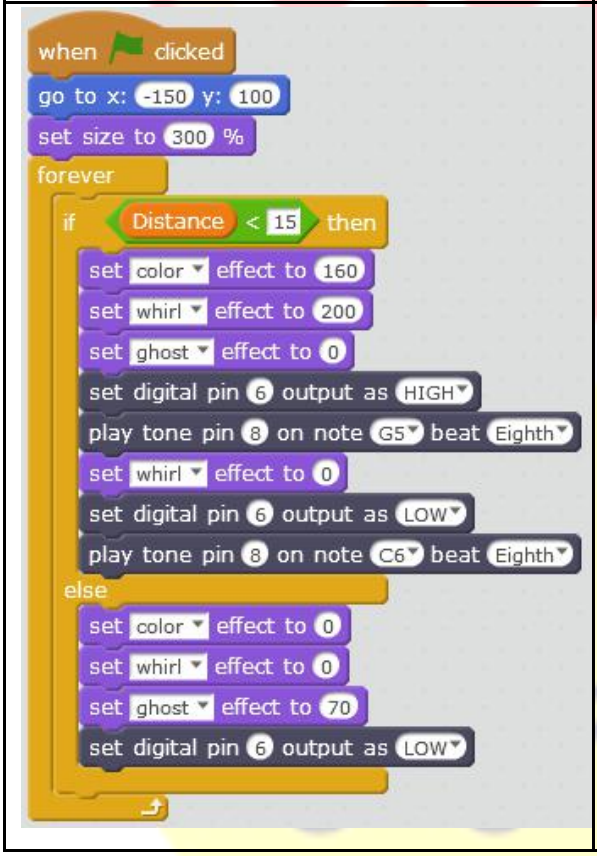
Star3 sprite 

[Algorithm] When flag is clicked, it will move to x:150, y:100.When distance is far, it will change to blue color and shown. LED-G is on. When distance is near, it will show its original color and partially disappeared. LED-G is off.

Coding	Location	Explanation
	Events Motion Looks Control Control>Operator\Data&Blocks Looks Looks MRTduino Control Looks Looks MRTduino	When the flags is clicked Move to x:150, y:100 Star3 become larger Endless Loop When the distance is far Change to blue color Star 3 is shown LED-G is on When the distance is near Original color is shown Star3 is partially disappeared LED-G is off

Star2 sprite

[Algorithm] When flag is clicked, it will move to x:-150, y:100. It will become bigger. If the distance is near (distance<15), it will become red turning whirl and shown. LED-R is on and note G5 on one-eighth is played. After that, star2 stops turning whirl, LED_R is off and note C6 on one-eighth is played. If distance is far, star 2 will show its original color, turning whirl and partially disappeared .LED-R is off.

Coding	Location	Explanation
	Events Motion Looks Control Control>Operator\Data&Blocks Looks Looks Looks MRTduino MRTduino Looks MRTduino MRTduino Control Looks Looks Looks MRTduino	When the flags is clicked Move to x:-150,y:100 Star become bigger Endless Loop When distance is near Change to red color Turning whirl Star2 is shown LED-R is on Play note G5 on one-eighth Stop turning whirl LED-R is off Play note C6 on one-eighth When distance is far Original color is shown Stop turning whirl Star2 is partially disappeared LED-R is off

Practice

When distance is near

When distance is far

Mission

The star will blink faster or slower according to the distance