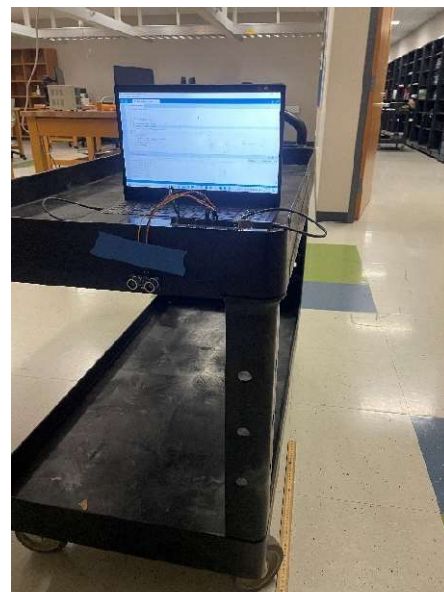
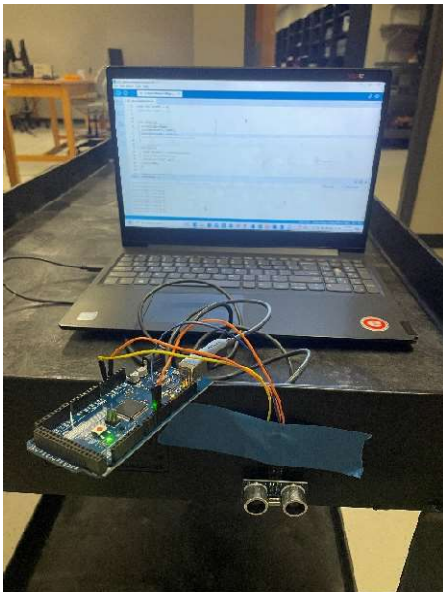


For the ultrasonic sensor, the ground truth was not only easily accessible but also easy to measure! We used a ruler and a tape rule at two different instances to measure the ground truth and then set up the sensor and an obstacle in a way that we could increase and decrease the distances we wanted to measure as needed.

Ground truth for ultrasonic



Testing Setup



For this setup, to get the data needed to rate the testing of the sensor, we varied the distance between the ultrasonic sensor and an obstacle and measured data recorded by the sensor at those distances.

Like said before to quantify the performance of a sensor, we need to measure/calculate its static characteristics and then analyze. For this sensor, the characteristics we measured (or could try to with the setup we had) were range, sensitivity, resolution, (accuracy, precision and reliability) which we then used to quantify the performance of the sensor as can be seen in the result folder.

Below are the measurement processes of the static characteristics;

- **Range**
First, we put the sensor and the object together, at which point the measurement distance is too small to be beyond the sensor's measurable range, so the readings are approximately infinite. Then we slowly move the object away until a recognizable reading appears, which we use as the minimum value of the sensor. Then we gradually move the object away from the sensor in units of 10cm, and when the reading shows infinity again, the description is beyond the maximum range, and then we gradually move the object closer to the sensor in 1cm units to find the critical point where the reading can be identified and the reading is approximately infinite. This distance was then considered the maximum value that the sensor can measure.
- **Sensitivity**
The sensor in different distance several times, the measured data was then averaged and compared with the actual distance. Then the measured distance and the actual distance are used as horizontal and vertical coordinates to plot their functions.
- **Resolution**
We tried this by setting the sensor at a premeasured distance and with the ruler in between the sensor and the object, we tried adjusting the distance in increments of 0.1cm till we start getting a discernable output from the sensor. But the data was not reliable due to too much uncertainty which you can observe in the deviation
- **Accuracy, Precision and Reliability**
For this we just took multiple readings of different distances, plotted the values against each other and extracted the data we needed to qualify and quantify these characteristics as can be seen in the result file.