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IoT : Sensors And Its Applications

(Temperature sensor & Humidity sensor)

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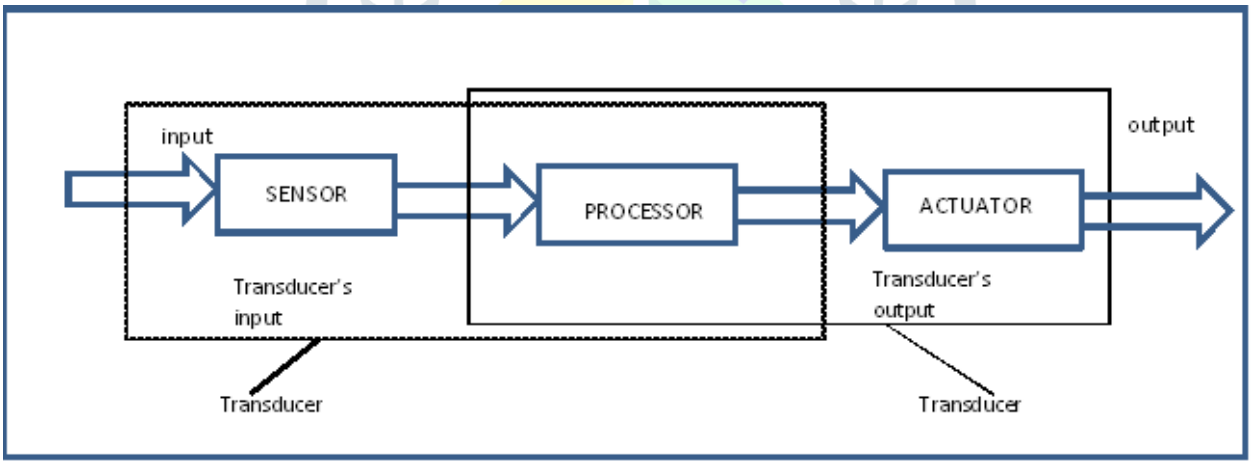
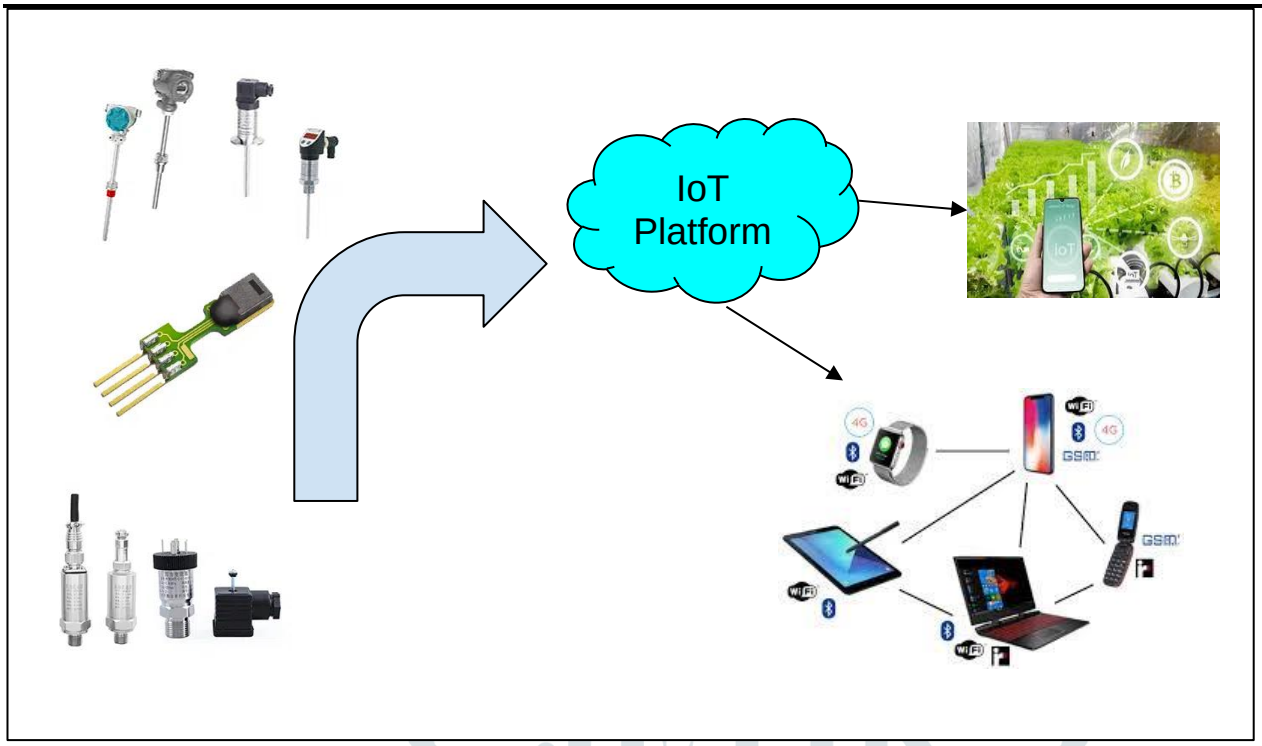
Abstract: The Internet of Things (IoT) refers to a network of interconnected devices, sensors, and objects capable of collecting and exchanging data over the Internet without human intervention. It bridges the gap between devices, data, and decision-making so businesses can remotely automate, monitor, and control equipment.parking, waste management, and energy monitoring. IoT is a device that provides a usable output in response to a specified measurement. The sensor attains a physical parameter and converts it into a signal suitable for processing (e.g., electrical, mechanical, optical) the characteristics of any device or material to detect the presence of a particular physical quantity. The output of the sensor is a signal that is converted to a human-readable form, like changes in characteristics, resistance, capacitance, impedance, etc.



Introduction:

What are the Roles of IoT sensors?

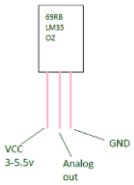
In the IoT system, two parts are very important: communication networks and connected devices. These devices mainly refer to sensors and actuators. As shown in the figure below, the bottom layer of the Internet of Things system is composed of sensor connections and networks to collect information. This is an important part of the Internet of Things system, which has the function of connecting the next layer of gateway and network layer.



IoT Sensor Types and Applications:

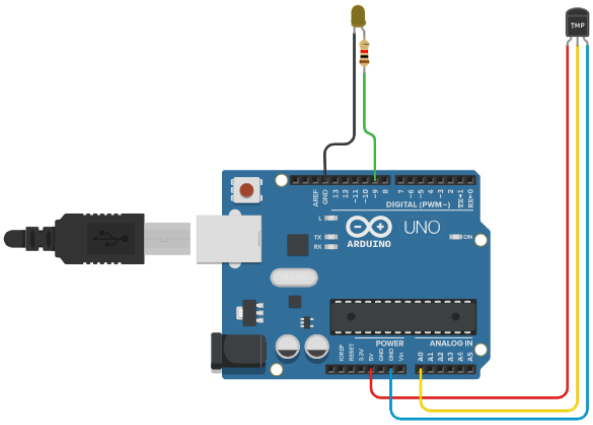
❖ **Temperature sensor**

Temperature sensors measure the heat in the heat source. They can detect temperature changes and convert these changes into data. Machinery used in manufacturing usually requires ambient temperature and equipment temperatures to be at a certain level. Similarly, in agriculture, the soil temperature is a key factor in crop growth. The temperature sensor can be roughly divided into contact type and non-contact type from the perspective of use. The former is that the temperature sensor is in direct contact with the measured object, and the temperature change of the measured object is sensed by the temperature-sensitive element. In the latter, the temperature sensor keeps a certain distance from the object to be measured, detects the intensity of infrared rays emitted from the object to be measured, and calculates the temperature. Temperature sensors are mainly used in areas closely related to temperatures, such as intelligent heat preservation and ambient temperature detection.



Example: Measurement of temperature using temperature sensor on Tinkercad

```
// C++ code
int senValue;
float Vout;
int C,F;
void setup()
{
pinMode(A0, INPUT);
pinMode(9, OUTPUT);
Serial.begin(9600);
}
void loop()
{
senValue=analogRead(A0);
Vout=senValue*(5000/1024.0);
C= (Vout-500)/10;
F= ((C*9)/5)+32;
if(C>30)
{
digitalWrite(9, HIGH);
}
else
{
digitalWrite(9, LOW);
}
Serial.println();
Serial.print(C);
}
```



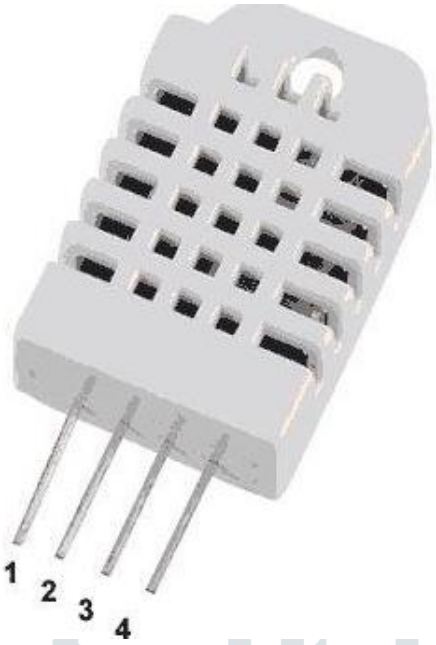
❖ Humidity sensors

Humidity sensors are widely used in health monitoring, environmental protection, human-machine interfaces, robots, and other aspects. A humidity sensor refers to the equipment or device that can convert humidity into an electrical signal that is easy to measure and process. The humidity sensor can measure the water vapor content in the air or other gases. Humidity sensors are commonly found in heating, ventilation, and air conditioning (HVAC) systems in industrial and residential sectors. They can be found in many other areas, including hospitals and weather stations, to report and predict the weather.

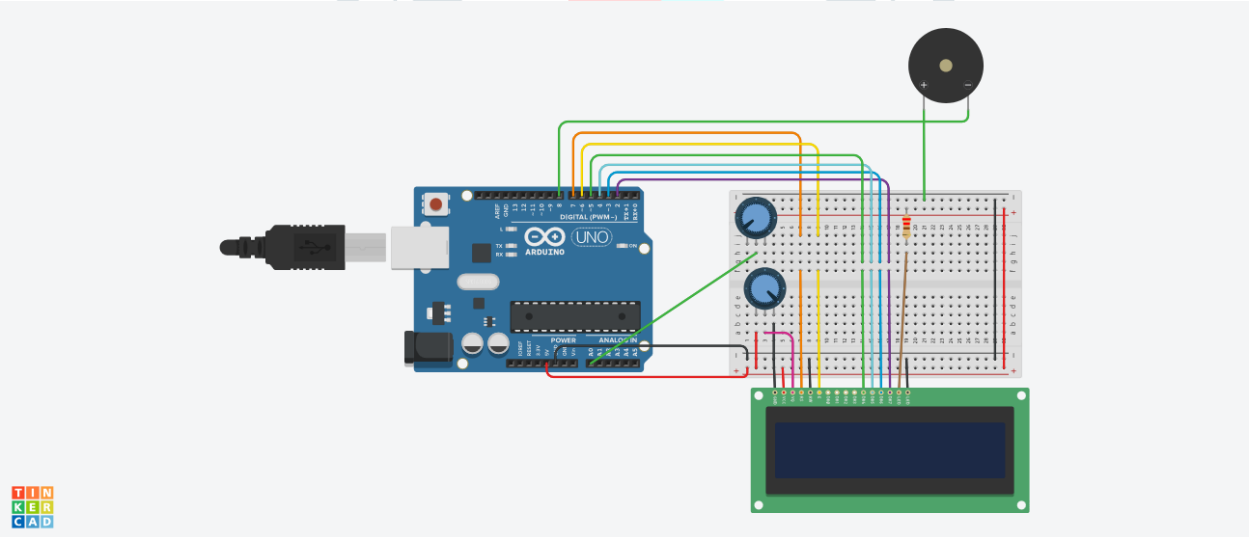
A humidity sensor is a device that detects and measures the amount of humidity, or water, in the surrounding air. They're available in many sizes and forms, ranging from handheld sensors to small components built into air quality systems. The readings from these sensors allow you to make adjustments if the air becomes too dry or humid.The DHT-22 (also named as AM2302) is a digital-output, relative humidity, and temperature sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and sends a digital signal on the data pin.In this example, you will learn how to use this sensor with Arduino UNO. The room temperature and humidity will be printed to the serial monitor.

The DHT-22 Sensor

DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND



The connections are simple. The first pin on the left to 3-5V power, the second pin to the data input pin and the right-most pin to the ground.



```
#include <Wire.h>

#include <LiquidCrystal.h>

//#include "DHT.h"
#define buzzer 8  //para simulación en tinkercad
//#define buzzer 50
#define potRango A0
//creo el objeto para la lcd
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);
//se define el simbolo ° para la lcd
byte grado[8] = {
```

```
  0b01110,
  0b01010,
  0b01110,
  0b00000,
  0b00000,
  0b00000,
  0b00000,
  0b00000
};

// Uncomment whatever type you're using!
#define DHTTYPE DHT22   // DHT 22  (AM2302), AM2321
//const int DHTPin = 22;  // entrada del sensor dht
//DHT dht(DHTPin, DHTTYPE);

//variables}
/* Rangos de temperatura
 * 1-Congelado -2 a 0
 * 2-Refrigerado 2 a 8
 * 3-Lugar fresco 8 a 15
 * 4-Ambiente 15 a 30
 * 5-Sin indicación Maximo 30
 * humedad entre 50 a 70%
 */
float rang1B=-2.0,rang1A=0.0,rang2B=2.0,rang2A=8.0,rang3B=8.0,rang3A=15.0,rang4B=15.0,rang4A=30.0,rang5A=30.0,humB=50.0,humA=70.0,temp,hume;
int rango,potPos;
byte alarmaTemp=0,alarmaHum=0,alarmaTempA=0,alarmaHumA=0,cont=60;
//La variable conteo da el tiempo en segundos para el envio de los mensajes por GSM
//Si se necesitan mas de 255 segundos, se debe cambiar de byte a int
unsigned long tiempo0,tiempoA;


void setup() {
  // put your setup code here, to run once:
  //PARAMETROS DE INICIALIZACION DE LA LCD
  lcd.begin(16, 2);
  lcd.createChar(0,grado);
  lcd.setCursor(0,0);
  lcd.print("Sensor temperatura");
  lcd.setCursor(0,1);
  lcd.print("   y humedad.");
  delay(1000);
  for (byte i=0;i<18;i++) {
   // DESPLAZO HACIA LA IZQUIERDA
   lcd.scrollDisplayLeft();
   delay(150);
   }
  pinMode(buzzer,OUTPUT);
  digitalWrite(buzzer,LOW);
```

```
  Serial.begin(9600);
  delay(500);
  lcd.clear();
  tiempo0=millis();
}

void loop() {
  // put your main code here, to run repeatedly:

  //Leo el potenciometro para definir que rango de temperatura se usará
  potPos=analogRead(potRango);

  /*Segun el valor de potPos le doy a la variable rango el valor que corresponde
   * Rango 1<=200
   * rango 2<=400
   * rango 3<=600
   * rango 4<=800
   * rango 5>800
   */
  if (potPos<=200){
  rango=1;
  }
  else{
   if (potPos<=400){
   rango=2;
   }
   else{
   if (potPos<=600){
            rango=3;
   }
   else{
            if (potPos<=800){
            rango=4;
            }
            else{
            rango=5;
            }
   }
   }
  }

  //Leo la temperatura del sensor
//  float hume = dht.readHumidity();
//  float temp = dht.readTemperature();
  hume=62;
  temp=5.1;
  //escribo en la pantalla
  lcd.setCursor(0,0);
  lcd.print("R| Temp = ");
  lcd.print(temp,1);
  lcd.write(byte(0));   //Simbolo de grado celsius
```

```
lcd.print("C ");
lcd.setCursor(0,1);
lcd.print(rango);
lcd.print("| Humedad = ");
lcd.print(hume,0);
lcd.print("% ");
delay(20);
//*****************************************************************************************************************
 **********//
 //Procedo a verificar temperatura y humedad de acuerdo a cada rango
 if (rango==1){
 if ((temp<rang1B)||(temp>=rang1A)){
 alarmaTemp=1;
 if (alarmaTemp!=alarmaTempA){
        Serial.println("Temperatura fuera de rango en CONGELADOR");
        alarmaTempA=alarmaTemp;
 }
 }
 else{
 alarmaTemp=0;
 if (alarmaTemp!=alarmaTempA){
        Serial.println("La temperatura en CONGELADOR ha vuelto a su rango normal");
        alarmaTempA=alarmaTemp;
 }
 }
 }

 if (rango==2){
 if ((temp<rang2B)||(temp>=rang2A)){
 alarmaTemp=1;
 if (alarmaTemp!=alarmaTempA){
        Serial.println("Temperatura fuera de rango en REFRIGERADOR");
        alarmaTempA=alarmaTemp;
 }
 }
 else{
 alarmaTemp=0;
 if (alarmaTemp!=alarmaTempA){
        Serial.println("La temperatura en REFRIGERADOR ha vuelto a su rango normal");
        alarmaTempA=alarmaTemp;
 }
 }
 }

 if (rango==3){
 if ((temp<rang3B)||(temp>=rang3A)){
 alarmaTemp=1;
 if (alarmaTemp!=alarmaTempA){
        Serial.println("Temperatura fuera de rango en LUGAR FRESCO");
        alarmaTempA=alarmaTemp;
 }
```

```
}
else{
alarmaTemp=0;
if (alarmaTemp!=alarmaTempA){
        Serial.println("La temperatura en LUGAR FRESCO ha vuelto a su rango normal");
        alarmaTempA=alarmaTemp;
}
}
}

if (rango==4){
if ((temp<rang4B)||(temp>=rang4A)){
alarmaTemp=1;
if (alarmaTemp!=alarmaTempA){
        Serial.println("Temperatura fuera de rango en AMBIENTE");
        alarmaTempA=alarmaTemp;
}
}
else{
alarmaTemp=0;
if (alarmaTemp!=alarmaTempA){
        Serial.println("La temperatura en AMBIENTE ha vuelto a su rango normal");
        alarmaTempA=alarmaTemp;
}
}
}

if (rango==5){
if (temp>=rang5A){
alarmaTemp=1;
if (alarmaTemp!=alarmaTempA){
        Serial.println("Temperatura fuera de rango en INDEFINIDO");
        alarmaTempA=alarmaTemp;
}
}
else{
alarmaTemp=0;
if (alarmaTemp!=alarmaTempA){
        Serial.println("La temperatura en INDEFINIDO ha vuelto a su rango normal");
        alarmaTempA=alarmaTemp;
}
}
}
if ((hume<humB)||(hume>=humA)){
alarmaHum=1;
if (alarmaHum!=alarmaHumA){
Serial.println("Humedad fuera de rango");
alarmaHumA=alarmaHum;
}
}
else{
```

```
 alarmaHum=0;
 if (alarmaHum!=alarmaHumA){
 Serial.println("La humedad ha vuelto a su rango normal");
 alarmaHumA=alarmaHum;
 }
 }
//*****************************************************************************************************
 ******************//
 //Si se ha presentado alarma hacer sonar el buzzer
 if (alarmaTemp==1){
 for (byte i=0;i<=6;i++)
 {
 digitalWrite(buzzer,HIGH);
 delay(100);
 digitalWrite(buzzer,LOW);
 delay(100);
 }
 digitalWrite(buzzer,LOW);
 }
 else
 {
 digitalWrite(buzzer,LOW);
 delay(500);
 }
 if (alarmaHum==1)
 {
 for (byte j=0;j<=3;j++)
 {
          digitalWrite(buzzer,HIGH);
          delay(200);
          digitalWrite(buzzer,LOW);
          delay(200);
 }
 digitalWrite(buzzer,LOW);
 }
 else
 {
 digitalWrite(buzzer,LOW);
 delay(500);
 }
 delay(300);

 //Verifico si yan ha pasado el tiempo estipulado para el envio de los datos por GSM
 tiempoA=millis()-tiempo0;
 if (tiempoA/1000>=cont){
 Serial.print("Temperatura=");
 Serial.print(temp);
 Serial.print("°C - Humedad=");
 Serial.print(hume);
 Serial.println("%");
 if (alarmaTemp==1){
```

```
  Serial.println("Se encuentra activa la alarma de temperatura");
  }
  else{
  Serial.println("Temperatura dentro del rango normal de operación");
  }
  if (alarmaHum==1){
  Serial.println("Se encuentra activa la alarma de humedad");
  }
  else{
  Serial.println("Humedad dentro del rango normal de operación");
  }
  tiempo0=millis();
  }

}
```

Conclusion:

Sensor applications play a vital role in modern technology by enabling real-time monitoring, control, and optimization across various industries through their ability to convert physical phenomena into measurable signals, leading to improved efficiency, safety, and automation in fields like healthcare, manufacturing, automotive, and environmental monitoring.

Temperature and humidity sensors are vital components in various modern applications, enabling precise environmental monitoring and control, which ultimately improves comfort, energy efficiency, product quality, and safety across diverse fields like HVAC systems, healthcare, agriculture, industrial production, and weather forecasting, making them indispensable tools for optimizing conditions in various environments and ensuring optimal functionality of devices and processes.

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