



ESTIMATION OF BIO-ORGANISM CONTENT IN AQUACULTURE POND BASED ON LIGHT ABSORPTION USING RGB COLOR MODEL AND SUPPORT VECTOR REGRESSION (SVR)

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Background Problem

- ▶ It is Important to monitor the bio-organisms content in aquaculture ponds to keep the animal cultivated in optimal conditions.
- ▶ Factors that can affect the quality of water include algae / phytoplankton. These factors can be beneficial or even detrimental to the cultivator. For example, phytoplankton (Chlorella Sp.) that exist in pond water can cause the colour of water in the pond will be solid green.
- ▶ Therefore it is necessary to have a tool to estimate water quality based on color to keep the cultivation animals in good condition

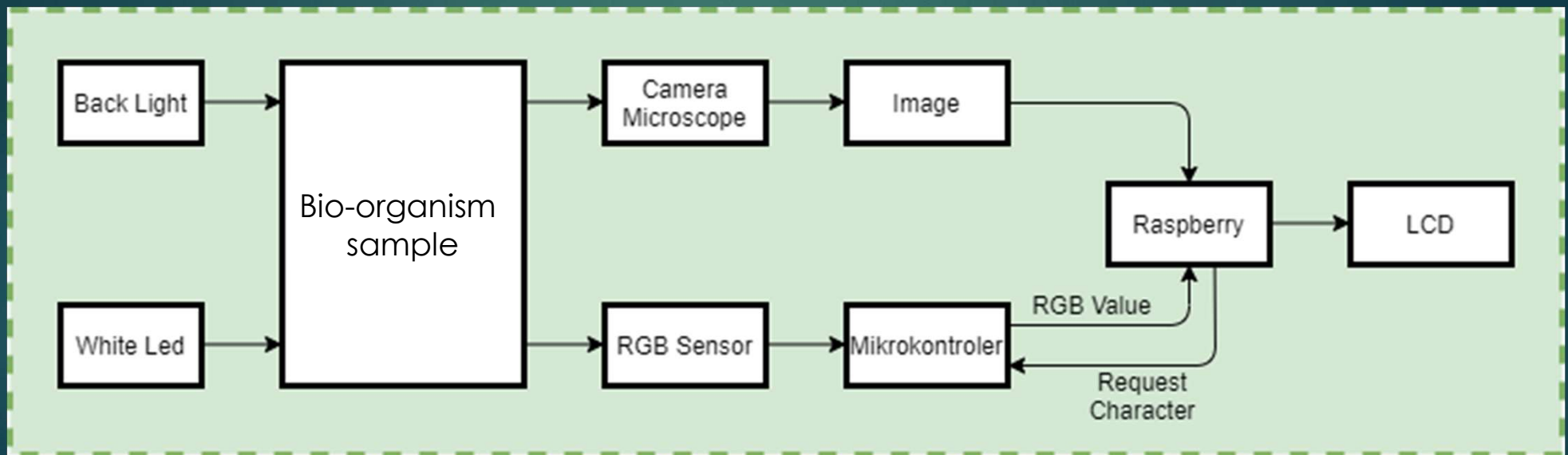
Goal Of Final Project

- ▶ Making hardware to estimate the bio-organisms content, based on light absorption using the RGB color space with output percentage.
- ▶ Making program to process the data obtained with Support Vector Regression (SVR).

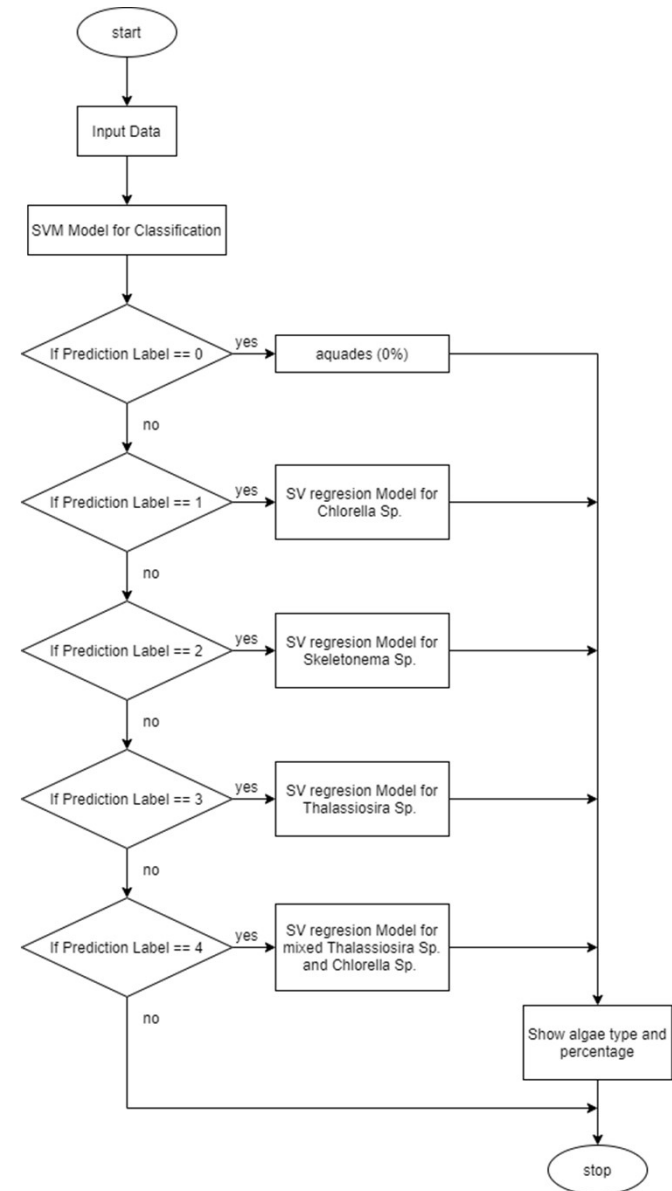
Problem Limitation

- ▶ Sample is conditioned and prepared by Politeknik Kelautan dan Perikanan Sidoarjo.
- ▶ Each water sample, contain a type of bio-organism (Chlorella Sp, Thalassiosira Sp., Skeletonema Sp.) with variations in concentrations of 10%, 20%, 30% 40%, 50%, 60% 70%, 80%, 90%, 100%.
- ▶ conducted experiments on samples with 1 type of bio organism and sample with a mixture of 2 types of bio organisms

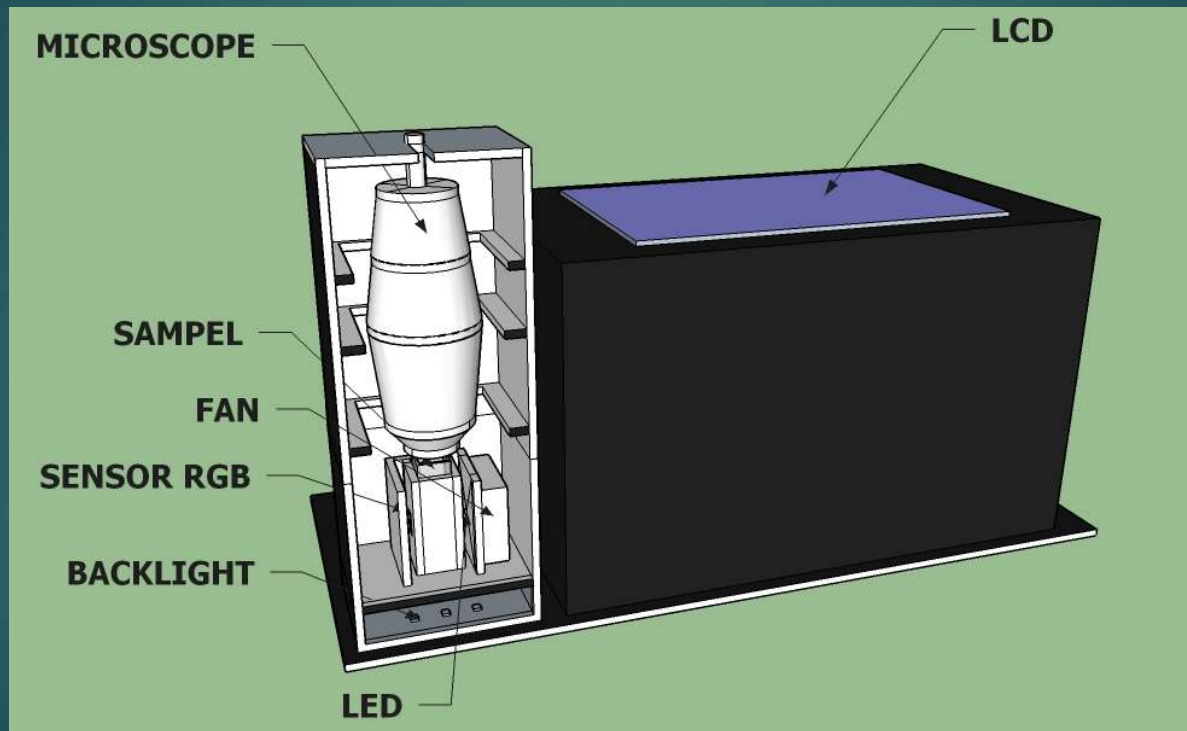
Diagram block



Flow Chart Prediction with SVR



Hardware Design



Final design

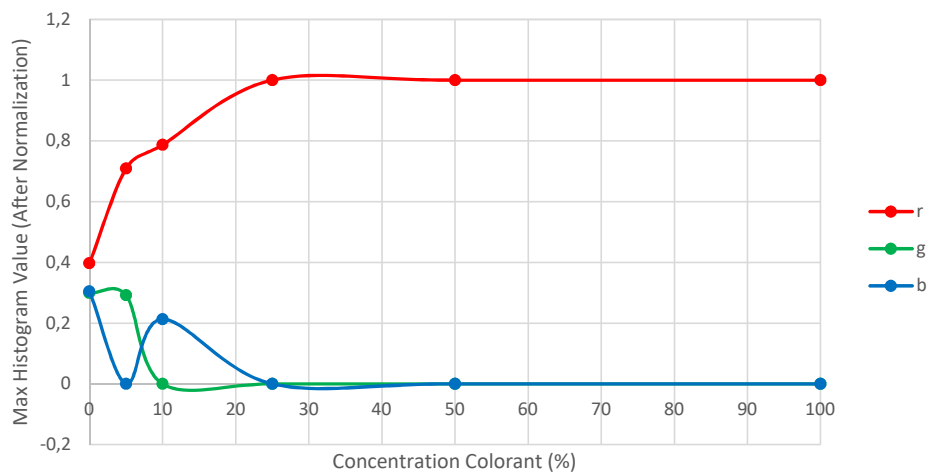


- Test Sample
- Initial Sample = 15 Drops of food colorant + 50ml water

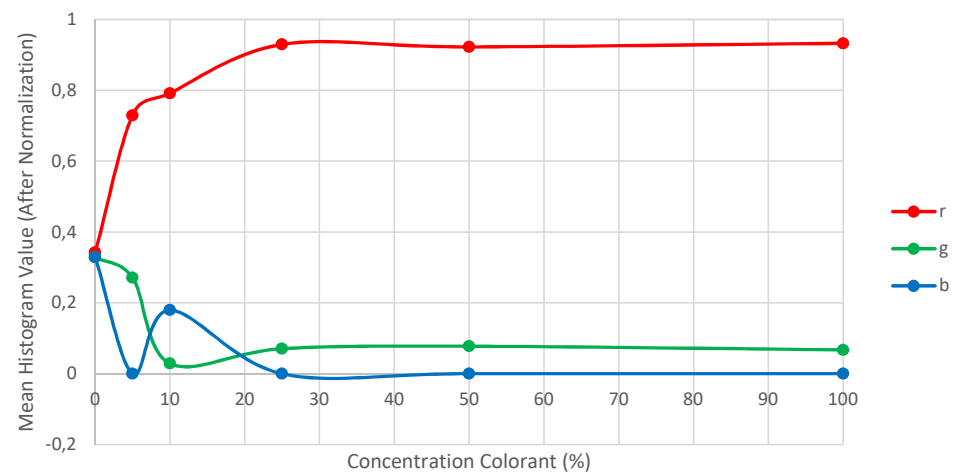
Concentration (%)	Composition
0	4ml Water
5	0.2ml Initial Sample + 3,8ml Water
10	0.4ml Initial Sample + 3,6ml Water
25	1ml Initial Sample + 3ml Water
50	2ml Initial Sample + 2ml Water
100	4ml Initial Sample

Data Obtained From Red Sample

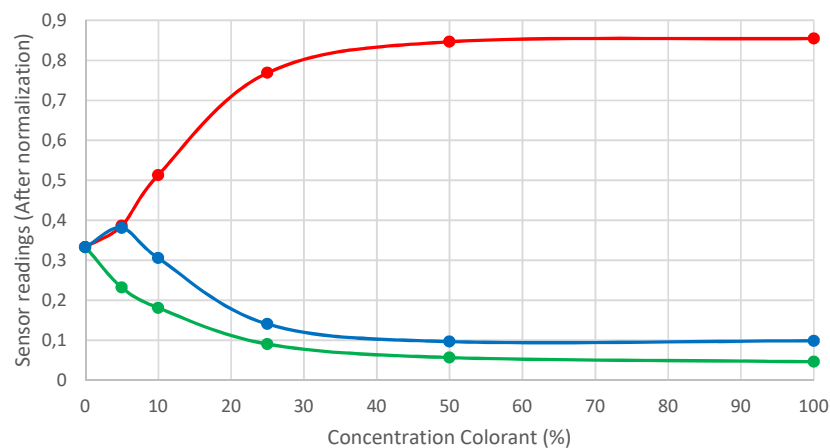
Max Histogram Value in Red Food Colorant
(Normalization)



Mean Histogram Value in Red Food Colorant
(Normalization)

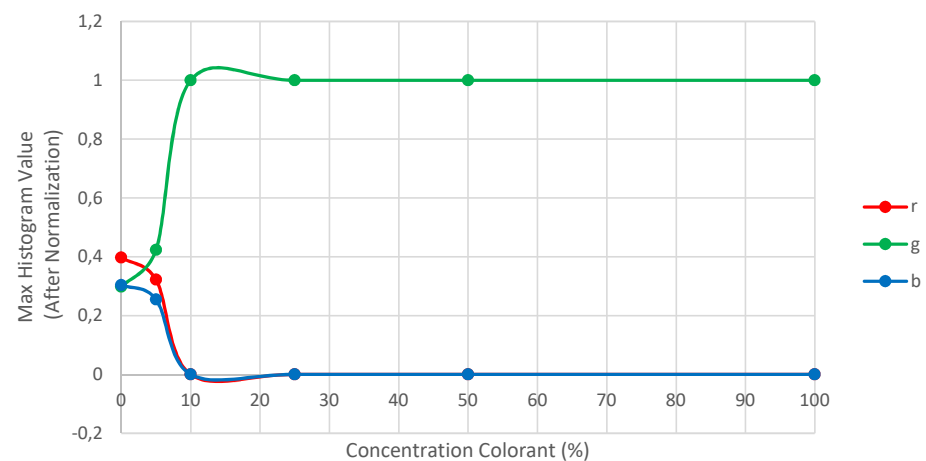


Value of Sensor RGB Readings in Red Food Colorant
(Normalization)

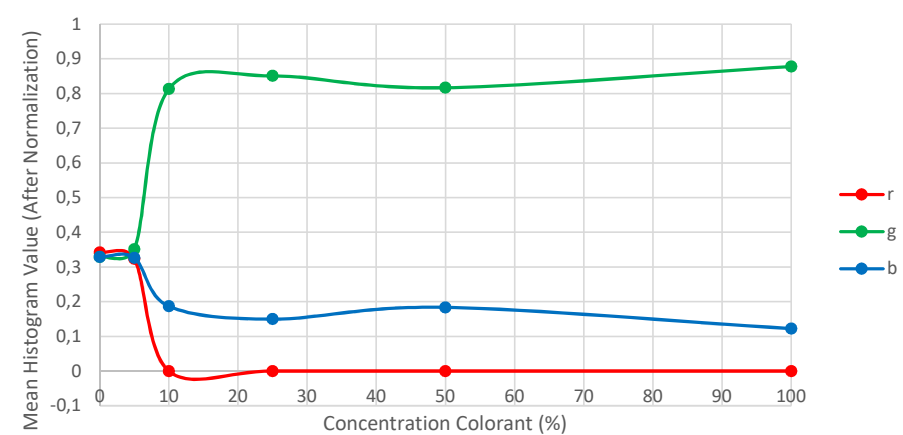


Data Obtained From Green Sample

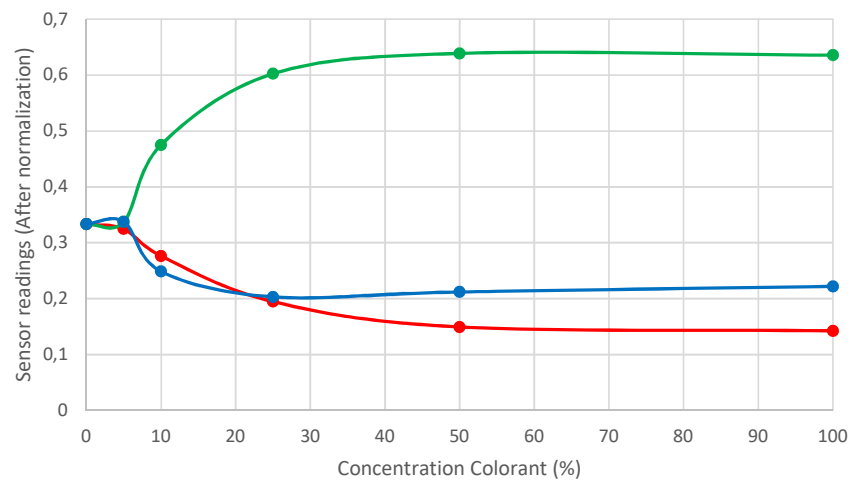
Max Histogram Value in Green Food Colorant
(Normalization)



Mean Histogram Value in Green Food Colorant
(Normalization)

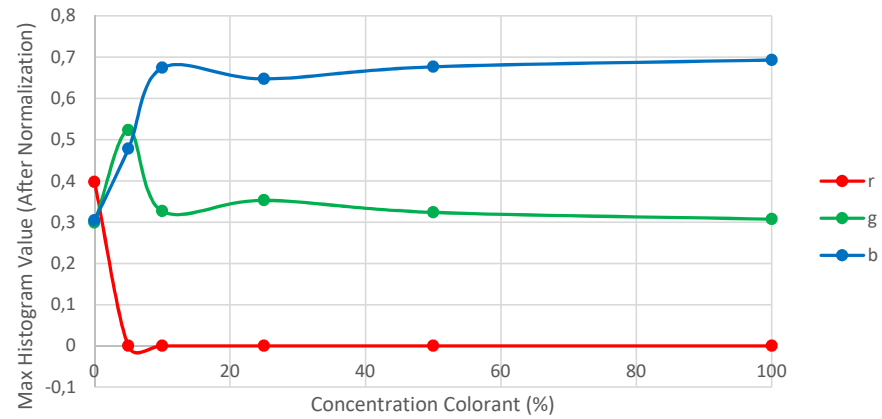


Value of Sensor RGB Readings in Green Food Colorant
(Normalization)

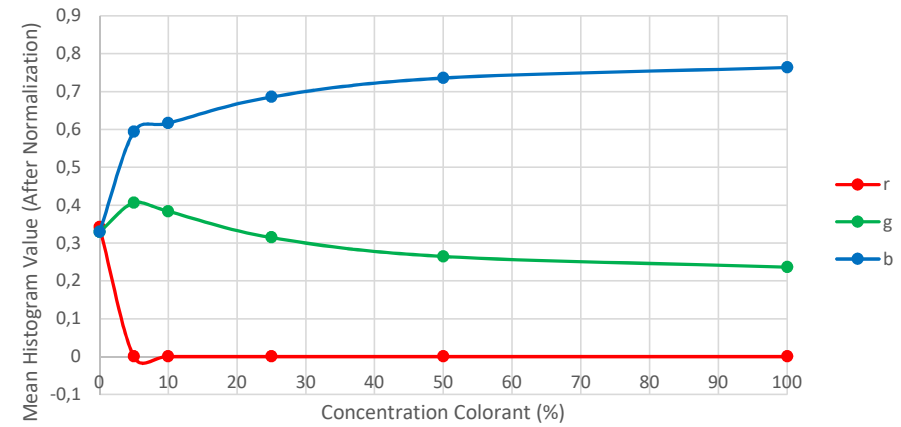


Data Obtained From Blue Sample

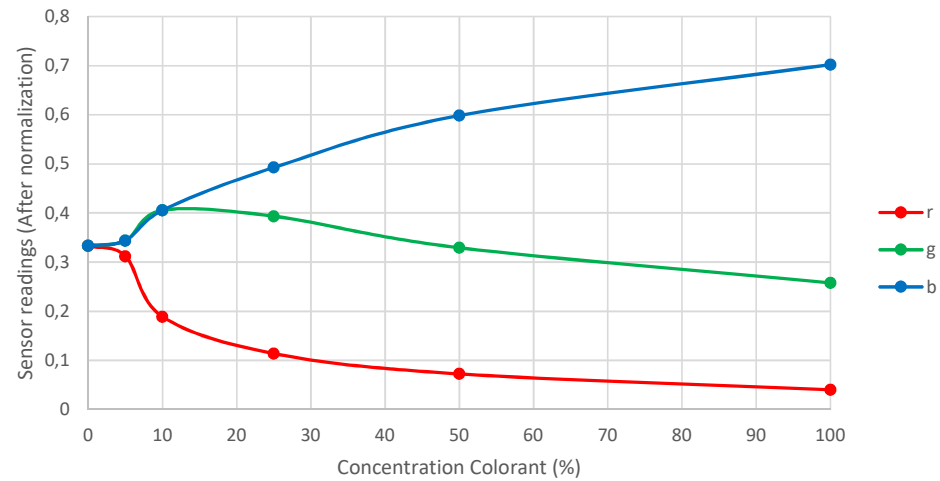
Max Histogram Value in Blue Food Colorant
(Normalization)



Mean Histogram Value in Blue Food Colorant
(Normalization)



Value of Sensor RGB Readings in Blue Food Colorant
(Normalization)

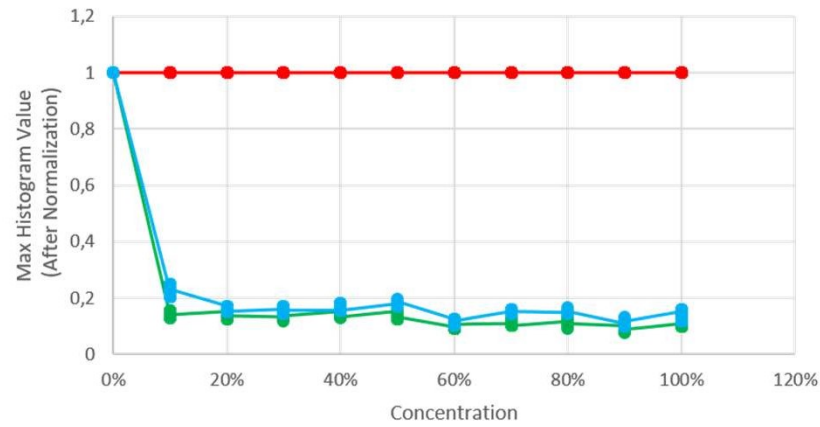


- Test Sample
- Initial Sample = 3 Drops of food colorant + 50ml water

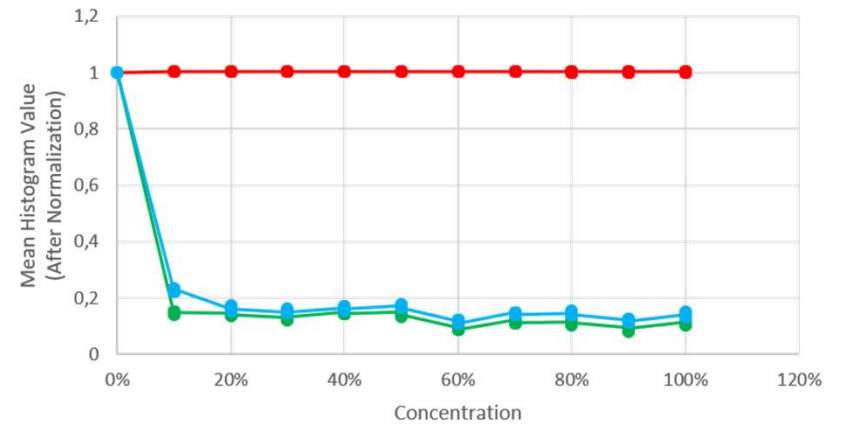
Cocentration (%)	composition
0%	4 ml Water
10%	0,4 ml Initial Sample + 3,6 ml water
20%	0,8 ml Initial Sample + 3,2 ml water
30%	1,2 ml Initial Sample + 2,8 ml water
40%	1,6 ml Initial Sample + 2,4 ml water
50%	2,0 ml Initial Sample + 2,0 ml water
60%	2,4 ml Initial Sample + 1,6 ml water
70%	2,8 ml Initial Sample + 1,2 ml water
80%	3,2 ml Initial Sample + 0,8 ml water
90%	3,6 ml Initial Sample + 0,4 ml water
100%	4 ml Initial Sample

Data Obtained From Red Sample

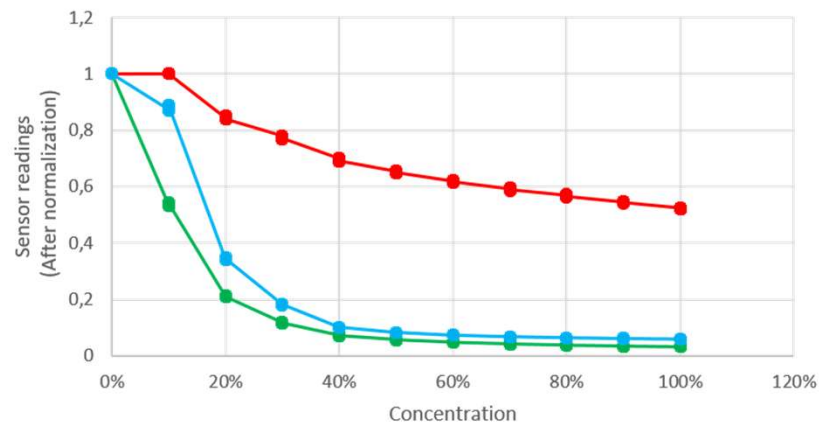
Max Histogram Value in Red Food Colorant
(Normalization)



Mean Histogram Value in Red Food Colorant
(Normalization)

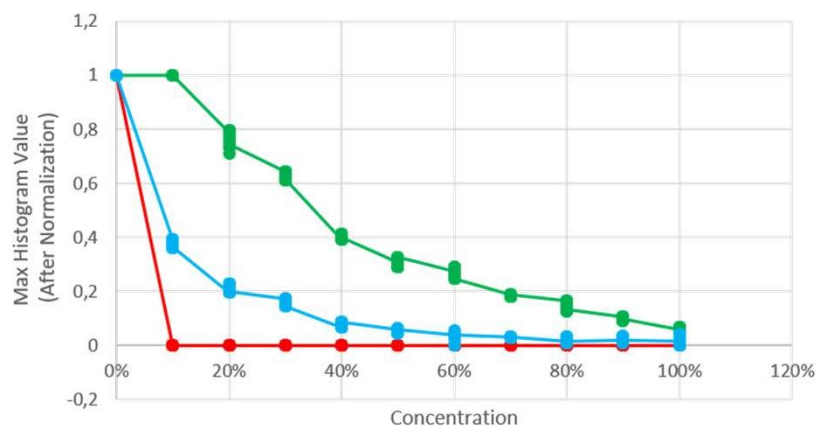


Value of Sensor RGB Readings in Red Food Colorant
(Normalization)

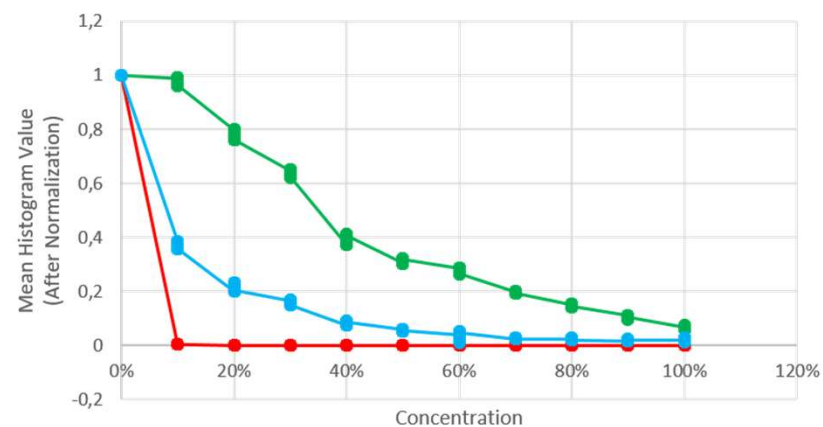


Data Obtained From Green Sample

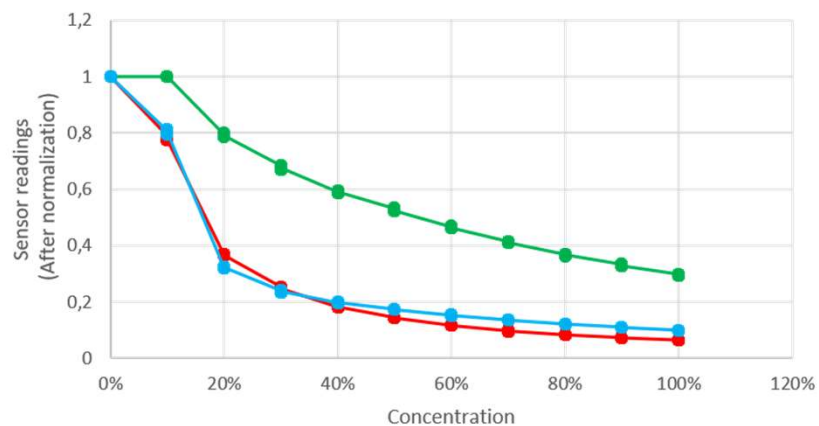
Max Histogram Value in Green Food Colorant
(Normalization)



Mean Histogram Value in Green Food Colorant
(Normalization)

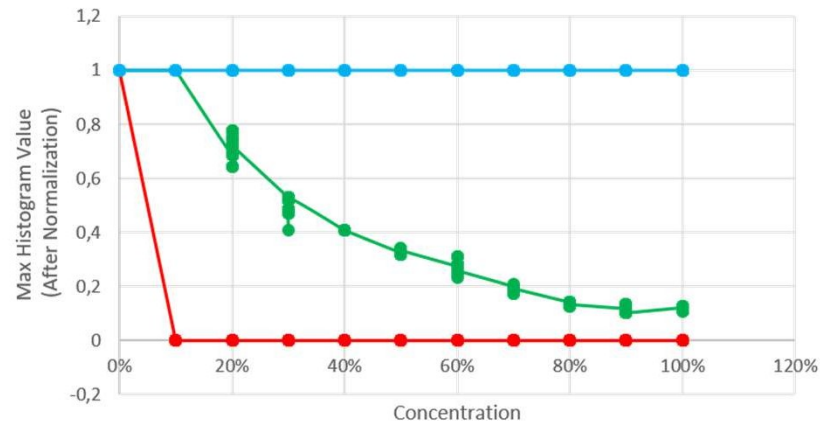


Value of Sensor RGB Readings in Green Food Colorant
(Normalization)

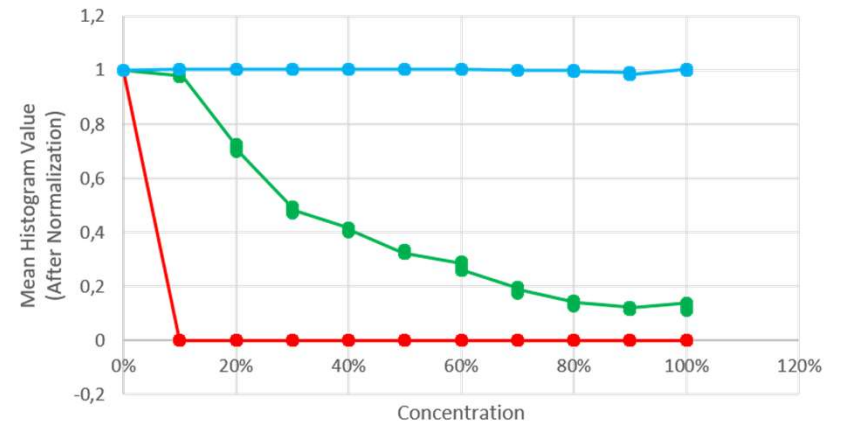


Data Obtained From Blue Sample

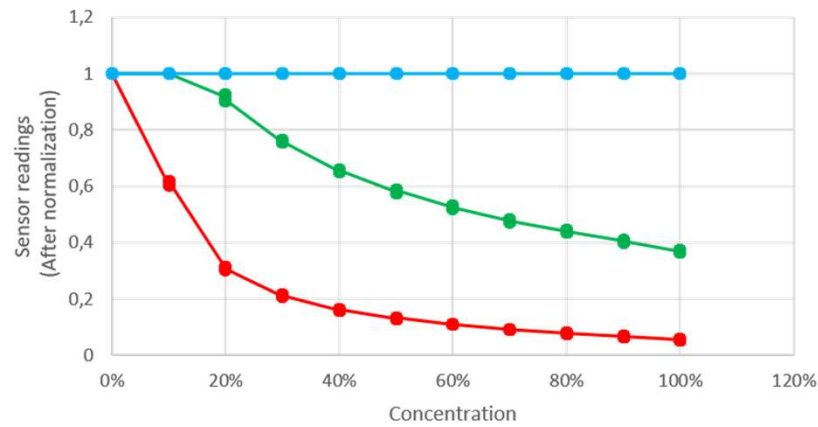
Max Histogram Value in Blue Food Colorant
(Normalization)



Mean Histogram Value in Blue Food Colorant
(Normalization)



Value of Sensor RGB Readings in Blue Food Colorant
(Normalization)



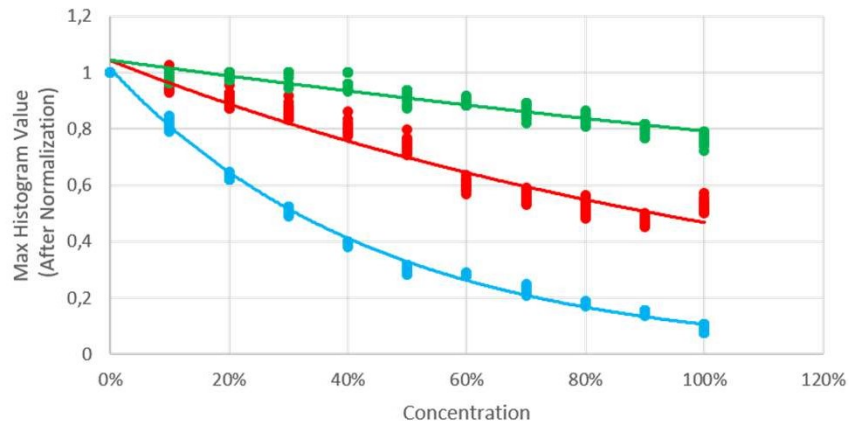
- Algae Sample
- Initial Sample = Chlorella Sp., Skeletonema Sp., Thalassiosira Sp,

Cocentration (%)	composition
0%	4 ml Water
10%	0,4 ml Initial Sample + 3,6 ml water
20%	0,8 ml Initial Sample + 3,2 ml water
30%	1,2 ml Initial Sample + 2,8 ml water
40%	1,6 ml Initial Sample + 2,4 ml water
50%	2,0 ml Initial Sample + 2,0 ml water
60%	2,4 ml Initial Sample + 1,6 ml water
70%	2,8 ml Initial Sample + 1,2 ml water
80%	3,2 ml Initial Sample + 0,8 ml water
90%	3,6 ml Initial Sample + 0,4 ml water
100%	4 ml Initial Sample

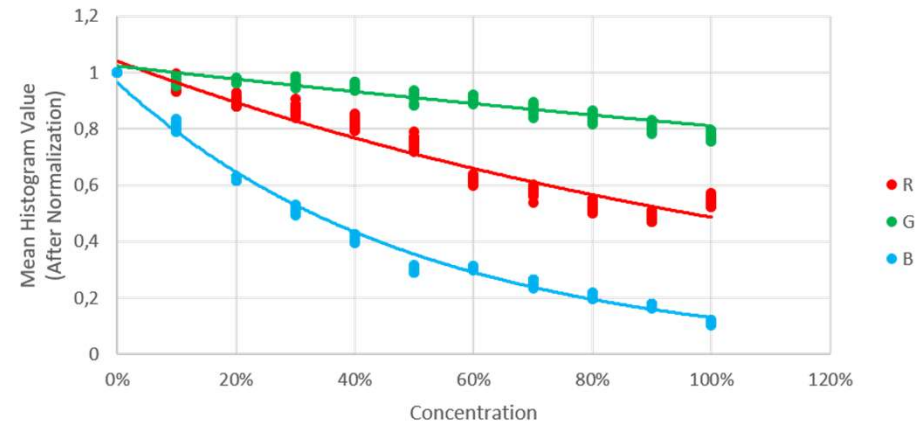
Data Obtained From *Chlorella* Sp.



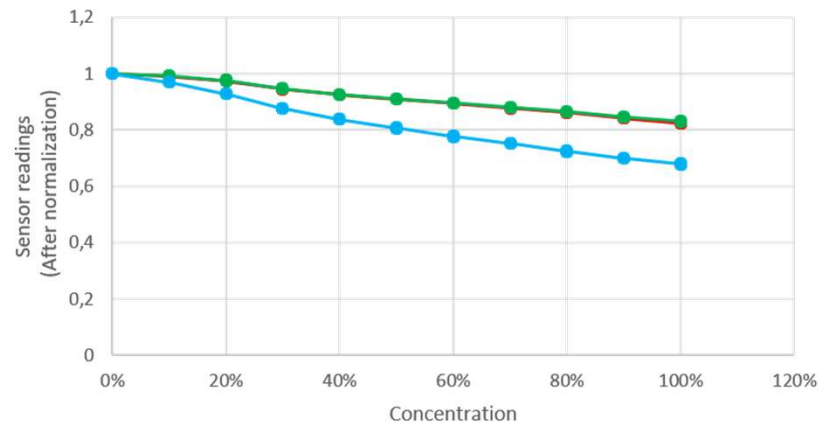
Max Histogram Value in Chlorella Sp.
(Normalization)



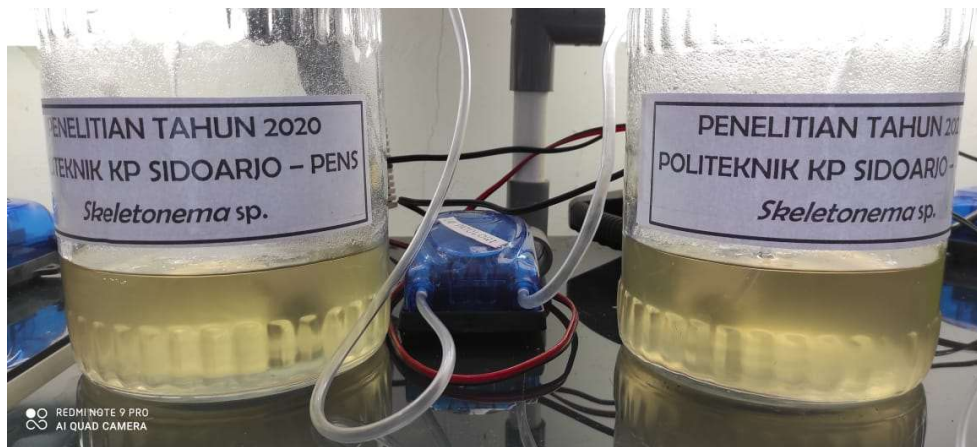
Mean Histogram Value in Chlorella Sp.
(Normalization)



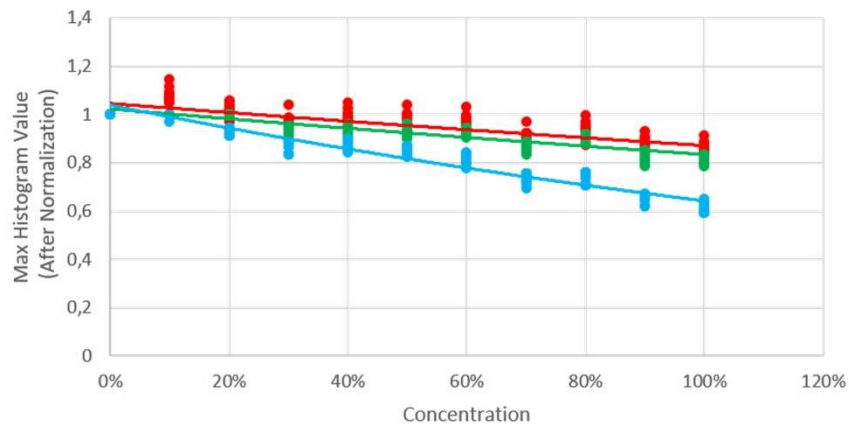
Value of Sensor RGB Readings in Chlorella Sp.
(Normalization)



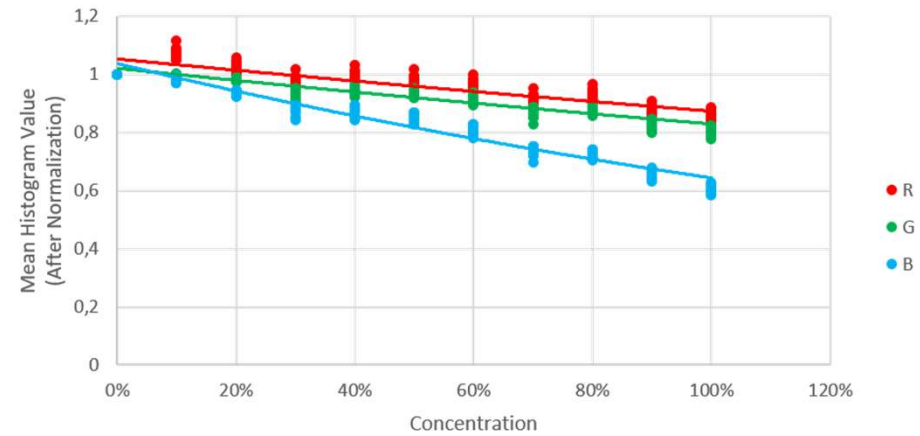
Data Obtained From *Skeletonema* Sp.



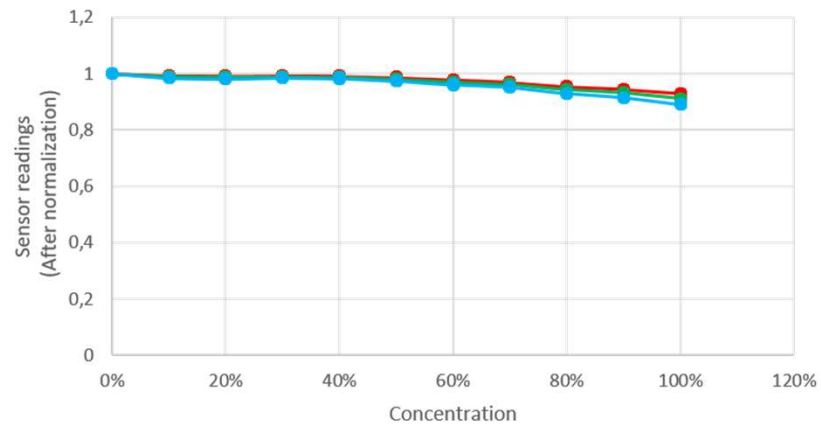
Max Histogram Value in Skeletonema Sp.
(Normalization)



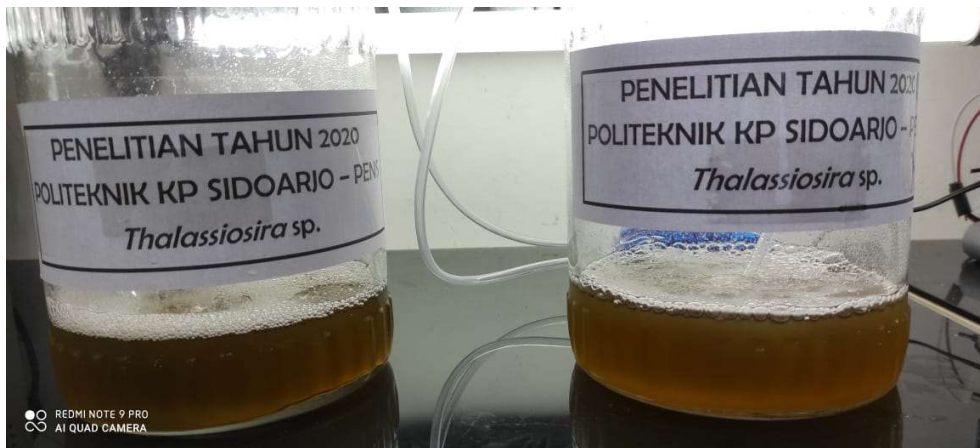
Mean Histogram Value in Skeletonema Sp.
(Normalization)



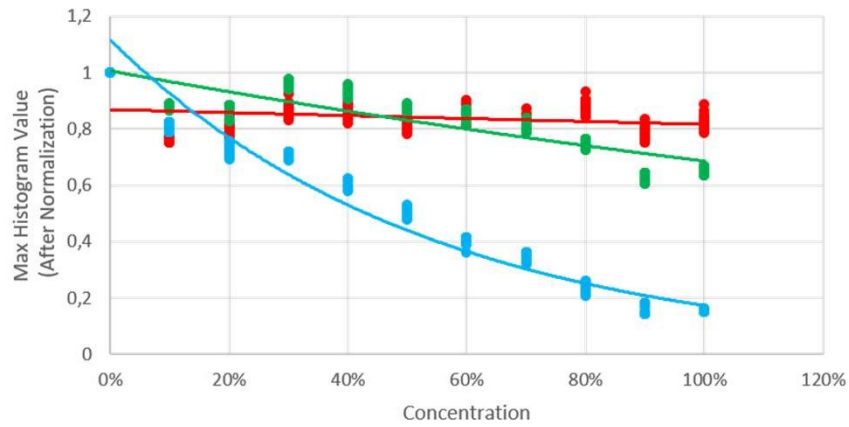
Value of Sensor RGB Readings in Skeletonema Sp.
(Normalization)



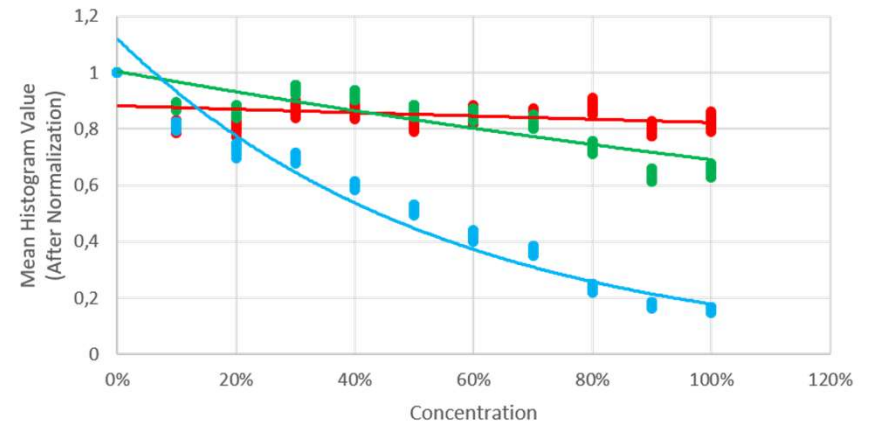
Data Obtained From *Thalassiosira* Sp.



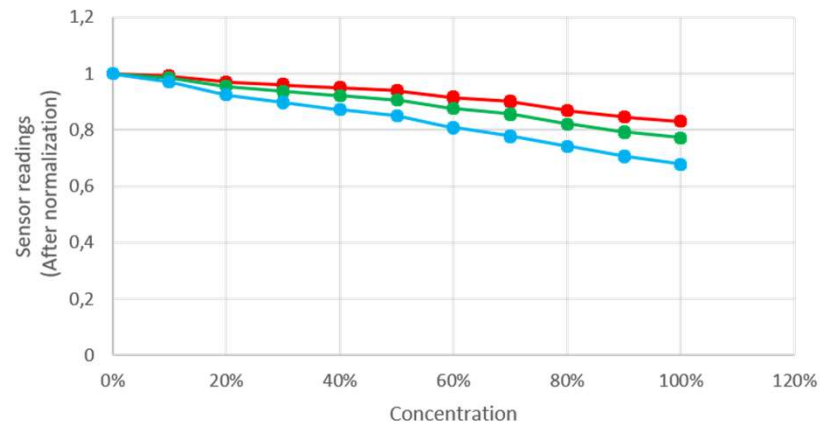
Max Histogram Value in Thalssiosira Sp.
(Normalization)



Mean Histogram Value in Thalssiosira Sp.
(Normalization)

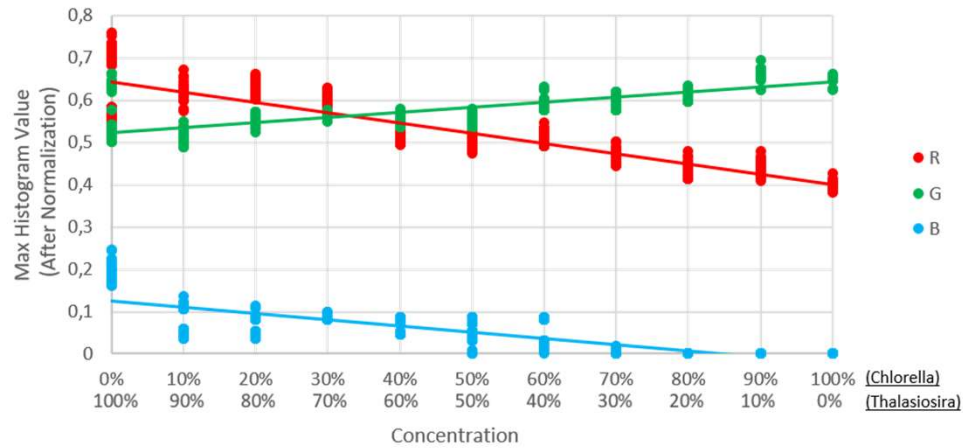


Value of Sensor RGB Readings in Thalassiosira Sp.
(Normalization)

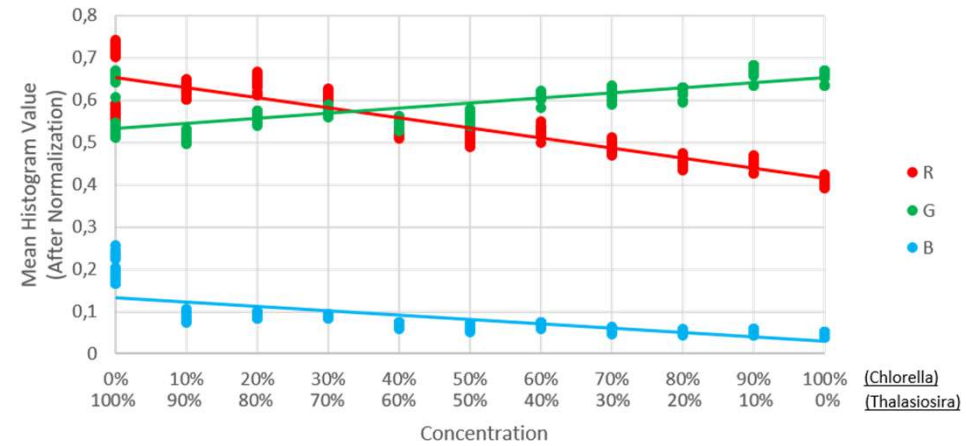


Data Obtained From Mixed *Chlorella* Sp. & *Thalassiosira* Sp.

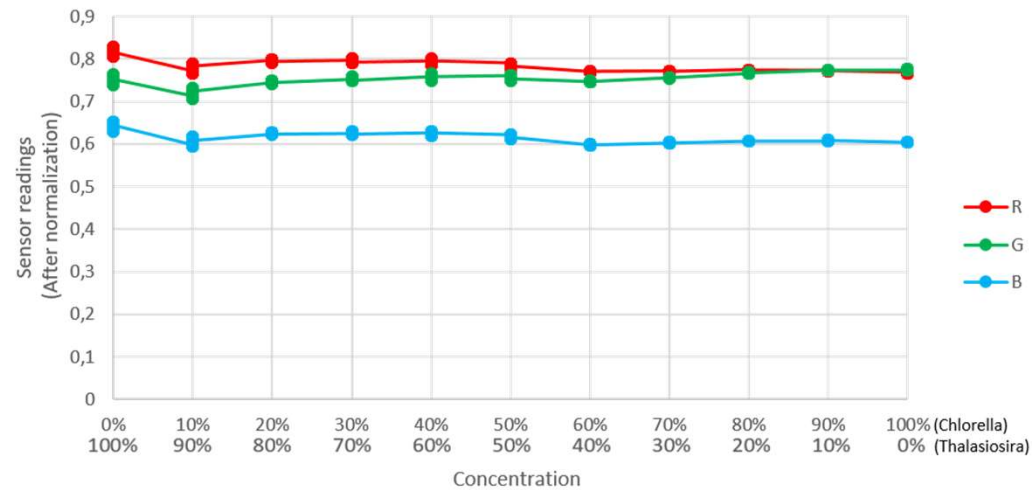
Max Histogram Value in mixed Thalassiosira & Chlorella
(After normalization)



Mean Histogram Value in mixed Thalassiosira & Chlorella
(After normalization)

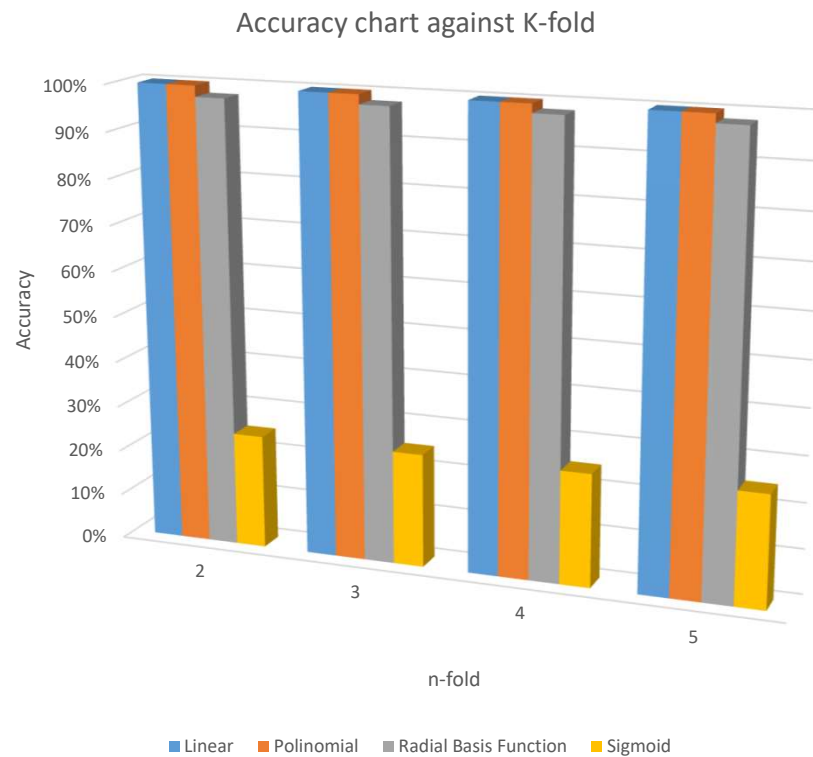


Value of Sensor RGB Readings in mixed Thalassiosira & Chlorella
(After normalization)



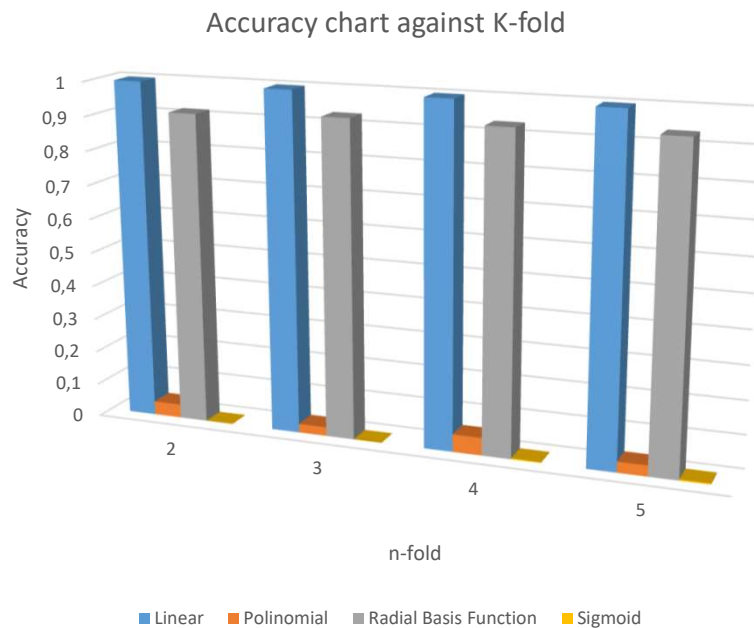
Kernel Selection

Kernel test for classification (SVC)



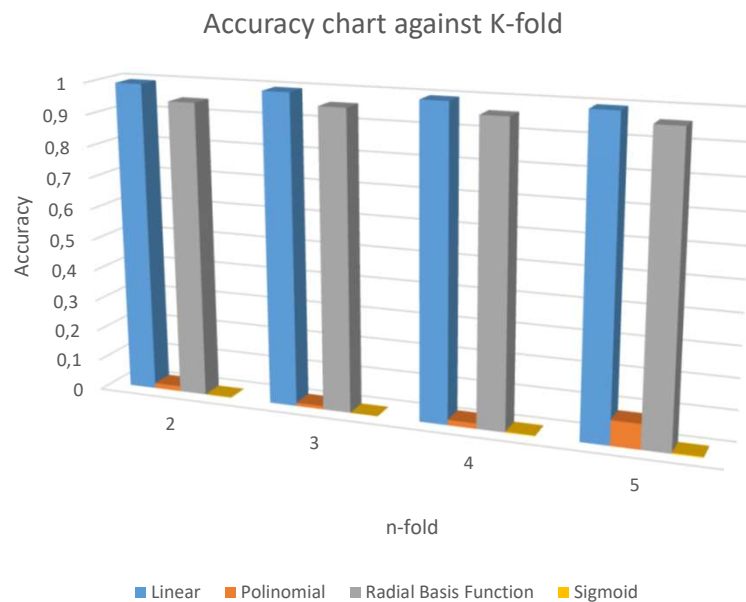
K-fold	kernel	Squared Correlation Coefficient
2	Linear	100%
2	polinomial	100%
2	radial basis function	97,63%
2	sigmoid	25%
3	Linear	100%
3	polinomial	100%
3	radial basis function	97,93%
3	sigmoid	25%
4	Linear	100%
4	polinomial	100%
4	radial basis function	98,10%
4	sigmoid	25%
5	Linear	100%
5	polinomial	100%
5	radial basis function	98,10%
5	sigmoid	25%

Kernel test for SV Regression (SVR) in Chlorella Sp.



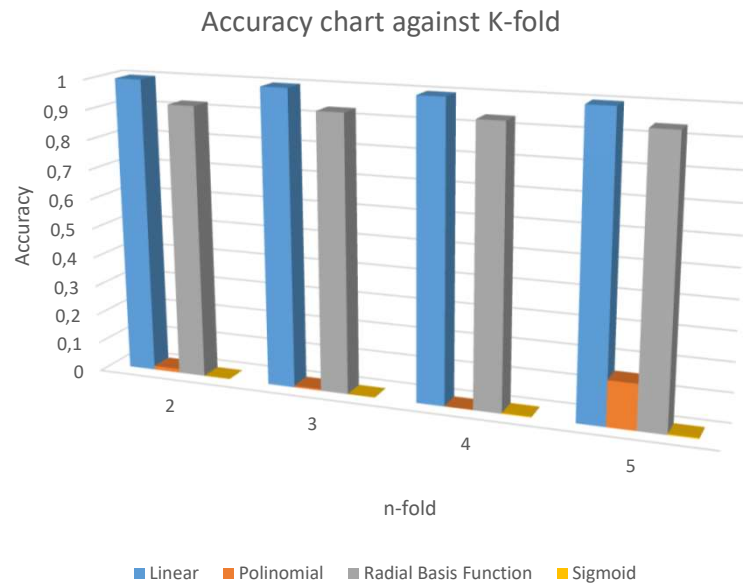
K-fold	kernel	MSE	Squared Correlation Coefficient
2	Linear	0,00730603	0,999176
2	polinomial	1,59E+18	0,0409134
2	radial basis function	0,732469	0,915598
2	sigmoid	8,4276	5,87E-05
3	Linear	0,00866085	0,999063
3	polinomial	1,94E+18	0,0263454
3	radial basis function	0,602463	0,930053
3	sigmoid	8,4292	7,85E-05
4	Linear	0,00956739	0,999026
4	polinomial	7,91E+18	0,052841
4	radial basis function	0,583858	0,931988
4	sigmoid	8,474	0,00297961
5	Linear	0,00861375	0,999034
5	polinomial	3,05E+18	0,0325853
5	radial basis function	0,554894	0,935405
5	sigmoid	8,5476	0,00373535

Kernel test for SV Regression (SVR) in Skeletonema Sp.



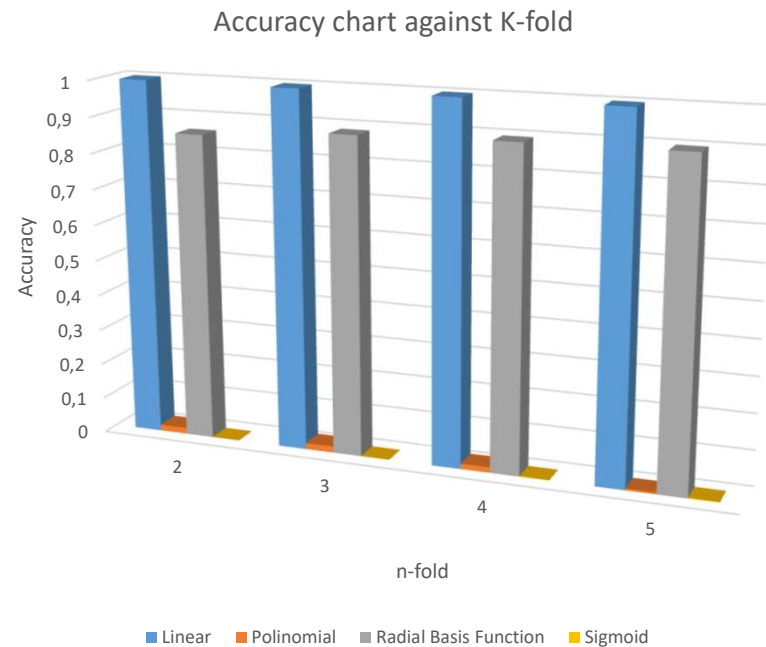
K-fold	kernel	MSE	Squared Correlation Coefficient
2	Linear	0,0452981	0,99455
2	polinomial	6,85E+18	0,0163877
2	radial basis function	0,475213	0,945779
2	sigmoid	8,4276	5,87E-05
3	Linear	0,0449354	0,99459
3	polinomial	5,73E+19	0,0103328
3	radial basis function	0,365963	0,958035
3	sigmoid	8,4292	7,85E-05
4	Linear	0,044923	0,994602
4	polinomial	6,94E+19	0,01745
4	radial basis function	0,344748	0,960176
4	sigmoid	8,474	0,00297961
5	Linear	0,0447855	0,994617
5	polinomial	5,72E+19	0,0808245
5	radial basis function	0,326541	0,961975
5	sigmoid	8,5476	0,00373535

Kernel test for SV Regression (SVR) in Thalassiosira Sp.



K-fold	kernel	MSE	Squared Correlation Coefficient
2	Linear	0,0151193	0,998173
2	polinomial	9,91E+17	0,0124997
2	radial basis function	0,690826	0,921587
2	sigmoid	8,4276	5,87E-05
3	Linear	0,0206597	0,997597
3	polinomial	7,71E+17	0,00544787
3	radial basis function	0,608633	0,92989
3	sigmoid	8,4292	7,85E-05
4	Linear	0,0251811	0,997229
4	polinomial	2,21E+18	0,001294
4	radial basis function	0,564944	0,934677
4	sigmoid	8,474	0,00297961
5	Linear	0,0178808	0,997864
5	polinomial	2,66E+19	0,152852
5	radial basis function	0,516797	0,938849
5	sigmoid	8,5476	0,00373535

Kernel test for SV Regression (SVR) in mixed *Chlorella* Sp. & *Thalassiosira* Sp.



K-fold	kernel	MSE	Squared Correlation Coefficient
2	Linear	0,00407624	0,999389
2	polinomial	9,65E+16	0,0171218
2	radial basis function	1,01966	0,859651
2	sigmoid	6,682	1,07E-04
3	Linear	0,0039859	0,999403
3	polinomial	4,34E+17	0,0175009
3	radial basis function	0,828619	0,885649
3	sigmoid	6,68778	5,21E-04
4	Linear	0,00396957	0,999405
4	polinomial	1,43E+17	0,0152491
4	radial basis function	0,763559	0,89443
4	sigmoid	6,69267	0,00128
5	Linear	0,00402912	0,999397
5	polinomial	1,67E+17	0,00512824
5	radial basis function	0,739355	0,897793
5	sigmoid	6,698	0,00177778

MAE Table				
Preiction		Actual		Absolute Error
Algae Type	Cocentration (%)	Algae Type	Cocentration (%)	
Chlorella Sp.	50,22286355	Chlorella Sp.	50	0,222863551
Skeletonema Sp.	70,25249457	Skeletonema Sp.	70	0,252494568
Thalassiosira Sp.	91,37054753	Thalassiosira Sp.	90	1,370547526
Thalassiosira Sp.	48,99300855	Thalassiosira Sp.	50	1,006991453
Chlorella Sp.	99,55370001	Chlorella Sp.	100	0,446299989
Thalassiosira Sp.	39,86967921	Thalassiosira Sp.	40	0,130320787
Chlorella Sp.	40,40390793	Chlorella Sp.	40	0,403907928
Chlorella Sp.	31,0870804	Chlorella Sp.	30	1,087080404
Skeletonema Sp.	38,29405123	Skeletonema Sp.	40	1,705948768
Skeletonema Sp.	22,25040257	Skeletonema Sp.	20	2,250402568
Mean Absolute Error (MAE)				0,887685754
Standart Deviation				0,719692799

Confusion Matrix				
		Actual		
		Chlorella Sp.	Skeletonema Sp.	Thalassiosira Sp.
Prediction	Chlorella Sp.	4	0	0
	Skeletonema Sp.	0	2	0
	Thalassiosira Sp.	0	1	3

Conclusion

- ▶ In the sample *Chlorella* Sp. has a dominant green color so that the G channel is dominant, for the *Skeletonema* Sp. sample. has a color that tends to be white so that the 3 channels have less significant differences, but the R channel is the most dominant, for the sample *Thalassiosira* Sp. has a color that tends to brown so that the R channel is the most dominant.
- ▶ The higher the concentration, the lower the sensor reading value, this is probably due to the amount of light absorbed by the sample compared to the light emitted or reflected.
- ▶ From the data obtained, the best kernel for classification (SVC) and regression (SVR) is a linear kernel where the kernel is obtained with an accuracy of approximately 90%, and when testing with 10 algae sample data, the mean absolute error is equal to $0,88 \pm 0,719$.



Thank You



KEMENTERIAN KELAUTAN DAN PERIKANAN
BADAN RISET DAN SUMBER DATA MAMUSIA KELAUTAN DAN PERIKANAN
POLITEKNIK KELAUTAN DAN PERIKANAN SIDOARJO
KAMPUS POLITEKNIK KELAUTAN DAN PERIKANAN
JALAN RING RUMUTAN KOTA POS 1 SEJATI - SIDOARJO JAWA TIMUR 61253
TEL. (031) 8911585, FAKS (031) 8912048
PUS. EL. (031) 8911585, poltekkelautan@sidopoli.go.id - LAMKIN - www.poltekkelautan.go.id



LEMBAR HASIL UJI (LHU)

LABORATORIUM BIOLOGI LINGKUNGAN

POLITEKNIK KELAUTAN DAN PERIKANAN SIDOARJO

Nama Sampel : Plankton Chlorella Sp, Skeletonema Sp. dan Thalassiosira Sp.
Jenis Sampel : Cair
Pemilik Sampel : Politeknik KP Sidoarjo – Politeknik Elektronika Negeri Surabaya (PENS)
Tanggal Penerimaan : 8 Januari 2021
Tanggal Pengujian : 8 Januari 2021
Nama Penguji : Anja Asmarani, S.Si. M.Si.
Era Insivitawati, S.Pi. M.Si.

No	Nama Sampel	Hasil Pengujian
1	Plankton Chlorella Sp.	820×10^4 sel/ml
2	Plankton Skeletonema Sp.	16×10^4 sel/ml
3	Plankton Thalassiosira Sp.	69×10^4 sel/ml

Mengetahui,
Ka. Prodi TFPI

Tri Ani Setyastuti, S.Pi. M.Si.

Sidoarjo, 8 Januari 2021

Koordinator Laboratorium

Era Insivitawati, S.Pi. M.Si.