APP PHY 157 WFY-FX-2

LAB REPORT 4

Feature Extraction from Images

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Background

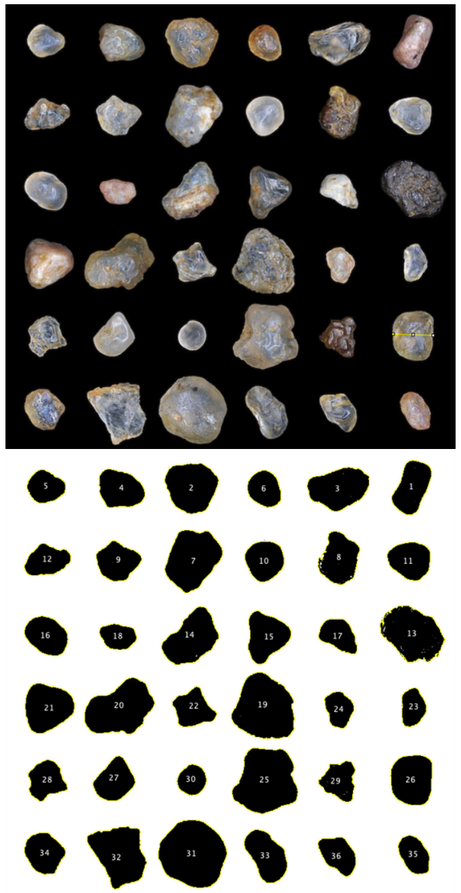
Features are parts or patterns of an object in an image that identifies the image. These include properties like corners, edges, regions of interest points, ridges, etc. Feature extraction requires you to define the pixels of the objects apart from the rest of the image pixels. And for this activity, we used ImageJ which is a free Java-based scientific image processing software.

Objectives

The goal of this activity is just to explore ImageJ and:

1. Extract features from objects in different images

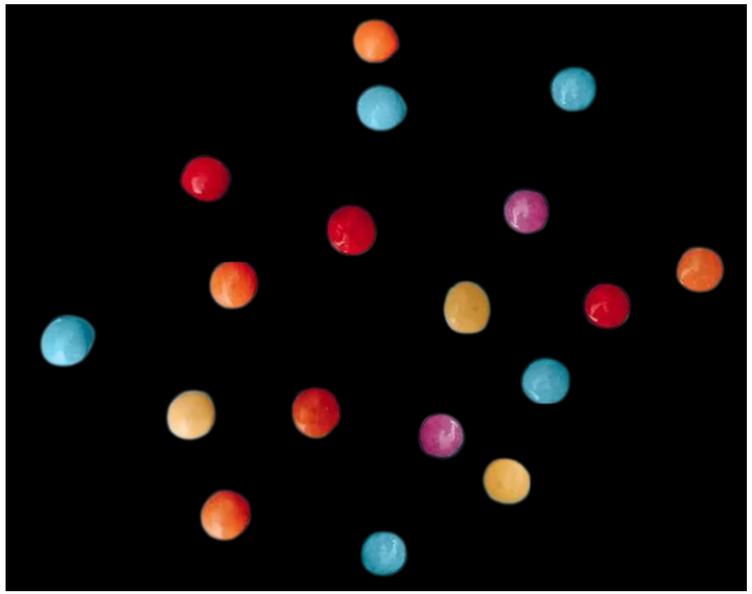
Results and Analysis

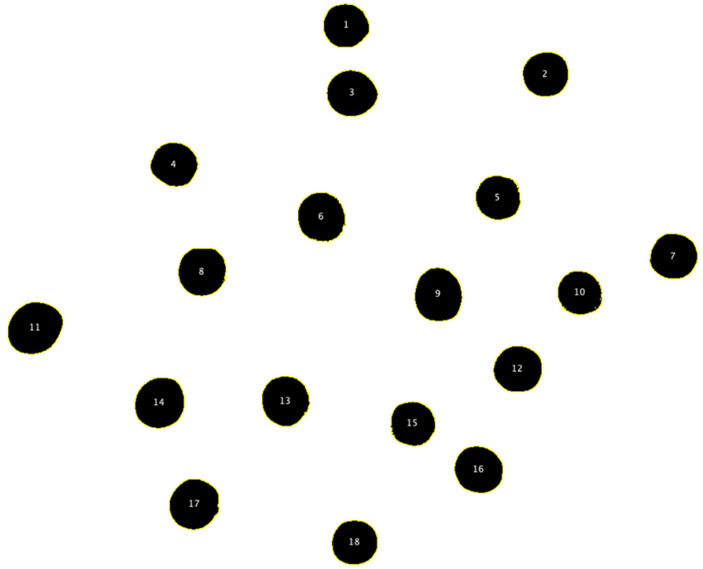


	Area	X	Y	Circ.	AR	Round	Solidity
1	3.562	20.511	2.019	0.727	1.872	0.534	0.950
2	5.162	9.410	2.002	0.843	1.048	0.954	0.976
3	4.851	16.829	2.065	0.744	1.584	0.631	0.959
4	3.457	5.833	2.114	0.818	1.332	0.751	0.973
5	2.345	2.069	2.009	0.844	1.192	0.839	0.970
6	2.372	13.090	2.109	0.860	1.201	0.833	0.977
7	6.261	9.466	5.636	0.800	1.296	0.772	0.968
8	3.860	16.850	5.623	0.671	1.363	0.734	0.931
9	3.141	5.689	5.754	0.810	1.145	0.873	0.954
10	3.066	13.092	5.699	0.881	1.052	0.950	0.981
11	3.193	20.415	5.689	0.866	1.170	0.854	0.978
12	2.628	2.135	5.714	0.733	1.577	0.634	0.945
13	6.313	20.527	9.383	0.543	1.404	0.712	0.941
14	5.112	9.421	9.615	0.735	1.581	0.633	0.947
15	3.911	13.177	9.517	0.755	1.174	0.852	0.949
16	3.196	2.132	9.483	0.861	1.351	0.740	0.976
17	2.338	16.820	9.464	0.748	1.530	0.654	0.956
18	1.863	5.720	9.522	0.821	1.453	0.688	0.968
19	7.830	13.078	13.132	0.792	1.133	0.883	0.964
20	6.787	5.813	13.155	0.732	1.571	0.637	0.930
21	4.667	2.168	13.089	0.832	1.072	0.932	0.979
22	2.813	9.496	13.159	0.718	1.113	0.899	0.899
23	1.853	20.550	13.094	0.772	1.588	0.630	0.964
24	1.955	16.836	13.172	0.798	1.347	0.742	0.957
25	8.069	13.169	16.793	0.759	1.120	0.893	0.941
26	4.498	20.516	16.717	0.863	1.202	0.832	0.984
27	3.118	5.545	16.766	0.830	1.259	0.794	0.975
28	2.734	2.100	16.745	0.747	1.085	0.922	0.912
29	2.544	16.857	16.780	0.683	1.127	0.887	0.901
30	1.715	9.442	16.735	0.877	1.088	0.919	0.972
31	8.843	9.487	20.453	0.865	1.067	0.937	0.983
32	6.153	5.788	20.472	0.690	1.295	0.772	0.919
33	3.746	13.187	20.540	0.757	1.781	0.562	0.947
34	3.109	2.004	20.405	0.854	1.145	0.874	0.969
35	2.202	20.619	20.497	0.808	1.605	0.623	0.972
36	2.551	16.798	20.494	0.783	1.547	0.646	0.964

The first image I used was of the rocks on a black background. Upon visual inspection of the raw image, there were 36 rocks of different shapes and sizes. Using ImageJ, it was able to identify each of the rocks and provide the selected features and descriptions for each. Features such as the area and solidity of the rocks are very useful, especially in determining their composition. In geology, rocks with higher solidity mean that they are tightly packed and may be rich in minerals. Descriptions on the shape of the rocks are also used to trace back the origin and study the environment in that they were formed in.

The next one is an image of scattered nips candy (I edited the background a little bit so that it is a solid black color, making the thresholding in ImageJ easier). The same features were extracted from each of the 18 candies. Although it might not seem really useful to know the features of a candy, generally speaking, it is actually quite useful in the food industry. The solidity of the candy may provide information on its texture, whereas the area can also give information on its taste. For most food, the larger the area, the greater the 'flavor release' they say.





	Area	X	Y	Circ.	AR	Round	Solidity
1	0.668	7.700	0.771	0.911	1.045	0.957	0.976
2	0.694	11.826	1.772	0.912	1.035	0.966	0.977
3	0.773	7.821	2.168	0.901	1.098	0.911	0.974
4	0.684	4.161	3.632	0.892	1.073	0.932	0.971
5	0.673	10.844	4.318	0.835	1.029	0.972	0.967
6	0.792	7.196	4.719	0.855	1.062	0.942	0.969
7	0.727	14.465	5.527	0.902	1.044	0.958	0.974
8	0.791	4.737	5.840	0.856	1.030	0.971	0.977
9	0.868	9.608	6.326	0.900	1.140	0.877	0.977
10	0.659	12.529	6.285	0.857	1.067	0.937	0.968
11	0.955	1.282	7.005	0.900	1.162	0.860	0.979
12	0.760	11.253	7.854	0.915	1.051	0.951	0.978
13	0.797	6.452	8.508	0.884	1.057	0.946	0.976
14	0.857	3.863	8.551	0.911	1.088	0.919	0.980
15	0.672	9.080	8.979	0.850	1.031	0.970	0.967
16	0.768	10.442	9.927	0.910	1.081	0.925	0.977
17	0.843	4.572	10.640	0.899	1.064	0.940	0.974
18	0.693	7.881	11.429	0.915	1.037	0.964	0.977

	Area	X	Y	Circ.	AR	Round	Solidity
1	13.124	12.552	2.050	0.695	1.890	0.529	0.971
2	2.815	26.263	1.382	0.699	2.040	0.490	0.951
3	3.847	20.601	1.868	0.713	1.329	0.753	0.887
4	3.960	6.888	4.757	0.607	2.276	0.439	0.947
5	17.035	17.706	8.556	0.726	1.816	0.551	0.979
6	3.198	25.175	6.195	0.593	2.160	0.463	0.947
7	9.055	10.774	8.999	0.658	1.544	0.648	0.918
8	9.562	23.476	12.056	0.176	2.413	0.414	0.551
9	7.248	5.204	11.571	0.878	1.223	0.818	0.985
10	5.005	28.822	12.756	0.650	1.999	0.500	0.933
11	3.345	14.357	14.093	0.879	1.216	0.822	0.974
12	15.777	9.126	17.930	0.271	1.014	0.986	0.525
13	4.504	17.355	18.143	0.637	1.989	0.503	0.921
14	1.990	26.608	17.899	0.565	1.806	0.554	0.874
15	5.791	2.396	18.958	0.859	1.307	0.765	0.978

SHELLS

Lastly, feature extraction was applied to seashells. As observed, there are around 19 visible shells in the raw image, however, ImageJ was only able to detect 15 of them. This may be because the software itself is not able to detect or account for cropped objects in the image. I intentionally chose this image to demonstrate that. Moreover, features such as the area, solidity, and shape descriptions of the shells are used by researchers in determining the shape and size of the organisms that produced them. Aside from that, they also give them insights on the organisms' growth rates and other characteristics.

Feature extraction is important in image processing because it allows us to analyze the image itself in a more meaningful way and draw out relevant and useful information which can then be used in different areas.

Reflection

This is definitely the easiest and least stressful activity so far. I am also glad to have been introduced to a new software, ImageJ. It is really easy to navigate and explore so I hope I get to use it from time to time even after this course. Although in terms of feature extraction, I found that the software is kind of sensitive to the background color of the image. I tried some photos with a gradient or non-solid color as background and the thresholding didn't really work. It also needed the objects to not have any shadows, so I had to do a 'pre-processing' on some of them. But overall, I'm excited to learn more about feature extraction and image segmentation in the next activities.

Self-evaluation

100/100

+ 5 bonus points

I believe I accomplished the required task for this activity and also did some extra steps

References

Here are the references I used to accomplish this activity:

Soriano, M. (2023). Activity 4. Feature Extraction from Images. https://docs.google.com/presentation/d/13wQuUHAu1C3-svxEgGJMmHcOs7YR8lMhbnA8rCC9SAo/edit#slide=id.gdc10dd73d7_0_0

Chatterjee, S. (2020, July 30). What is Feature Extraction? Feature Extraction in Image Processing. GreatLearning. https://www.mygreatlearning.com/blog/feature-extraction-in-image-processing/