# Lesson 3 – Coding Sensors - 1

## What are Sensors

A sensor is a device that **detects and responds** to some type of input from the physical environment.

The **input can be** light, heat, motion, moisture, pressure or any number of other environmental phenomena.

The **output is generally a signal** that is converted to a human-readable display at the sensor location or transmitter over a network for reading or further processing.

## Types of Sensors

Sensors can be categorized in multiple ways. Most common is to classify them as either active or passive.

**Active sensor** is one that requires an external power source to be able to respond to environmental input and generate output.

**Passive sensor** on the other hand, doesn't require an external power source to detect environmental input. It relies on the environment itself for its power, using sources such as light or thermal energy.

## Temperature Sensor

Temperature is one of the most commonly measured environmental quantities.

There are different types of temperature sensors such as a thermocouples, thermistors, semiconductor temperature sensors, resistance temperature detectors (RTDs) etc.

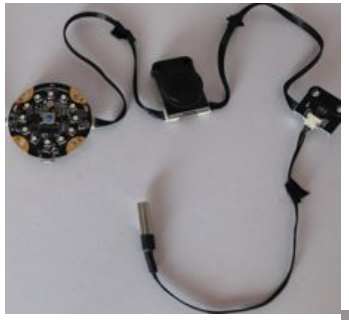

Based on requirement, different types of sensors are used in different applications.

# Sensor No 1 – Temperature Sensor

## Project with Temperature Sensor

Temperature sensors are used to monitor temperature and execute actions.

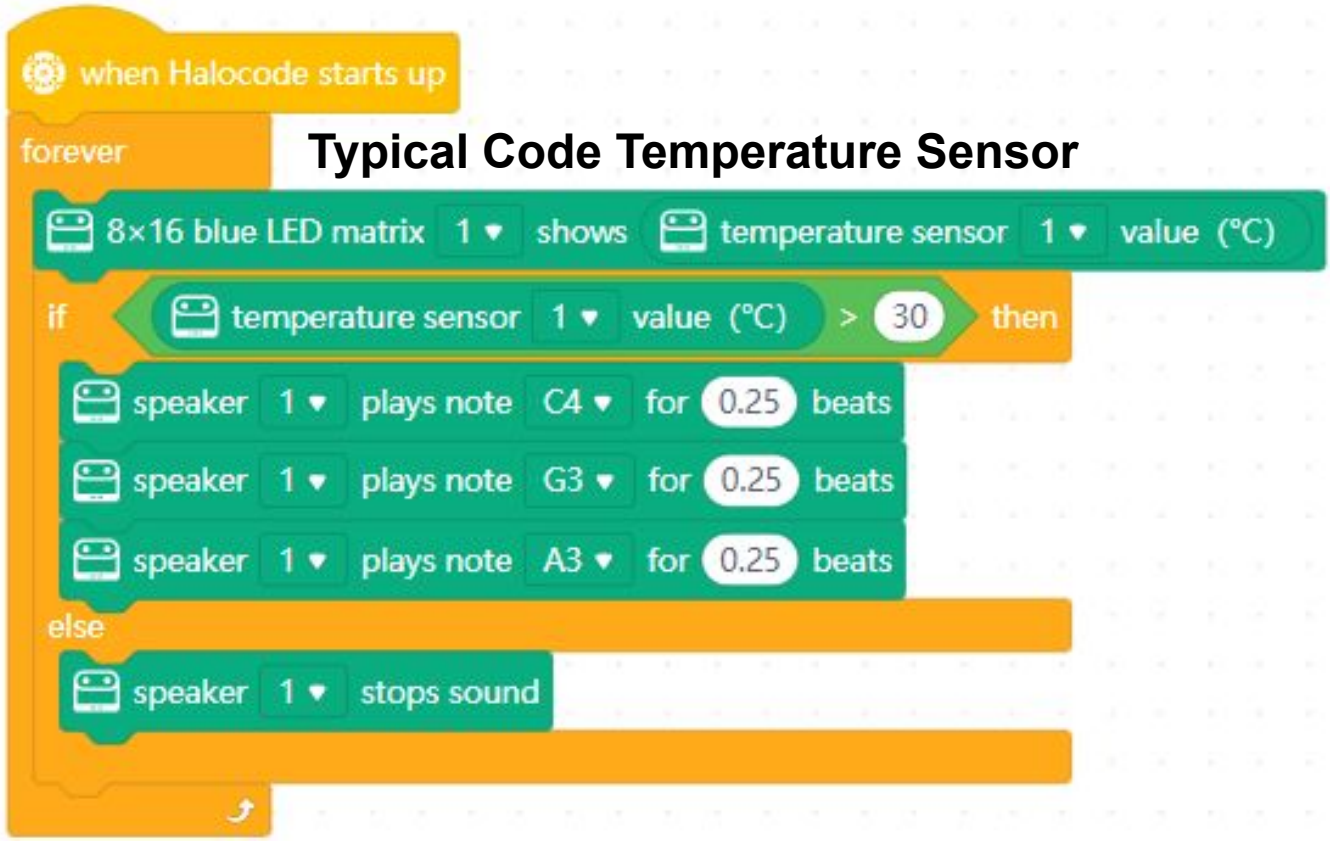
Ever wondered how your AC switches go on and off automatically?



The story line is that:

Temp sensor is monitoring the temperature of the room. If it rises to 30 degrees, an alarm will go up.

## Typical Code Temperature Sensor



# Sensor No 2 – IR Sensor

## Infrared (IR) sensor.

**It is** an electronic device to detect
& measures infrared radiation in the environment.

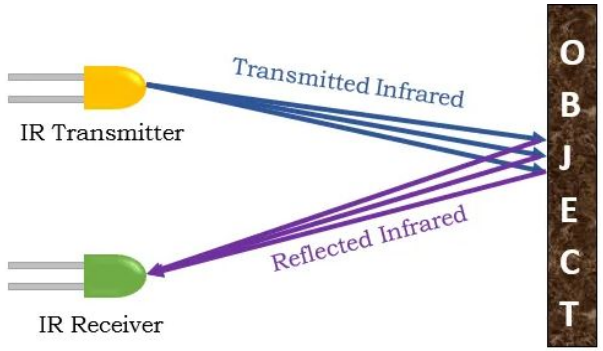
Anything that has a temperature above **five degree kelvin (-268.15 C)** emits heat, and in turn **gives out infrared radiation**.

These fall in the visible light region of the EM spectrum.

IR is however, **invisible to the human eye**, but visible to some animals.

**Working of IR Sensor:**

- IR source that emits radiation of required wavelength.
- This radiation reaches the object & is reflected back.
- The reflected radiation is detected by the IR receiver.
- The detected radiation is then processed based on its intensity.




There are two **types of infrared sensors:** active and passive.

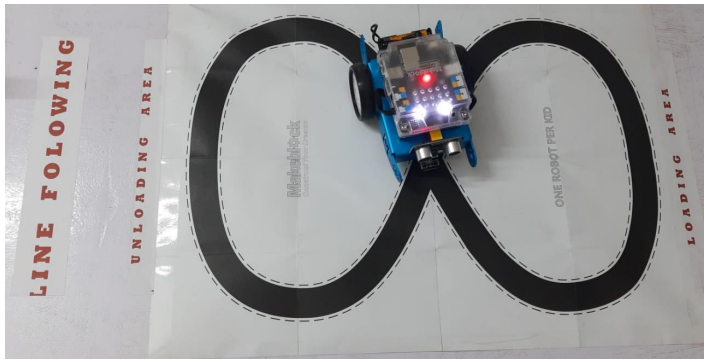
## Project with IR Sensor  - Line Following Robot.

In factory floors robot deliver sub assemblies. Wondered How?

A line follower consists of an infrared light sensor and an infrared LED.
It works by illuminating a surface with infrared light;
the sensor then picks up the reflected infrared radiation
and, based on its intensity, determines the reflectivity of the surface in question.

Light-coloured surfaces will reflect more light than dark surfaces, resulting in their appearing brighter to the sensor.

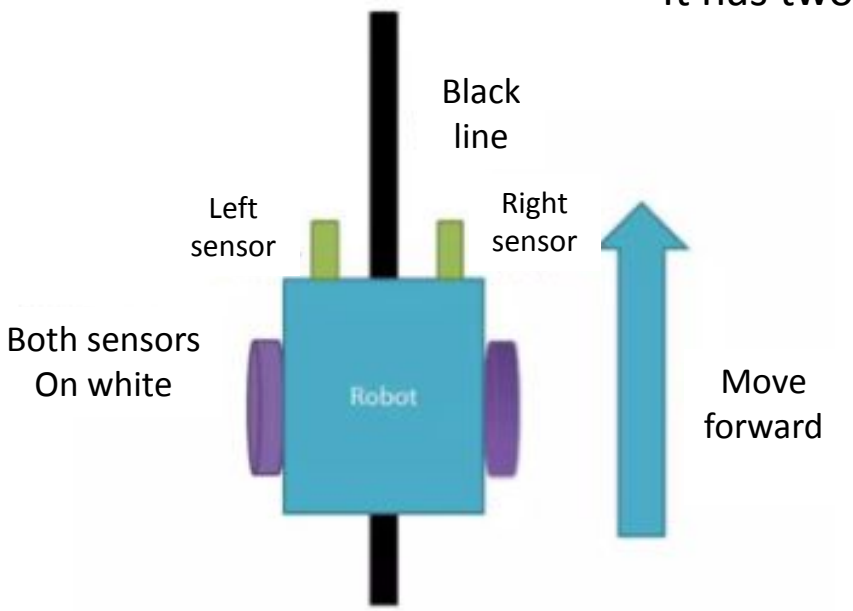
This allows the sensor to detect a dark line on a pale surface, or a pale line on a dark surface.



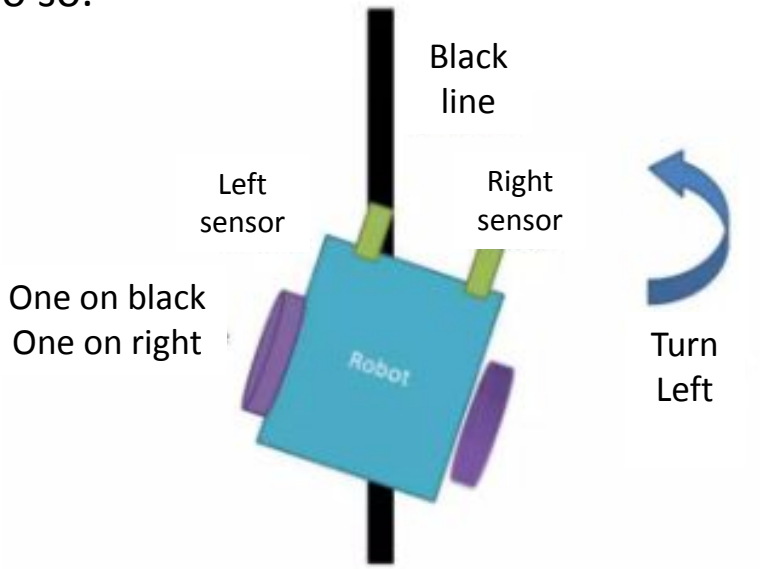

This then enables a robot to follow a pre defined line.

# Working Principle

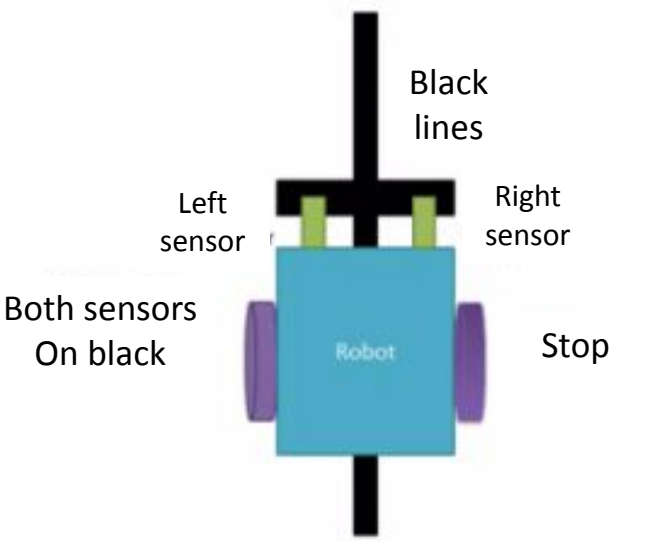
The robot has been coded to follow white surface
It has two sensors to do so.




Sit 1: When both sensors see white
the robot keeps moving forward




Sit 2 or 3: When both sensors sees black under one
it instructs the motor
to turn in opposite direction to get of of black




Sit 4: When it sees black under both sensors
Ex at a traffic crossing
It instructs it to stop.

Useful Hint:

Because the line follower uses an infrared LED to illuminate its target and an infrared sensor to detect the reflected light, it will actually work in low-light conditions or even in the dark!

However, this also means that it can easily become saturated — in other words, everything will look white to it, like an over-exposed photograph

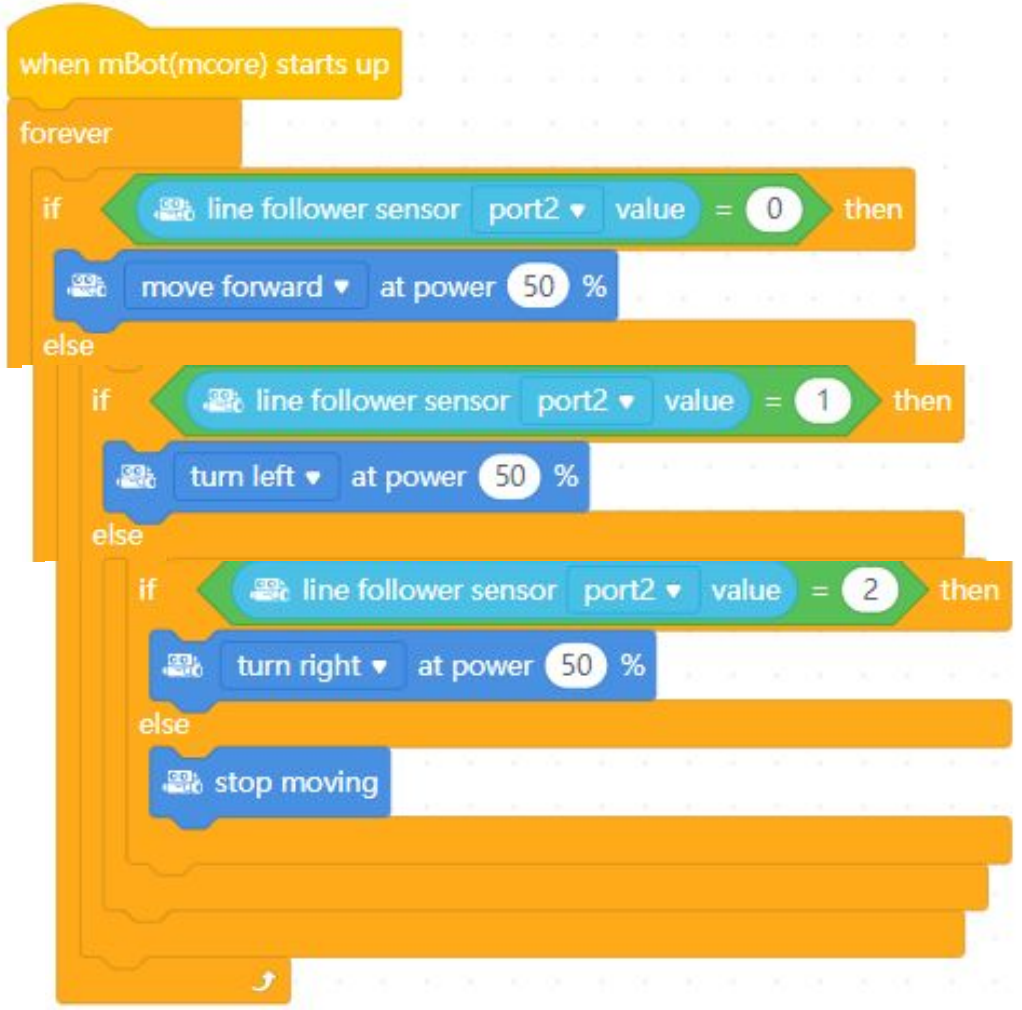
To avoid saturating the infrared sensor, consider mounting it underneath the robot or adding a cardboard shield to block ambient or undesired  radiations.

# Typical Code IR Sensor following a Black line

**Code evaluating first condition**

**Code evaluating second condition**

**Code evaluating third condition**



# Sensor No 3 – Ultrasonic Sensor

## Ultrasonic Sensor

It is a four pin device
that measures the distance to an object
using ultrasonic sound waves
at a frequency above  the range of human hearing.

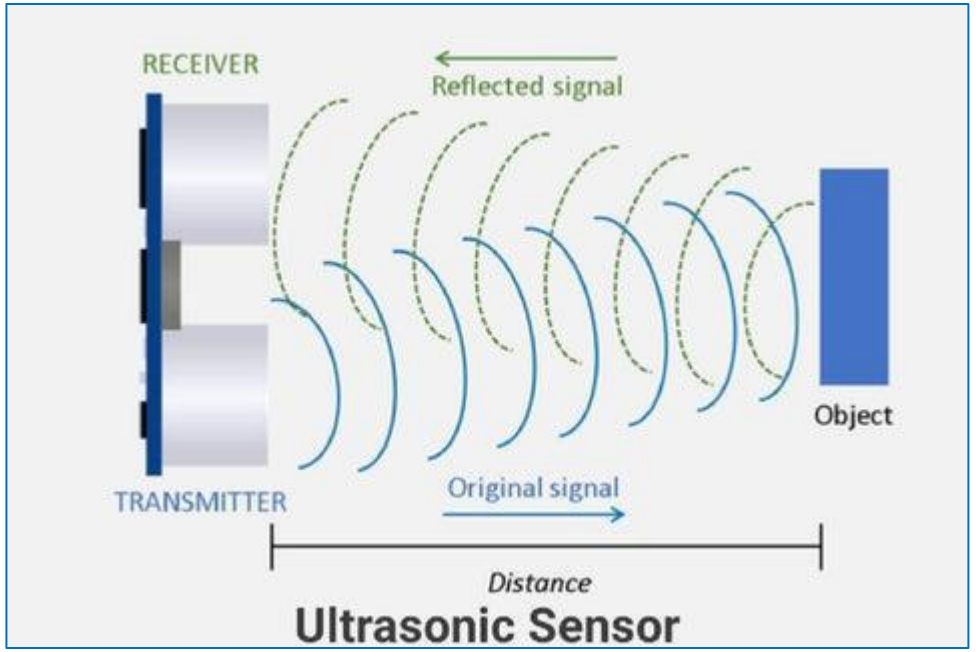
## Working of Ultrasonic Sensor

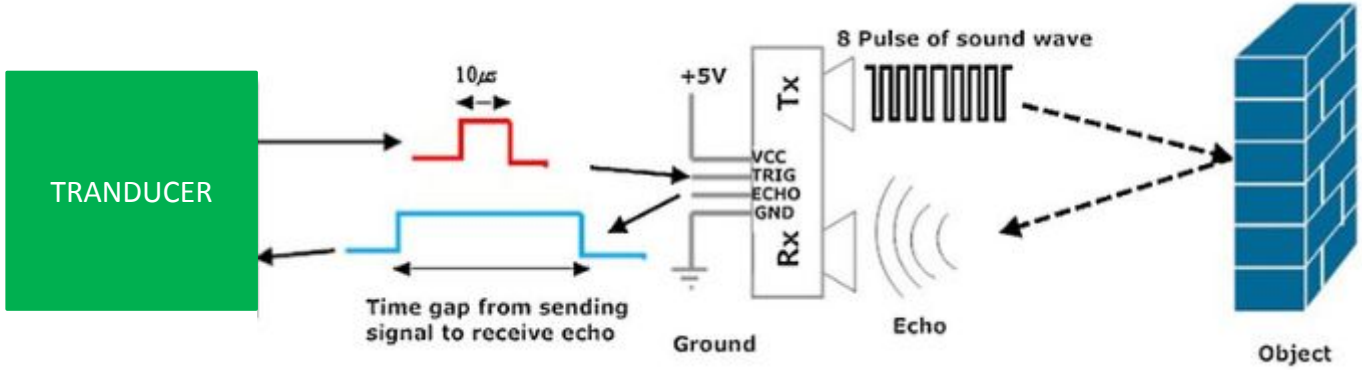
It consists of an ultrasonic pulse generator.

This pulse is transmitted at 40kHz through air.

If on the way, it meets an obstacle it will bounce back to the sensor.

By calculating the travel time of reflected signal & the speed of soundthe distance can be calculated.




TRANDUCER
10μs
+5V
Tx
VCC
TRIG
ECHO
GND
Rx
8 Pulse of sound wave
Time gap from sending signal to receive echo
Ground
Echo
Object

# Common uses of Coded Ultrasonic Sensors

**Basic applications**

- Anti-Collision Detection.
- People Detection.
- Contouring or Profiling.
- Presence Detection.

**Industrial Applications**

- Box Sorting using a Multi-Transducer System.
- Easy Control of Trash Collection Vehicles.
- Pallet Detection with Forklifts.
- Bottle Counting on Drink Filling Machines.

## Project with Ultrasonic Sensor

Using **mBot** to measure
distance to an obstacle that comes in front of it.

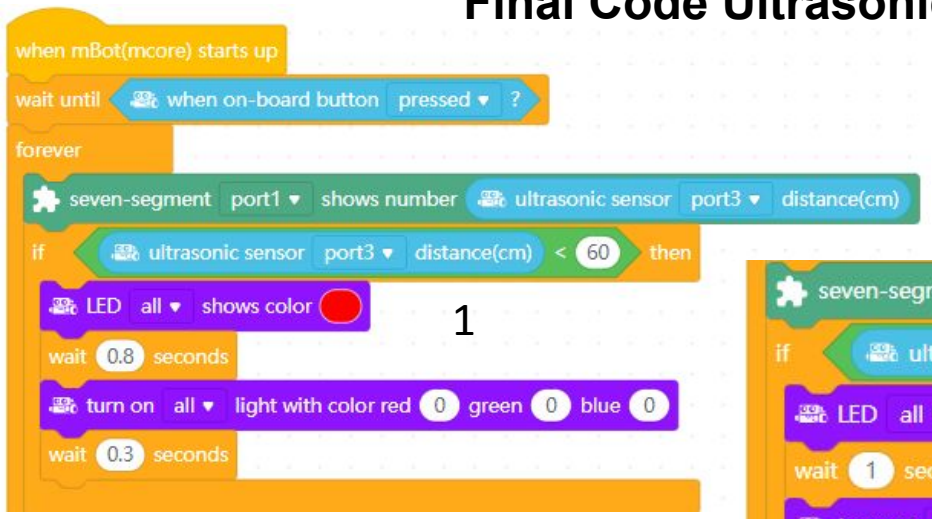
The story line is when the object is:

- Beyond 60 cm both its LED's should be purple.
- Between 60 and 20 they should be red.

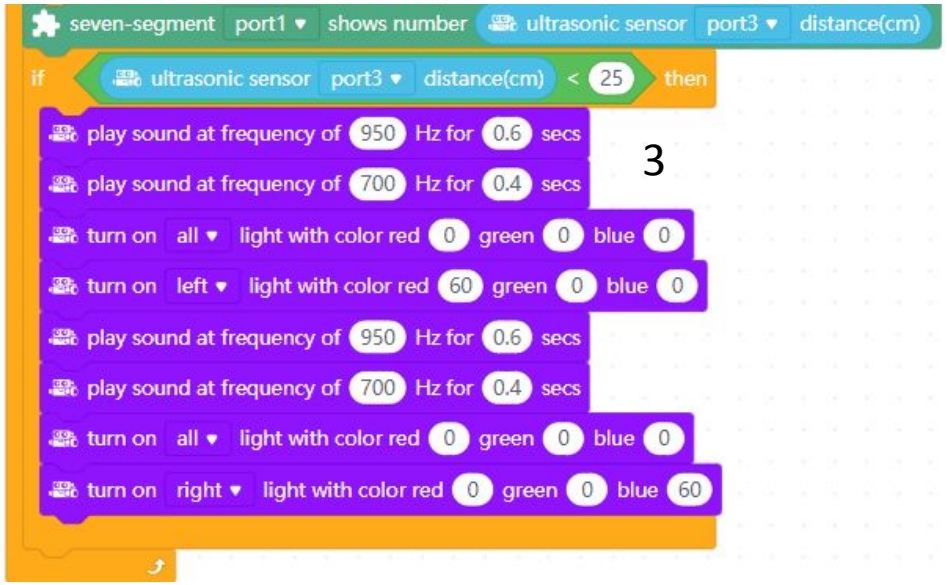
- Less than 20, one LED should light along with music.

In addition, in all cases the distance must be displayed on the screen.

# Final Code Ultrasonic Sensor

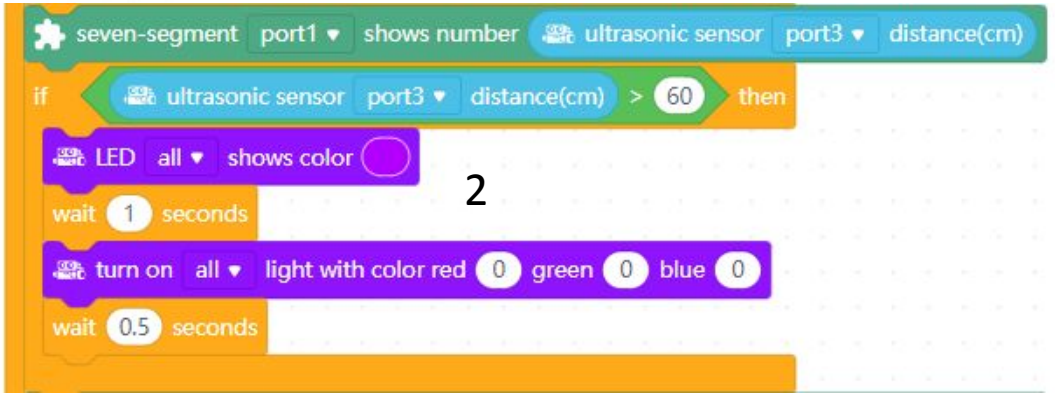



1




3

Code has three parts
Place one below the other

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Code Karega India Badhega