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Milestone #1: Get familiar with your sensor and propose testing plans

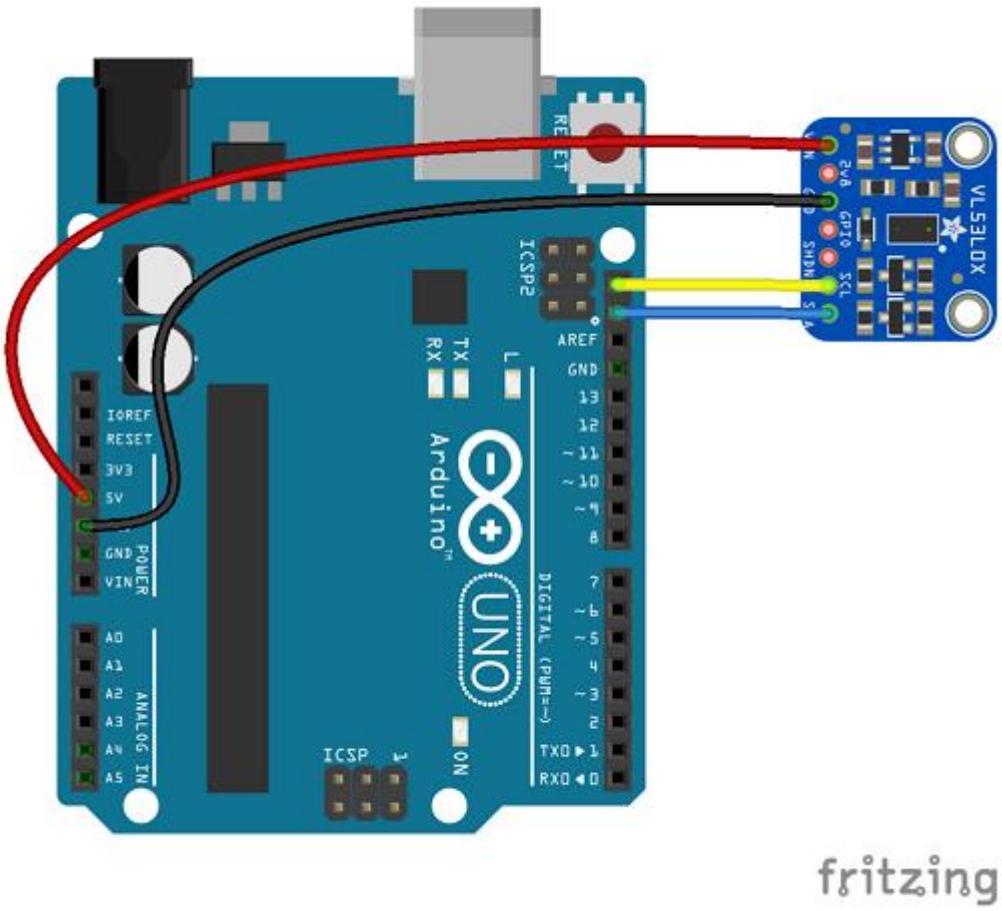
Part 1

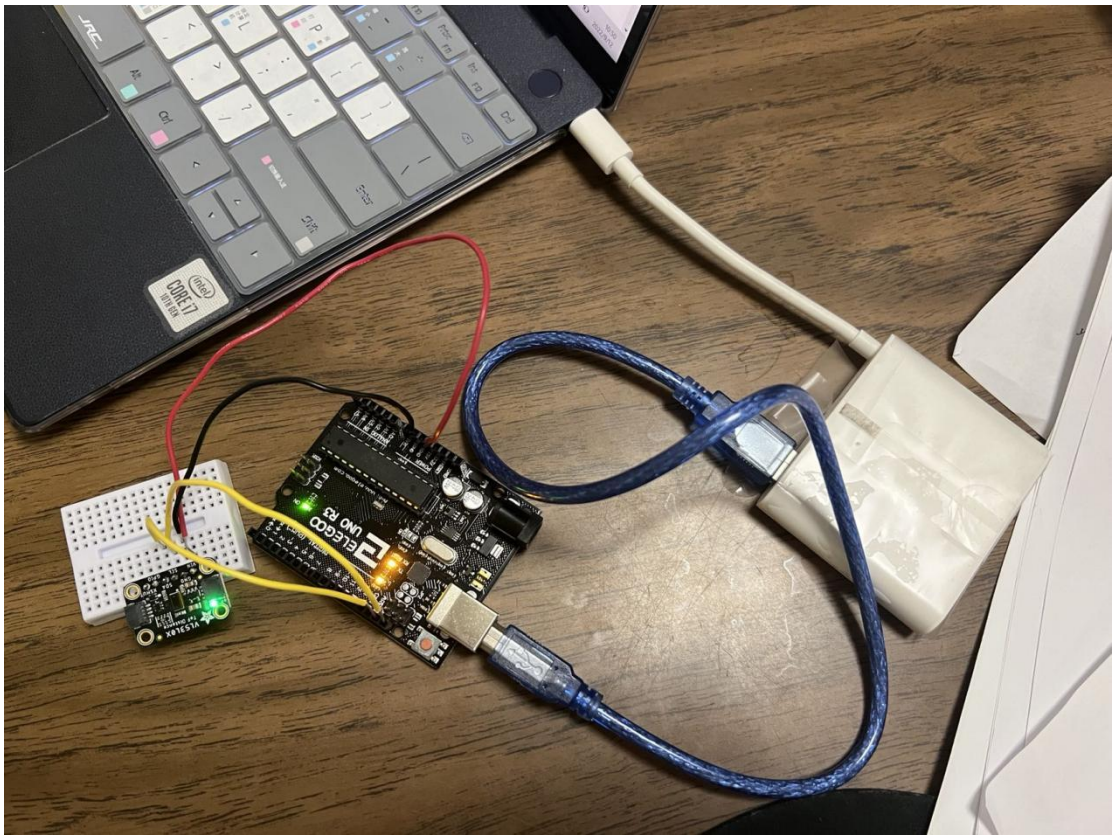
First of all, students need to study the basic of the sensor and know how it works, test the sensor with Arduino and then proposal the testing plans.

1. The summary of the main findings from your sensor study

Operating voltage	3.3V/5V
Mounting holes size	2.0mm
Ranging distance	30 ~ 2000mm
Ranging accuracy	±5% (high speed mode), ±3% (high accuracy mode)
Ranging time (min)	20ms (high speed mode), 200ms (high accuracy mode)
Field of view	25°
Laser wavelength	940nm
Operating temperature	-20 ~ 70°C

2. Wiring diagram of how you connect the sensor to Arduino, or a picture of your connected hardware

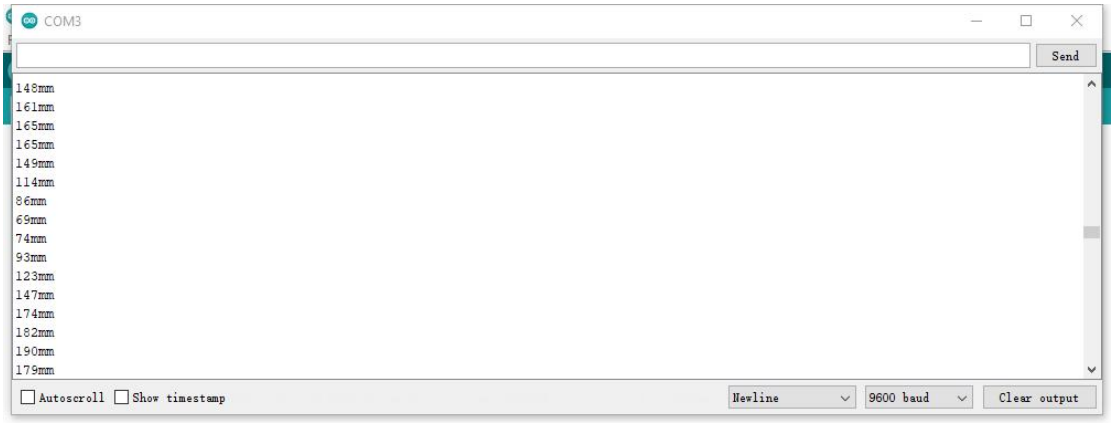




3. Arduino code

```
#include <Wire.h>
#include <VL53L0X.h>

VL53L0X sensor;

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

  sensor.setTimeout(500);
  if (!sensor.init())
  {
    Serial.println("Failed to detect and initialize sensor!");
    while (1) {}
  }

#if defined LONG_RANGE
  // lower the return signal rate limit (default is 0.25 MCPS)
  sensor.setSignalRateLimit(0.1);
  // increase laser pulse periods (defaults are 14 and 10 PCLKs)
  sensor.setVcselPulsePeriod(VL53L0X::VcselPeriodPreRange, 18);
  sensor.setVcselPulsePeriod(VL53L0X::VcselPeriodFinalRange, 14);
#endif

#if defined HIGH_SPEED
  // reduce timing budget to 20 ms (default is about 33 ms)
  sensor.setMeasurementTimingBudget(20000);
#elif defined HIGH_ACCURACY
  // increase timing budget to 200 ms
  sensor.setMeasurementTimingBudget(200000);
#endif
}

void loop()
{
  Serial.print(sensor.readRangeSingleMillimeters());
  Serial.print("mm");
  if (sensor.timeoutOccurred()) { Serial.print(" TIMEOUT"); }

  Serial.println();
}
```

4. Screenshot of the sensor readings



Part 2

The second half of milestone 1

I want to use the Time of flight sensor to test the distance.

1. I want to test the Range of the Time of flight sensor .

The range about the distance that the Time of flight sensor can measure is 0~2m. Taking the wall as a reference, I first will measure the distance of 2m perpendicular to the wall with a ruler, then draw a straight line parallel to the wall with the ruler at the distance of 2m perpendicular to the wall as reference line 1, and draw a 3m straight line perpendicular to the wall and cross the reference line 1 as the reference line 2. Take the intersection of the sensor wall and the reference line 2 as the starting point, translate the sensor on the reference line 2 at the same distance each time, gradually increase the vertical distance between the sensor and the wall, and observe the change of measured data on the computer. When the distance between the sensor and the wall is more than 2m, observe the change of measured distance data on the computer.

2. I want to test the Sensitivity of the Time of flight sensor .

Change the measuring distance unit of the sensor displayed in the computer from M to

cm, and then to mm, gradually reduce the distance unit, and observe the change of the data corresponding to the same measuring distance on the computer within the measuring range.

3. I want to test the Resolution of the Time of flight sensor .

First, set the increment of the distance measured by the sensor to 10cm, and observe the data change on the computer as the sensor moves away from the wall surface on the reference line 2. If the change of 10cm can be detected, reduce the increment of 10cm to 5cm to continue the test; If the change of 10 cm cannot be detected, change the increment of 10 cm to 15 cm and continue the test.

4. I want to reduce the Static Error of the Time of flight sensor .

Let the line of sight and the ruler scale be as vertical as possible, measure it repeatedly for 5 times, and take the average value to reduce the error.

5. I want to test the Accuracy of the Time of flight sensor .

Compare the data measured by the sensor with the data measured by the ruler for many times at the same distance within the allowable range of measurement.

6. I want to test the Linearity of the Time of flight sensor.

I will import the measurement data into matlab, and check its linearity with the Curve Fitting tool.

7. I want to test the Precision of the Time of flight sensor.

I will calculate the variance between the output distance of the sensor and the actual distance to get its Precision.