As stated, to properly test the sensor, we had to first use a reliable equipment to measure the quantity detects and measures which in this case was linear and angular acceleration. The measurement gotten from the reliable equipment is called the ground truth.

<u>To measure angular acceleration ground truth,</u>

To measure angular acceleration ground truth, an encoder was used. The encoder was able to measure the position change of the drill it was mounted on. Then the change in position was compared to the change in time. Using that information, the angular velocity of the drill was determined which was then converted to angular acceleration using the centripetal acceleration formula below

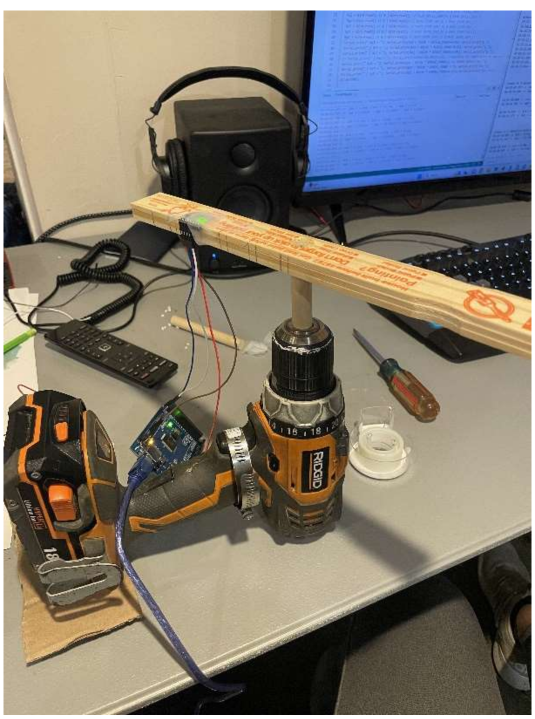
$$a_c = \frac{v^2}{r} \; and \; v = \omega r \; which \; turns \; into \; a_c = \omega^2 r$$

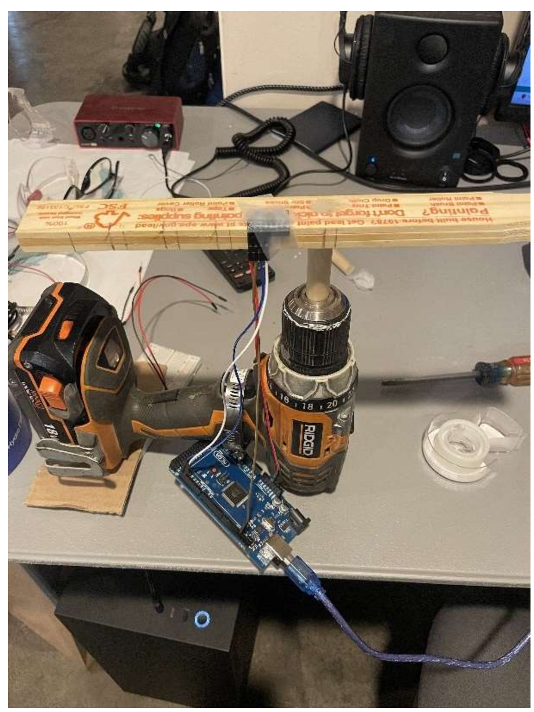
which we then fed into the sensor to see what readings the sensor would give out

<u>Sensor measurement Process</u>

We mounted the sensor on a drill and then varied the angular acceleration (from our ground truth) of the drill which was in turn measured by the sensor (recall the purpose of the whole project was to see how far off the sensor reading was from the actual). Since the linear accelerometers measure changes in acceleration and we had access to only a reliable constant angular velocity, we built a testing apparatus based on centripetal acceleration. The equation is Ac = omega * r, in with Ac is the centripetal acceleration card, omega is the angular velocity, and r is the radius away from the center. This way, the linear acceleration facing towards the center of the spin, would be variable by omega. The gyroscope of the MPU 6050 measures in degree per second of rotation. A simple conversion between the omega found from the encoder to degrees per second was able to accurately describe the expected movement

Testing Setup for gyroscope



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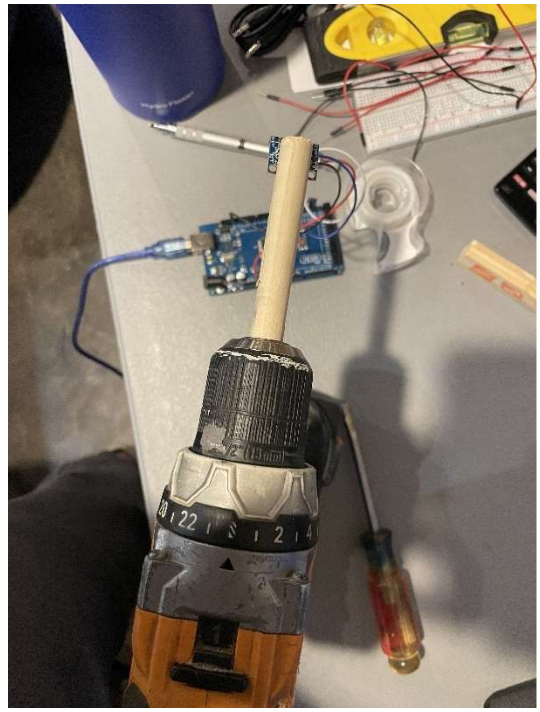
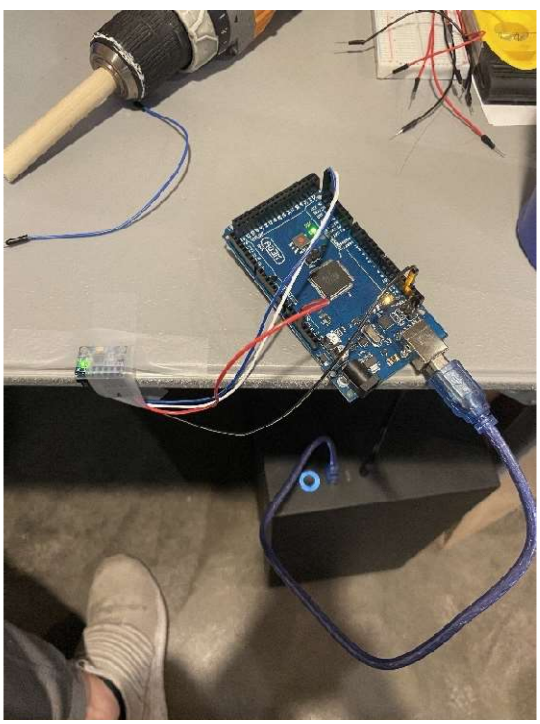
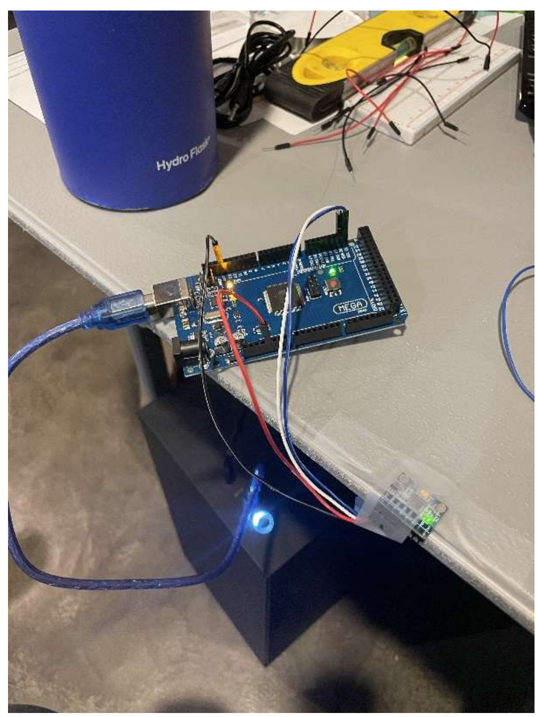
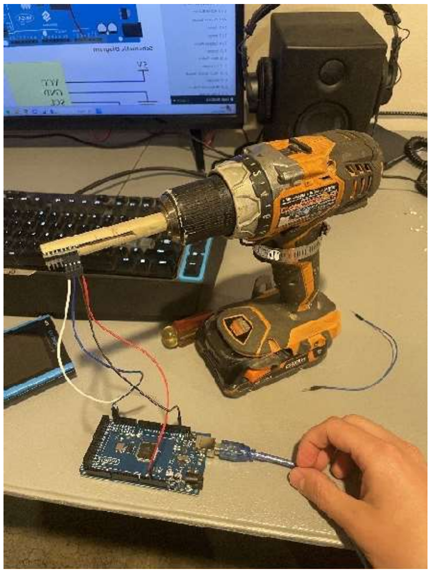
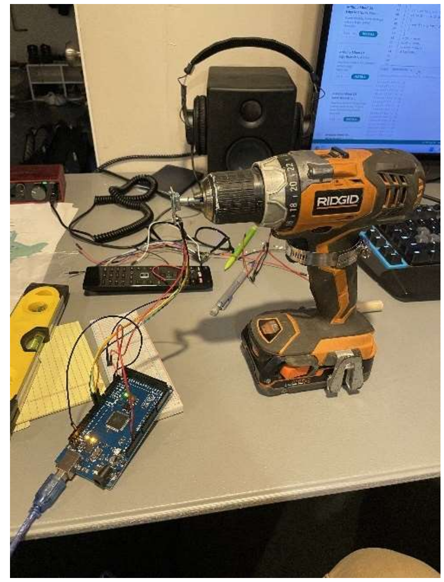




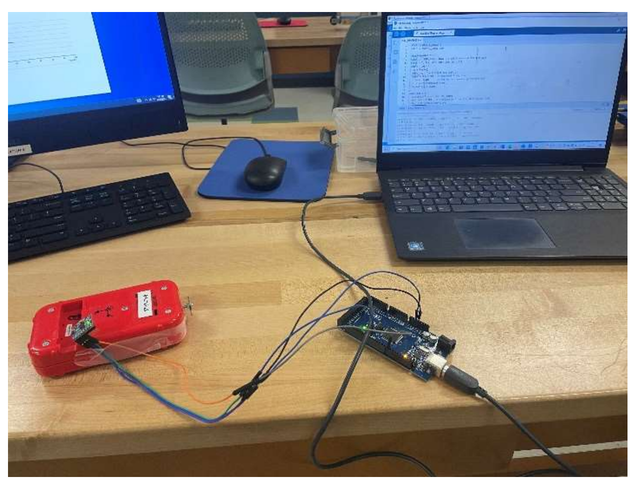

MEGA





At first, we thought our measurement process included linear acceleration but our professor pointed out to us that our measurement process did not account for linear acceleration and suggested us to use a measurement process presented by one of the other teams which was to mount the sensor on a moving object and then rotate the sensor to x, y and z directions as the accelerometer was measures 3D and then using the equations of motion use distance to calculate the different accelerations we wanted to give to the object! Which we tried! We mounted the sensor on an iOLab (a device that has an accelerometer and gyroscope used in laboratories to measure a lot of quantities including linear and angular acceleration) and then rotated the sensor 90 degrees to measure both the x, y, z acceleration as well, as can be seen in the testing process file. This enabled us to be able to measure linear and even angular acceleration. Below is the testing setup.

Testing Setup for accelerometer



Linear acceleration in x-axis

Linear acceleration in y-axis

Linear acceleration in z-axis

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, repeatability, sensitivity and resolution which we then used to quantify the performance of the sensor as can be seen in the result folder