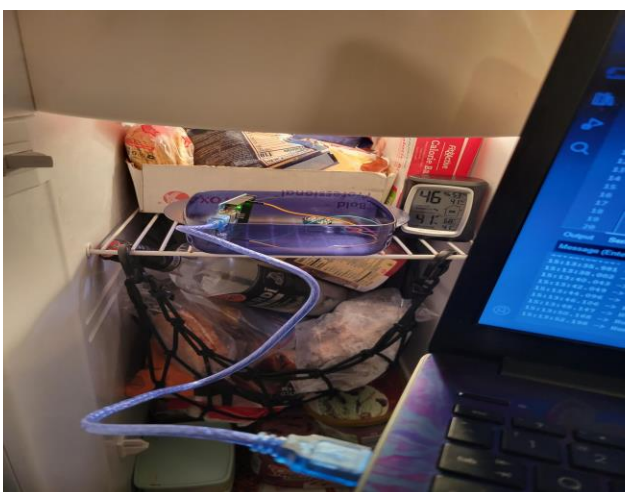
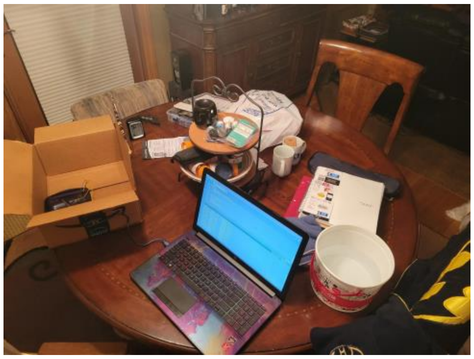
DHT –11 _ Summary and Discussion – Reno Hoffman

Testing Environments-

Temp test



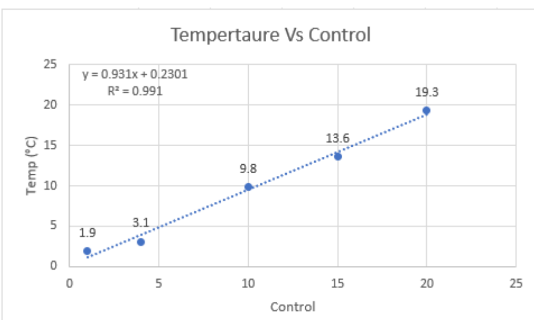
Humidity test area



Data-

Temperature

Measured °C	Control
19.3	20
13.6	15
9.8	10
3.1	4
1.9	1



Humidity

MatLab Code

```
yHumidityup = [linspace(51,51,5),linspace(52,52,3),linspace(53,53,3),...
linspace(54,54,2),55,55,56,56,56,57,57,57,58,58,59,59,59,60,60,61,61,62,...
62,63,64,64,65,65,66,67,67,68,68,69,69,70,71,71,72,73,73,74,74,...
75,75,76,77,77,78,78,79,79,79,80,80,80,81,81,81,82,82,82,82,83,...
83,83,83,83,84,84,84,84,84];
length(yHumidityup);
plot(xHumidityup,yHumidityup);
title('Humdity vs. Control')
ylabel('Humidity (%)');
```

```
xlabel('Control');
```

Results:

Testing Character	Resolution	Sensitivity – Linear Fit	Linearity	Accuracy
Temperature	0.1°C (8-bit)	0.931	Yes	+-1.5°C Max
Humidity	1%(8-bit)	0.4564	NO	+-4.2% Max

Looking at the DHT-11 Sensor, I tested it seems to function well within acceptable parameters.

Discussion:

I believe that some additional testing I could have done would have tried to test range and other static characteristics. However, with testing I think I have gotten a decent grasp of how well the DHT-11 works and how its application could be useful for somebody to use.

Ultrasonic Sensor Module _ Summary and Discussion – Haizi Cao, Haoxuan Li

Results:

	2.12	9.97	20.19	29.91	42.74	48.74	59.28	69.64	80.34
	2.12	9.97	20.79	29.9	40.52	49.74	59.36	69.66	80.53
	2.12	11.84	20.69	30.41	42.72	49.34	59.38	63.26	80.69
	2.02	13.6	22.09	30.43	42.28	49.74	59.24	69.52	80.79
	2.12	13.48	20.79	30.41	42.62	49.34	59.38	69.62	81
	2.12	9.6	20.79	30	42.71	49.33	59.14	69.74	81.09
	2.12	9.6	20.81	30	41.24	48.95	59.38	69.64	81.24
	2.02	9.72	20.79	29.9	40.86	48.95	59.28	69.64	81.22
	2.12	9.62	20.79	30.41	40.78	48.95	59.24	64.36	80.88
	2.12	9.6	20.79	30.43	40.4	48.95	59.14	69.64	80.79
	2.12	9.72	20.69	30.43	40.33	49.95	59.38	70.07	80.81
	2.02	9.71	20.79	30.41	40.41	49.14	59.38	70.05	80.72
	2.12	9.6	20.79	30.43	40.31	50.1	59.34	69.93	80.79
	2.12	13.14	20.69	30.41	41.34	49.74	58.97	69.95	80.79
	2.12	13.14	20.81	30.95	41.22	49.33	59.26	69.93	80.9
	2.02	13.14	20.79	30.53	41.81	49.74	59.38	70.38	80.97
	2.12	11.14	20.79	30.53	41.31	49.74	59.28	69.64	80.88
	2.14	11.12	20.79	31.05	41.34	49.33	59.38	70.07	80.97
	2.12	9.26	20.79	31.05	41.81	49.33	59.28	61.71	80.98
	2.02	9.26	21.78	30.97	42.6	49.34	59.38	70.07	80.98
	2.12	13.24	23.02	30.95	41.79	49.34	59.38	70.09	80.81
	2.12	9.71	21.66	31.47	41.69	49.34	59.41	70.09	80.88
	2.12	9.6	20.79	30.97	42.72	49.33	59.38	70.4	80.9
	2.02	9.67	22.91	30.95	42.16	50.29	59.41	69.66	81
	2.12	9.71	20.79	30.95	40.88	50.29	59.5	70.07	80.91
	2.12	9.6	23.02	30.95	41.33	50.28	59.28	70.05	80.84
	2.12	9.6	23.03	30.95	41.79	50.28	59.38	70.07	80.71
	2.02	9.71	20.79	30.43	41.79	50.29	59.38	70.07	80.72
	2.12	9.62	21.64	30.95	42.62	50.28	59.38	70.09	80.91
		9.62	20.48	30.95	42.72	49.93	59.38	70.09	80.91
		9.72	21.76	30.95	40.53	49.95	59.28	70.07	80.81
		9.62	20.47	30.95	40.62	49.95	59.5	70.1	80.83
AVERAGE y/(cm)	2.096551724	10.4890625	21.1746875	30.624375	41.5621875	49.60375	59.3284375	69.2928125	80.8621875
	0.043333181	1.445982277	0.798475048	0.40127093	0.829532	0.467143915	0.103745764	2.028528152	0.170399061
PRECISION/(cm)	0.982607369	0.137856198	0.037708941	0.013102992	0.019958815	0.009417512	0.001748668	0.029274727	0.002107277
STATIC ERROR/(cm)	0.044100199	1.469119463	0.81125146	0.407691673	0.842805355	0.474618692	0.105405802	2.060986664	0.173125619
y1/(cm)	2.140651924	11.95818196	21.98593896	31.03206667	42.40499286	50.07836869	59.4338433	71.35379916	81.03531312
y2/(cm)	2.052451525	9.019943037	20.36343604	30.21668333	40.71938214	49.12913131	59.2230317	67.23182584	80.68906188
x/(cm)	2	10	20	30	40	50	60	70	80

	90.21	99.71	109.71	121.72	129.84	140.1	150.02	160.55	170.64	179.84	186.33
	89.86	100.1	109.69	121.26	129.95	140.03	148.86	160.43	170.67	179.59	186.34
	89.93	99.69	109.9	121.28	130.02	140.02	150.59	160.45	170.72	179.53	186.05
	89.86	100.05	109.79	121.33	129.93	139.97	150.28	159.91	170.69	179.52	186.26
	89.76	99.81	110	121.26	130.1	139.95	150.67	159.79	170.78	179.95	186.09
	89.64	100.12	109.97	121.41	130.03	140.03	150.81	160.29	170.76	179.57	186.19
	89.66	99.5	110.02	121.71	129.95	140.12	150.84	160.03	170.62	179.57	185.97
	89.76	99.97	109.88	121.66	130.6	140.09	150.87	159.67	170.67	179.64	186.87
	89.74	99.59	110.09	121.45	130.03	140.1	150.74	160.22	170.64	179.64	185.83
	89.76	99.97	109.53	121.6	130.1	140.03	150.72	160.29	170.64	179.55	186.91
	89.83	99.31	110	121.6	130.05	140.14	150.81	160.21	170.62	179.64	186.79
	89.83	99.79	109.81	121.26	130.03	140.07	150.84	160.33	170.69	179.91	186.36
	89.83	99.97	109.98	121.09	130.12	140.05	150.84	160.34	170.6	179.67	186.86
	89.74	99.97	109.86	120.88	130.12	140.14	150.72	160.31	170.64	179.57	186.36
	89.72	99.86	109.91	120.74	130.05	140.1	150.74	160.29	170.55	180.05	186.29
	89.64	99.86	110	120.81	130.12	140.47	150.74	159.88	170.62	179.57	186.38
	89.67	99.95	110	120.72	130.05	140.02	150.41	160.34	170.62	179.62	186.34
	89.66	99.59	109.95	120.62	130.4	140.09	150.83	160.33	170.62	180.03	186.22
	89.67	100.24	109.98	120.6	130.48	140.47	150.29	160.33	170.53	179.69	186.47
	89.67	99.95	109.95	120.69	130.48	140.05	150.29	160.34	170.72	179.64	187.1
	89.67	100.26	109.98	120.53	130.02	140.45	150.74	160.36	170.69	180	186.74
	89.69	100.21	110	120.88	130.05	140.1	150.84	160.29	170.72	179.67	186.62
	89.57	100.16	109.98	120.86	130.1	140.1	150.43	159.93	170.69	179.66	186.79
	89.76	100.14	110	120.55	130.12	140.12	150.76	160.33	170.72	180.03	186.59
	89.93	99.69	110.07	120.62	130.36	140.07	150.74	160.36	170.71	179.52	186.16
	90.1	100.07	110.05	120.43	130.05	140.1	150.31	159.81	170.6	179.64	186.6
	90.21	100.03	109.71	120.41	130.03	140.5	150.83	159.88	170.6	179.53	186.52
	90.19	100.03	110.09	120.43	130.38	140.09	150.86	159.9	170.64	179.64	186.53
	90.12	99.86	109.98	120.43	130.12	140.09	150.71	160.22	170.64	179.52	186.26
	90.21	99.97	109.98	120.41	129.93		150.71	159.9	170.59	179.59	187.17
	90.12	99.67	110.02	120.47	130.12		150.76		170.62	179.6	186.36
	90.21	99.67	110.07	120.36			150.47		170.67		186.24
AVERAGE y/(cm)	89.850625	99.89875	109.9359375	120.9396875	130.1203226	140.1262069	150.5959375	160.177	170.6540625	179.6835484	186.4559375
	0.203407496	0.225343488	0.127936981	0.446888439	0.177772669	0.145564627	0.378985977	0.232151531	0.05611703	0.166453488	0.316848341
PRECISION/(cm)	0.002263841	0.002255719	0.001163741	0.003695135	0.001366218	0.001038811	0.002516575	0.001449344	0.000328835	0.00092637	0.00169932
STATIC ERROR/(cm)	0.206662222	0.228949213	0.129984103	0.454039109	0.180711259	0.148141192	0.385050138	0.236120221	0.05701496	0.169204972	0.321918236
y1/(cm)	90.05728722	100.1276992	110.0659216	121.3937266	130.3010338	140.2743481	150.9809876	160.4131202	170.7110775	179.8527534	186.7778557
y2/(cm)	89.64396278	99.66980079	109.8059534	120.4856484	129.9396113	139.9780657	150.2108874	159.9408798	170.5970475	179.5143434	186.1340193
x/(cm)	90	100	110	120	130	140	150	160	170	180	187

After testing, the detection range of this type of sensor is 2.1cm to 186.5cm, which is less than 2cm to 400cm. In addition, the static error of this type of sensor is 0.445cm, with a precision of 0.63mm, which is much smaller than the 3mm in the manufacturer's data sheet. In the end, we believe that the testing performance of this sensor is poor.

Discussion:

In this experiment, we gained a certain understanding of the working principle and performance of ultrasonic sensors. We hope to minimize the impact of environmental noise on this experiment in future experiments.

MPU-6050

Data -

g along x-axis	Degrees from level
-0.06	6.7
-0.08	8.5
-0.1	9.1
-0.11	9.6
-0.13	10.1
-0.14	10.85
-0.16	11.55

g along y-axis	Degrees from level
0.02	2.45
0.03	3.35
0.04	3.95
0.06	4.9
0.08	5.65
0.09	6.45
0.11	7.3
0.13	8.6
0.15	9.6

Angle around x-axis in degrees	Initial reading	Delayed reading
0	<0.03, -0.02, 1.10>	<0.03, -0.02, 1.12>
5	<0.04, -0.05, 1.11>	<0.04, -0.06, 1.10>
10	<0.04, -0.17, 1.10>	<0.04, -0.17, 1.09>
15	<0.01, -0.26, 1.07>	<0.01, -0.26, 1.07>

Angle around y-axis in degrees	Initial reading	Delayed reading
0	<0.03, -0.02, 1.10>	<0.03, -0.02, 1.12>
5	<-0.05, -0.01, 1.10>	<-0.05, -0.01, 1.10>
10	<-0.13, -0.01, 1.09>	<-0.13, -0.01, 1.09>
15	<-0.22, -0.01, 1.07>	<-0.22, -0.01, 1.07>

Results -

	Sensitivity (LSB/g)	Range (x)	Range (y)	Range (z)	Drift
Experimental Value	20287	-2.01 - 1.99	-2.00 - 2.00	-1.98 - 2.02	0.0039
Percent Error	23.82%	0.5%	0%	1%	0.4624%

Improvements -

The idea behind this testing was that since the sensor outputs 1 g in the downwards direction when stationary and level, 9.81 m/s^2 could be a control value coming from the gravitational constant. From there, the sine of the angle at which the sensor was placed from level would be multiplied by the gravitational constant to get the acceleration of the side axis. However, due to the kinematic nature of acceleration, this plan was flawed. It is uncertain that the ideas governing this plan were even accurate.

An appropriate way to conduct this test would be far removed from the original plan. A more appropriate method for testing sensitivity would be to attach the sensor to a rotating platform. The platform's cycles per minute and the distance between the sensor and the center of rotation could be used to find the sensor's centripetal acceleration. The sensor could then be moved further from the axis or rotation to achieve multiple accelerations. This can then be repeated to find measurements for each axis of the sensor. The data could then be compiled in a comparable manner.

When deciding upon a method for acquiring data, a major concern was preventing complications. Motion could easily cause tension in the wiring and either disconnect the sensor or damage the equipment. In a future attempt, it may be beneficial to find a method for remotely collecting the data. This would untether the sensor from the bulky computer allowing for a freer range of motion.