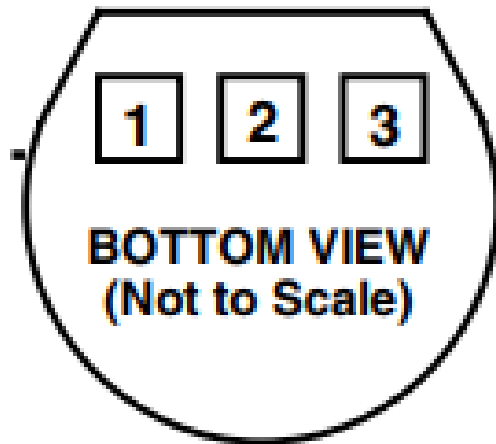




Microcontrollers & Applications

Lecture 5.3: Temperature (TMP36 & LM35) and Soil Moisture Sensors

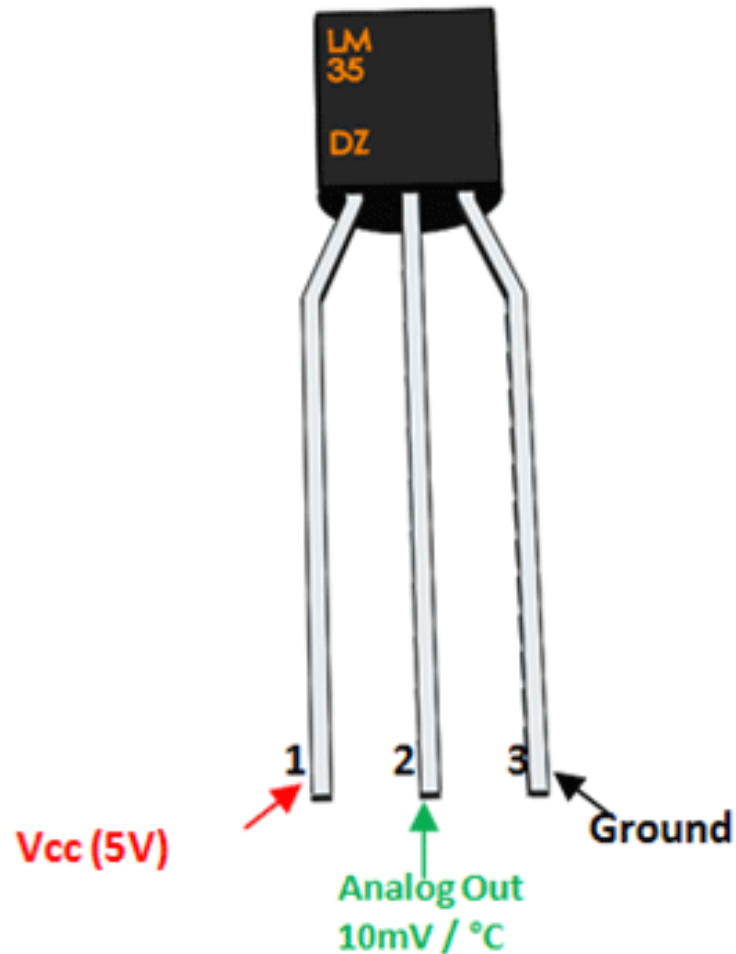
Temperature Sensor: TMP36



PIN 1, $+V_S$; PIN 2, V_{OUT} ; PIN 3, GND

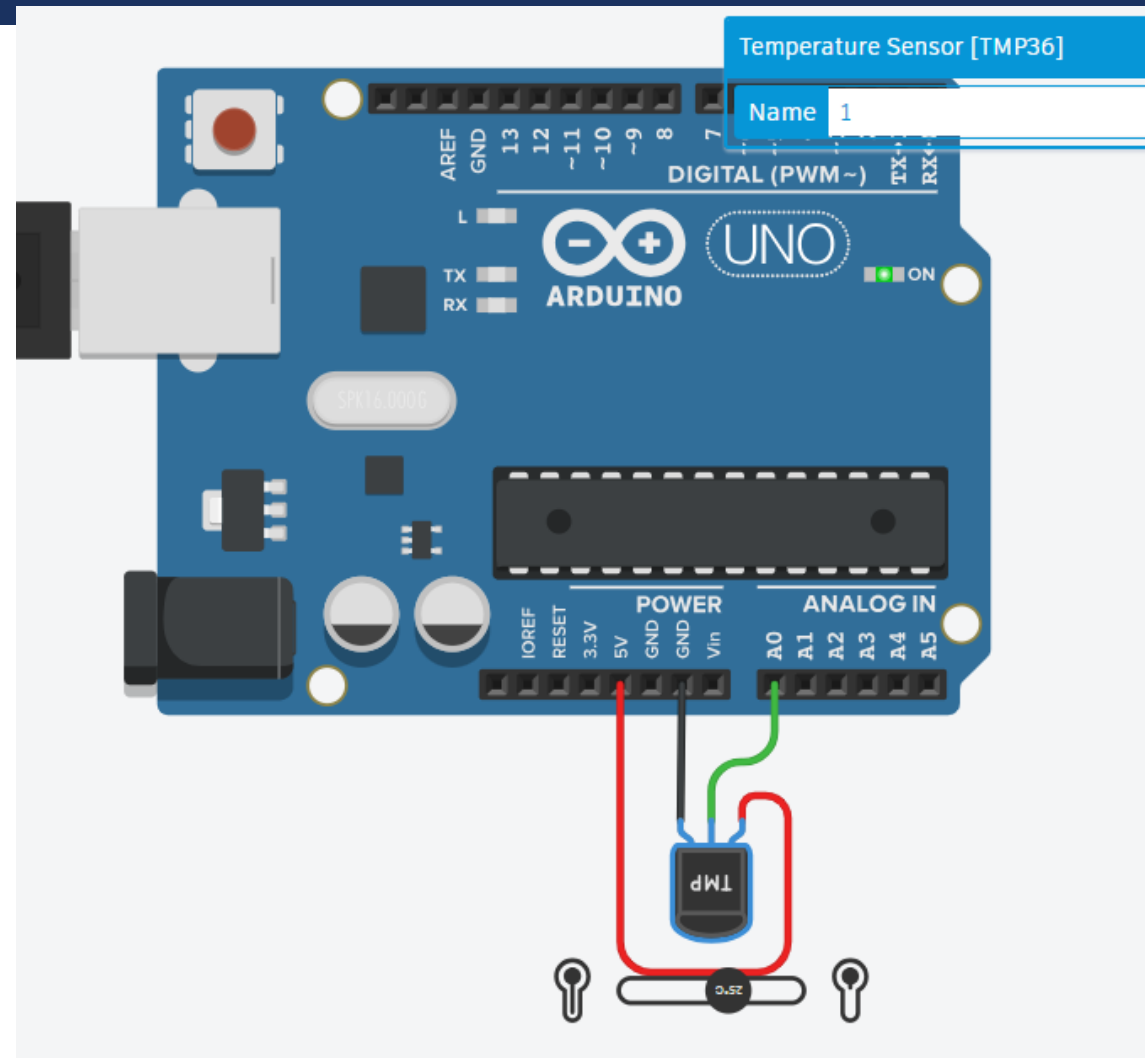
- $+V_S = 2.7 \text{ V to } 5.5 \text{ V}$
- Accuracy: $\pm 2 \text{ }^\circ\text{C}$ ($1 \text{ }^\circ\text{C}$ near $+25 \text{ }^\circ\text{C}$)
- $T = -40 \text{ }^\circ\text{C to } +125 \text{ }^\circ\text{C}$
- $I < 50 \text{ } \mu\text{A}$
- Scale factor: $10 \text{ mV / }^\circ\text{C}$
- $V_{out} = 750\text{mV}$ at $25 \text{ }^\circ\text{C}$

Temperature Sensor: LM35



- Vcc = 4 V to 20 V
- Accuracy: ± 1 °C (0.5 °C near +25 °C)
- T = -55 °C to +150 °C
- I < 60 μ A
- Scale factor: 10 mV / °C

Temperature Sensor: Arduino Example (1)



Temperature Sensor: Arduino Example (2)

```
/*
  @2024 by Yalcin Isler (https://me.islerya.com)

  TMP36:
  * 750 mV = 25 oC
  * 10 mV / oC
  * mVolt = analogPin * 5000.0 / 1023.0 (if Vs = 5V)
  * Temperature = 25.0 + (mVolt-750.0)/10.0
*/

#define TMP36 A0

void setup()
{
  Serial.begin(9600);
}

void loop()
{
  int iTmp = analogRead(TMP36);
  float fVolt = iTmp * 5000.0 / 1023.0; // mV level
  Serial.println((fVolt-750.0)/10.0+25.0);
  delay(1000);
}
```

Temperature Sensor: Arduino Example (3)

```
/*
  @2024 by Yalcin Isler (https://me.islerya.com)

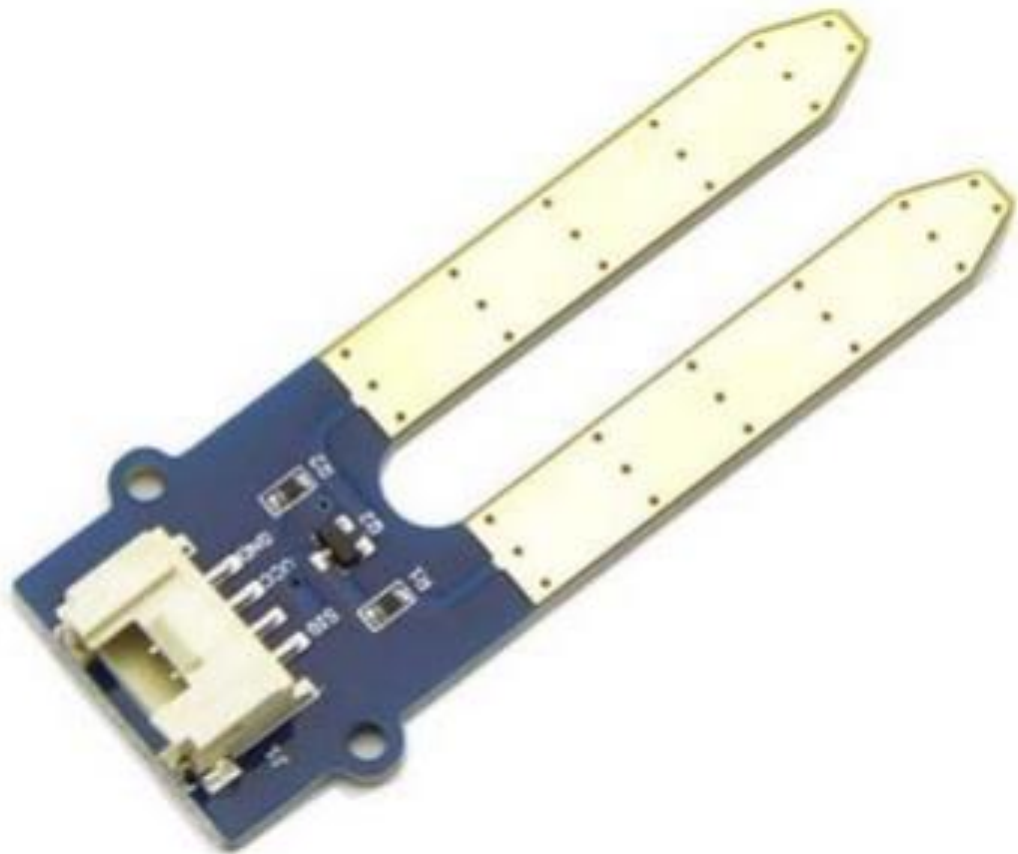
  LM35:
  * 0 mV = 0 oC
  * 10 mV / oC
  * mVolt = analogPin * 5000.0 / 1023.0 (if Vcc = 5V)
  * Temperature = mVolt/10.0
*/

#define LM35 A0

void setup()
{
  Serial.begin(9600);
}

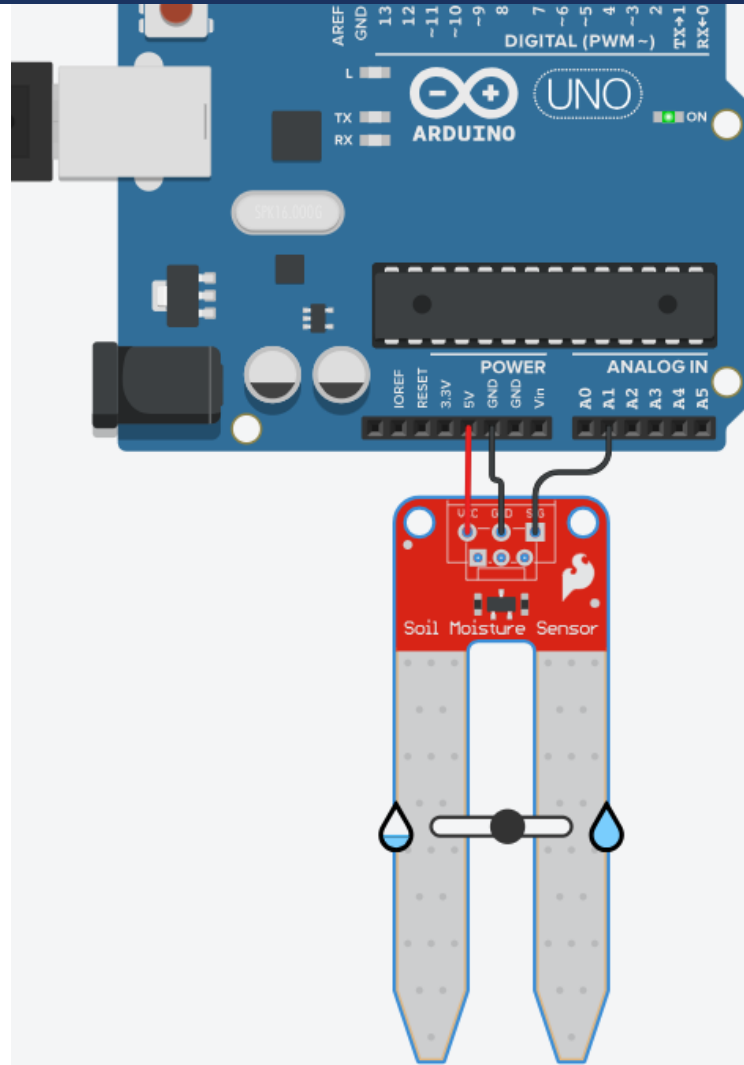
void loop()
{
  int iTmp = analogRead(LM35);
  float fVolt = iTmp * 5000.0 / 1023.0; // mV level
  Serial.println(fVolt/10.0);
  delay(1000);
}
```

Soil Moisture Sensor



- $V_{cc} = 3.3\text{ V to }5\text{ V}$
- $I < 35\text{ mA}$
- $V_{out} = 0\text{ to }300$ if sensor in dry soil
- $V_{out} = 300\text{ to }700$ if sensor in humid soil
- $V_{out} = 700\text{ to }950$ if sensor in water

Soil Moisture Sensor: Arduino Example (1)



Soil Moisture Sensor

Name 1

Serial Monitor

```
numid 3011  
Humid Soil  
Humid Soil  
Humid Soil  
Humid Soil  
Humid Soil
```


Soil Moisture Sensor: Arduino Example (2)

```
/*
    @2024 by Yalcin Isler (https://me.islerya.com)
*/

#define SOIL_MOISTURE A1

void setup() {
    Serial.begin(9600);
}

void loop() {
    unsigned int iSoilMoisture =
        analogRead(SOIL_MOISTURE);

    if (iSoilMoisture < 300)
        Serial.println("Dry Soil");
    else if (iSoilMoisture > 700)
        Serial.println("Soil in water");
    else
        Serial.println("Humid Soil");
    delay(1000);
}
```

Left to Students

Design a plant watering system with a digitally-controlled active-high valve to control water dropping and a digitally-controlled active-high heater:

If soil is dry then it opens a valve to give water to the plant.

If soil is humid then it closes water and heater.

If soil is in water then it opens a heater to evaporate the water more quickly.

If temperature is lower than 25 oC then it opens the heater (heats upto 35 oC).

If temperature is higher than 35 oC then it closes the heater in all cases.

Reports to LCD

soil moisture level and the temperature

whether heater and water valves are open or not

All in all, our aim is to quarrantee that the soil is humid and the temperature is between 25 oC and 35 oC.



Thanks for
listening 😊

YALÇIN İŞLER

Assoc. Prof.