Session Plan
Unit 3: Sensors and Actuators

Schools of Specialized Excellence
Delhi Board of School Education

Session Plan
Sensors and Actuators

Teacher Name		**Target Grade**	10	**Curriculum Component**	Applied Learning Module

Module Title	Introduction to sensors		
Week Title	Sensors and Actuators	**Week Number**	1
Important Concepts	- Types & the Basic biological sensing process -Sensor characteristics, -Need for sensors, -Basic working principles - Applications of sensors		

Learning Standards

1. Explain the Sensor Types & the Biological Sensing Process.
2. Discuss the Sensor Characteristics.
3. Describe the Need for Sensors.
4. Explain the Working Principles of Sensors & their applications.

Inquiry Questions

1. What do you know about the 5 senses of humans?
2. Give me one example of a Sensor of an Embedded System used in our Day-to-day Life?
3. Name the Sensor used in our Smart TV Remote Control?

Classroom Inquiry Process

Day 1: Output Devices.	**Lesson Aims** 1. Explain the Types & the Biological Sensing Process. 2. Discuss the Sensor Characteristics. 3. Describe the Need for Sensors. 4. Demonstrate the Working Principles of Sensors & their applications.

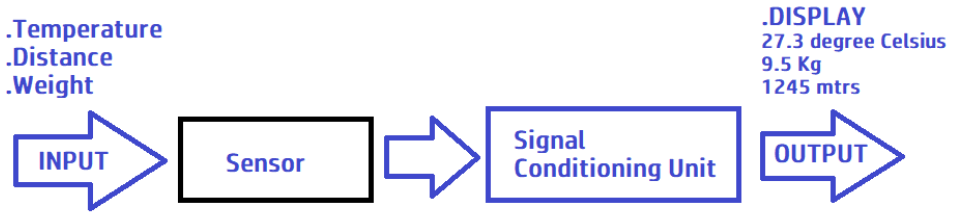
	Activity Title: 1. **Ice-breaking on Sensors (20 Mins)** 2. **Introduction to Sensors, & its characteristics (20 Mins)** 3. **Working of Sensors (10 Mins)** 4. **Types of Sensors (20 Mins)** 5. **Need for Sensors (15 Mins)** 6. **Application of Sensors (20 Mins)** 7. **Doubt Clarification / Q & A Session (10 Mins)** 8. **Instructions for taking Home Assignment (5 Mins) (Individual)** **Activity Description:** 1. **Ice-breaking on Embedded System:** At the beginning, show them the Five senses of Humans like **Sight, Sound, Smell, Taste, and Touch** & How the Human Body Receives Sensory Information & Take decision accordingly. Compare with the Input, Control & Output of the Embedded System / Arduino Control System**.** Show them the Real-Life Application where the Sensors play a vital role in Safety, like Sensors used in cars (Reverse Movement) and Air Bag Systems. **2. Introduction to Sensors & its Characteristics:** Brief introduction to the Sensor & Its Characteristics using an example. ● Sensor is an electronic device that measures physical Quantities such as temperature, pressure, distance, speed, torque, acceleration, etc., from devices, appliances, and other systems. **Characteristics of Sensors:** ● **Sensitivity:** Relative Change in output response divided by the change in input response. Susceptible sensors show more significant fluctuations in output because of fluctuations in input. **Example: Weighing Machine used in Jewellery Shop.** ● **Range:** It is the difference between the smallest and the most significant outputs that a sensor can provide. **Example: Radio Frequency (RF) Remote-based Central Locking System in a Car.**

- **Reliability** is the ratio between the number of times a system operates properly and the number of times it is tried.
  Example: InfraRed (IR) Sensor in TV Remote.
- **Accuracy:** It shows how the closer output of the sensor is to the expected value.
  Example: Mercury Thermometer Versus Digital Thermometer

3. Working of Sensors:

It detects and responds to input from the physical environment, like light, heat, motion, moisture, and pressure; the output is generally a signal converted to a human-readable format.

In specific Applications, An analogue sensor alone may not be sufficient to analyse / Process the obtained signal. In those cases, a **signal conditioning unit** is used to maintain the sensor's output voltage levels in the desired range concerning the end device we use.



Working of Sensor

4. Types of Sensors:

There are two types of sensors:

- Analog
- Digital

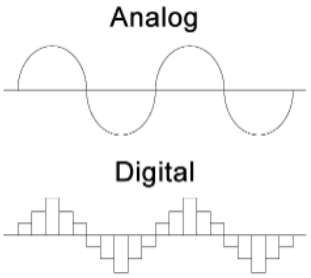
Analog Sensors:

Analog sensors convert the Physical Quantity input into Output Analog Signals, which vary continuously. Thermocouples used in gas water heaters offer an excellent example of analogue sensors.

Digital Sensor:

Digital sensors produce a discrete signal that is a digital representation of a measurement. This sensor will display binary output in ones and zeros**.**
(1's – ON & 0's – OFF)

For example, digital sensors are now used to measure humidity, temperature, atmospheric pressure, and air quality.



Analog & Digital Signals

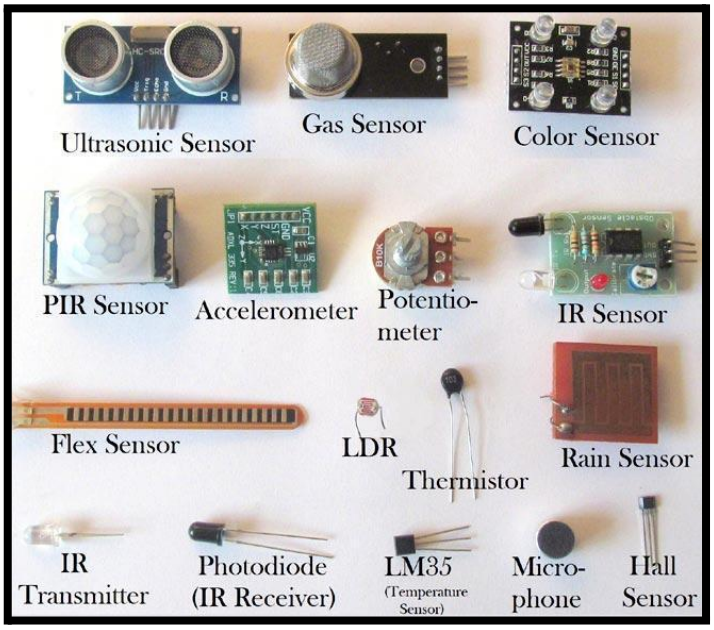
5.Need for Sensors:

- To develop Low-Cost Automation Projects like an Automatic Corridor Light control system, Automatic Handwash/Sanitizer Dispenser, and Drinking Water Tank Control System.

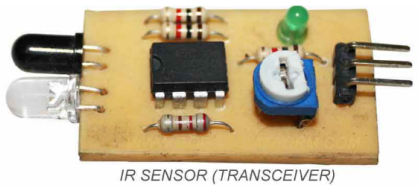
- To Implement Safety and Process Control in Appliances like Door Control in Microwave ovens, Temperature control of AC / Refrigerator.

6. Applications of Sensors:

Here are the types of Sensors based on Applications:

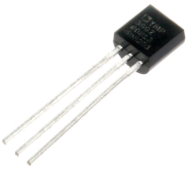


- **Light-Distance**
  - IR Sensor (IR Transmitter / IR LED)
  - Photodiode (IR Receiver)
  - Light Dependent Resistor

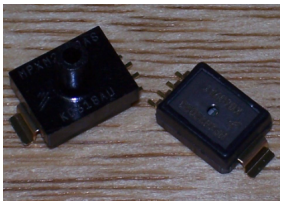


IR SENSOR (TRANSCEIVER)

- **Temperature**
  - Thermistor
  - Thermocouple

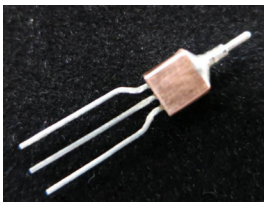


- **Pressure/Force/Weight**
  - Strain Gauge (Pressure Sensor)
  - Load Cells (Weight Sensor)

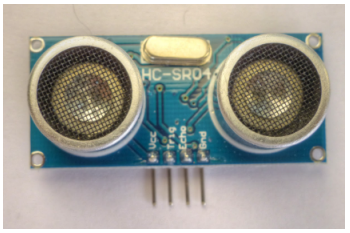


- **Position**
  - Potentiometer
  - Encoder

- **Hall Sensor** (Detect Magnetic Field)

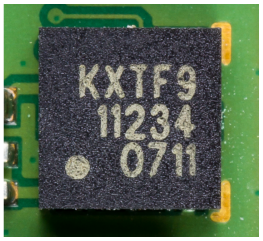


- **Sound**
  - Microphone
- **Ultrasonic Sensor-Distance**

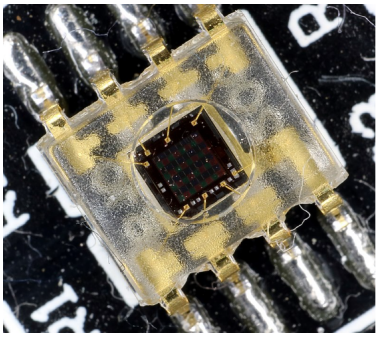


- **Touch Sensor-Smart Phone Screen**

- **Accelerometer / Tilt Sensor-Smart Phone Games**



- **Color Sensor**



7. Doubt Clarification /Q & A Session- Do the Learning check using these Prompt Questions:

- Explain any 2 Differences between Analog & Digital Sensors.
- List out the Types of Sensors used in our Smart Phones.

8. Take-Home Assignment

	List all the Sensors Present in a CAR & Classify the type as Analog & Digital Sensor in your Handouts. Refer to This Video: https://www.youtube.com/watch?v=X2K_y7AhfGg : https://www.youtube.com/watch?v=R5YfLySWQAc **References** Watch This Video: https://www.youtube.com/watch?v=NePXqRwvmbs Types of Sensor: Sensors - which one to use
Day 2: Input Devices- Sensors & Types (Analog & Digital).	**Lesson Aims** 1. Explain the Sensing Process of Analog Sensor. 2. Discuss the Analog Sensor Characteristics. 3. Explain the Types of Analog Sensors. 4. Integration of Analog Sensor with Arduino. **Activity Title:** **1. Ice-breaking on Analog Sensors (10 Mins)** **2. Introduction to Analog Sensors (25 Mins)** **3. How does it work (20 Mins)** **4. Types of Analog Arduino Sensors (20 Mins)** **5. Demo Activity -Integration on Analog Sensor with Arduino (25 Mins)** **6. Doubt Clarification / Q & A Session (10 Mins)** **7. Instructions for taking Home Assignment (10 Mins) (Individual)** **Activity Description:** **1. Ice-breaking on Embedded System:** At the beginning, Show them the Real-Life Application like Temperature control in Air conditioners, Weight Measurement in Weighing Scale. Demonstrate how the Physical Quantity is Converted into Human Readable Display. **2. Introduction to Analog Sensors:** Brief introduction on the Analog Sensors using an example. Analog Sensor senses a signal which is a continuous signal that represents a quantity. An analogue sensor trades efficiency for a more continuous and slightly more accurate signal.

The analogue quantities known to be continuous include speed, pressure, displacement, and temperature. For instance, you can use a thermometer to measure the temperature of a liquid.

By obtaining continuous readings, the analogue sensor will respond immediately to any changes in the temperature of the liquid as it heats up or cools down.

3. How does it work?

- Analog Sensors measure external parameters like Distance, Weight, and Temperature and give an Analog voltage as an output. They produce a continuous output signal or voltage proportional to the measured quantity.

- The output voltage may be from the range of 0 to 5V. Low logic 0 (0V-3.5V) and High logic (3.5V-5V).

- For Example:
  Using Sound Sensor, the Intensity/amplitude levels of the sound wave are converted to electrical voltage. Sound sensors are used in door alarms, music systems, burglar alarms, and computers.

4. Type of Analog Arduino Sensor:

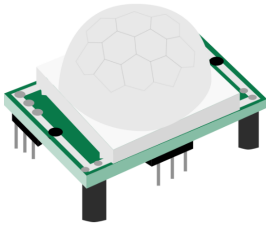
- **Digital Temperature and the Humidity sensor (DHT1 1)**

DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND

Humidity Sensor Connection diagram

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air. It spits a digital signal on the data pin

- **PIR (Passive Infrared) Motion Detection Sensor**



PIR Sensor Connection Diagram

Passive Infra-Red sensors can detect the movement of objects that radiate IR light (like human bodies). Therefore, using these sensors to detect human movement or occupancy in security systems is very common.

Coding:

```
int ledPin = 13;              // LED
int pirPin = 2;              // PIR Out pin
int pirStat = 0;               // PIR status
void setup() {
 pinMode(ledPin, OUTPUT);
 pinMode(pirPin, INPUT);
 Serial.begin(9600);
}
void loop(){
 pirStat = digitalRead(pirPin);
 if (pirStat == HIGH) {          // if motion detected
   digitalWrite(ledPin, HIGH);  // turn LED ON
   Serial.println("Hey I got you!!!");
 }
 else {
   digitalWrite(ledPin, LOW); // turn LED OFF if we have no motion
 }
}
```

- **Water Sensor**

Water Sensor: Connection Diagram

Water sensor brick is designed for water detection, which can be widely used in sensing rainfall, water level, and even liquid leakage.

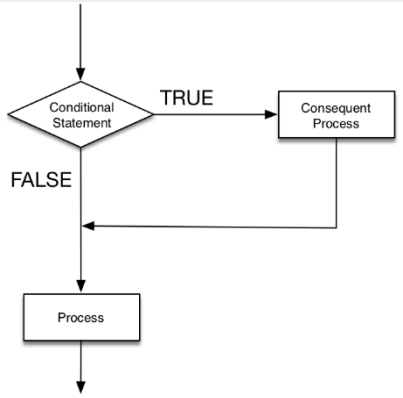
Coding:

```
#define Grove_Water_Sensor 8 // Attach Water sensor to Arduino Digital Pin 8
#define LED 9 // Attach an LED to Digital Pin 9 (or use onboard LED)

void setup() {
  pinMode(Grove_Water_Sensor, INPUT); // The Water Sensor is an Input
  pinMode(LED, OUTPUT); // The LED is an Output
}

void loop() {
  /* The water sensor will switch LOW when water is detected.
  Get the Arduino to illuminate the LED and activate the buzzer
  when water is detected, and switch both off when no water is present */
  if( digitalRead(Grove_Water_Sensor) == LOW) {
    digitalWrite(LED,HIGH);
  }else {
    digitalWrite(LED,LOW);
  }
}
```

	5. Demo Activity on Integration of Analog sensors with Arduino: Emergency Lighting System **Objective:** Whenever a room gets dark, a light bulb automatically turns ON and eliminates the darkness. **Components Required** Arduino UNO-1 LDR-5 Mega ohm LED-Red Color Jumping Wires Resistor-10 Kilo Ohm & 220 Ohm **Connection Procedure:** ● Connect the 3.3V of Arduino to the positive rail and ground to the negative rail of the breadboard. ● Place the LDR on the breadboard and attach the 10k ohm resistor to one of the legs of the LDR. Connect the A0 pin of Arduino to the same column of resistor and LDR. ● This is to fetch the light intensity from LDR to the Arduino through the A0 pin. ● Connect the other end of the resistor to the negative rail of the breadboard. ● Connect the other end of LDR to the positive rail of the breadboard. ● Place the LED on a breadboard and connect the positive end of the LED to the 220ohm resistor. ● Connect the other end of the resistor to pin 13 of Arduino. ● Connect the LED's negative end to the breadboard's negative rail. **Briefing on If-else Command:** **The simplest statement** is a single **if** statement. This construct simply executes an additional block of code when a condition is found to be **true** (non-zero in C). if (<conditional statement>) { //Consequent Process

}

This is depicted in the following flow-chart.



if-else

A Boolean condition is either TRUE or FALSE. You use the combination of **if** and **else** statements to perform different processes for each outcome. This construct simply executes one block of code for the TRUE condition and another for the FALSE.

if (<conditional statement>) {

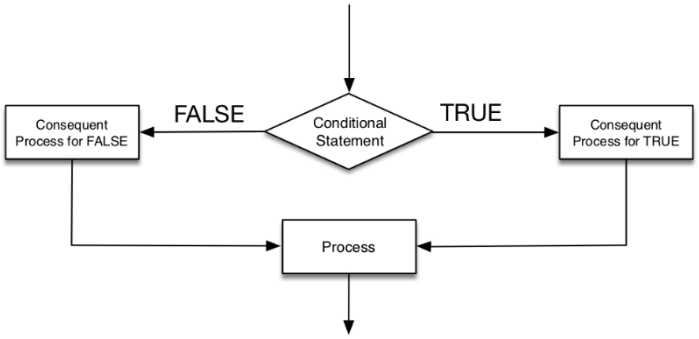
//Consequent Process for TRUE

} else {

//Consequent Process for FALSE

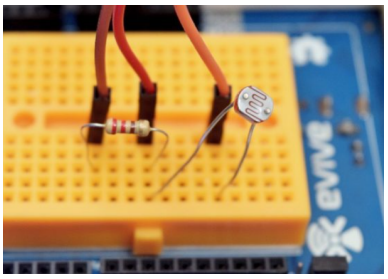
}

This is depicted in the following flow-chart.

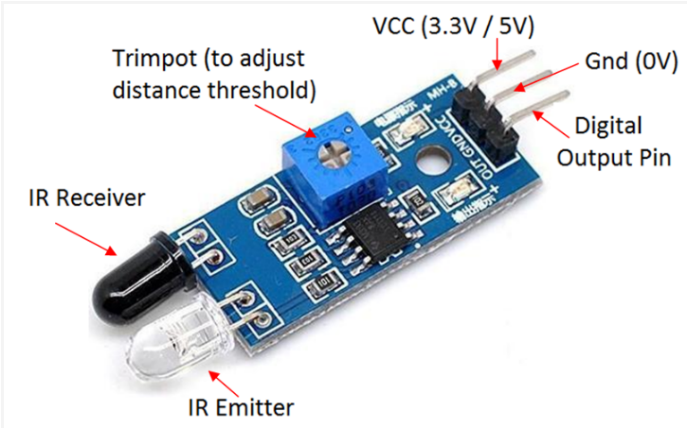


Coding:

```
const int ledPin = 13;
const int ldrPin = A0;
void setup() {
  Serial.begin(9600);
  pinMode(ledPin, OUTPUT);
  pinMode(ldrPin, INPUT);
}

void loop() {
  int ldrStatus = analogRead(ldrPin);

  if (ldrStatus <= 400)
  {
    digitalWrite(ledPin, HIGH);
    Serial.print("Its Dark, Turn on the LED:");
    Serial.println(ldrStatus);

  }
  else
  {
    digitalWrite(ledPin, LOW);
    Serial.print("Its Bright, Turn off the LED:");
    Serial.println(ldrStatus);
  }

}
```

	Schematic Diagram:  LDR Connection diagram **6. Doubt Clarification /Q & A Session- Do the Learning check using these Prompt Questions:** ● How does the Analog Sensor Works? ● List out the Applications of Analog sensors used in our Home. **7. Take-Home Assignment** Make a Page Learning Report (Components Required, Procedure & Learning Outcomes) on this Project: **Arduino Temperature Sensor**. **Watch This Video:** https://www.youtube.com/watch?v=-_XkGju35MI **References** **Watch This Video:** https://www.youtube.com/watch?v=cmc-BPtkdAU
Day 3: Digital Sensors & Types	**Lesson Aims**: 1. Demonstrate the Sensing Process of the Digital Sensor. 2. Discuss the Digital Sensor Characteristics. 3. Explain the Types of Arduino Digital Sensors. 4. Integration of Digital Sensor with Arduino. **Activity Title:** **1. Ice-breaking on Digital Sensors (10 Mins)** **2. Introduction to Digital Sensors (20 Mins)** **3. How does it work (20 Mins)** **4. Types of Arduino Digital Sensors (20 Mins)**

	5. **Demo Activity -Integration of Digital Sensor with Arduino (30 Mins)** 6. **Doubt Clarification / Q & A Session (10 Mins)** 7. **Instructions for taking Home Assignment (10 Mins) (Individual)** **Activity Description:** 1. **Ice-breaking on Digital Sensor:** At the beginning, show them the Real-Life Application like Smart Lamp Control using Smart Phone, Air Conditioner Control using IR Sensors in Smart Phones. Demonstrate how the Physical Quantity is Converted into Human Readable Display. Watch This Link: Video 2. **Introduction to Digital Sensors:** Brief introduction on the Digital Sensors using an example. Digital sensors are the sensors in which the signal is directly converted into the digital signal output. Digital sensors just act as switches. They are either on or off and will only change state when a threshold signal is reached. **Let us take an example:** Proximity sensors or infrared (IR) Sensors are designed to detect the location of an object or person as it pertains to the sensor itself. When an object or obstacle that are close enough to block the view in front of 2 LEDs, it triggers the infrared trans-receiver module. Therefore, it Gives an ON or OFF Signal. It is an object or obstacle detection Switch module. It detects objects or obstacles within 30cm (recommended up to about 20cm) in front of the trans-receiver IR LEDs.

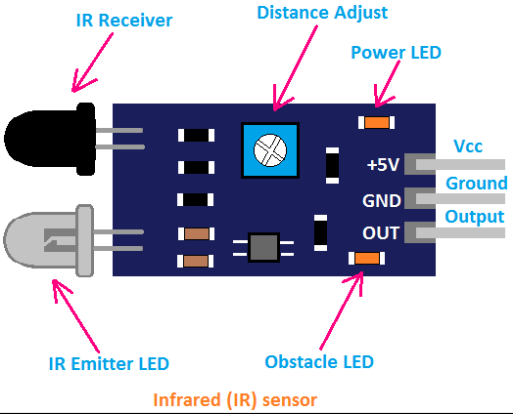


3. How does it work?

Let us understand the Working of Digital Sensors (Infrared sensors as Proximity sensors).

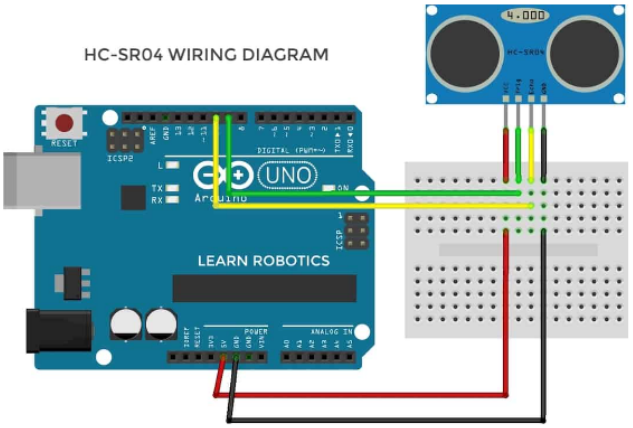
When there is an object that is close enough, the IR electromagnetic detection received by the IR receiver is higher than the threshold level (user pre-set level), the sensor will change the output switch mode so that a microprocessor board such as Arduino can execute what is going to do next.

When there are no obstacles or objects within the detection distance, the output is at a HIGH position (5V or 3.3V). When the length is shorter than or equal to the threshold set, the output signal will change to position LOW (0V). Adjusting the potentiometer/trim pot on the board can set the distance threshold.

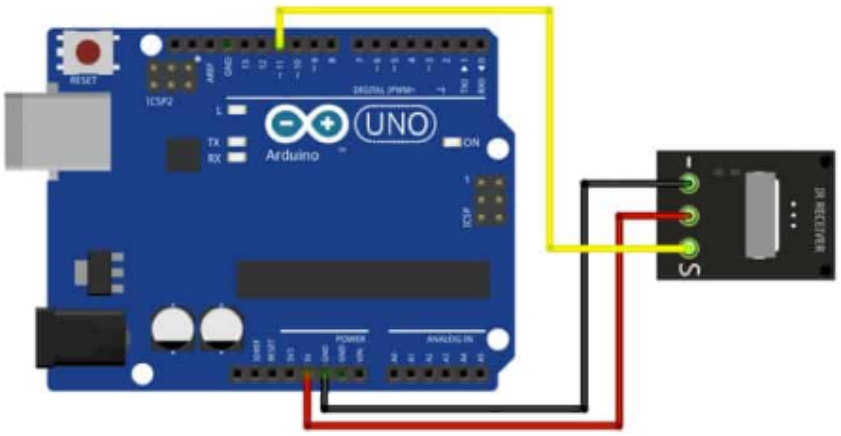


4. Type of Arduino Digital Sensors:

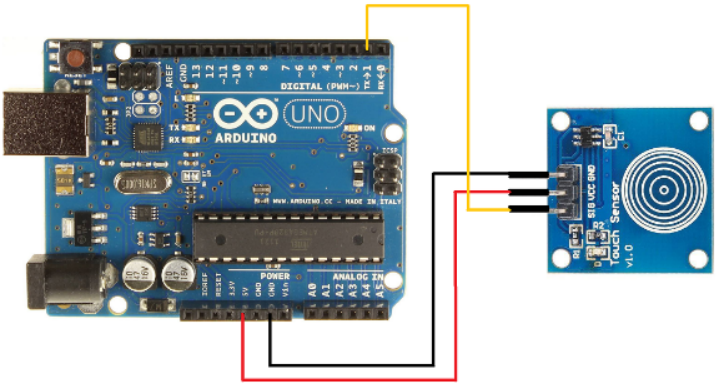
- **Ultrasonic Sensors-Obstacle Detection with Limited Range**



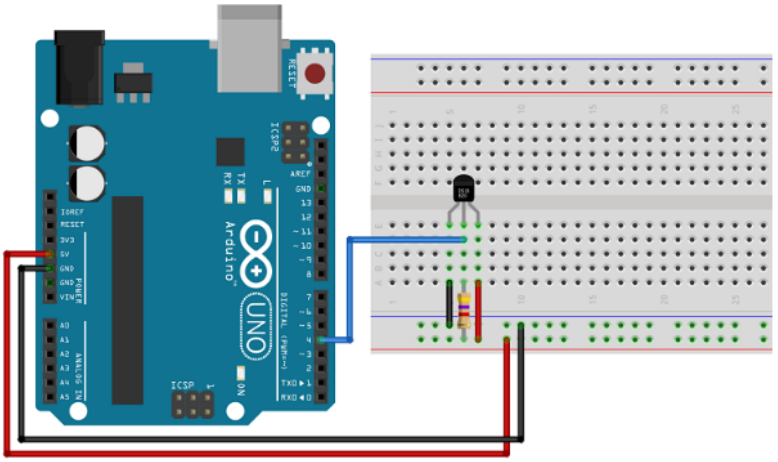
- **Infrared Receiver- Control via TV Remote**



- **Capacitive Touch Sensor**



- **Digital Temperature Sensor**

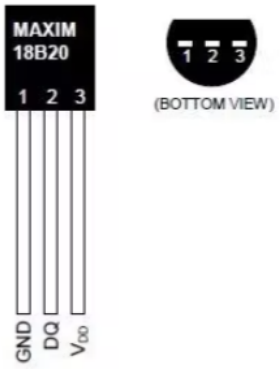


5. Demo Activity: Digital Temperature sensor with Arduino

Objective: To measure the Temperature of Any Environment

Introduction to Temperature Sensors:

- DS18B20 is a 1-Wire digital temperature sensor from Maxim IC. Reports degrees in Celsius with 9 to 12-bit precision, from -55 to 125 (+/-0.5).
- Applications include thermostatic controls, industrial systems, consumer products, thermometers, or any thermally sensitive system



Sensor Pin Diagram

Components Required

- Arduino UNO-1
- LED-Red Color
- Jumping Wires
- DS18B20 1-Wire Digital Temperature Sensor
- Resistor-220 Ohm

Connection Table:

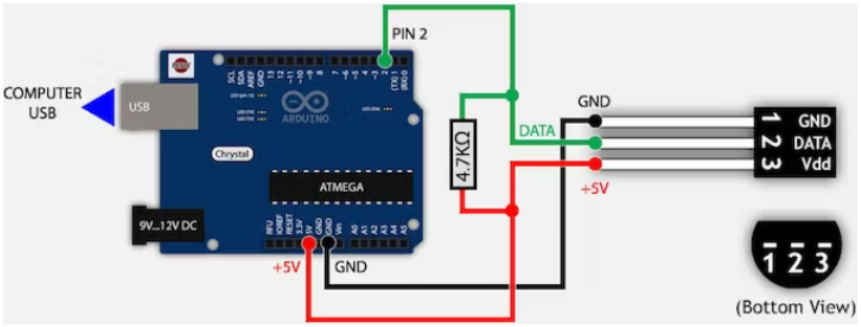
Connection Table

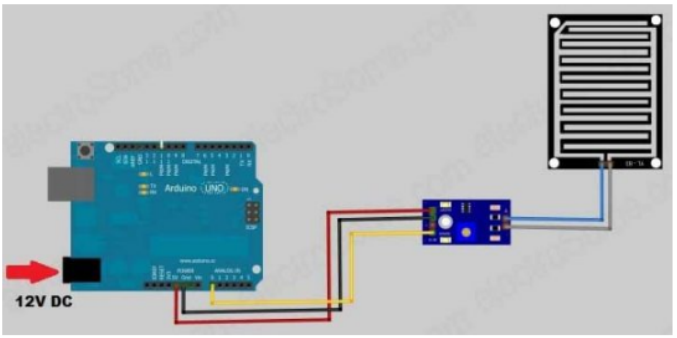
Arduino	DS18B20
GND	GND
D2	DQ
5V	VDD

Coding:

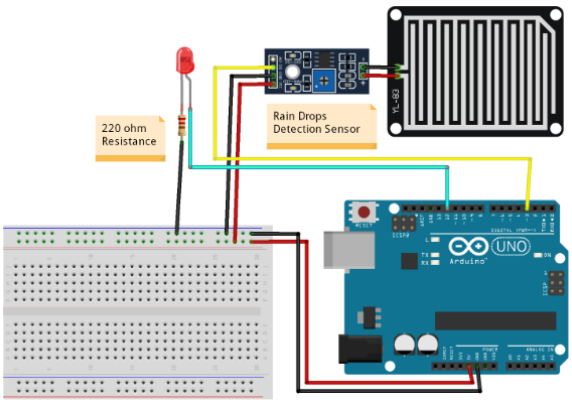
```
#include <OneWire.h>

#include <DallasTemperature.h>

// Data wire is plugged into digital pin 2 on the Arduino

#define ONE_WIRE_BUS 2
```

```
// Setup a oneWire instance to communicate with any OneWire device

OneWire oneWire(ONE_WIRE_BUS);

// Pass oneWire reference to DallasTemperature library

DallasTemperature sensors(&oneWire);

void setup(void)

{

 sensors.begin();          // Start up the library

 Serial.begin(9600);

}

void loop(void)

{

 // Send the command to get temperatures

 sensors.requestTemperatures();

 //print the temperature in Celsius

 Serial.print("Temperature: ");

 Serial.print(sensors.getTempCByIndex(0));

 Serial.print((char)176);//shows degrees character

 Serial.print("C  |  ");

 //print the temperature in Fahrenheit

 Serial.print((sensors.getTempCByIndex(0) * 9.0) / 5.0 + 32.0);

 Serial.print((char)176);//shows degrees character

 Serial.println("F");
```

	delay(500); **}** ● **Schematic Diagram**  **6. Doubt Clarification /Q & A Session- Do the Learning check using these Prompt Questions:** ● How does the Digital Sensor Works? ● List out the Applications of Digital sensors used in our Home. **7. Take-Home Assignment:** Make a Page Learning Report (Components Required, Procedure & Learning Outcomes) on this Project: **Arduino Capacitive Touch Sensor.** Watch This Video: How to use TTP223 Capacitive touch Arduino module **References:** Watch This Video: https://www.youtube.com/watch?v=KLGbPgls18k
Day 4: Ultrasonic & Rainwater Sensor	**Lesson Aims** 1. Explain the Project Objective to develop the product. 2. Listing Out the Materials/Components Required for the Project. 3. Integrate the Input/Output Devices with Arduino Controller as per Procedure.

	4. Program & Verify the Project Outcome. **Activity Title:** **1. Ice-breaking on Arduino Project (10 Mins)** **2. Introduction to Activity-1 (10 Mins)** **3. Specify / Select the Material Required (10 Mins)** **4. Connection Procedure & Coding (25 Mins)** **5. Introduction to Activity-2 (10 Mins)** **6. Specify / Select the Material Required (10 Mins)** **7. Connection Procedure & Coding (25 Mins)** **8. Doubt Clarification / Q & A Session (10 Mins)** **9. Instructions for Taking Home Assignment (10 Mins) (Individual)** **Activity Description:** **1. Ice-breaking on Arduino Projects:** At the beginning, show them the video having Significance & Real-Life Applications of Arduino Like Smart Dustbin, Home Automation by Alexa, Portable Human Following robot. Explain how it is planned & executed. **2. Introduction to Activity-1:** Objective of the activity is to get the Reading for Water Detection. **3. Materials Required:** ● Arduino Board ● Rainwater sensor ● Connecting Wires ● Bread Board **4. Connection Procedure:** 

Schematic Diagram



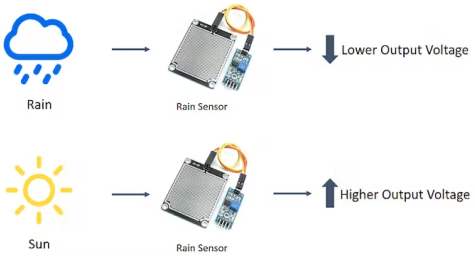
Connection Diagram

Operations:

A rain sensor is composed of a rain detection plate with a comparator who manages intelligence.

The rain sensor detects water that comes short-circuiting the tape of the printed circuits.

The sensor acts as a variable resistance that will change status: the resistance increases when the sensor is wet and the resistance is lower when the sensor is dry.



	The comparator has 2 outputs connected to the rain sensor, a digital output (0/1) and an analogue output (0 to 1023). **Sensor characteristics:** ● Voltage: 3, 3v-5v ● Sensor Dimension: 3.9 x 5.4 cm ● Sensitivity potentiometer ● 2 control LED's **Connections** Arduino --> Comparator 5V --> VCC GND --> GND DO --> D4 AO --> A0 **Coding:** **RAIN WATER DETECTION** //getting the reading for water detection void setup() { Serial.begin(9600); pinMode(A0,INPUT); } void loop() { int sensorValue=analogRead(A0); Serial.println(sensorValue); delay(100); } **RAIN WATER DETECTION WITH LED** void setup()

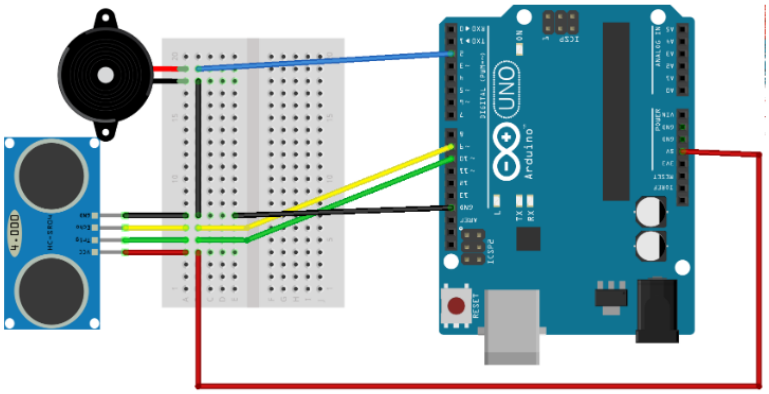
```
{
Serial.begin(9600);
pinMode(A0,INPUT);
pinMode(13,OUTPUT);


}
void loop()
{
int sensorValue=analogRead(A0);
Serial.println(sensorValue);
if(sensorValue<240)
digitalWrite(13,HIGH);
if(sensorValue>240)
digitalWrite(13,LOW);
}
```

5. **Introduction to Activity -2:** The objective of the activity is to detect the Obstacle & Warning using Ultrasonics sensors, Buzzer & Arduino.

6. **Materials Required:**

- Arduino Board
- Ultrasonic sensor
- Connecting Wires
- Buzzer
- Bread Board

7. **Connection Procedure:**



Connection Diagram:

- Connect the Buzzer positive terminal to the Arduino pin 2 and the negative terminal to the Gnd.
- Connect the VCC pin of ultrasonic to +5v pin and the Gnd to the ground.
- Connect trig pin to pin 10 and echo pin to pin 9.

Coding:

```
/*
This code should work to get warning cross the buzzer when something be closer than 0.5 meter
*/
// Define pins for ultrasonic and buzzer
int const trigPin = 10;
int const echoPin = 9;
int const buzzPin = 2;
void setup()
{
pinMode(trigPin, OUTPUT); // trig pin will have pulses output
pinMode(echoPin, INPUT); // echo pin should be input to get pulse width
pinMode(buzzPin, OUTPUT); // buzz pin is output to control buzzering
}
void loop()
{
// Duration will be the input pulse width and distance will be the distance to the obstacle in centimeters
int duration, distance;
// Output pulse with 1ms width on trigPin
digitalWrite(trigPin, HIGH);
```

	`` delay(1); digitalWrite(trigPin, LOW); // Measure the pulse input in echo pin duration = pulseIn(echoPin, HIGH); // Distance is half the duration devided by 29.1 (from datasheet) distance = (duration/2) / 29.1; // if distance less than 0.5 meter and more than 0 (0 or less means over range) if (distance <= 50 && distance >= 0) { // Buzz digitalWrite(buzzPin, HIGH); } else { // Don't buzz digitalWrite(buzzPin, LOW); } // Waiting 60 ms won't hurt any one delay(60); } ``` 8. **Doubt Clarification /Q & A Session- Do the Learning check using these Prompt Questions:** • Mention the Types of Sensors used in this project. • Explain any one safety Precaution to be taken while doing this Project. 9. **Take-Home Assignment:** Make a one Page Learning Report (Components Required, Procedure & Learning Outcomes) on this Project. **References** YouTube video https://www.youtube.com/watch?v=r6BR83tsNTQ ULTRASONIC PROJECTS Top 5 Arduino-Ultrasonic Sensor Projects for beginners RAINWATER SENSOR https://www.youtube.com/watch?v=SVRvx1OQhQg
Day 5: Actuators - working and types	**Lesson Aims** 1. Explain the Actuators & their work. 2. Classify the Types of Actuators. 3. Interpret the Application of Actuators in our day-to-day life. **Activity Title:** 1. **Ice-breaking on Actuators (10 Mins)**

2. **Introduction to Actuators (25 Mins)**
3. **Types of Actuators & its Working (20 Mins)**
4. **Safety Precautions while working with Actuators (20 Mins)**
5. **Application of Actuators (25 Mins)**
6. **Doubt Clarification / Q & A Session (10 Mins)**
7. **Instructions for Taking Home Assignment (10 Mins) (Individual)**

Activity Description:

1. Ice-breaking on Actuators:

At the beginning, show them the video having Significance & Real-Life Applications of Actuators like Robots, Toy cars. Also, Show the video of the Drone System in which Actuators Play a vital role.

2. Introduction to Actuators:

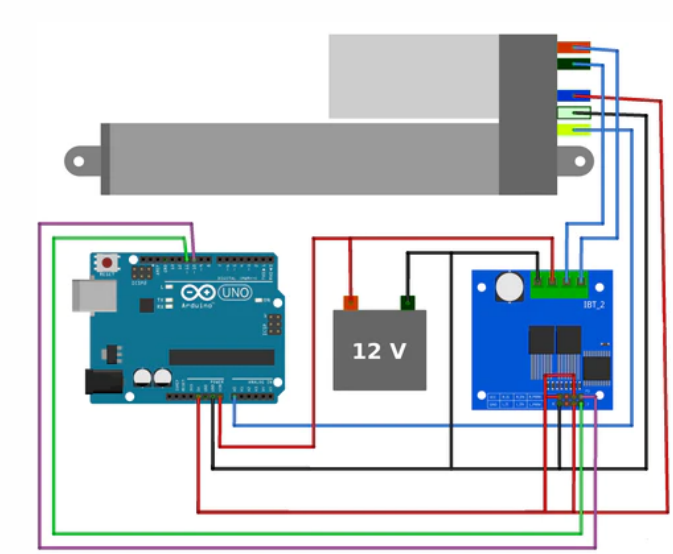
An actuator is a part of a device or machine that helps to achieve physical motion by converting any energy, like electrical, air, or hydraulic, into mechanical force. In simple words, it produces motion.

3. Types of Actuators & Its Working:

- **Linear Actuators**
- **Rotary Actuators**

Linear Actuators:

A **linear actuator** is an actuator that creates motion in a straight line, in contrast to the circular motion of a conventional electric motor. Linear actuators **make movement possible in robots**. This will allow any robotic application to interact with its environment through wheels, grippers, arms, and legs.

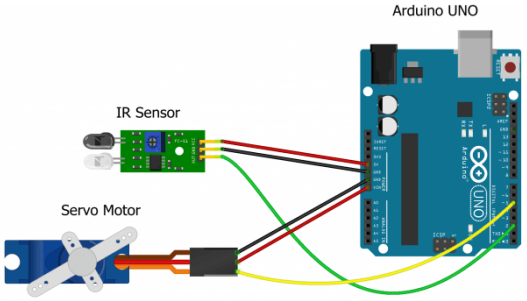


Linear Actuator Connection Diagram

IN1 pin	IN2 pin	Direction
LOW	LOW	Linear Actuator A stops
HIGH	HIGH	Linear Actuator A stops
HIGH	LOW	Linear Actuator A extends
LOW	HIGH	Linear Actuator A retracts

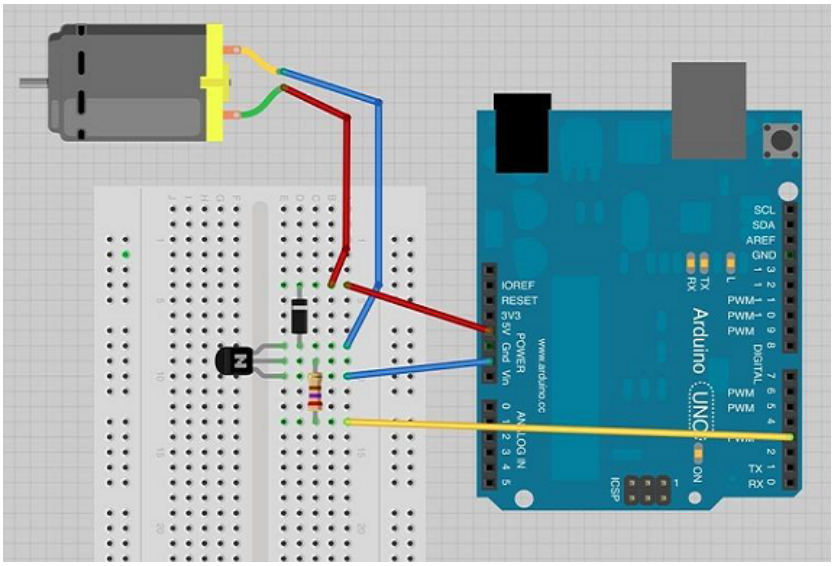
Rotary Actuators:
A **Rotary actuator** is an actuator that creates motion in a Circular.

Servo Motors:
A servo motor, or simply a servo, is a rotary actuator that rotates or pushes parts of a machine to which it is connected with precision. They turn at a particular angle and then stop.



DC Motors:

A **DC motor** is a class of rotary electrical motors that converts direct current (DC) electrical energy into mechanical energy. DC motors typically have just two leads, one positive and one negative. The motor will rotate if you connect these two leads directly to a battery, and the motor will spin. If you switch the leads, the motor will turn the opposite.



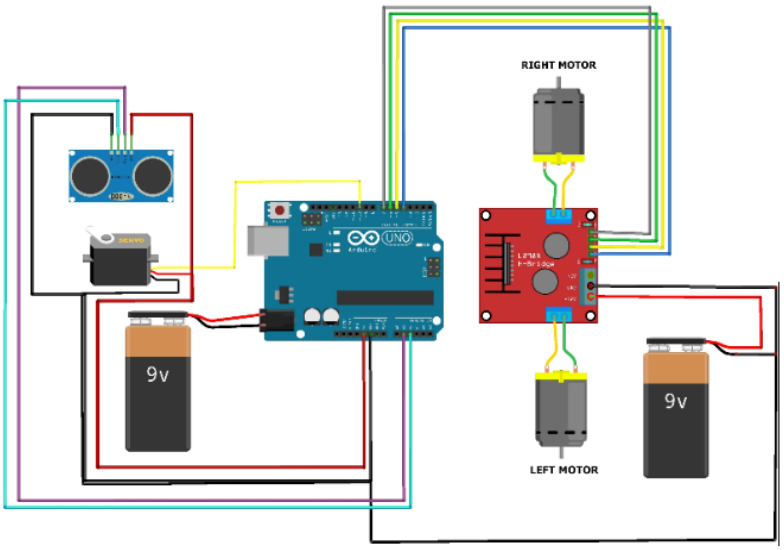
4. Safety Precautions while working with Actuators

- Test the output of the circuit BEFORE connecting it to the Arduino Controller.
- Use a Multimeter to ensure the voltage is not higher than 5V.
- The Arduino will be damaged if the voltage is higher than 5V.
- Always use a Motor Driver Circuit to run any Motor. Do not drive the motor directly from Arduino board pins. This may damage the board.
- Don't EVER hook a motor (or other inductive loads like a relay) up to it directly.
- Always use a current limiting resistor like 220 Ohm to Interface with LED.
- Don't supply it with more than 9V unless you know what Thermal Resistance and Power Dissipation mean.
- Get some inline fuses if you're plugging them into unknown circuits.

- Don't plug it into unknown circuits

5. Application of Actuators:

Obstacle Avoiding Car: Based on the Obstacle, the Car will decide whether to move Left or Right by itself.



Coding:
Refer to this Sheet:
https://docs.google.com/document/d/1ypVxTewetpFNXzFKGbFBT5hUOj6WSX5orfkGZPDFqBU/edit?usp=sharing

6.Doubt Clarification /Q & A Session- Do the Learning check using these Prompt Questions:

- List any two differences between the DC motor & Servo Motor?
- What is the need for a Motor Driver in the Arduino?

	7. Take-Home Assignment: Make a Page Learning Report (Components Required, Procedure & Learning Outcomes) on this Project: **Automatic Door Opening using Sensors & Actuators** Watch This Video: https://www.youtube.com/watch?v=HuIppQPLuPs **References** Watch This Video: https://www.youtube.com/watch?v=1n_KjpMfVT0