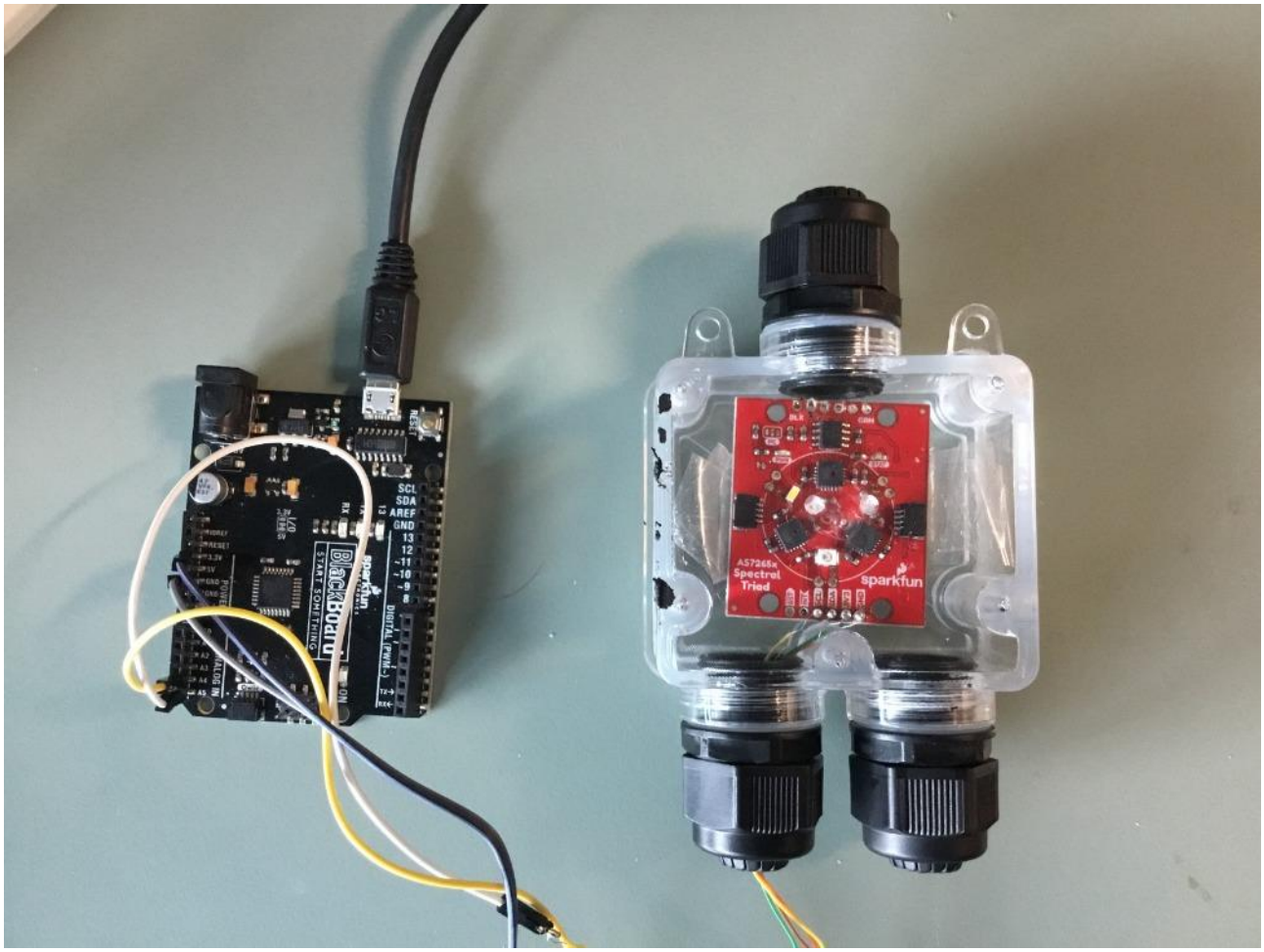
New Experimental Set up of Triad Spectroscopy Sensor Test-Bed

Then experiment It was modified by incorporating the suggestions of the professor vita read. In fact, in the first phase the spectrometer was outside the liquid container. In this second phase, however, the spectrometer is placed inside the liquid itself. In particular, the marine environment will be simulated in this experimental setup. That is, the sensor will have immersed in a liquid or water, the photometric spectrum measurements will take place inside the liquid itself.

The simulation experiment will take place in the following way. Two liters of water will be placed inside the tank for each experiment. Two liters of water will be poured inside the tank and an IP69 box will also be placed in it. It will contain the spectrophotometer that will be fixed inside.
After diluting a dye in the liquid the tank will be hermetically closed with its lid. This guarantees perfect darkness inside the tank. We thus reproduced the experimental conditions of a laboratory spectrometer. It was agreed in the review of the second delivery that the experiment will be focused on the perception of the spectrophotometer of the different colors dissolved in the water. Different dyes will be inserted from time to time inside the tank and the relative samplings will be carried out through the spectrometer.

To colour the water we used powdered dye or flasks of food colouring.
We used red and blue colouring powder and Cherry Red, Blue green, grape purple, green, incense purple, navy blue, sky blue, brown, rose, yellow green, orange red, lemon yellow, black, orange, sunset red, pink, orange yellow, red, dark green, grass green 6ml flasks.

The spectrophotometer was placed in an ip69 box (perfectly waterproof) and immersed in liquid.


SCL
SDA
AREF
GND
13
12
~11
~10
~9
8
DIGITAL (PWM~)
BeagleBoard
START SOMETHING
AS7265x
Spectral
Triad
sparkfun

Two types of liquid colour recognition experiments were carried out. The first type of experiment involved powdered solution (red or blue) which was added in increasing proportions from 1 to 5 teaspoons for each experiment. This was done in order to assess the sensitivity of the instrument to colour density. In addition, this made it possible to verify Lambert-Beer's

law of optics, also known as Beer-Lambert's law or Beer-Lambert-Bouguer's law, which is an empirical relationship that correlates the amount of light absorbed by a material to the concentration of the liquid it passes through. The validity of this law has been verified with respect to an unknown sample.

In addition, the two colours, red and blue, were mixed at various different concentrations and the results of the spectrophotometric waves resulting from the measurements were analysed.

The second type of experiment involved the use of 20 different liquid dyes in 6ml bottles which were added to pure water in each case. The experiment showed how the spectrum measurement also varies in liquids and how stable the measurements can be considered to be.

This experiment also makes it possible to set up a neuronal model to recognise colours that are not known a priori.

First type of experiment

Phase 1

Example 1 : 0 BLUE / 0 RED (pure water : no teaspoons of red color no teaspoons of blue color)

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

675.02,182.86,241.05,101.65,131.24,165.92,42.90,47.34,160.56,32.64,66.69,11.01,15.93,12.25,27.70,85.72,14.70,19.46,

Example 2: 1 BLUE / 0 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

505.03,120.61,137.18,58.23,51.50,59.76,9.35,8.61,68.32,9.84,26.48,4.84,10.90,8.99,21.45,73.48,15.28,19.46,

Example 3: 2 BLUE / 0 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

517.88,119.64,125.42,57.24,53.16,62.12,9.35,9.15,69.46,9.84,26.48,4.40,10.90,8.99,21.45,73.48,15.87,19.46,

Example 4: 3 BLUE / 0 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

529.73,121.59,124.44,57.24,53.99,62.91,9.35,9.15,70.60,9.84,27.46,4.40,10.06,8.99,21.45,73.48,15.28,19.46,

Example 5: 4 BLUE / 0 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

565.31,131.31,136.20,64.15,59.80,69.20,9.35,8.61,75.16,9.84,28.44,4.40,10.90,8.99,21.45,74.59,10.58,15.57,

Example 6: 5 BLUE / 0 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

576.19,133.26,140.12,65.14,60.64,69.98,9.35,8.61,76.29,9.84,29.42,4.40,10.90,8.99,21.45,75.70,10.58,15.57,

Example 7: 5 BLUE / 1 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

578.16,129.37,123.46,60.20,57.31,69.20,9.35,8.61,77.43,9.84,29.42,4.40,10.90,8.99,22.34,76.82,10.58,15.57,

Example 8: 5 BLUE / 2 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

578.16,129.37,124.44,61.19,57.31,69.20,9.35,8.61,78.57,9.84,29.42,4.40,10.06,8.99,22.34,76.82,11.17,15.57,

Example 9: 5 BLUE / 3 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

581.13,129.37,125.42,61.19,58.14,69.98,9.35,8.61,78.57,9.84,29.42,4.40,10.90,8.99,22.34,79.04,11.17,15.57,

Example 10: 5 BLUE / 4 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

576.19,128.39,127.38,62.18,58.97,70.77,9.35,8.61,79.71,9.84,30.40,4.40,10.90,8.99,22.34,79.04,11.76,16.54,

Example 11: 5 BLUE / 5 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

563.34,125.48,120.52,59.22,56.48,66.84,9.35,8.61,77.43,9.84,29.42,4.40,10.90,8.99,23.24,79.04,11.76,16.54,

Phase 2

Example 12 : 0 BLUE / 0 RED (reset pure water)

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

164.06,75.87,192.05,80.93,104.66,133.68,61.59,88.76,181.06,56.34,59.83,11.45,18.44,13.07,22.34,51.21,26.45,24.32,

Example 13 : 0 BLUE / 1 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

558.40,123.53,137.18,66.12,65.62,80.21,9.90,9.15,112.73,27.28,64.73,9.25,14.25,10.62,25.92,85.72,13.52,17.51,

Example 14 : 0 BLUE / 2 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

453.63,106.02,132.28,65.14,64.79,78.63,9.35,8.61,96.79,23.25,60.81,8.37,14.25,10.62,25.92,85.72,12.93,17.51,

Example 15 : 0 BLUE / 3 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

451.66,106.02,133.26,65.14,63.96,78.63,9.35,8.61,92.24,21.46,59.83,8.37,14.25,10.62,25.92,85.72,12.93,17.51,

Example 16 : 0 BLUE / 4 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

452.65,106.02,133.26,65.14,64.79,79.42,9.35,8.61,91.10,19.67,58.85,8.37,14.25,10.62,25.92,85.72,12.93,17.51,

Example 17 : 0 BLUE / 5 RED

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

450.67,105.05,133.26,65.14,64.79,78.63,9.35,8.61,91.10,18.33,56.89,7.93,13.41,9.80,25.92,85.72,12.93,17.51,

Second type of experiment

Example 18 : Cherry Red,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

64.24,36.96,132.28,57.24,61.47,77.06,7.70,8.61,85.40,20.12,38.25,5.72,10.06,8.17,14.30,43.42,17.64,21.40,

Example 19 : Blue green,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

66.22,34.04,118.56,53.29,58.14,71.56,7.15,8.61,71.74,8.94,27.46,3.08,10.06,8.17,14.30,46.76,17.64,21.40,

Example 20 : grape purple,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

70.17,35.02,111.70,53.29,57.31,71.56,7.70,8.61,69.46,8.94,27.46,4.40,10.06,8.17,15.19,47.87,18.22,21.40,

Example 21 : green,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

59.30,32.10,107.78,52.31,56.48,69.98,7.70,8.61,69.46,8.94,27.46,3.52,10.06,8.17,15.19,47.87,18.22,21.40,

Example 22 : incense purple,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

71.16,34.04,105.82,51.32,55.65,69.98,7.70,8.61,70.60,8.94,30.40,4.84,10.90,8.17,15.19,43.42,18.22,21.40,

Example 23 : navy blue,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

68.19,34.04,109.74,52.31,57.31,72.34,8.25,9.15,80.85,8.94,30.40,3.52,11.73,8.99,17.87,51.21,19.99,22.38,

Example 24 : sky blue,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

70.17,34.04,110.72,52.31,57.31,72.34,8.25,9.15,80.85,9.39,30.40,3.52,11.73,8.99,17.87,51.21,20.58,22.38,

Example 25 : brown,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

70.17,35.02,116.60,54.28,60.64,77.06,8.25,9.15,78.57,9.39,34.33,5.28,11.73,8.99,17.87,51.21,21.75,23.35,

Example 26 : rose,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

72.15,35.99,118.56,54.28,61.47,78.63,9.90,11.30,93.38,24.59,42.17,6.17,12.57,9.80,19.66,54.55,28.22,26.27,

Example 27 : yellow green,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

75.11,35.02,113.66,50.33,58.97,77.85,10.45,11.30,85.40,10.28,34.33,5.28,12.57,9.80,19.66,54.55,26.45,24.32,

Example 28 : orange red,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

129.47,43.77,92.11,47.37,48.18,59.76,8.80,18.29,142.34,28.17,44.14,7.49,10.90,8.99,14.30,37.85,10.58,16.54,

Example 29 : lemon yellow,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

132.43,46.69,111.70,50.33,59.80,125.81,63.24,78.00,167.39,44.72,44.14,7.93,10.90,8.99,14.30,36.74,11.76,17.51,

Example 30: black,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

151.21,46.69,96.03,51.32,53.99,66.84,7.70,8.07,70.60,8.94,27.46,4.84,10.06,8.17,12.51,35.62,10.58,16.54,

Example 31: orange,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

130.46,43.77,92.11,46.39,49.84,62.91,22.00,59.17,167.39,39.35,44.14,7.93,10.90,8.99,15.19,40.08,11.17,17.51,

Example 32: sunset red,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

215.45,58.36,107.78,62.18,63.96,77.85,51.14,74.24,176.50,42.03,45.12,8.37,11.73,8.99,15.19,38.96,11.76,17.51,

Example 33: pink,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

153.19,50.58,121.50,65.14,64.79,83.35,10.45,16.68,175.36,42.48,51.00,7.49,13.41,9.80,15.19,40.08,8.23,14.59,

Example 34: orange yellow,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

154.18,49.61,119.54,66.12,64.79,74.70,35.20,67.24,202.69,42.03,51.98,7.49,13.41,9.80,16.09,41.19,8.23,14.59,

Example 35: red,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

156.15,50.58,129.34,69.09,68.94,82.57,7.70,11.83,171.95,38.90,51.98,7.05,13.41,9.80,16.09,41.19,7.64,14.59,

Example 36: dark green,

A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

157.14,50.58,124.44,67.11,67.28,80.99,7.15,7.53,105.90,8.94,38.25,3.52,12.57,9.80,14.30,38.96,7.05,13.62,

Example 37: grass green,

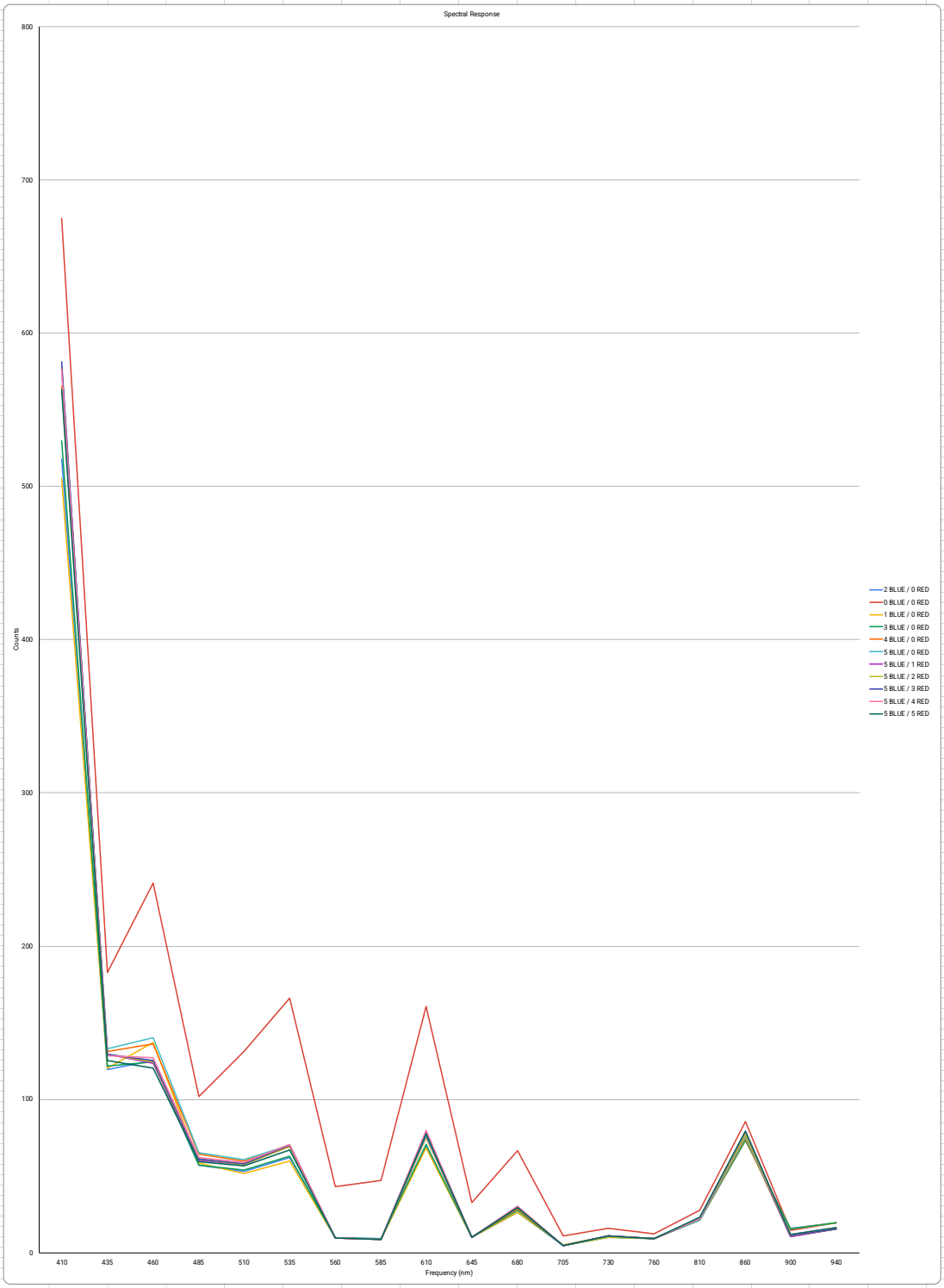
A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

165.05,52.53,134.24,71.06,71.43,87.28,7.15,8.07,113.87,9.39,42.17,5.28,14.25,9.80,15.19,41.19,7.64,13.62,

First Experiment Spectral Response Graph

Phase 1

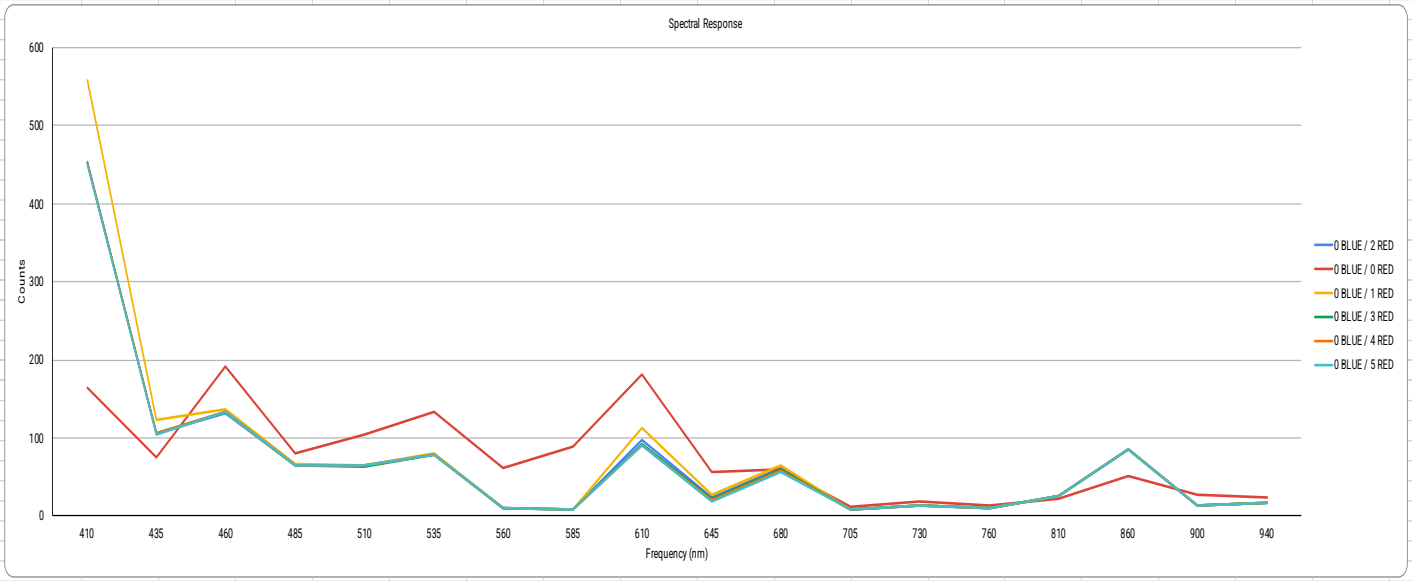
Object	410	435	460	485	510	535	560	585	610	645	680	705	730	760	810	860	900	940
0 BLUE / 0 RED	675,02	182,86	241,05	101,65	131,24	165,92	42,9	47,34	160,56	32,64	66,69	11,01	15,93	12,25	27,7	85,72	14,7	19,46
1 BLUE / 0 RED	505,03	120,61	137,18	58,23	51,5	59,76	9,35	8,61	68,32	9,84	26,48	4,84	10,9	8,99	21,45	73,48	15,28	19,46
2 BLUE / 0 RED	517,88	119,64	125,42	57,24	53,16	62,12	9,35	9,15	69,46	9,84	26,48	4,4	10,9	8,99	21,45	73,48	15,87	19,46
3 BLUE / 0 RED	529,73	121,59	124,44	57,24	53,99	62,91	9,35	9,15	70,6	9,84	27,46	4,4	10,06	8,99	21,45	73,48	15,28	19,46
4 BLUE / 0 RED	565,31	131,31	136,2	64,15	59,8	69,2	9,35	8,61	75,16	9,84	28,44	4,4	10,9	8,99	21,45	74,59	10,58	15,57
5 BLUE / 0 RED	576,19	133,26	140,12	65,14	60,64	69,98	9,35	8,61	76,29	9,84	29,42	4,4	10,9	8,99	21,45	75,7	10,58	15,57
5 BLUE / 1 RED	578,16	129,37	123,46	60,2	57,31	69,2	9,35	8,61	77,43	9,84	29,42	4,4	10,9	8,99	22,34	76,82	10,58	15,57
5 BLUE / 2 RED	578,16	129,37	124,44	61,19	57,31	69,2	9,35	8,61	78,57	9,84	29,42	4,4	10,06	8,99	22,34	76,82	11,17	15,57
5 BLUE / 3 RED	581,13	129,37	125,42	61,19	58,14	69,98	9,35	8,61	78,57	9,84	29,42	4,4	10,9	8,99	22,34	79,04	11,17	15,57
5 BLUE / 4 RED	576,19	128,39	127,38	62,18	58,97	70,77	9,35	8,61	79,71	9,84	30,4	4,4	10,9	8,99	22,34	79,04	11,76	16,54
5 BLUE / 5 RED	563,34	125,48	120,52	59,22	56,48	66,84	9,35	8,61	77,43	9,84	29,42	4,4	10,9	8,99	23,24	79,04	11,76	16,54



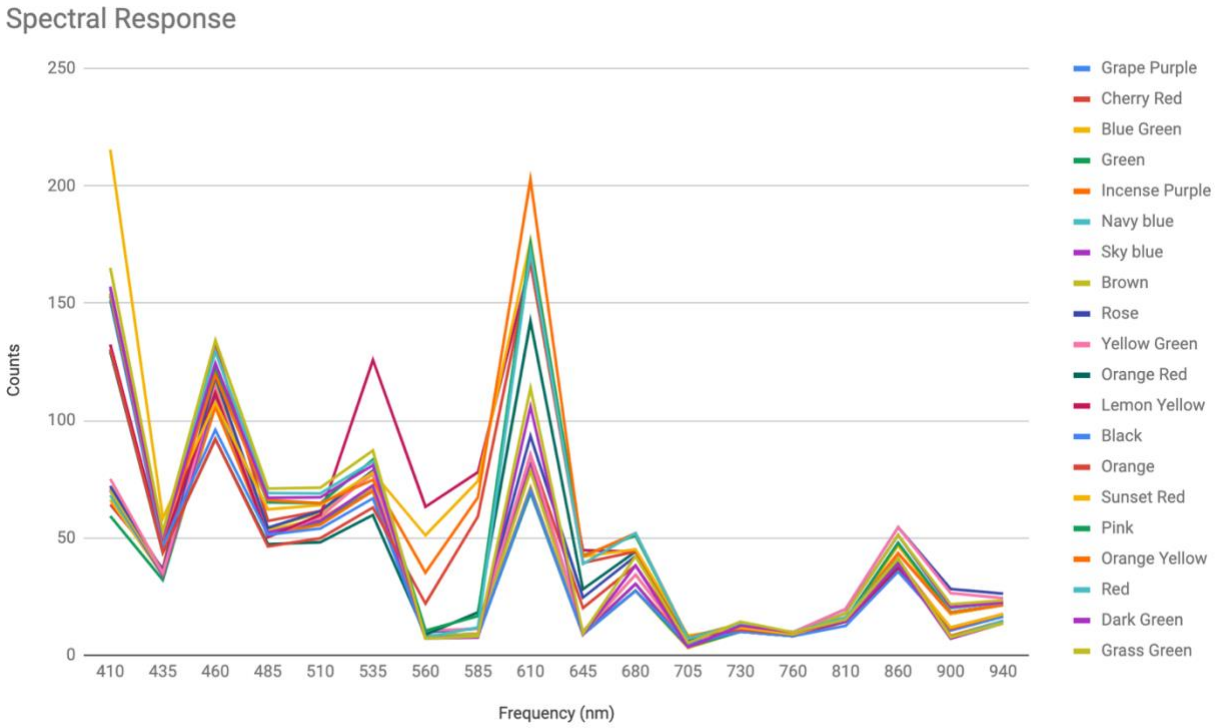
First Experiment Spectral Response Graph

Phase 2

Object	410	435	460	485	510	535	560	585	610	645	680	705	730	760	810	860	900	940
0 BLUE / 0 RED	164,06	75,87	192,05	80,93	104,66	133,68	61,59	88,76	181,06	56,34	59,83	11,45	18,44	13,07	22,34	51,21	26,45	
0 BLUE / 1 RED	558,4	123,53	137,18	66,12	65,62	80,21	9,9	9,15	112,73	27,28	64,73	9,25	14,25	10,62	25,92	85,72	13,52	
0 BLUE / 2 RED	453,63	106,02	132,28	65,14	64,79	78,63	9,35	8,61	96,79	23,25	60,81	8,37	14,25	10,62	25,92	85,72	12,93	
0 BLUE / 3 RED	451,66	106,02	133,26	65,14	63,96	78,63	9,35	8,61	92,24	21,46	59,83	8,37	14,25	10,62	25,92	85,72	12,93	
0 BLUE / 4 RED	452,65	106,02	133,26	65,14	64,79	79,42	9,35	8,61	91,1	19,67	58,85	8,37	14,25	10,62	25,92	85,72	12,93	
0 BLUE / 5 RED	450,67	105,05	133,26	65,14	64,79	78,63	9,35	8,61	91,1	18,33	56,89	7,93	13,41	9,8	25,92	85,72	12,93	



Second Experiment Spectral Response Graph



Object	410	435	460	485	510	535	560	585	610	645	680	705	730	760	810	860	900	940
Cherry Red	64,24	36,96	132,28	57,24	61,47	77,06	7,7	8,61	85,4	20,12	38,25	5,72	10,06	8,17	14,3	43,42	17,64	21,4
Blue Green	66,22	34,04	118,56	53,29	58,14	71,56	7,15	8,61	71,74	8,94	27,46	3,08	10,06	8,17	14,3	46,76	17,64	21,4
Grape Purple	70,17	35,02	111,7	53,29	57,31	71,56	7,7	8,61	69,46	8,94	27,46	4,4	10,06	8,17	15,19	47,87	18,22	21,4
Green	59,3	32,1	107,78	52,31	56,48	69,98	7,7	8,61	69,46	8,94	27,46	3,52	10,06	8,17	15,19	47,87	18,22	21,4
Incense Purple	71,16	34,04	105,82	51,32	55,65	69,98	7,7	8,61	70,6	8,94	30,4	4,84	10,9	8,17	15,19	43,42	18,22	21,4
Navy blue	68,19	34,04	109,74	52,31	57,31	72,34	8,25	9,15	80,85	8,94	30,4	3,52	11,73	8,99	17,87	51,21	19,99	22,38
Sky blue	70,17	34,04	110,72	52,31	57,31	72,34	8,25	9,15	80,85	9,39	30,4	3,52	11,73	8,99	17,87	51,21	20,58	22,38
Brown	70,17	35,02	116,6	54,28	60,64	77,06	8,25	9,15	78,57	9,39	34,33	5,28	11,73	8,99	17,87	51,21	21,75	23,35
Rose	72,15	35,99	118,56	54,28	61,47	78,63	9,9	11,3	93,38	24,59	42,17	6,17	12,57	9,8	19,66	54,55	28,22	26,27
Yellow Green	75,11	35,02	113,66	50,33	58,97	77,85	10,45	11,3	85,4	10,28	34,33	5,28	12,57	9,8	19,66	54,55	26,45	24,32
Orange Red	129,47	43,77	92,11	47,37	48,18	59,76	8,8	18,29	142,34	28,17	44,14	7,49	10,9	8,99	14,3	37,85	10,58	16,54
Lemon Yellow	132,43	46,69	111,7	50,33	59,8	125,81	63,24	78	167,39	44,72	44,14	7,93	10,9	8,99	14,3	36,74	11,76	17,51
Black	151,21	46,69	96,03	51,32	53,99	66,84	7,7	8,07	70,6	8,94	27,46	4,84	10,06	8,17	12,51	35,62	10,58	16,54
Orange	130,46	43,77	92,11	46,39	49,84	62,91	22	59,17	167,39	39,35	44,14	7,93	10,9	8,99	15,19	40,08	11,17	17,51
Sunset Red	215,45	58,36	107,78	62,18	63,96	77,85	51,14	74,24	176,5	42,03	45,12	8,37	11,73	8,99	15,19	38,96	11,76	17,51
Pink	153,19	50,58	121,5	65,14	64,79	83,35	10,45	16,68	175,36	42,48	51	7,49	13,41	9,8	15,19	40,08	8,23	14,59
Orange Yellow	154,18	49,61	119,54	66,12	64,79	74,7	35,2	67,24	202,69	42,03	51,98	7,49	13,41	9,8	16,09	41,19	8,23	14,59
Red	156,15	50,58	129,34	69,09	68,94	82,57	7,7	11,83	171,95	38,9	51,98	7,05	13,41	9,8	16,09	41,19	7,64	14,59
Dark Green	157,14	50,58	124,44	67,11	67,28	80,99	7,15	7,53	105,9	8,94	38,25	3,52	12,57	9,8	14,3	38,96	7,05	13,62
Grass Green	165,05	52,53	134,24	71,06	71,43	87,28	7,15	8,07	113,87	9,39	42,17	5,28	14,25	9,8	15,19	41,19	7,64	13,62