Data Transfer

Long Range

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The objective of this project is to send data of various sensors installed in the vehicle to a computer located at some another place a long distance away from the computer continuously and effectively.

The data can be temperature of various components of vehicle, fuel information, GPS location etc.

LoRa

LoRa (from "long range") is a physical proprietary radio communication technique. It is based on spread spectrum modulation techniques derived from chirp spread spectrum (CSS) technology.

1. **Long Range**: Can transmit up to 20 kms in rural areas and 5 kms in urban settings, making it ideal for wide area loT applications.
2. **Low Power**: LoRa devices are energy efficient, running on batteries for many years
3. **Adaptive Data Rate**: Helps in optimizing energy consumption and enhances network capacity.
4. **High Capacity**: Can support millions of messages per base station, making it an excellent choice for dense sensor networks.
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Characteristics of LoRa

Modulation	Chirp Spread Spectrum
Frequency	Unlicensed ISM Band (868 MHz)
Bandwidth	250KHz and 125 KHz
Maximum Data Rate	50 Kbps
Maximum Payload Length	243 bytes
Spread Factor	7 to 12
Coverage Range	5 Km (Urban); 20 Km (Rural)
Topology	Star on Star
Adaptive Data Rate	Yes
Authentication/Encryption	Yes (AES 128b)
Allow Private Network	Yes
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Components Required for Data Transfer

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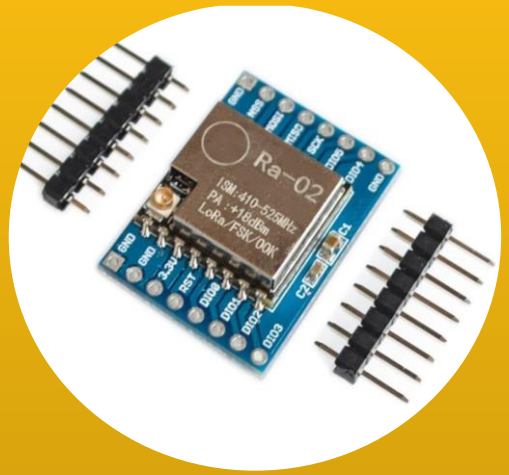


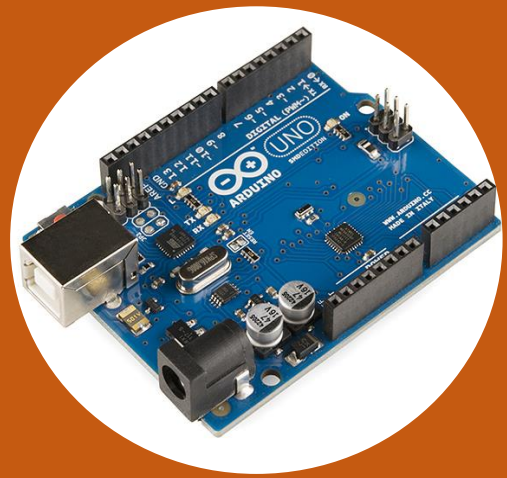
Two SX1278 LoRa Transceivers

The SX1278 transceivers feature the LoRa long range modem that provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption. One will be connected to the microcontroller which is placed in the vehicle to take in the data from different sensors and one will be connected to the computer at work station.

It costs about ₹400 to 500

LoRa module product link

Helix antenna product link



Arduino Uno

Arduino UNO is a microcontroller board. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It will be placed in the vehicle and various sensors and one LoRa transceiver will be connected to it. The transceiver will act as transmitter and will send data to the other transciever.

It costs about ₹300 to 400

Arduino Uno product link

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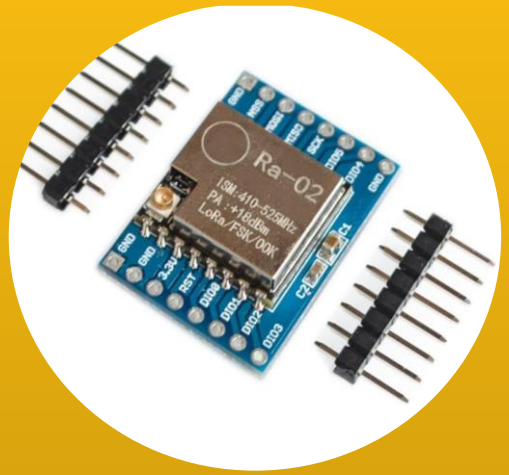

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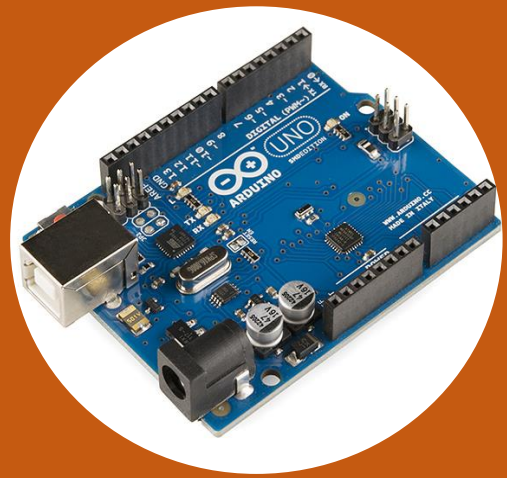

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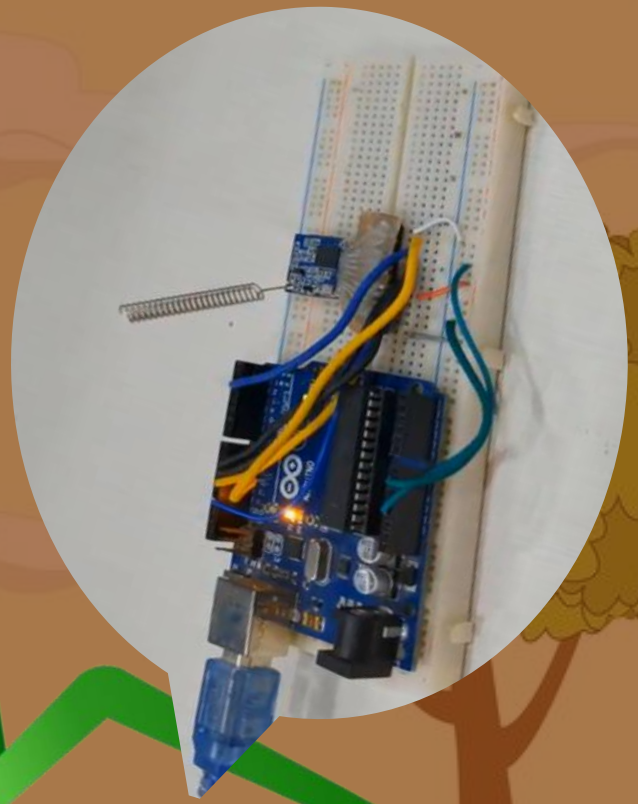
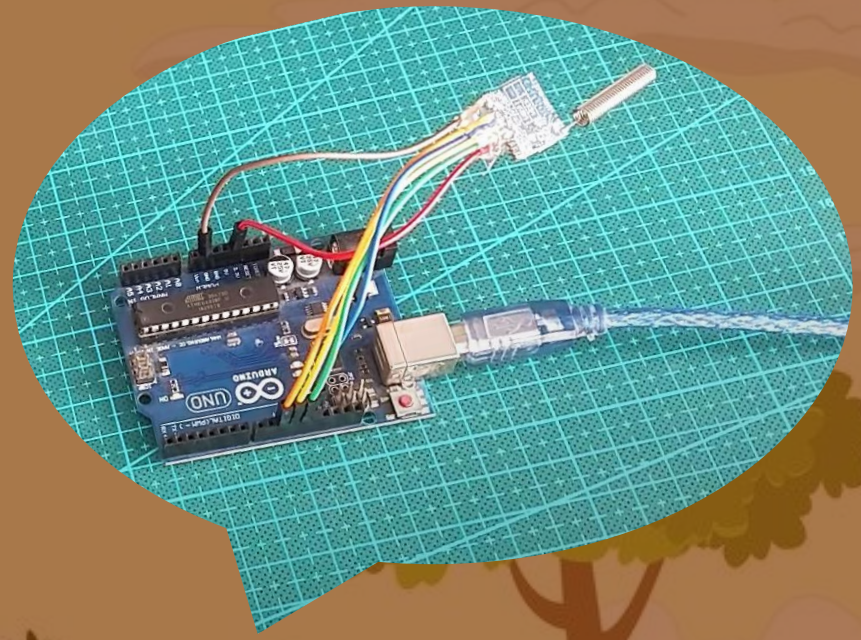
Another Arduino Uno connected with PC and one transceiver



Arduino Uno with one transceiver and various sensor inside the vehicle



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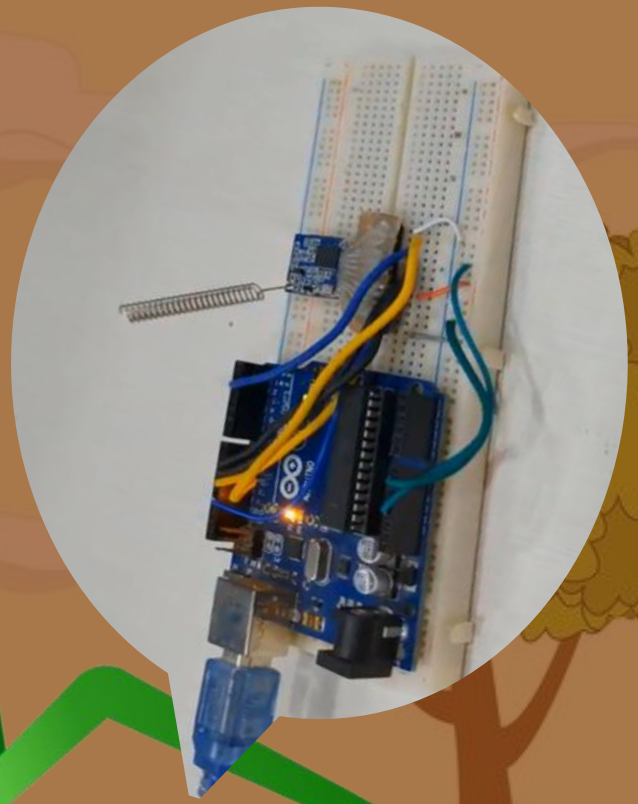

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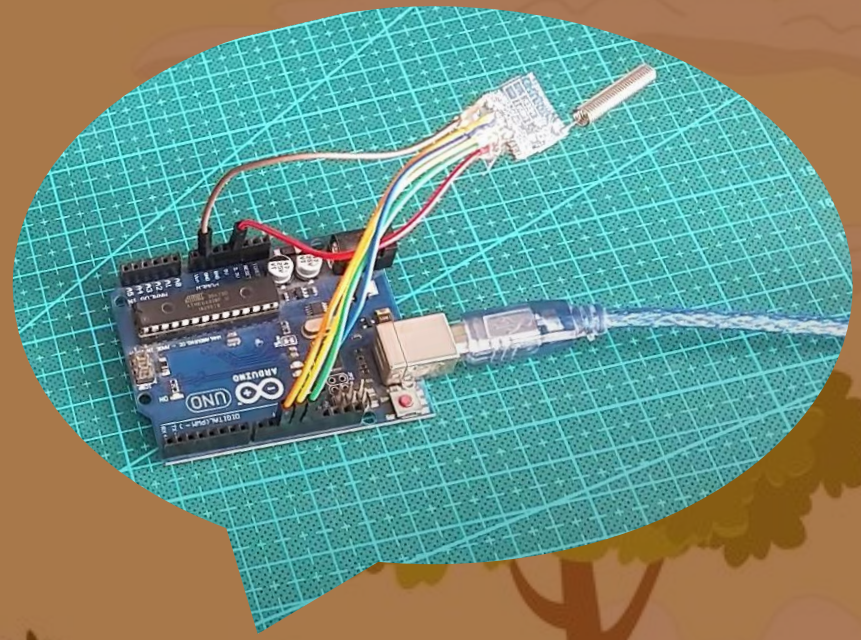
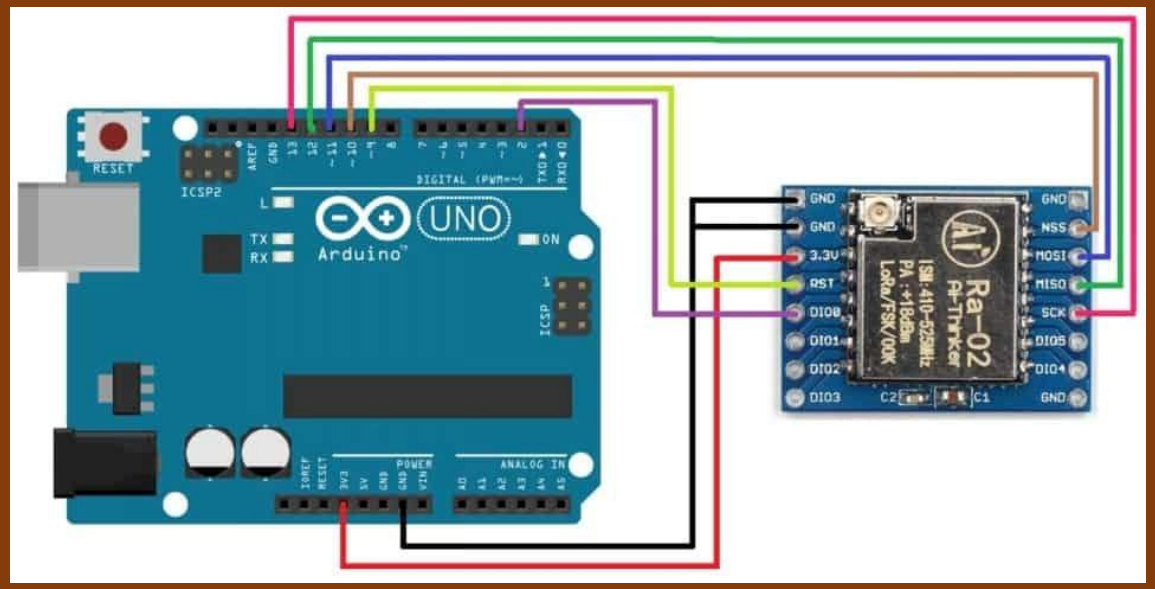


Rough Sketch of Wring



LoRa VCC to Arduino 3.3V or an external 3.3V power supply (check the module's voltage requirements).

LoRa GND to Arduino GND.

LoRa SCK to Arduino SCK, 13 (SCK is the SPI clock pin).

LoRa MISO to Arduino MISO, 12(Master In Slave Out).

LoRa MOSI to Arduino MOSI, 11 (Master Out Slave In).

LoRa NSS (or CS) to an Arduino digital pin (e.g., D10).

LoRa DIO0 to an Arduino digital pin (e.g., D2) - this is the interrupt pin used to receive data.

LoRa RST (Reset) to an Arduino digital pin (e.g., D9) if available; otherwise, you can connect it directly to 3.3V.

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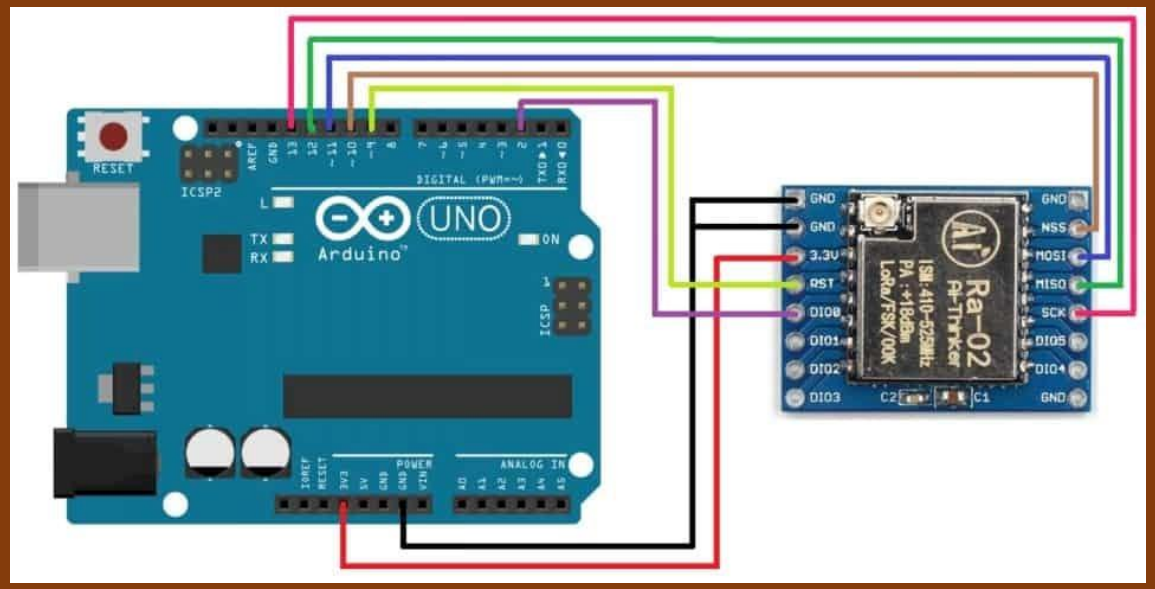

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Coolant Sensor

It is a sensor that is used to measure the temperature of vehicle around engine.
It doesn't directly measure the temperature.
We first find the resistance dependent of it with temperature then use voltage divider circuit with Arduino to calculate the temperature by Steinhart–Hart equation.

$$\frac{1}{T} = A + B\ln R + C(\ln R)^3$$

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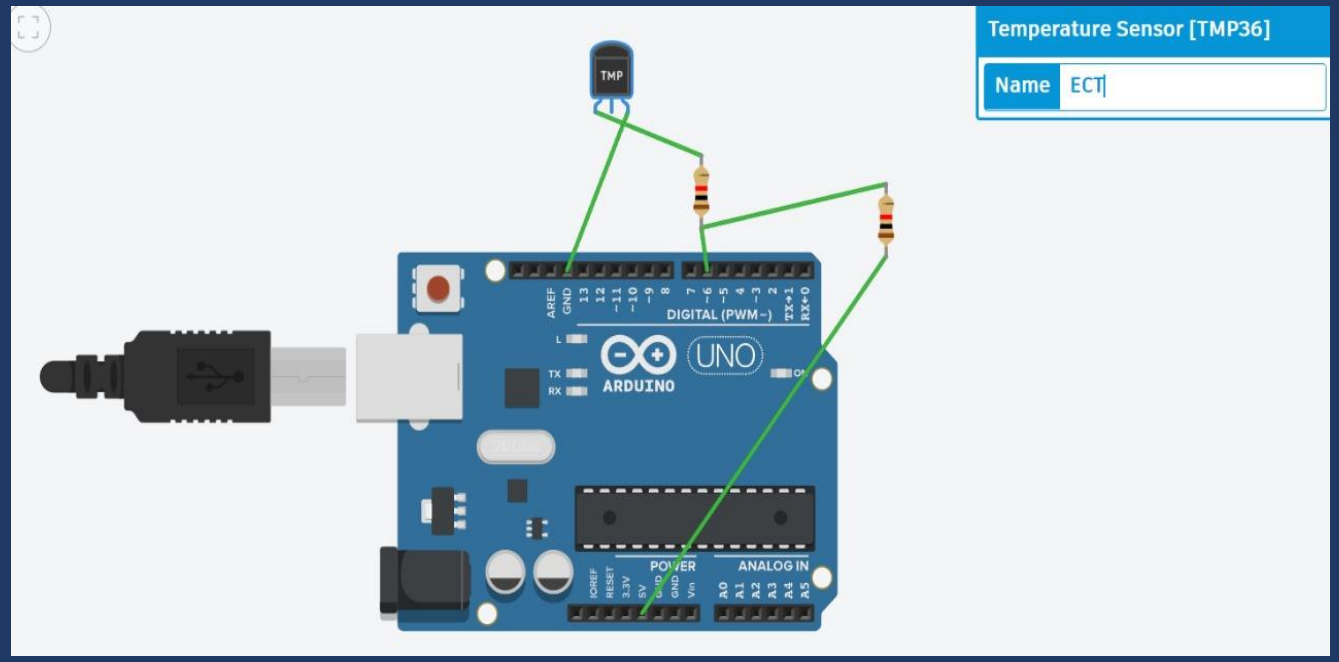
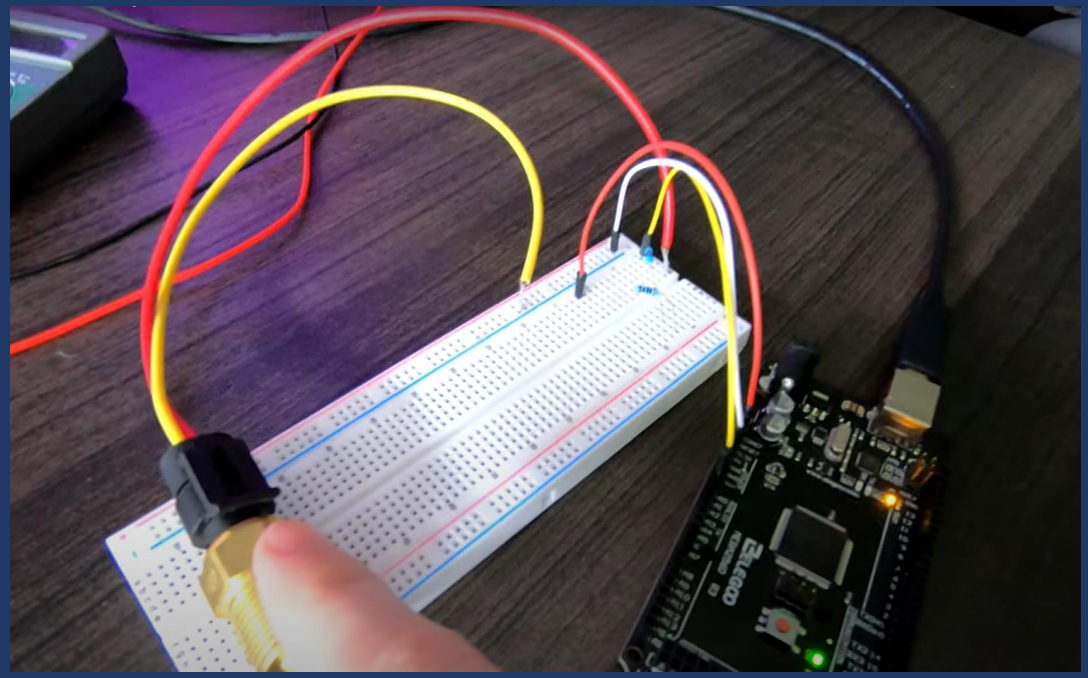
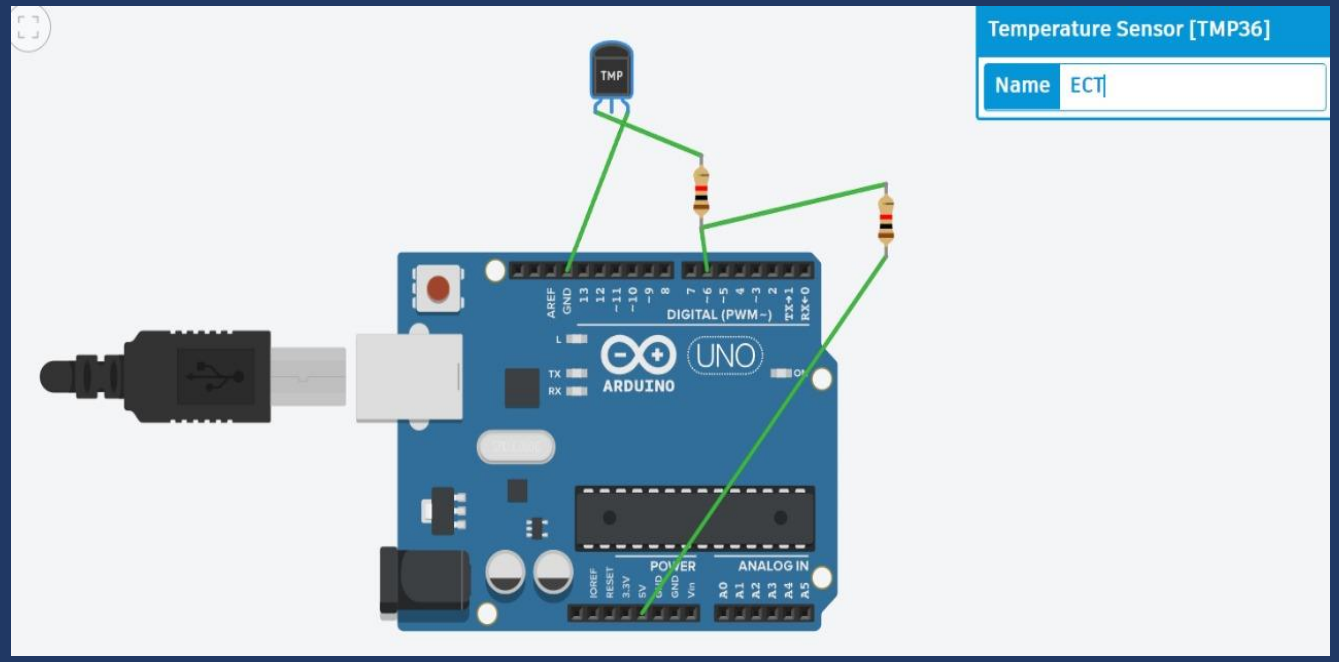


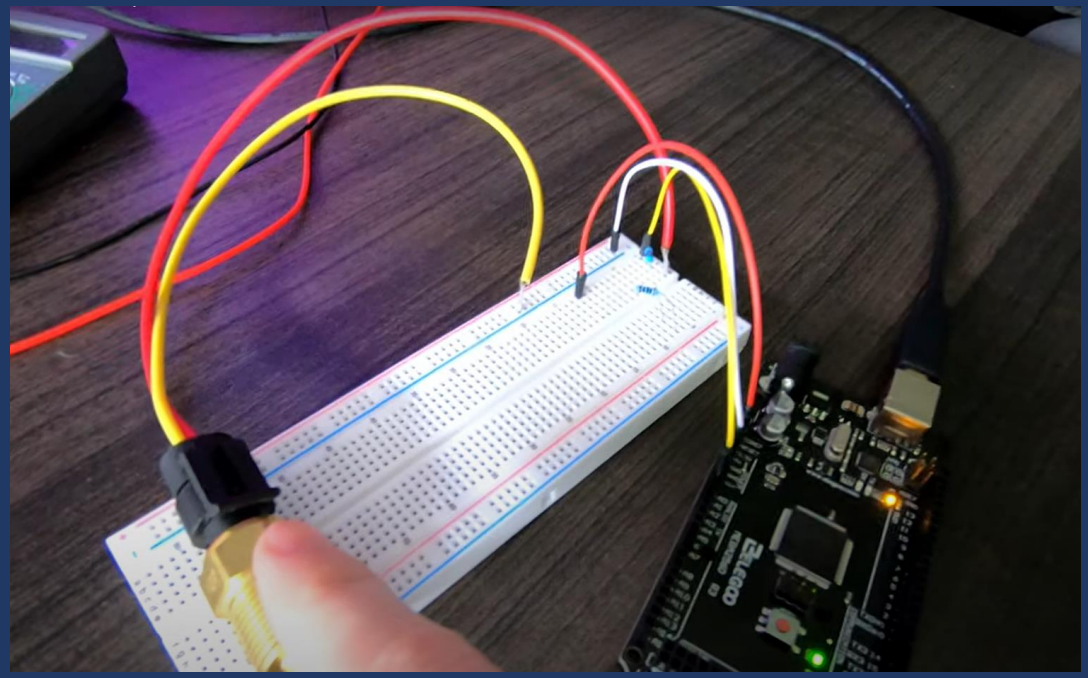


ECT has two wires, one of them will be connected to the ground and the second will be connected by the voltage-dividend. The above resistors have the values of difference of individual resistances across the wires.

ECT web address

Wring





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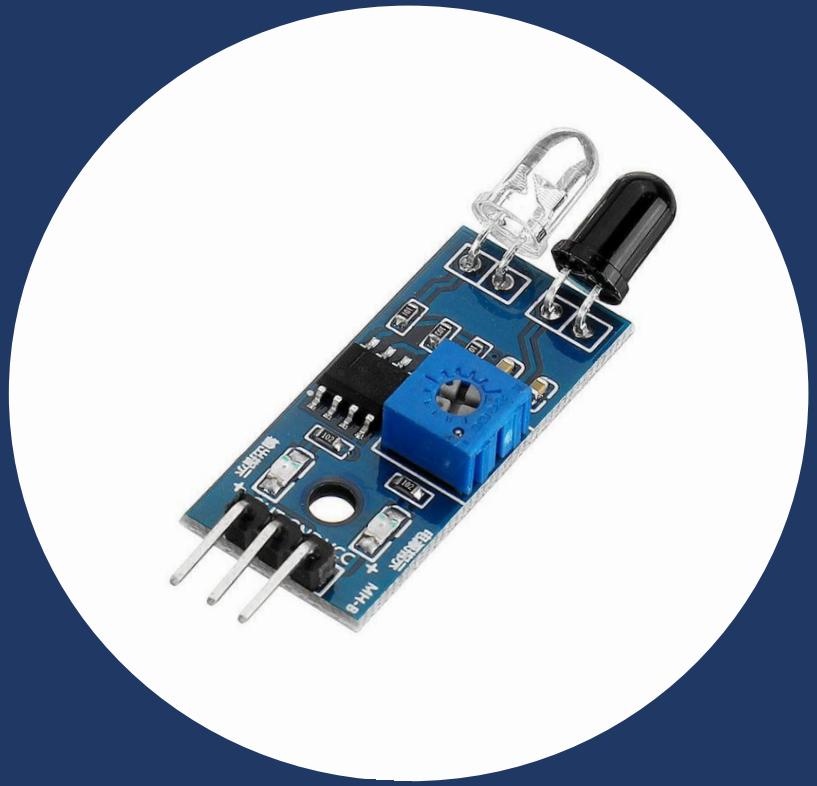

It is a sensor that can be used to form a tachometer which can be used to measure the rotations per minute.

IR transmits IR rays which reflect back to the IR receiver and then IR Module generates an output or pulse which is detected by the Arduino controller

After 5 seconds Arduino calculates RPM for a minute using the given formula:

RPM=count x 12 / (number of spokes of wheel)

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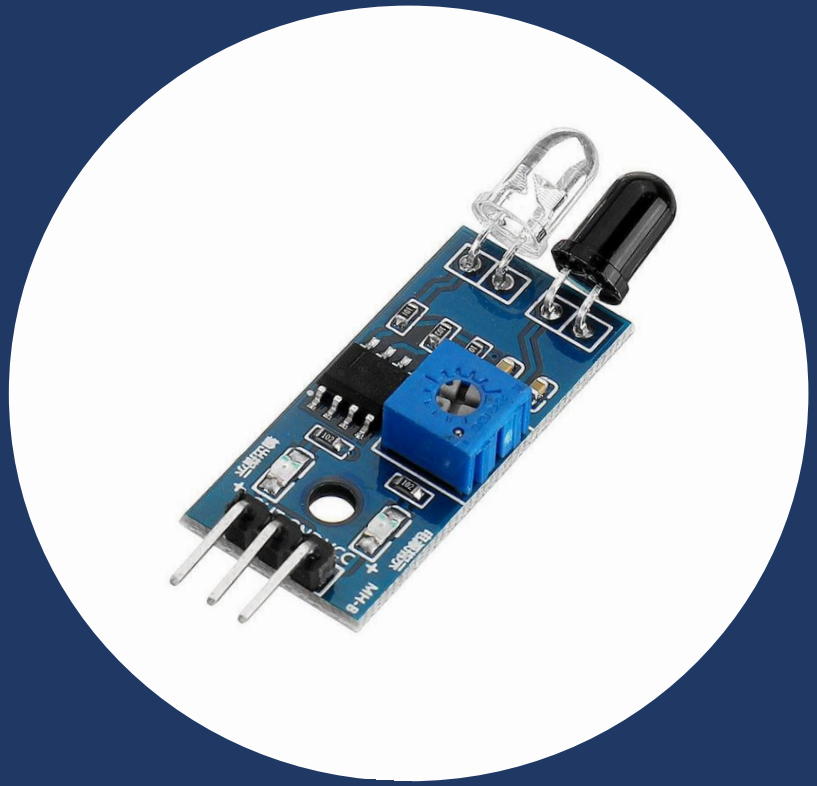

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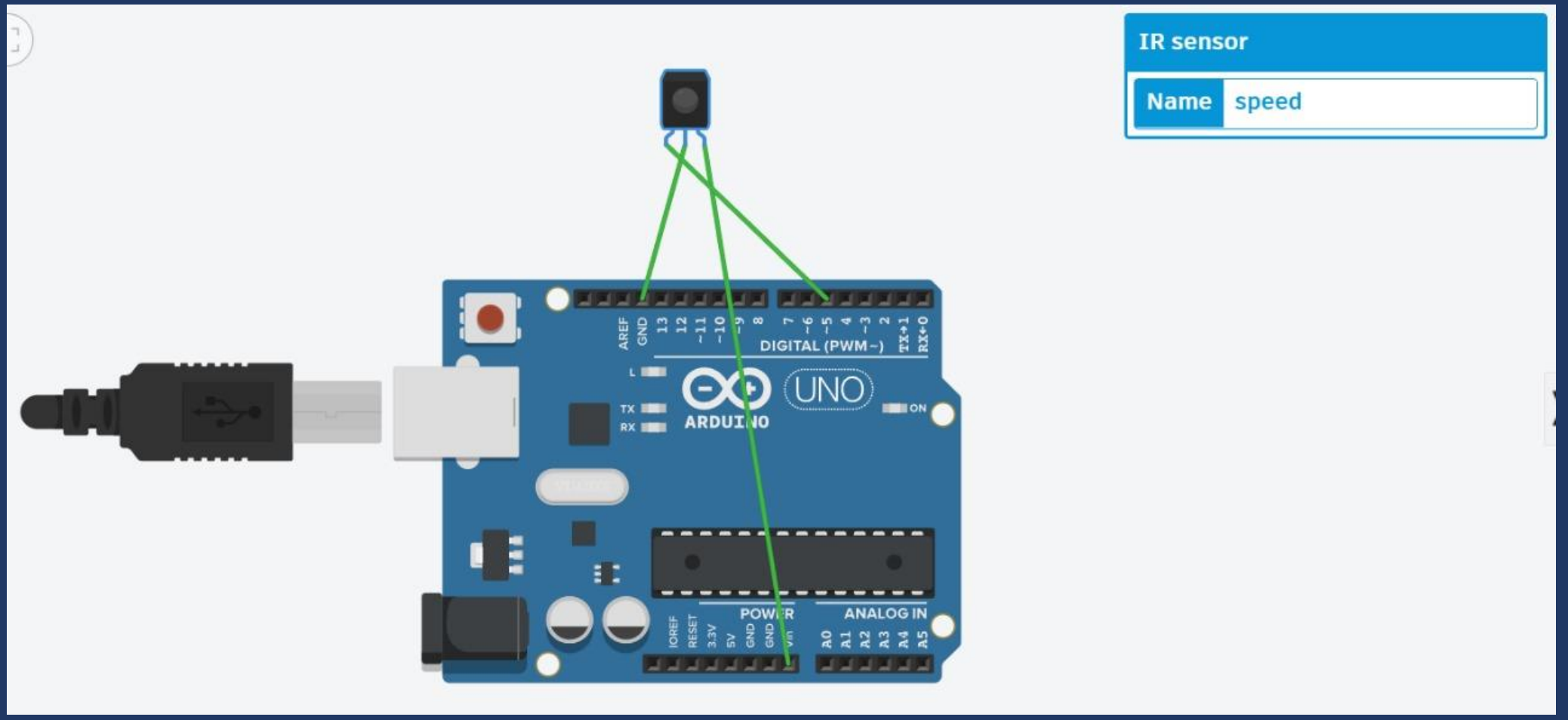

IR Sensor product link

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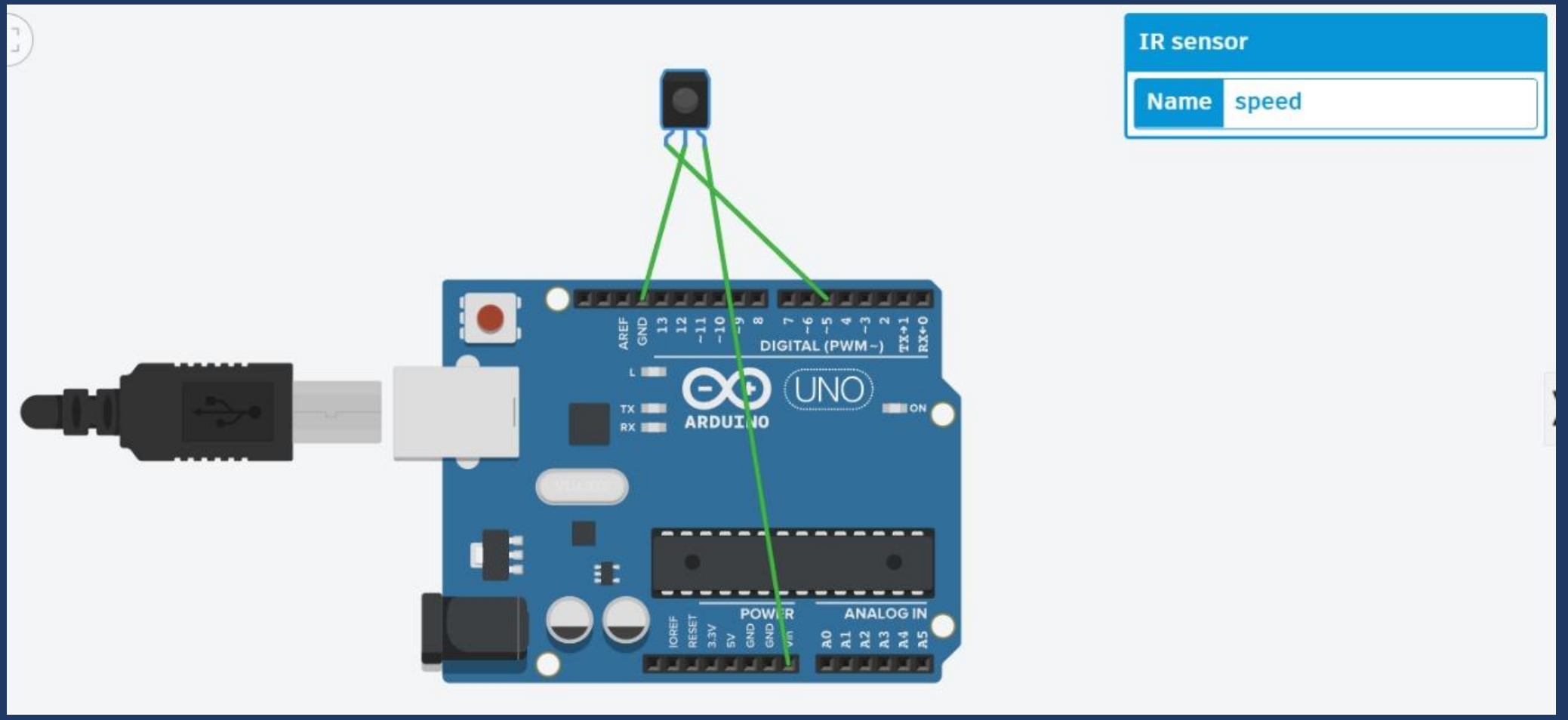

IR Sensor product link

NEO-6M GPS

It is a sensor that is used to get the geolocation data.
Along with latitude and longitude it gives data like number of satellites being tracked, horizontal dilution of position, altitude above mean sea level, height of geoid respectively

Its output looks like:
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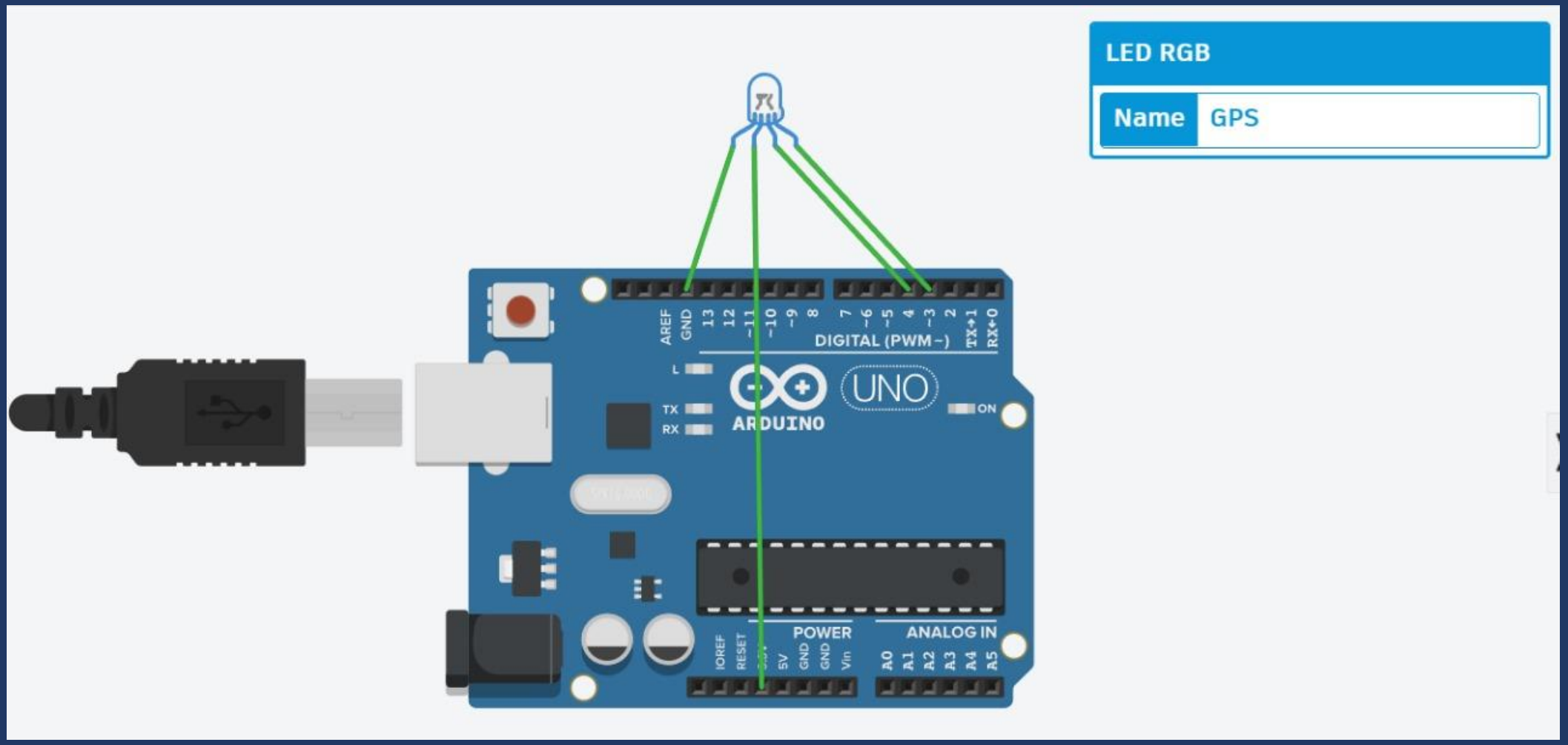

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