Feature Extraction from Images

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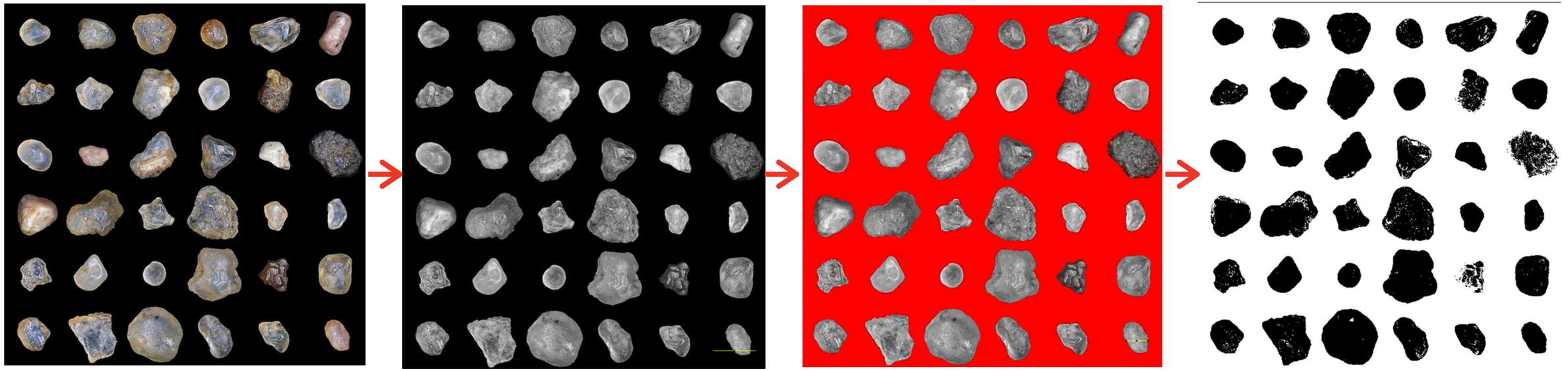
OBJECTIVE

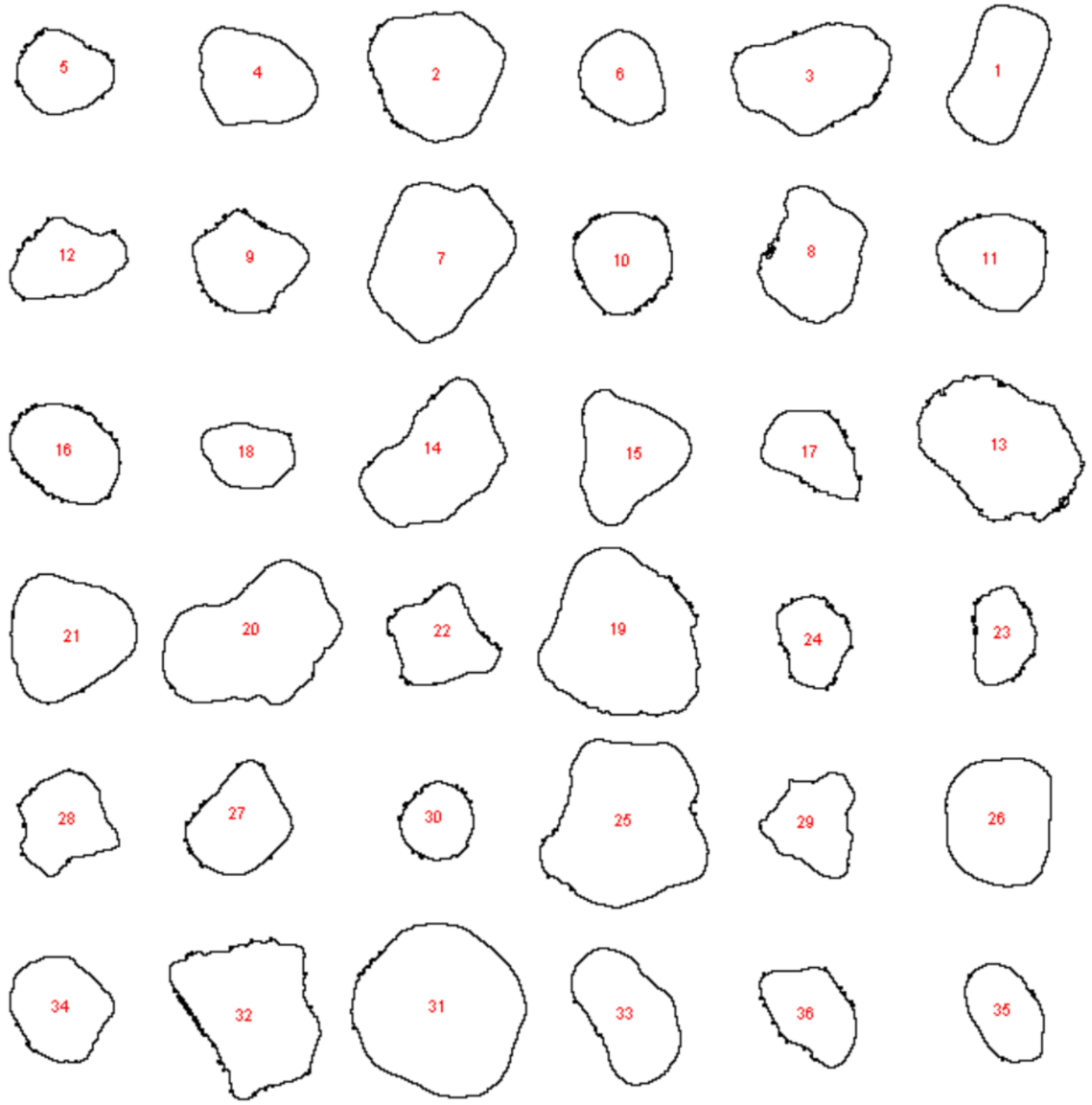
- Measure and extract properties from images automatically using the ImageJ software

SAND GRAINS



Test Image | Grayscale Image | Adjusted Threshold | Binary Image

Figure 1. Feature-extraction process of the provided sand image using Image J. The test image is first converted to a grayscale image then the threshold is adjusted to segment the individual sand grains. The adjustment is applied then the image is made into a binary image that is ready to be analyzed by the software



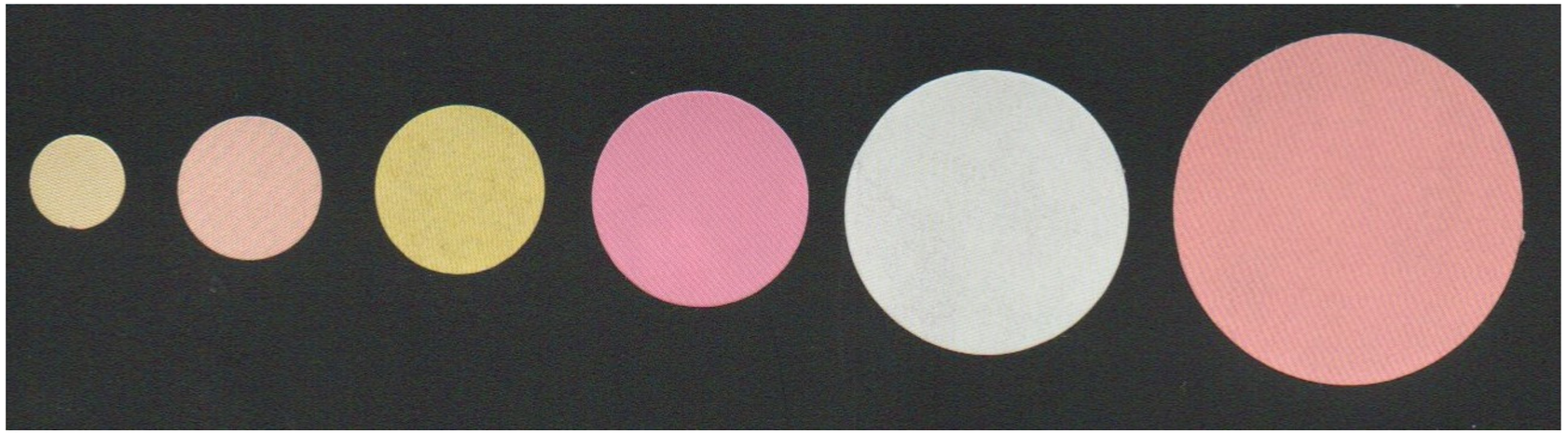
(a) Labeled and Feature-Extracted Image

	Label	Area	X	Y	Circ.	AR	Round	Solidity
1	Sand grains by AKlepnev.jpg	91.169	102.969	9.099	0.713	1.876	0.533	0.936
2	Sand grains by AKlepnev.jpg	131.631	46.592	9.021	0.708	1.047	0.956	0.955
3	Sand grains by AKlepnev.jpg	124.154	84.302	9.341	0.632	1.584	0.631	0.938
4	Sand grains by AKlepnev.jpg	88.277	28.432	9.583	0.823	1.341	0.746	0.964
5	Sand grains by AKlepnev.jpg	59.569	9.325	9.036	0.629	1.194	0.838	0.936
6	Sand grains by AKlepnev.jpg	60.246	65.300	9.561	0.776	1.207	0.829	0.950
7	Sand grains by AKlepnev.jpg	159.846	46.880	27.457	0.774	1.299	0.770	0.953
8	Sand grains by AKlepnev.jpg	99.754	84.374	27.427	0.624	1.348	0.742	0.924
9	Sand grains by AKlepnev.jpg	79.569	27.702	28.068	0.545	1.140	0.877	0.913
10	Sand grains by AKlepnev.jpg	78.154	65.323	27.782	0.531	1.051	0.952	0.940
11	Sand grains by AKlepnev.jpg	80.954	102.488	27.732	0.626	1.172	0.853	0.944
12	Sand grains by AKlepnev.jpg	66.769	9.643	27.860	0.604	1.572	0.636	0.906
13	Sand grains by AKlepnev.jpg	164.215	103.032	46.512	0.545	1.412	0.708	0.932
14	Sand grains by AKlepnev.jpg	130.585	46.663	47.686	0.698	1.582	0.632	0.930
15	Sand grains by AKlepnev.jpg	99.938	65.734	47.180	0.758	1.177	0.850	0.938
16	Sand grains by AKlepnev.jpg	81.877	9.631	47.019	0.514	1.343	0.745	0.935
17	Sand grains by AKlepnev.jpg	59.138	84.245	46.920	0.567	1.539	0.650	0.911
18	Sand grains by AKlepnev.jpg	47.046	27.844	47.206	0.809	1.454	0.688	0.952
19	Sand grains by AKlepnev.jpg	199.908	65.233	65.548	0.716	1.132	0.883	0.949
20	Sand grains by AKlepnev.jpg	173.600	28.341	65.659	0.724	1.572	0.636	0.924
21	Sand grains by AKlepnev.jpg	120.031	9.816	65.310	0.809	1.071	0.933	0.963
22	Sand grains by AKlepnev.jpg	71.723	47.042	65.684	0.523	1.121	0.892	0.868
23	Sand grains by AKlepnev.jpg	47.169	103.187	65.340	0.504	1.591	0.628	0.915
24	Sand grains by AKlepnev.jpg	49.446	84.334	65.736	0.530	1.352	0.740	0.896
25	Sand grains by AKlepnev.jpg	206.369	65.693	84.137	0.695	1.121	0.892	0.931
26	Sand grains by AKlepnev.jpg	114.585	103.005	83.743	0.881	1.205	0.830	0.978
27	Sand grains by AKlepnev.jpg	79.138	26.970	83.991	0.631	1.265	0.790	0.929
28	Sand grains by AKlepnev.jpg	69.077	9.475	83.890	0.634	1.078	0.927	0.892
29	Sand grains by AKlepnev.jpg	65.938	84.405	84.079	0.693	1.129	0.885	0.892
30	Sand grains by AKlepnev.jpg	43.631	46.774	83.851	0.565	1.077	0.929	0.920
31	Sand grains by AKlepnev.jpg	226.215	46.993	102.727	0.810	1.070	0.934	0.974
32	Sand grains by AKlepnev.jpg	157.169	28.201	102.819	0.430	1.292	0.774	0.895
33	Sand grains by AKlepnev.jpg	95.477	65.783	103.172	0.733	1.785	0.560	0.933
34	Sand grains by AKlepnev.jpg	79.169	8.987	102.495	0.793	1.144	0.874	0.954
35	Sand grains by AKlepnev.jpg	55.938	103.532	102.952	0.724	1.615	0.619	0.955
36	Sand grains by AKlepnev.jpg	64.954	84.123	102.928	0.552	1.545	0.647	0.915

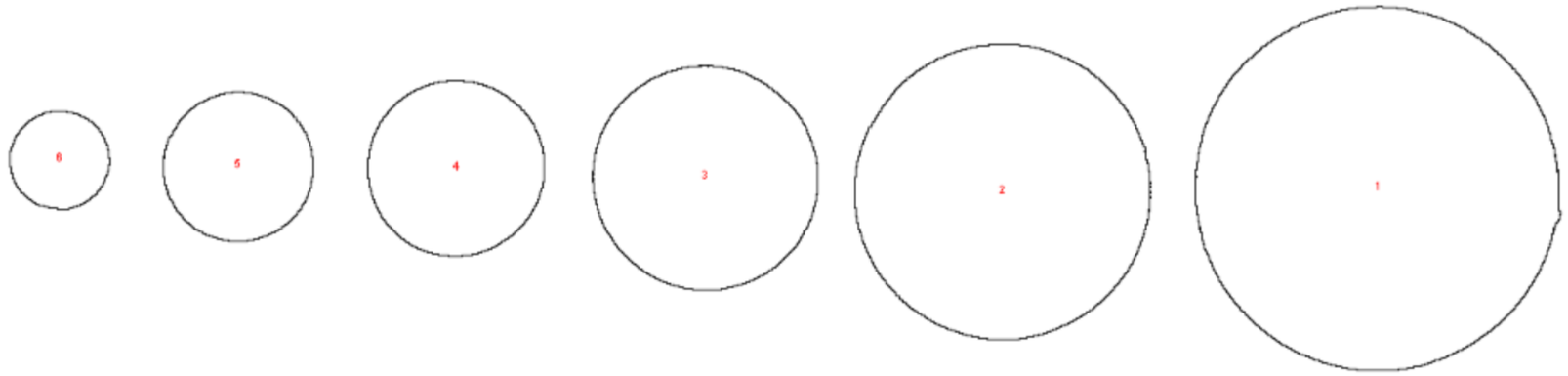
(b) Feature Measurements of the sand grains

Figure 2. Results of feature extraction with ImageJ. The individual sand grains are labeled and the area and shape characteristics are measured.

AREA ESTIMATION USING IMAGEJ



(a) Test image of circles with varying radius.



(b) Test image of labeled and the area measured using ImageJ

Figure 3. The area of each circle is measured by ImageJ.

ANALYSIS

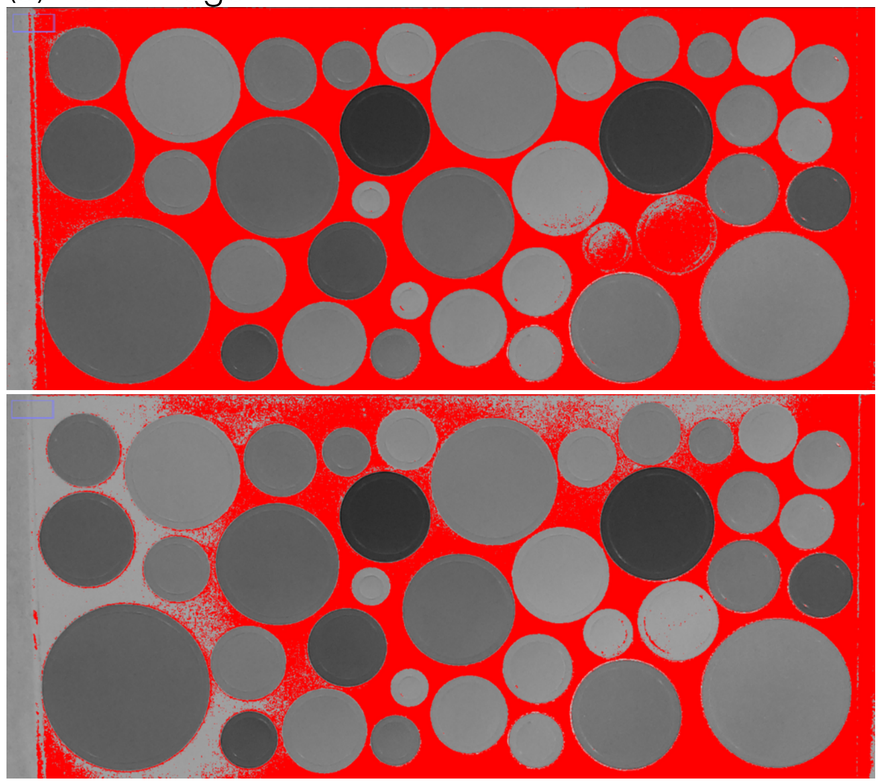
Table 1. Area estimation by ImageJ software vs. measured area

Label	Area(ImageJ)	Area(ruler)	% deviation
1	4.715	4.711963	0.064464
2	3.111	3.14	0.923567
3	1.796	1.76625	1.68436
4	1.107	1.1304	2.070064
5	0.801	0.785	2.038217
6	0.35	0.331663	5.528964

As shown in Table 1, the area estimated by the ImageJ software deviates from the actual area measured with a ruler by 0.06% to 5.5%. The greater deviation also occurs at the smallest circle, where there is a side that loses its roundness, as seen in Figure 3(a). This is also noted in ImageJ where the roundness of Label 6 is at 0.979, while the rest have a roundness measured at 0.99

LIMITATIONS

(a) Test image



(b) Grayscale of image with different threshold adjustments

Figure 4. Threshold adjustment limitations. For this particular image, all of the circles cannot be completely segmented from the background, since color levels and contrast for each circle vary.

REFLECTION

This activity was a nice change of pace compared to the first two activities.

I was able to test the accuracy of the software using personally measured data. One problem that occurred during the activity was the one discussed in the limitations. I had to test two sets of circle images before landing on the one that I used in this report.

I would also like to thank Ma'am Jing for this semester.

SELF-GRADE

For this activity, I would give myself a score of 110. 33.3 points for technical correctness, since I was able to meet the objectives and was able to produce the desired results. I also able to explore the software used.

I also give myself 33.3 points for the quality of the presentation, as I presented the results and figures properly and concisely. The figures are also captioned accordingly.
I give 33.3 points for self-reflection. I properly assessed myself based on the rubrics and whether I met all the criteria and objectives. I also cited the references after this slide.

I give myself the additional 10 points to test the technique's accuracy and presented limitations that I encountered in the activity.

REFERENCES

Soriano, M. (2021). Feature Extraction from images.

Yumol, A. (2019, February 25). Length and area estimation in images. *$bash*. *https://albertyumol.github.io/LAestimation/#*

APPENDIX

Table 2. Features measured by Image J for Figure 4(b)

Label	**Area**	X	Y	Circ.	AR	Round	Solidity
1	4.715	10.142	1.428	0.892	1.001	0.999	0.992
2	3.111	7.626	1.448	0.9	1.005	0.995	0.992
3	1.796	5.627	1.356	0.883	1.011	0.989	0.989
4	1.107	3.949	1.29	0.9	1.011	0.99	0.987
5	0.801	2.486	1.281	0.886	1.01	0.99	0.985
6	0.35	1.285	1.236	0.897	1.022	0.979	0.98