ARVIND MAFATLAL GROUP

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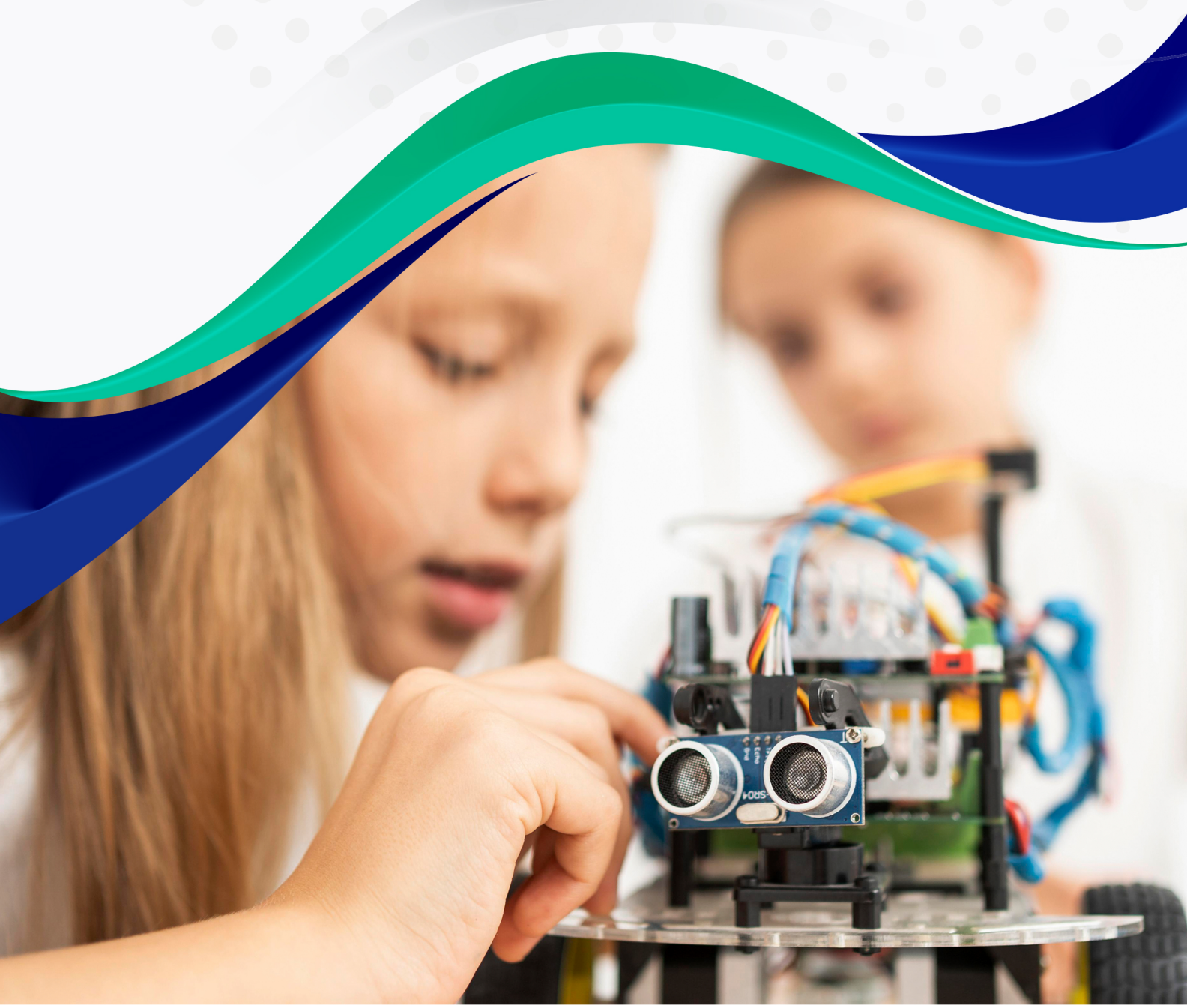
SENSORBOT



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Module-1: Introduction to Sensorbot

1.1. Introduction

The Sensorbot project is focused on exploring the independent capabilities of robots, particularly those embodied in Sensorbot—a sophisticated robotic vehicle equipped with a variety of sensors. In this project we will learn to program the electronic and mechanical components of Sensor Bot, gaining practical skills along the way.

Sensors are crucial, as they enable Sensor Bot to perceive and understand its environment, allowing it to navigate, avoid obstacles, follow lines, and solve mazes autonomously. Understanding how Sensorbot reacts differently based on what it senses will give you a hands-on understanding of robots and sensors. This experience will open doors for more exploration in robotics.

1.2. What is a robot?

A robot can be defined as a mechanical device capable of performing various tasks on the given command or according to instructions programmed in advance.

1.3. What is a sensor?

A **sensor** is a device which measures or detects a physical property and records, indicates, or responds to the given command.

Sensors can measure:

- Amount of light
- Colour of light
- Distance to an object
- Touch/amount of pressure
- Sound level
- Position
- Acceleration
- Magnetic field
- Temperature
- Humidity

- Amount of moisture
- Heartbeat
- Presence of smoke or gas
- Signal from remote control
- Radio waves

1.4. Why do we need robots?

Robots are used for various purposes in various areas where humans cannot perform much effectively. Some fields as such are:

- **Industry - Manufacturing**: Robots are used in making things like cars or gadgets. They can do tasks like assembling parts, welding, painting, and cutting metal.
- **Remote Operations**: Sometimes, robots go to places where it's too dangerous or hard for people to go, like deep under the ocean, in outer space, or places with radiation. They can help explore or do tasks in these places.
- **Service Sector**: Robots are also used to help people in places like hospitals, homes, and stores. In hospitals, they might help with surgeries or assist patients. At home, robots can clean floors or mow lawns. In stores, they might help stock shelves or count items.

Exercise 1

A. Multiple Choice Questions (MCQs):

1. What is SensorBot?

a) A mechanical device
b) A super smart robot car with sensors
c) A computer program
d) A book about robots

2. What is the purpose of sensors in SensorBot?

a) To make it heavier
b) To help it avoid obstacles and understand the world
c) To make it look cool
d) To drain its battery faster

3. What is a robot?
   a) A type of sandwich
   b) A mechanical device capable of performing tasks
   c) A type of bird
   d) A type of computer program

4. Why do we need robots in the industry?
   a) To make humans work harder
   b) To replace humans entirely
   c) To assist in tasks like manufacturing and welding
   d) To make coffee for humans

5. Where are robots used in the service sector?
   a) In outer space
   b) In hospitals, homes, and stores
   c) In schools only
   d) In amusement parks only

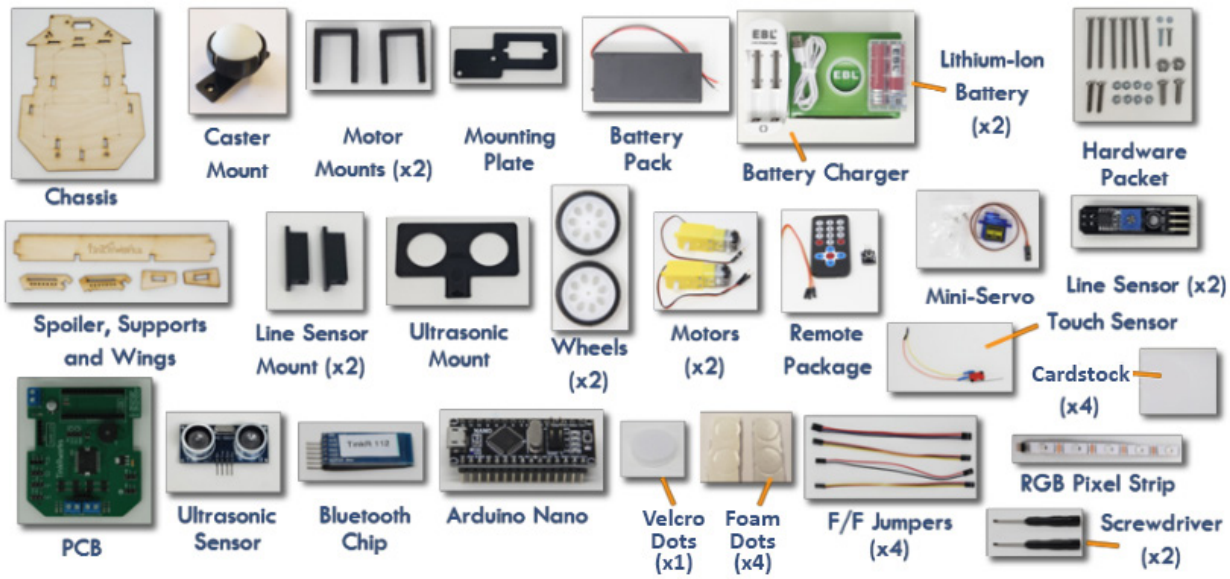
B. Fill in the Blanks:

1. A sensor is a device that detects or measures a physical property and _____.
2. Robots are used in various fields where humans cannot perform effectively, such as _____.
3. Sensors can measure a variety of things, including the amount of _____.
4. Robots in the service sector can help with tasks such as assisting patients in _____.
5. Sensorbot is like a super smart robot car with lots of sensors to help it _____ the world around it.

Module 2: Parts of Sensorbot

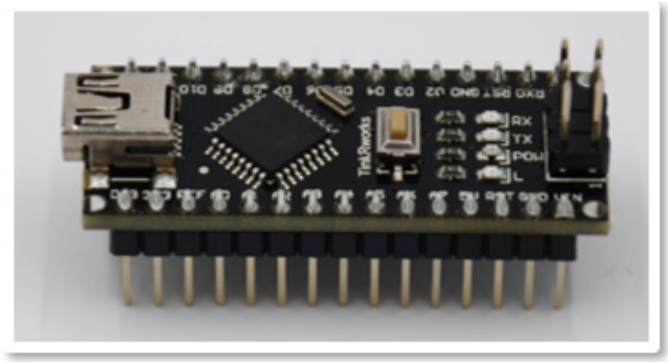
2.1. Kit Dissection

Following are the parts of our Morse code project.



In our Sensorbot we have various components like Arduino, PCB, Bluetooth etc. Now let's understand them one by one.

2.2. Arduino



The Arduino is a **microcontroller**

A small computer that can run simple programs.

Can be used to run motors, LEDS, many other components.

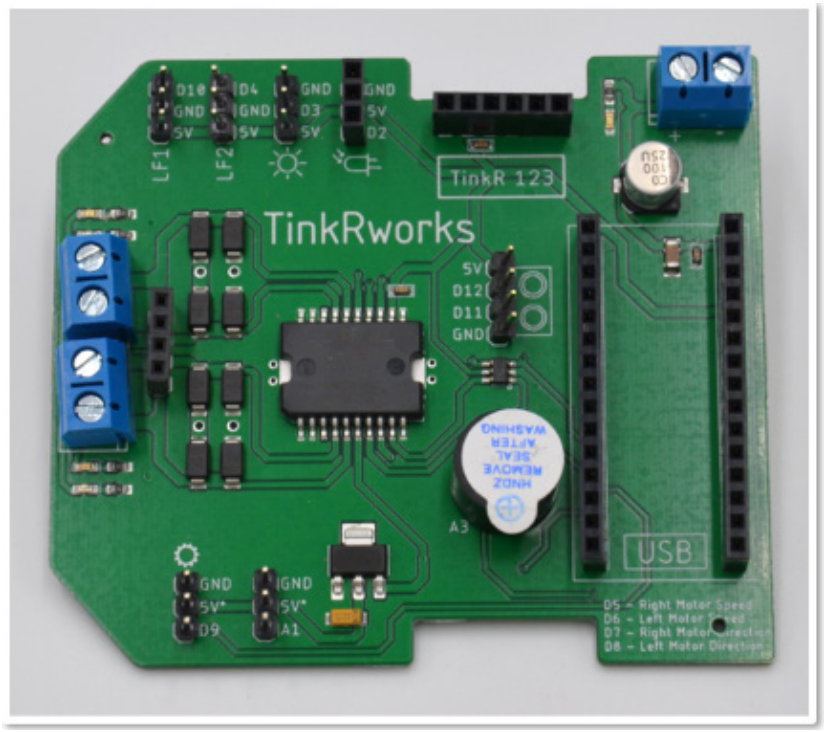
Can understand signals sent by sensors and other electronics.

There are several different types of Arduinos – we'll be using one called an **Arduino Nano**.

2.3. What's a PCB?

A printed circuit board (PCB) contains connections to all the electronic components of a device.

The PCB for this project was specially designed to contain the electronic connections we need for this bot.



Exercise 2

A. Multiple Choice Questions (MCQs):

1. Which of the following components is used for wireless communication in the robot?
   a) Caster Motor
   b) Ultrasonic Sensor
   c) Bluetooth Chip
   d) Servo Motor

2. The RGB pixel strip on the robot is most likely used for:
   a) Moving the robot
   b) Detecting obstacles
   c) Providing visual feedback
   d) Charging the battery

3. What is the main function of the line sensors in the robot?
   a) Measuring distance
   b) Detecting lines on the ground
   c) Gripping objects
   d) Powering the robot

4. The caster is most likely connected to which part of the robot?
   a) Battery Pack
   b) Remote Control
   c) Wheels
   d) Ultrasonic Sensor

5. A screwdriver is included in the robot kit. What is it primarily used for?
   a) Programming the robot
   b) Assembling the robot
   c) Charging the battery
   d) Controlling the robot remotely

6. What is an Arduino?
   a) A type of computer mouse
   b) A programming language
   c) A microcontroller platform used to build digital devices and interactive objects
   d) A type of sensor

7. How can you get familiar with the Arduino?
   a) By watching a tutorial
   b) By attending a seminar
   c) By listening to a podcast
   d) By playing a game

8. What does PCB stand for?
   a) Printed Circuit Board
   b) Personal Computer Board
   c) Power Control Block
   d) Programmable Circuit Breaker

9. What is the purpose of attaching an Arduino Nano?
   a) To charge the battery
   b) To connect to the internet
   c) To control Sensorbot's movements
   d) To play music

10. What is the purpose of installing a battery in SensorBot?
   a) To provide power for the sensors
   b) To provide power for the motors
   c) To provide power for the lights
   d) All of the above

B. State True or False:

1. Arduino is a small computer that performs complex problems
2. PCB contains all the electronic connections to the components in the device

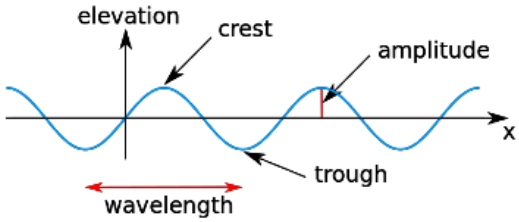
C. Fill in the Blanks:

1. An ultrasonic sensor uses _____ to measure distance in robotics.
2. The primary purpose of a line-following sensor is to detect _____ on the ground.
3. An RGB LED strip can emit light in _____, _____, _____ different colours.
4. A servo motor is typically used for precise control of _____ and _____.
5. A touch sensor can detect _____ when a robot is touched or pressed.

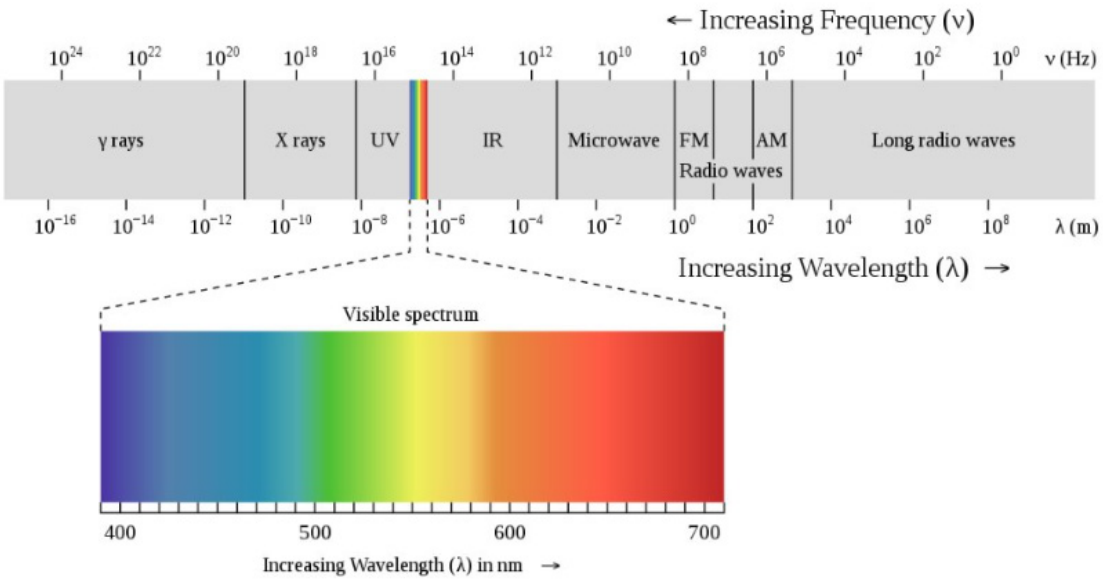
Module-3: Lights

3.1. What is light?

Light is a form of energy that can travel in a straight line like a wave. The length between crest and trough in the wave is called wavelength.



3.2. Wavelengths of light



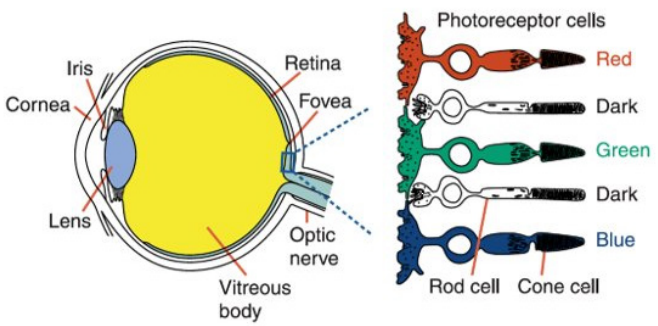
3.3. How do our eyes sense the different colours?

The human eye has 4 types of photoreceptors that detect light.

Three types of cells detect colour and are called cones.

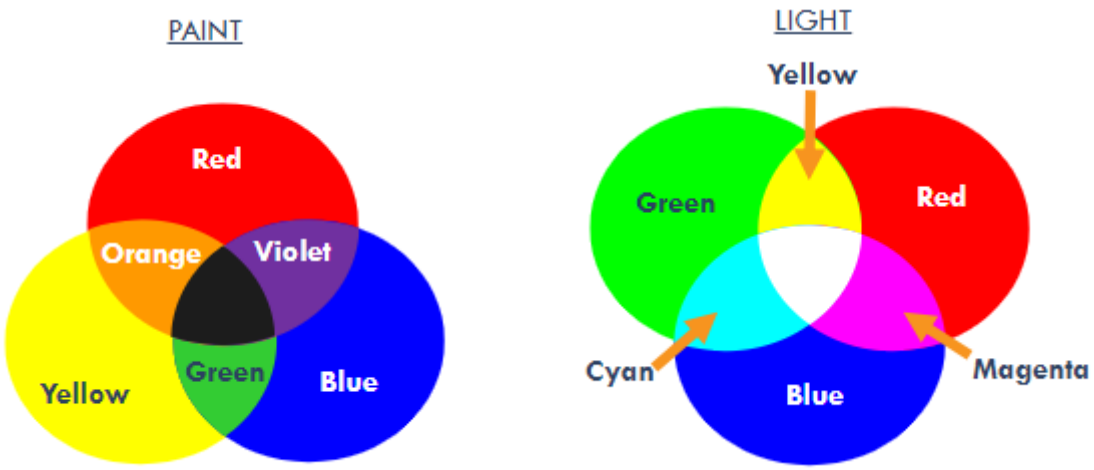
Cones need a medium or higher amount of light to detect colour.

Rods detect low levels of light, but do not detect colour.

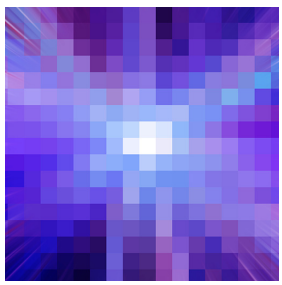


3.4. Mixing Colours

By mixing the primary colours we get multiple different secondary colours. Primary colours in lights are different from the basic primary colours. We consider Red, Green and Blue as the primary colours in lights. Let's understand with an example.



3.5. Digital screens



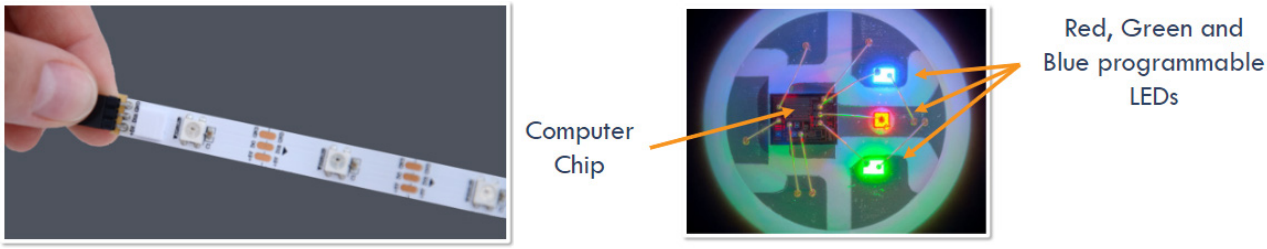
Digital screens are made up of thousands of tiny squares called pixels.

Each pixel contains a red, a green, and a blue light.

When you zoom in, they look like this.

3.6. RGB Pixel

In our project, we will use RGB pixels to display different colours as indicators of the sensorbot.



3.7. RGB colour codes chart

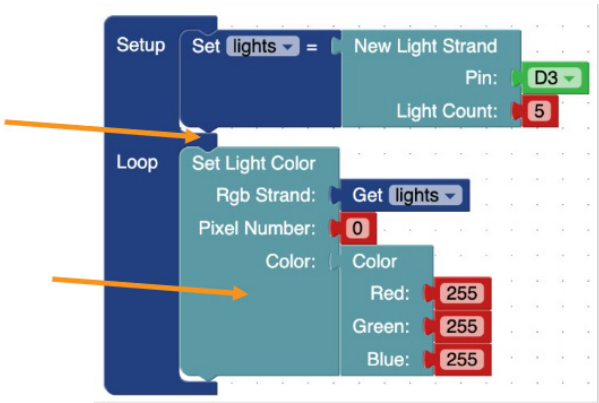
- You can change the colour and brightness of each pixel using programming.
- The intensity level of each colour depends on the values you can use are between 0 and 255.
- The combination of these values creates a colour.
- These values create a colour with full green, full blue, and no red.

COLOR	NAME	RED	GREEN	BLUE
	WHITE	255	255	255
	RED	255	0	0
	GREEN	0	255	0
	BLUE	0	0	255
	YELLOW	255	255	0
	HOT PINK	255	0	150
	PURPLE	200	0	255
	TURQUOISE	0	255	255
	ORANGE	255	100	0
	LIME	100	255	0

3.8. Programming the RGB pixel

This block tells the Arduino how many LEDs we have and what pin they are connected to. Change the pin to D3 as it is connected to D3 pin in PCB circuit.

This block tells the Arduino what color to make one RB Pixel.



3.8.1. Variables

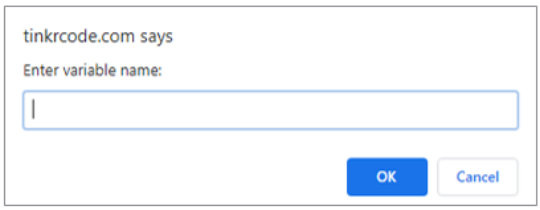
A Variable is a temporarily storage location with a specific name.

A variable can contain numbers, text, datasets, actions, etc.

If you want to use other Variables, you must first create them.

To do this, go to the Variables drawer and click on New Global Variable.

This box will appear. Name your variable and click OK.



This block will appear somewhere on your workspace.

3.8.2. Using Variables

To assign the variable a value, use the "Set" block.

If you want to use a variable, you use the "Get" block.

You can change the value of a variable by using a second "Set" block.

If your variable is a number, you can use it to do math.

3.8.3. Variables as Counters

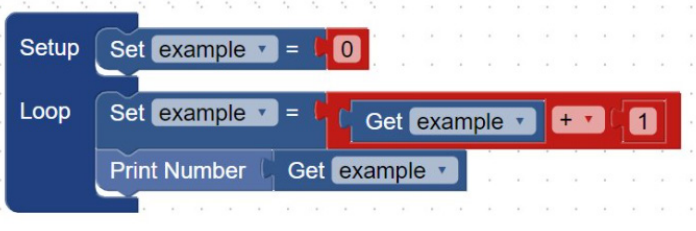
You can use a Variable to count how many loops have passed.

In your Setup (which only runs once) set the variable to 0.

Use math to add to the variable.

We can use a Print block to see the variable values as the loop runs.

Click 'Run'



Exercise 3

A. Multiple Choice Questions (MCQs):

1. What is light?

a) A type of food
b) An energy that can travel in a straight line in the form of waves
c) A type of music
d) A type of clothing

2. How do our eyes sense different colours?

a) By tasting them
b) By smelling them
c) By seeing them
d) By hearing them

3. What are the primary colours of lights?

a) Red, yellow, blue
b) Red, green, blue
c) Red, purple, orange
d) Red, black, white

4. What is an RGB pixel used for in the project?

a) To measure temperature
b) To display different colours as indicators of the SensorBot
c) To play music
d) To detect motion

5. What is the RGB colour code range?

a) 0 to 10
b) 0 to 100
c) 0 to 255
d) 0 to 1000

6. In the RGB colour code system, what values create a colour with full green, full blue, and no red?
   a) Red = 0, Green = 255, Blue = 255
   b) Red = 255, Green = 0, Blue = 255
   c) Red = 0, Green = 0, Blue = 255
   d) Red = 255, Green = 255, Blue = 0

B. Fill in the Blanks:

1. Wavelengths of light are measured in _____.
2. Our eyes sense different colours by detecting different wavelengths of _____.
3. Digital screens use tiny dots called _____ to display images.
4. Variables are used in programming to store _____.
5. An RGB colour chart helps in selecting specific _____ for the RGB pixel.
6. Mixing the primary colours red, green, and blue in lights produces various _____ colours.

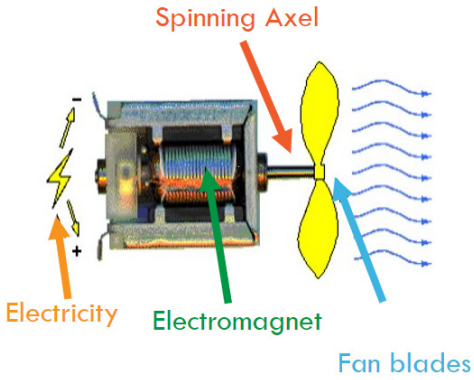
Module 4: Introduction to Motors

4.1. What is a motor?

A motor is a rotary machine, driven by an electrical current. It Converts electrical energy into mechanical energy.

Rotary machine = machine with rotating part

Our bots have two motors to move around.



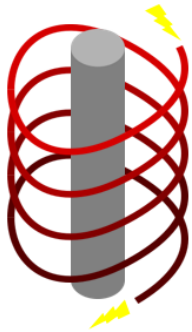
4.2. How does a motor work?

Inside the motor is an electromagnet.

An **electromagnet** is a device that turns into a magnet when you run electricity through it.

You can make an electromagnet just by making a coil of wire and putting electricity through it.

You can also put a piece of metal inside of the coil to make the magnetic field stronger.



4.3. Changing the speed of a motor

The speed of a motor can be changed by either increasing or by decreasing the voltage into the motor.

"**Voltage** is the amount of electrical power available to push electricity through a circuit and is measured in units of Volts."

Exercise 4

A. Multiple Choice Questions (MCQs):

1. What is a motor?

a) A machine that converts mechanical energy into electrical energy
b) A machine that converts electrical energy into mechanical energy
c) A machine that produces light energy
d) A machine that converts sound energy into mechanical energy

2. How does a motor work?

a) By converting mechanical energy into electrical energy
b) By converting electrical energy into mechanical energy
c) By converting mechanical energy into heat energy
d) By converting electrical energy into heat energy

3. Which energy transformation occurs in an electric motor?

a) Electrical to mechanical
b) Mechanical to electrical
c) Electrical to thermal
d) Mechanical to thermal

4. Changing the speed of a motor involves:

a) Adding more weight to the motor/bot
b) Decreasing the electrical current to the motor
c) Increasing the electrical current to the motor
d) Increasing the colour of the bot casing

5. What is the function of a rotary machine?

a) To produce sound
b) To generate heat
c) To rotate or spin
d) To produce light

6. How many motors do our bots have to move around?
   a) One
   b) Two
   c) Three
   d) Four

7. Why do our bots have two motors?
   a) To increase stability
   b) To improve mobility
   c) To provide backup in case one fails
   d) To increase the number of spinning parts

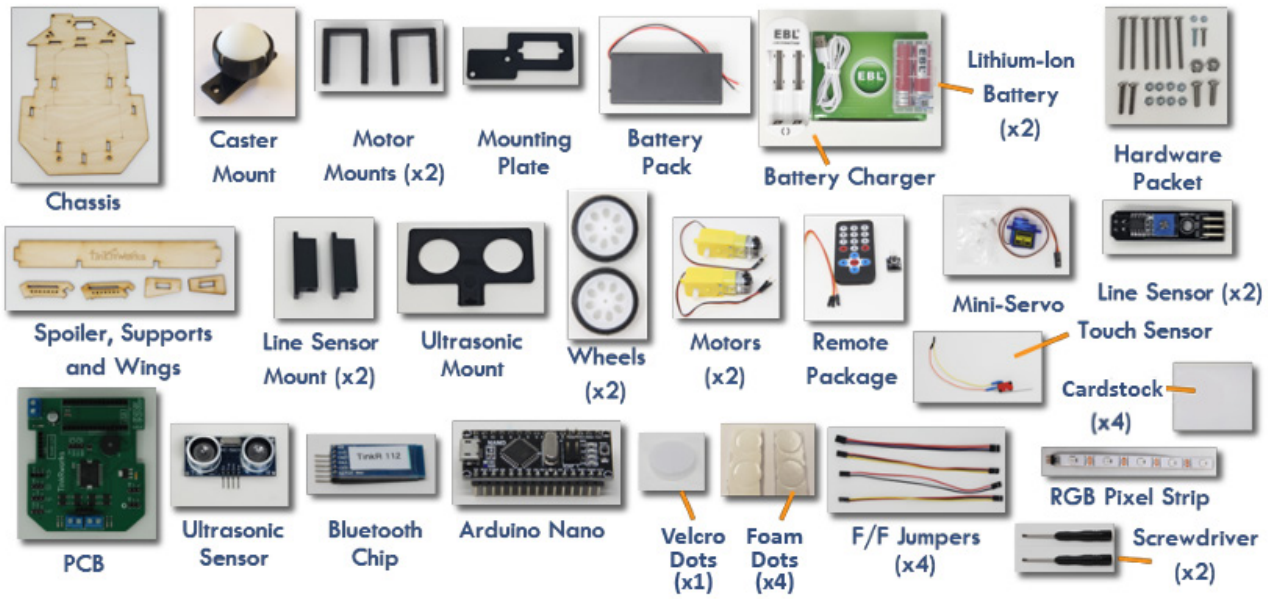
B. Fill-in-the-Blank Questions:

1. A motor is a machine that converts _____ into _____ energy.
2. The speed of a motor can be adjusted by changing the amount of _____ flowing to it.
3. A rotary machine is a machine with a _____ part.
4. In robotics, motors are used to create _____.
5. Our bots use _____ motors to move around.

Module 5: Understanding Sensorbot Components

5.1. Kit Dissection

These are the parts we will be using while building our Sensorbot project.

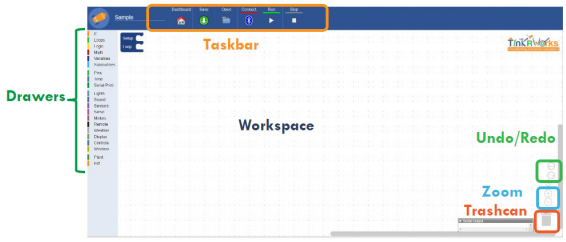
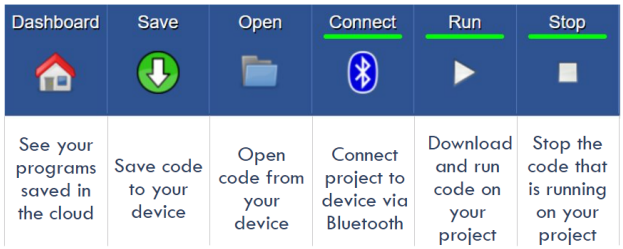


Module 6: Programming Movement

6.1. TinkRCode

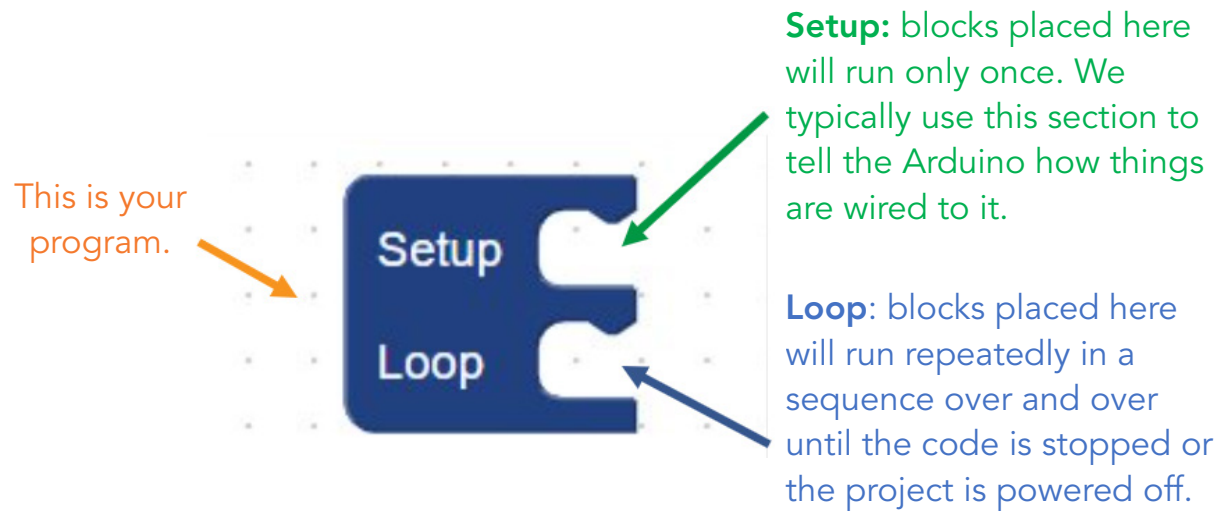
To program our robot, we need to establish a connection with a computer and in the computer, we must have a programming platform. For this project, we will be using a cloud-based programming platform called "TinkRcode.com". Let's learn how to use the platform.

How do we program our bot?	
• Go to tinkrcode.com or open the TinkRcode app. • Select "Sign In" • Enter the organization, username, and password you have been given.	
Make a New Program	

TinkRcode Anatomy	
Run your program	

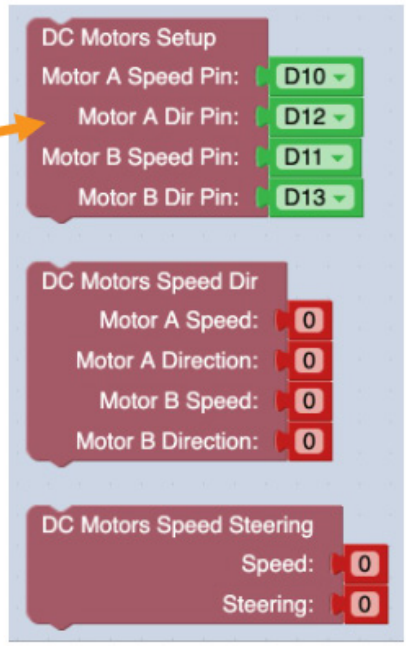
6.2. TinkRcode Program Block

- TinkRcode uses drag-and-drop coding blocks.
- What's this block for?



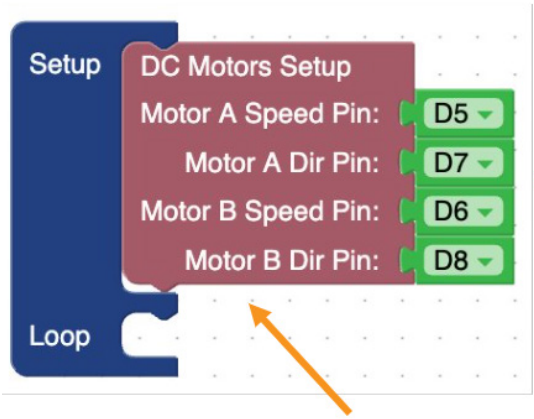
6.2.1. TinkRcode Motor Blocks

Select "DC Motors Setup" and drag it out of the drawer.



Click on "Motors" to find coding blocks for steering.

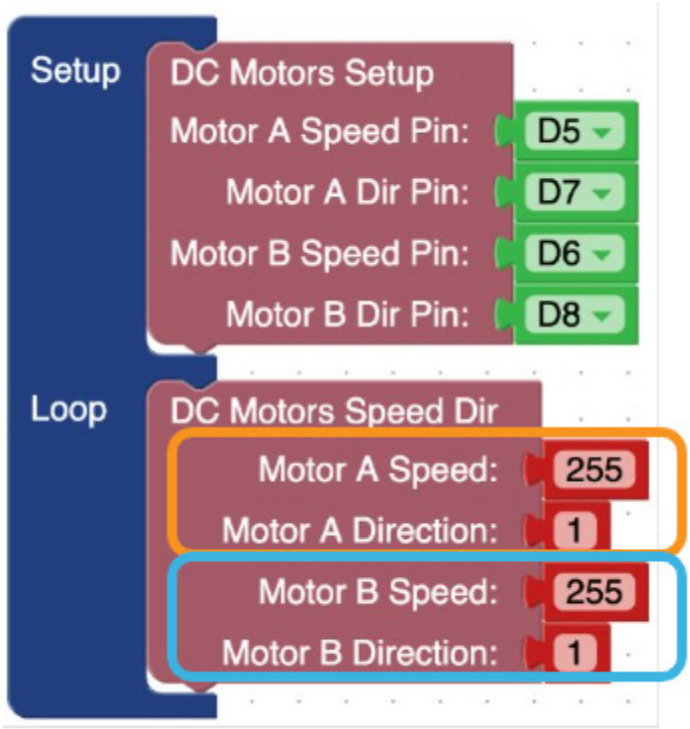
6.2.2. Motor's setup



Change the Speed and Direction Pin numbers for Motors A and B to match the digital pins where the motor wires connect to the Arduino board.

This block tells the Arduino which digital pins control each motor.

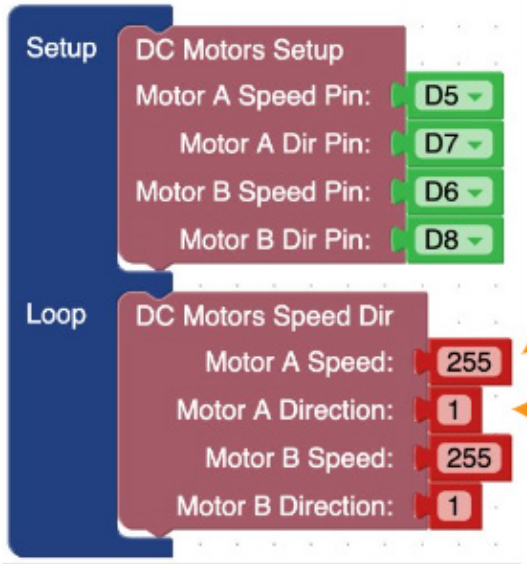
6.2.3. Add Motors speed direction block



Motor A = Right motor

Motor B = Left motor

6.2.4. Add numbers to move motors



Speed Range:

0 – 255

(Stop) (Full speed)

Direction can be:

1 = Forward

0 = Backward

Go ahead and program both motors to go forward to make sure that all your wires are connected up correctly.

Exercise 5

A. Multiple Choice Questions (MCQs):

1. How do we program our bot using TinkRCode?
   a) By writing code on a piece of paper
   b) By using a cloud-based programming platform called TinkRcode.com
   c) By sending Morse code signals
   d) By singing a song to the bot

2. What is the purpose of learning how to wire motors?
   a) To connect the bot to the internet
   b) To understand how motors work
   c) To charge the bot's battery
   d) To cook dinner for the bot

3. What is the purpose of installing Bluetooth?
   a) To make the bot fly
   b) To connect the bot to other devices wirelessly
   c) To play music for the bot
   d) To change the colour of the bot's lights

4. What is the main feature of TinkRCode program blocks?
   a) They are made of wood
   b) They can be eaten
   c) They use drag-and-drop coding
   d) They are invisible

5. What does the "Motor's setup" block do in TinkRCode?
   a) It sets up the bot's motors for programming
   b) It sets up a picnic for the bot's motors
   c) It teaches the bot's motors to dance
   d) It sets up a race for the bot's motors

B. Fill-in-the-Blank Question:

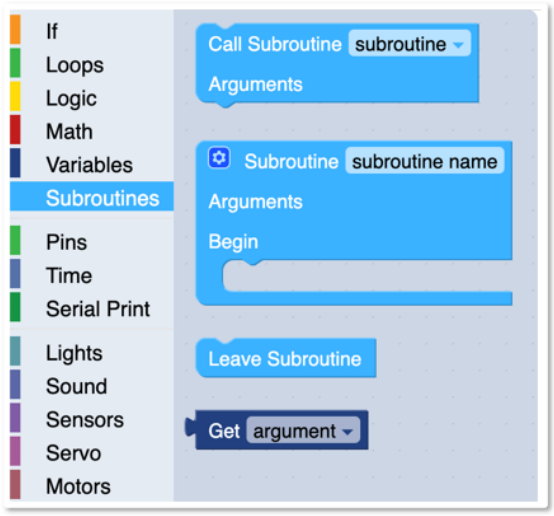
1. The speed for motor A and motor B in the SensorBot can be set between _____ and _____.
2. To move the SensorBot forward, the speed for both motors must be greater than _____. Additionally, to move forward, the direction for both motors should be set to _____.
3. To move backwards, the direction for both motors should be _____.
4. If motor A's direction is set to 1 and motor B's direction is set to 0, with both motors running at 150, the SensorBot will _____.

Module 7: Subroutines

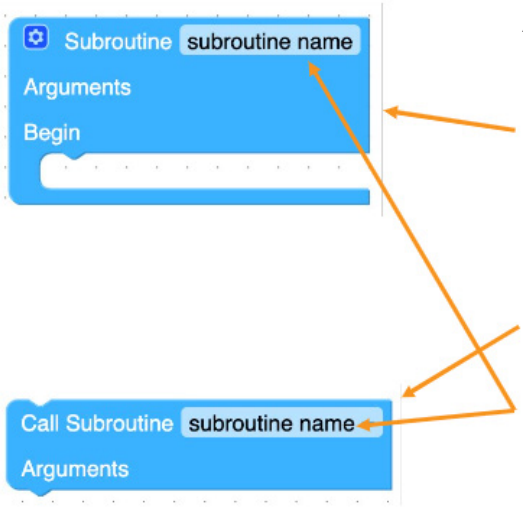
7.1. Introduction

A subroutine is a sequence of commands that are grouped and given a name. It can be run by calling it, using its name. In TinkRcode, you can think of a subroutine as a custom-made command.

7.2. How to create a subroutine



Subroutine blocks are found in the subroutine drawer.



A subroutine is made using two blocks:

- The Subroutine block is the *definition* that contains all the code that the subroutine will run when it's called.
- The Call Subroutine block tells the Arduino to run all the code that's packed into the subroutine's definition.
- The two blocks are linked by a shared name.

Exercise 6

A. Multiple Choice Questions (MCQs):

1. What is a subroutine?
   a) A type of fruit
   b) A sequence of commands grouped and given a name
   c) A type of vehicle
   d) A type of animal

2. What is the purpose of a subroutine?
   a) To confuse programmers
   b) To make programming easier by grouping commands together
   c) To increase the size of the program
   d) To make the program run slower

3. How can you create a subroutine in TinkRCode?
   a) By singing a song
   b) By typing random letters on the keyboard
   c) By grouping commands and giving them a name
   d) By pressing random buttons

4. What is the function of a subroutine in TinkRCode?
   a) To make the program more colourful
   b) To make the program run faster
   c) To organize and simplify the program
   d) To make the program disappear

5. How can you run a subroutine in TinkRCode?
   a) By turning off the computer
   b) By calling it using its name
   c) By deleting it from the program
   d) By hiding it in a secret folder

B. True or False:

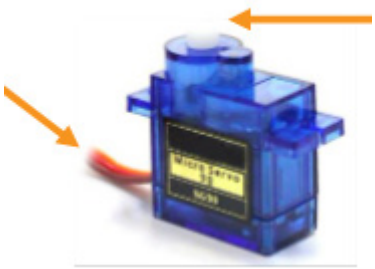
1. Subroutine blocks can be found in a variable drawer.
2. A subroutine is a sequence of commands that can be combined and given a name.
3. A subroutine minimizes the programming space.

Module 8: Servo

8.1. Introduction

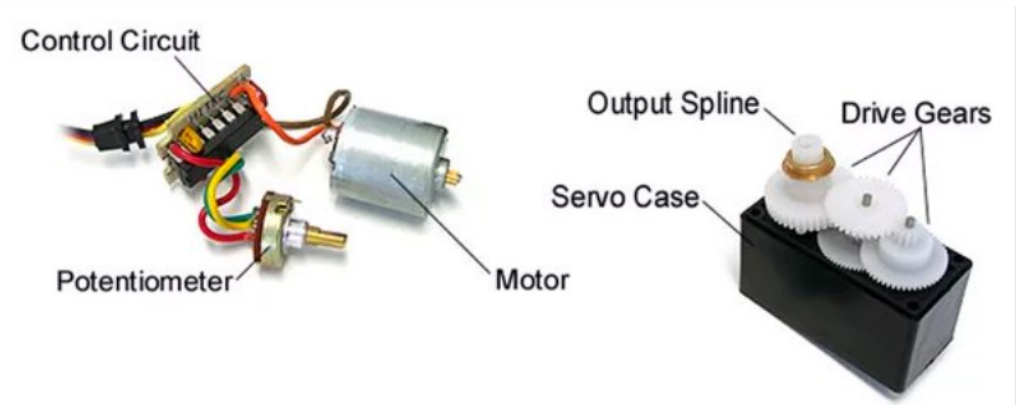
A servo is a motor that can turn to a specific angle between 0° and 180°

The servo motor is powered via 5V power and ground wires. It receives a control signal through a wire that plugs into a digital pin.



The head of the servo motor will turn. It has teeth on it like a gear so it can connect with other components.

8.2. Servo Mechanics



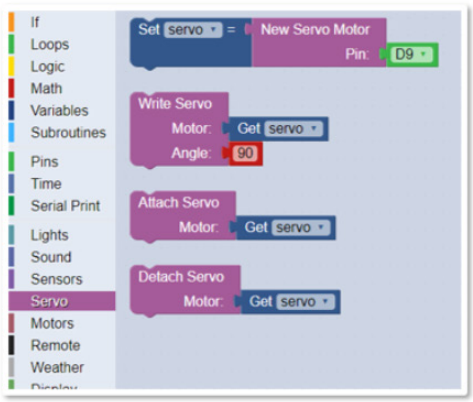
8.2.1. How do servos work?

1. The Arduino tells the control circuit what position to turn to (0 to 180 degrees).
2. The control circuit reads the current position of the servo shaft with the potentiometer.
3. The control circuit turns on the motor (in either direction) until it matches the position that the Arduino has requested.

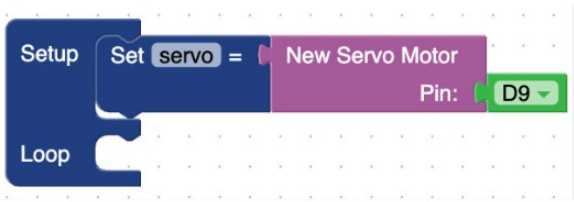
- The control circuit adjusts the motor's speed depending on how far the current position is from the desired position.
- If the motor is near the instructed position, it will turn slowly, otherwise, it will turn quickly.
- This is called proportional control. This means the motor will only work as hard as necessary to accomplish the task at hand.

8.2.2. Setting up Servo

The blocks you'll need are found in the Servo drawer.



In setup, you'll need to initialize the servo



8.2.3. Attach and Detach Servo

- To start the Arduino communicating with the Servo you need to first "attach" it.
- Then you can tell the servo where to move.
- The delay gives the servo time to move.
- Then you want the Arduino to stop talking or "detach" from the servo.

Exercise 7

A. Multiple Choice Questions (MCQs):

1. What is a servo?

a) A type of fruit
b) A type of motor
c) A type of computer program
d) A type of clothing

2. What is the range of angles a servo can turn to?

a) 0° to 360°
b) 0° to 90°
c) 0° to 180°
d) 0° to 270°

3. How does a servo work?

a) By using magnets
b) By converting electrical energy into mechanical energy
c) By turning to a specific angle based on signals from the Arduino
d) By spinning continuously

4. What does the control circuit of a servo do?

a) Reads the current position of the servo shaft with a potentiometer
b) Adjusts the motor's speed depending on the desired position
c) Tells the Arduino what position to turn the servo to
d) Controls the colour of the servo

5. What is proportional control in servos?

a) When the servo turns at a fixed speed
b) When the servo turns slowly regardless of the desired position
c) When the motor adjusts its speed depending on how far the current position is from the desired position
d) When the motor turns quickly regardless of the desired position

B. Fill-in-the-Blank Questions:

1. A servo motor is typically used to control _____ and _____ in a precise manner.
2. A servo motor is controlled by sending it _____ of varying widths to indicate the desired position.
3. Servo motors can be connected to Arduino using the _____ pin, which allows communication of control signals.
4. To ensure accurate control of a servo motor, a _____ is typically used within the motor to determine its current position.
5. The _____ control method in servo motors adjusts the motor's speed depending on the distance between the current position and the desired position.
6. When setting up a servo motor in Arduino, you need to define which _____ the servo motor will use to receive its control signal.
7. Servos are commonly used in robotics because they offer precise _____ and _____ capabilities for various components.

Module 9: Ultrasonic Sensor

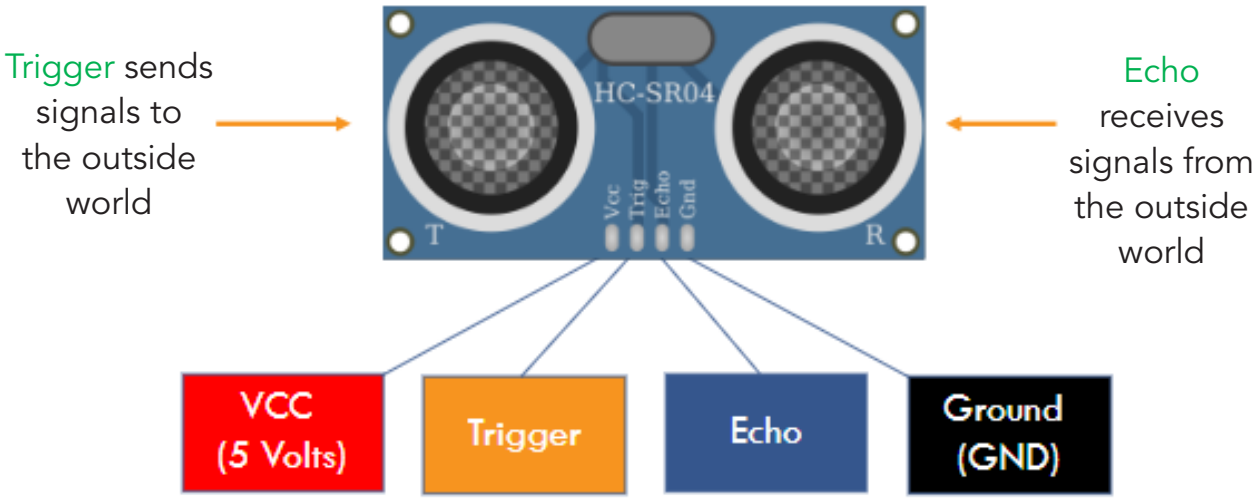
9.1. Introduction

The ultrasonic sensor sends a sound wave (that you can't hear) and counts how long it takes for the sound to bounce back.

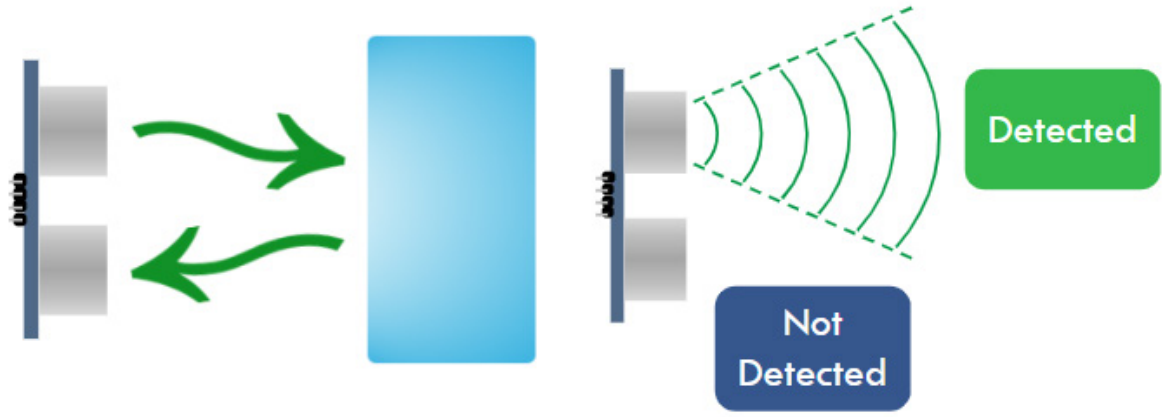
This side Transmits the sound wave.

This side Receives the reflected sound wave.

9.1.1. Pins that connect to the Arduino



9.2. How it works?



An ultrasonic sensor is a device that uses sound you can't hear to figure out how far away things are. It sends out sound waves that bounce off objects and come back, and then it measures how long it takes for them to come back. Based on that time, it can tell how far away the objects are. So, it's like using sound to see how close or far things are from you!

9.3. Our sensor works like echolocation!

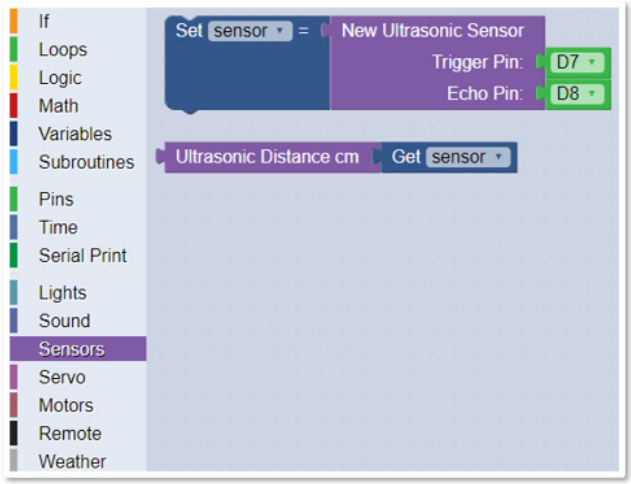
Echolocation is a technique used by bats, dolphins and other animals to determine the location of objects using reflected sound. This allows the animals to move around in darkness, so they can navigate, hunt, identify friends and enemies, and can avoid obstacles.

To understand more about echolocation let's watch this video.

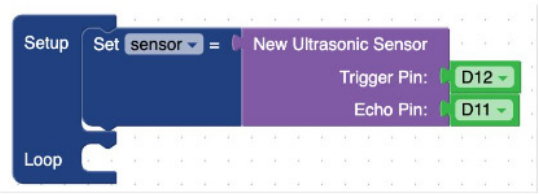
9.3.1. Other animals who use echolocation

9.4. Programming Ultrasonic Sensor

9.4.1. Setup Ultrasonic Sensor



- From the sensor drawer, get a sensor setup block, and add it the setup part of your program.



- Change the Trigger Pin to D12 & the Echo Pin to D11.

- Pull this block from the Sensor drawer.
- This block checks to see if the Ultrasonic sensor detects something.
- If it has detected something, it tells you how far away that object is.

9.4.2. Making Decisions

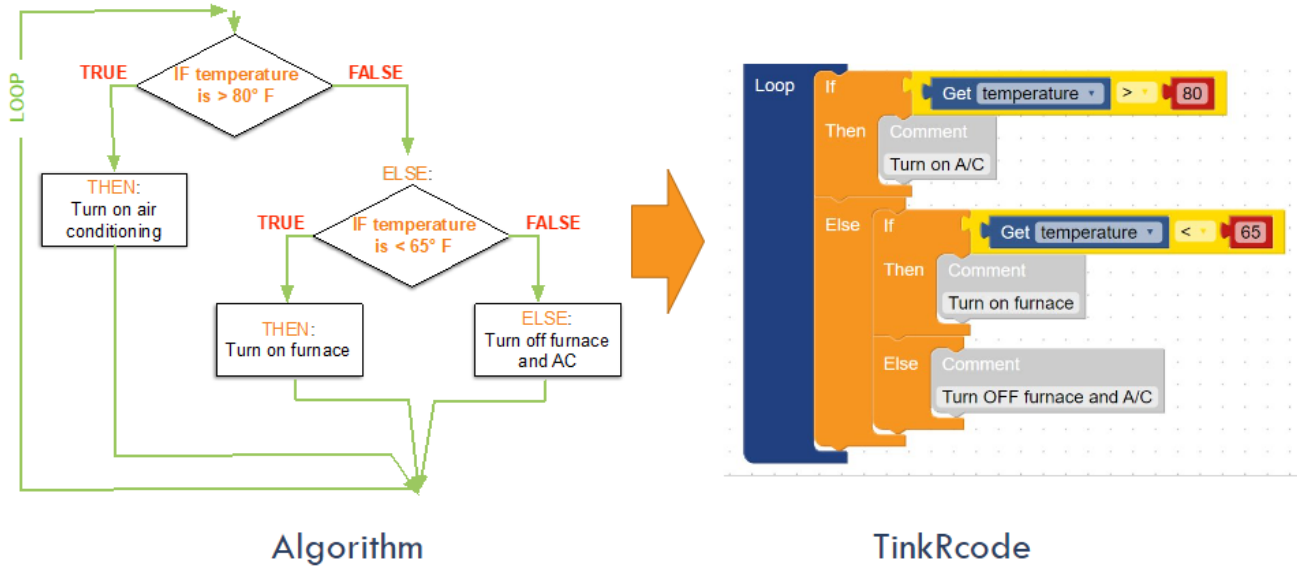
Based on the distance calculated by the ultrasonic sensor the robot can be programmed to execute different tasks. This is called making decisions.

We want our robot to react to objects in the environment.

It will have to make decisions about how to move based on what it 'sees.'

For this, we will need to use a conditional statement.

9.4.3. How would this look in TinkRcode?



Algorithm TinkRcode

Exercise 8

A. Multiple Choice Questions (MCQs):

1. What does the ultrasonic sensor do?

a) Sends visible light waves
b) Sends sound waves
c) Measures temperature
d) Measures humidity

2. How does the ultrasonic sensor determine the distance to objects?

a) By counting the number of objects
b) By measuring the colour of the objects
c) By sending out sound waves and measuring the time it takes for them to bounce back
d) By using GPS coordinates

3. What technique does the ultrasonic sensor work similar to?
   a) Sonar
   b) Radar
   c) Echolocation
   d) Infrared sensing

4. What is the purpose of assembling the ultrasonic sensor?
   a) To make it look nicer
   b) To understand its internal components
   c) To increase its range
   d) To make it waterproof

5. How can you program the ultrasonic sensor to make decisions based on distance?
   a) By using colour codes
   b) By using GPS coordinates
   c) By using conditional statements
   d) By using Morse code

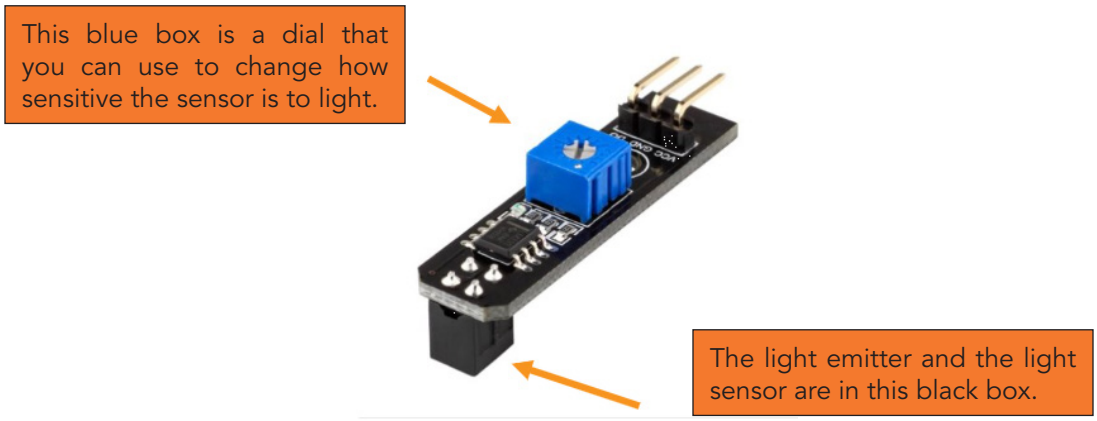
B. Fill in the Blanks:

1. Pins that connect to the Arduino are typically _____ or _____.
2. Other animals who use echolocation include _____ and _____.
3. Ultrasonic sensor measures the distance of a target object in _____ or _____.
4. How would this look in TinkRcode? - You would use _____ to make decisions based on ultrasonic sensor readings.

Module 10: Reflectance Sensor

10.1. Introduction

The sensor sends out a special kind of light that we can't see with our eyes, called infrared light. Then it looks for this light bouncing back from objects. That's why we call it a reflectance sensor!



10.2. How does it work?

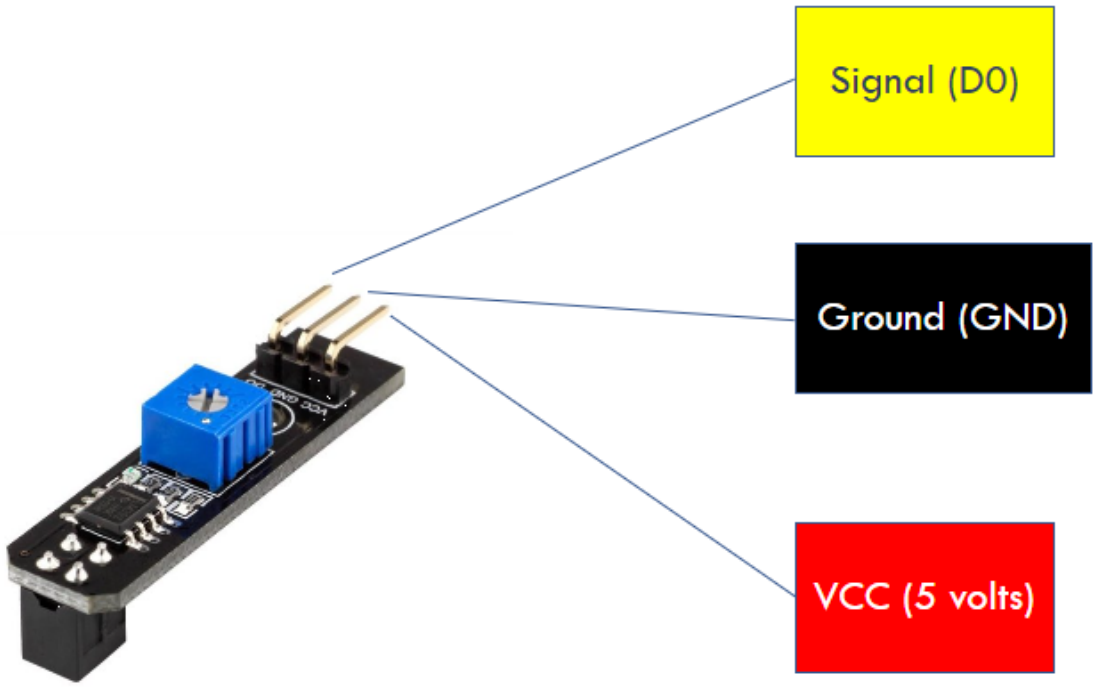
Reflectance sensors transmit IR light and measures how much bounces/reflects back.

Bright surfaces absorb a little and reflect a lot.

Dark surfaces absorb a lot and reflect little.

Based on how much light is reflected, the Arduino can determine what surface the bot is over.

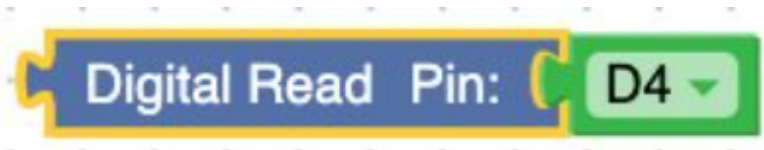
10.3. Reflectance Sensor Wiring



10.4. Programming Reflectance Sensor

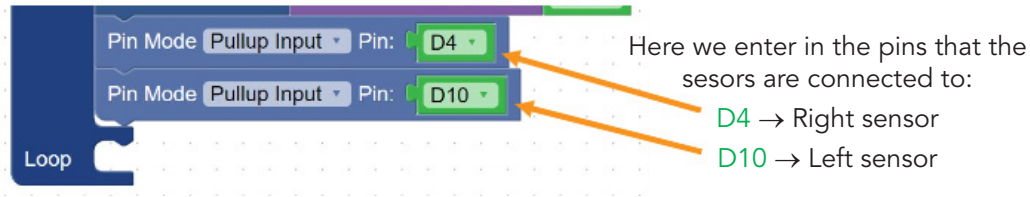
10.4.1. Setup Reflectance Sensor

- To access data coming from the Reflectance sensors, we will read directly from the **digital pins** they are attached to.
- The **Digital Read** block accesses the data coming from a digital pin.
- Digital pins use **Binary**
  - Binary is a system that uses 0s and 1s.
  - 0 means false.
  - 1 means true.



- The reflectance sensor pin will give us
  - A **True** if it senses a **dark** surface.
  - A **False** if it senses a **light** surface.

10.4.2. Setup Reflectance Sensor using Pin Mode Block



- We need to tell the Arduino how we want our pin data.
- Options are:
  - Output: Used when the Arduino sends a value to a device.
  - Input: Used when the Arduino reads a value from a device: this gives us gives us a True if it detects something dark and false when it detects something light

- Pullup Input: Returns the same data as Input, but is required for the Arduino to understand the sensors.

10.4.3. Print output

- When we talk about Binary responding in a **True** or **False**, we call it a **Boolean**.
- When we wanted to print out a number, we used 

- Now we need to use 

- We are going to label what prints out so we know what it is. To do that, we will use

Exercise 9

A. Multiple Choice Questions (MCQs):

1. What type of light does the reflectance sensor use?
   a) Visible light
   b) Ultraviolet light
   c) Infrared light
   d) X-ray light

2. How does the reflectance sensor work?
   a) It emits sound waves and measures their reflection
   b) It emits visible light and measures its reflection
   c) It emits infrared light and measures its reflection
   d) It emits radio waves and measures their reflection

3. What is the purpose of installing the Reflectance Sensor?
   a) To learn about light reflection
   b) To increase the brightness of the sensor
   c) To enable the sensor to follow black or white line
   d) To measure temperature changes

4. What does Reflectance Sensor Wiring involve?
   a) Connecting the sensor to a computer
   b) Attaching the sensor to a robot
   c) Setting up the sensor's power source
   d) Connecting the sensor to the Arduino or microcontroller

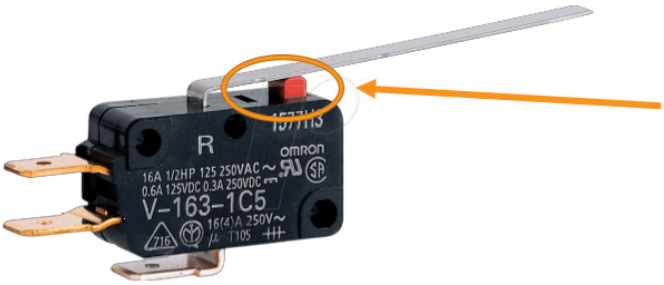
5. What is the first step in programming the Reflectance Sensor?
   a) Setting up the sensor
   b) Calibrating the sensor
   c) Installing the sensor
   d) Writing code to control the sensor

B. Match the following:

1.	black wire	a)	Signal
2.	yellow wire	b)	GND
3.	red wire	c)	Vcc

Module 11: Touch Sensor

11.1. Introduction



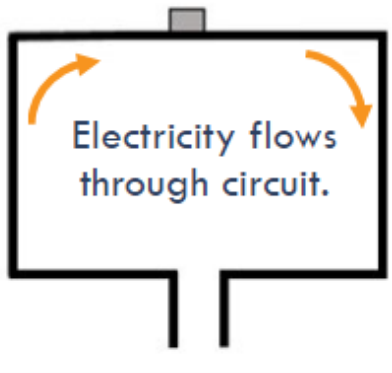
This is called a **lever switch**.

When the lever is pushed (as indicated by the arrow), it triggers the circled switch (in red) to close.

If this is put at the front of a robot, the robot can detect when it bumps into an obstacle.

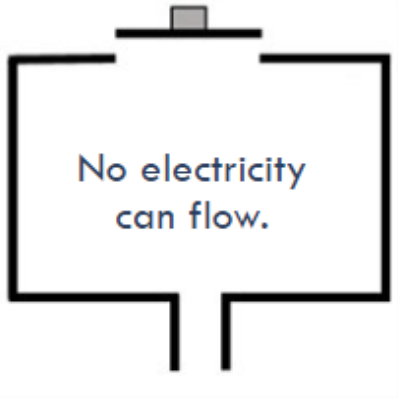
11.2. How does the Touch Sensor work?

When the switch closes it completes a circuit, allowing electricity to flow through.



Pins reads 0 or 'False'

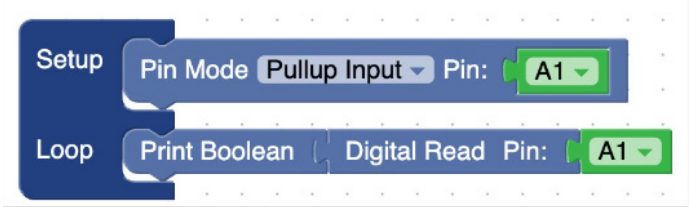
When the lever is released, the circuit becomes incomplete, and electricity cannotflow through.



Pins reads 1 or 'True'

11.3. Programming Touch Sensor

11.3.1. Setup Touch Sensor



The Touch Sensor is connected to an analog pin, but we are going to read it digitally.

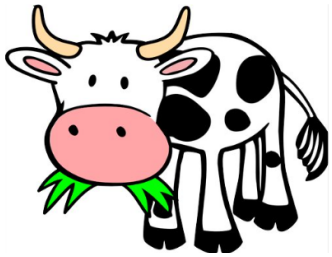
To see what value the sensor is returning, create a print command that reads the value on pin A1 and prints it out.

11.3.2. Introducing Function and How does the function work?

A function takes inputs, performs some operations on those inputs and creates output(s).

Here's a real-world example:

Inputs



Function

Output

A function is a subroutine that produces something.

It is made up of instructions that are used to create output from the input.

Here's what it looks like in TinkRcode:

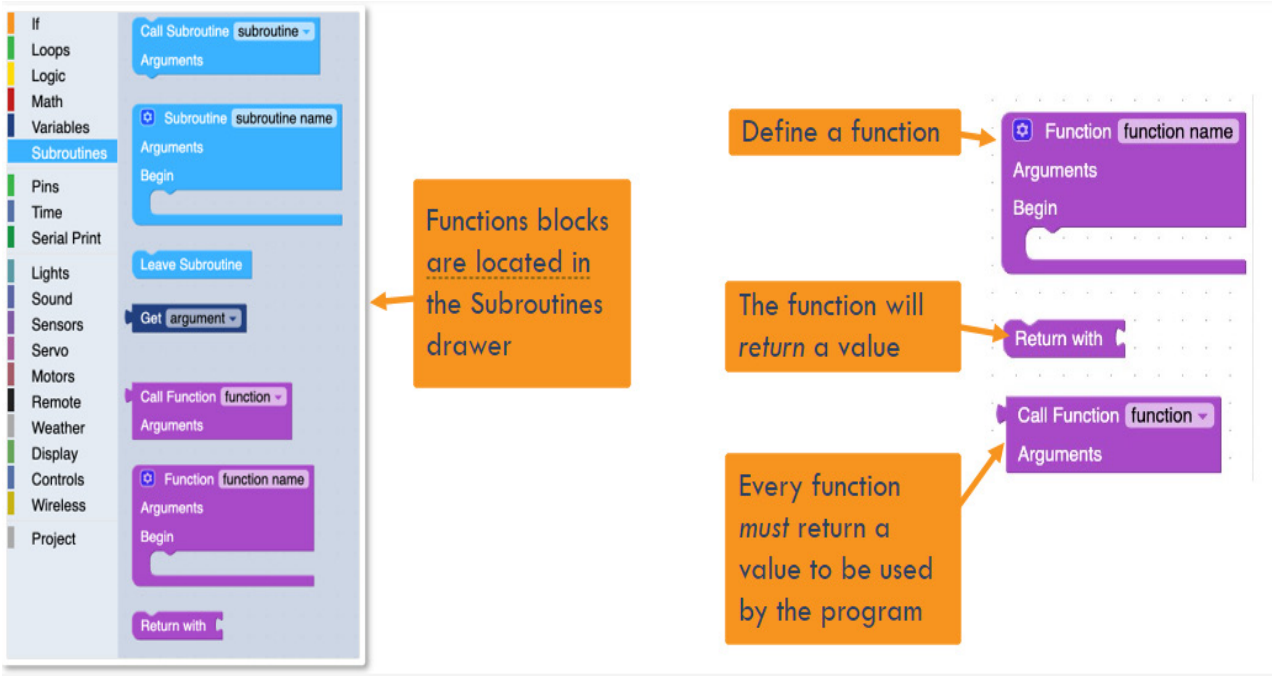
Inputs

Function

Output

11.3.4. Making a function in TinkRcode

Functions blocks are located in the Subroutines drawer



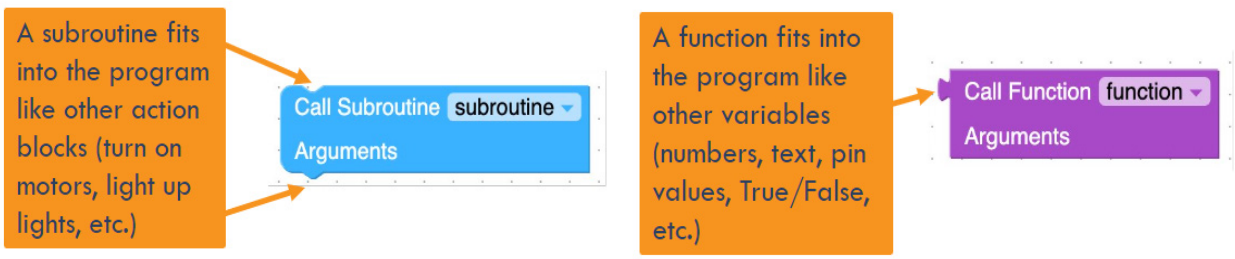
11.3.5. What is the difference between a subroutine and a function?

Subroutine

Performs an action, does a task. Used when a task is needed, but no value is produced. Think of a subroutine as a *verb*.

Function

Produces a value (data) and returns it to the part of the program that called it. Think of a function as a *noun*.



Exercise 10

A. Multiple Choice Questions (MCQs):

1. What is the function of a touch sensor?

a) Measures temperature changes
b) Detects the presence or absence of objects
c) Emits infrared light
d) Measures sound intensity

2. How does the Touch Sensor work?

a) By emitting sound waves
b) By detecting changes in light intensity
c) By sensing pressure or touch
d) By measuring humidity levels

3. What is the purpose of learning how to install a Reflectance Sensor?

a) To understand the principles of touch-sensing
b) To enhance the sensitivity of the touch sensor
c) To detect colours
d) To detect objects using infrared light

4. What is the first step in setting up the Touch Sensor?

a) Connecting it to the power source
b) Calibrating the sensor
c) Installing the necessary software
d) Mounting the sensor onto the device

5. Where are Function blocks located in TinkRcode?
   a) Motor settings
   b) Colour adjustments
   c) Subroutines drawer
   d) Sound effects

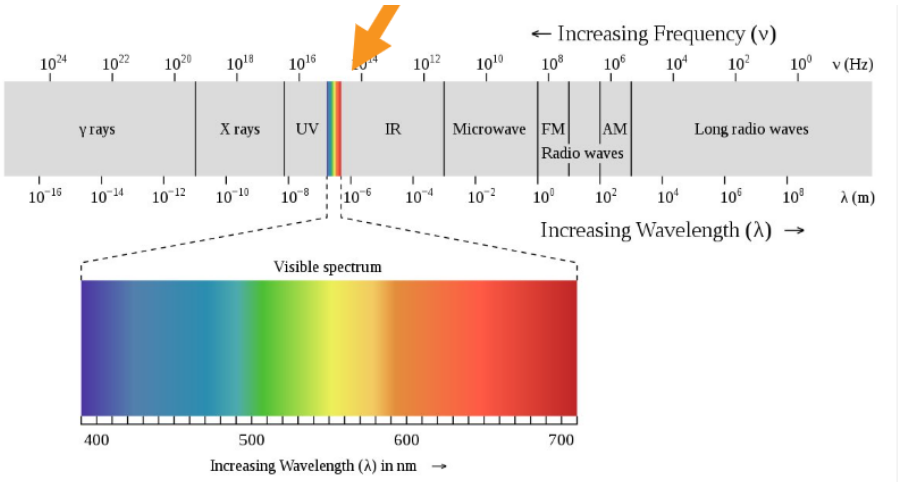
B. Fill in the blanks:

1. A _____takes Inputs, performs some operations on inputs and it creates some output.
2. Function blocks are located in _____drawer.

Module 12: IR Sensor

12.1. Introduction

Infrared is a type of electromagnetic radiation that is part of the electromagnetic spectrum, which includes various types of light, such as visible light, ultraviolet, X-rays, and radio waves. The part of the spectrum we can see is called the Visible Spectrum, and it's where all the colours we know are found. Infrared light starts where the colour red ends, and even though we can't see it, it's still there, doing important things like helping sensors see in the dark or sense heat.



12.2. What is IR used for?

We can use an IR filter to see IR light.

All objects give off IR light in proportion to heat.

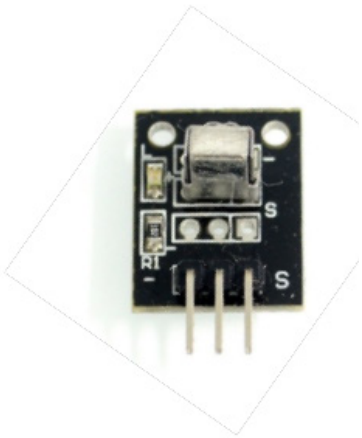
Visible light

Infrared light

12.3. Remote and Sensor

The remote control is a gadget that sends signals to your Sensor bot, TV or other electronic devices. When you press a button on the remote, it sends out invisible rays called **infrared (IR) signals**. Now, the IR sensor, which is like a tiny receiver, picks up these signals when you point the remote at it. So, when you press a button on your remote, the IR sensor "sees" the signal and tells your bot or other device what to do, like moving forward, changing the channel or turning up the volume.

Remote Control



IR Sensor

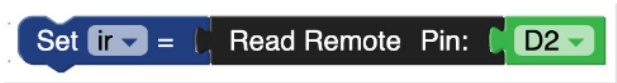
12.4. Programming with the IR Sensor

12.4.1. Setup

This block is provided in the IR drawer.

This block reads the IR sensor, and if a button on the remote is being pressed, the value of that remote button will be put into a variable named ir.

Your IR sensor is connected to pin D2.



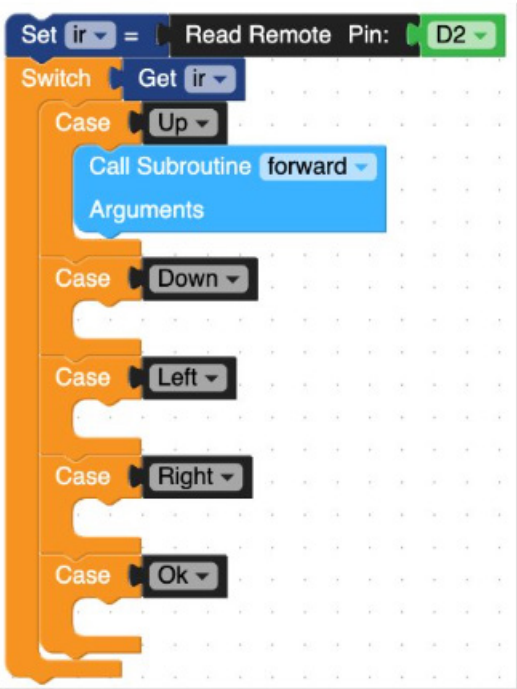
12.4.2. The Case Block

The Switch block needs a variable. This variable is used to pick one of the case blocks to run.

The value in the Case block indicates that the block will run when the variable equals that value.

There can be lots of cases. Drag in as many Case blocks as you need.

The Default block is used when none of the values match.



Exercise 11

A. Multiple Choice Questions (MCQs):

1. What is the purpose of an IR sensor?
   a) To emit visible light
   b) To detect ultraviolet radiation
   c) To receive infrared signals
   d) To measure sound intensity

2. What is IR used for?

a) Filtering visible light
b) Generating heat in objects
c) Emitting invisible rays for communication
d) Enhancing colour perception

3. What does the IR sensor do when receive signals from a remote control?

a) Emits visible light
b) Converts signals to sound waves
c) Detects infrared signals and interprets them
d) Sends signals back to the remote control

4. What function does the IR sensor serve as a remote control?

a) It emits infrared signals to the remote control.
b) It amplifies the signals sent by the remote control.
c) It receives and interprets the signals from the remote control.
d) It converts signals to visible light.

5. Which part of the remote control and electronic device communication system does the IR sensor represent?

a) Transmitter
b) Receiver
c) Amplifier
d) Reflector

B. State True or False:

1. The part of the spectrum we can see is called the Visible Spectrum.
2. The IR sensor is connected to pin D5.

Answer Key

Exercise 1

A. Multiple Choice Questions (MCQs):

1. b) A super smart robot car with sensors
2. b) To help it avoid obstacles and understand the world
3. b) A mechanical device capable of performing tasks
4. c) To assist in tasks like manufacturing and welding
5. b) In hospitals, homes, and stores

B. Fill in the Blanks:

1. records, indicates or otherwise responds to it
2. industry, healthcare, and exploration
3. light, temperature, and sound
4. hospitals
5. understand

Exercise 2

Q.1 Multiple Choice Questions (MCQs):

1. Bluetooth Chip
2. Providing visual feedback
3. Detecting lines on the ground
4. Wheels
5. Assembling the robot
6. c) A microcontroller platform used to build digital devices and interactive objects
7. a) By watching a tutorial
8. a) Printed Circuit Board
9. c) To control Sensorbot's movements
10. b) To provide power for the motors

Q.2 State True or False:

1. False
2. True

Q.3 Fill in the Blanks:

1. Ultrasonic waves
2. Lines
3. Red, Green, Blue
4. Position, Angle
5. Physical contact

Exercise 3

A. Multiple-Choice Questions:

1. b) An energy that can travel in a straight line in the form of waves
2. c) By seeing them
3. b) Red, green, blue
4. b) To display different colours as indicators of the SensorBot
5. c) 0 to 255
6. a) Red = 0, Green = 255, Blue = 255

B. Fill-in-the-Blank Questions:

1. Nanometres
2. Light
3. Pixels
4. Data
5. Colours
6. Secondary

Exercise 4

A. Multiple Choice Questions:

1. b) A machine that converts electrical energy into mechanical energy
2. b) By converting electrical energy into mechanical energy
3. a) Electrical to mechanical
4. c) Increasing the electrical current to the motor
5. c) To rotate or spin
6. b) Two
7. b) To improve mobility

B. Fill-in-the-Blank Questions:

1. Electrical, mechanical
2. Electrical current
3. Rotating
4. Motion
5. Two

Exercise 5

A. Multiple Choice Questions:

1. b) By using a cloud-based programming platform called TinkRcode.com
2. b) To understand how motors work
3. b) To connect the bot to other devices wirelessly
4. c) They use drag-and-drop coding
5. a) It sets up the bot's motors for programming

B. Fill-in-the-Blank:

1. 0, 255
2. 100, 1
3. 0
4. spin or rotate in place

Exercise 6

A. Multiple Choice Questions:

1. b) A sequence of commands grouped and given a name
2. b) To make programming easier by grouping commands together
3. c) By grouping commands and giving them a name
4. c) To organize and simplify the program
5. b) By calling it using its name

B. State True or False:

1. False
2. True
3. True

Exercise 7

A. Multiple Choice Questions:

1. b) A type of motor
2. c) 0° to 180°
3. c) By turning to a specific angle based on signals from the Arduino
4. a) Reads the current position of the servo shaft with a potentiometer
5. c) When the motor adjusts its speed depending on how far the current position is from the desired position

B. Fill-in-the-Blank:

1. Position, angle
2. Pulses
3. Signal
4. Potentiometer
5. Proportional
6. Pin
7. Position, movement

Exercise 8

A. Multiple Choice Questions (MCQs):

1. b) Sends sound waves
2. c) By sending out sound waves and measuring the time it takes for them to bounce back
3. c) Echolocation
4. b) To understand its internal components
5. c) By using conditional statements

B. Fill in the Blanks:

1. Digital or analog pins
2. Bats and dolphins
3. Centimeters or inches
4. Conditional statements

Exercise 9

A. Multiple Choice Questions (MCQs):

1. c) Infrared light
2. c) It emits infrared light and measures its reflection
3. c) To enable the sensor to detect objects
4. d) Connecting the sensor to the Arduino or microcontroller
5. a) Setting up the sensor

B. Match the following:

1. b) GND
2. a) Signal
3. c) Vcc

Exercise 10

A. Multiple Choice Questions (MCQs):

1. b) Detects the presence or absence of objects
2. c) By sensing pressure or touch
3. a) To understand the principles of touch sensing
4. d) Mounting the sensor onto the device
5. c) Subroutines drawer

B Fill in the blanks:

1. Function
2. subroutine

Exercise 11

A. Multiple Choice Questions (MCQs):

1. c) To receive infrared signals
2. c) Emitting invisible rays for communication
3. c) Detects infrared signals and interprets them
4. c) It receives and interprets the signals from the remote control.
5. b) Receiver

B. State true or false:

1. True
2. False

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