Activity 7:
FEATURE EXTRACTION

Genesis Vertudez – 202003099

App Physics 157 - Computational Analysis and Modeling in Physics

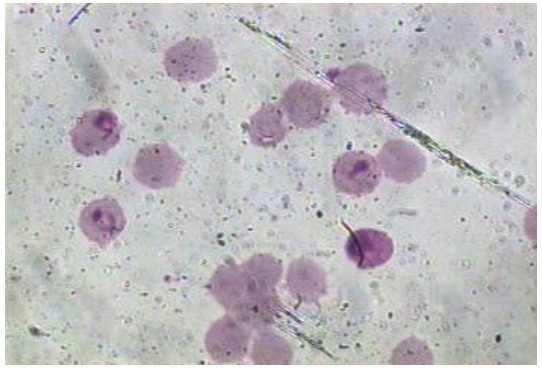
Submitted to Dr. Maricor Soriano; Mx. Rene Principe Jr.

OBJECTIVES

- Extract features of an original image from its cleanly segmented image
- Label desired objects in the image

FEATURE EXTRACTION – MALARIA CELLS

Now that we have the cleanly segmented image, we can now **extract features** from the original image.



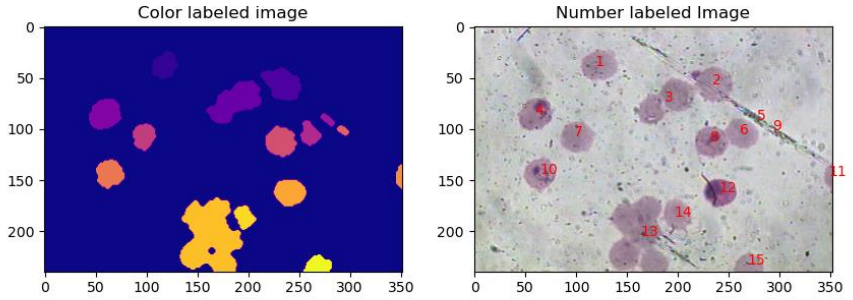
Original image

Segmented image

Shown on the left again are the original image and the segmented image of the malaria cells.

We can then label each blob of cell individually, with colors or with numbers as shown in the right. The number labels are placed on the centroid of each blob, which is a feature also extracted from it. One cell is counted as one continuous (connected) white patch. Human judgment might suggest that cells number 3 and 13 are actually still a group of cells, which is more likely correct. However, this needs a more advanced methods to actually discern the individual cells in that group.

The image on the right shows the extracted features of each cell, including their area, convex area which is the area of the smallest convex shape that can bound the cell, bounding box area, major and minor axes lengths, and eccentricity which is a measure of roundness.



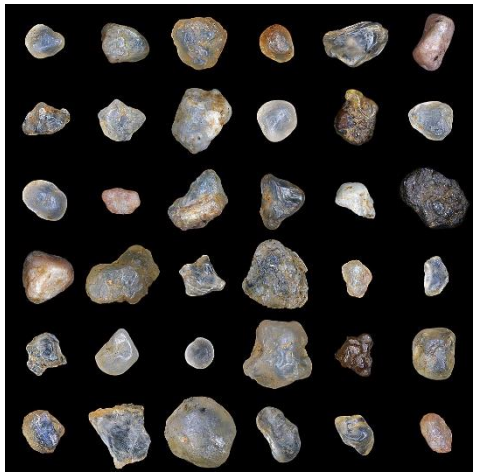
Labeled image

	area	convex_area	bbox_area	major_axis_length	minor_axis_length	eccentricity
1	508	551	728	28.665532	22.922793	0.600448
2	874	958	1320	41.005534	28.087826	0.728565
3	1301	1475	2268	60.044176	29.215674	0.873642
4	742	770	960	33.758593	28.155161	0.551742
5	98	101	182	17.229406	7.348337	0.904488
6	334	361	525	24.461777	18.562709	0.651271
7	454	476	621	26.511210	22.079777	0.553504
8	695	728	961	30.800515	28.910757	0.344884
9	79	82	120	13.180091	7.666895	0.813401
10	586	619	812	27.618415	27.401151	0.125186
11	137	140	168	24.321240	7.571274	0.950311
12	645	660	832	31.442428	26.229878	0.551433
13	3070	3794	4526	77.037501	57.896996	0.659684
14	334	357	528	24.118864	18.284408	0.652143
15	344	361	476	27.509182	16.891941	0.789269

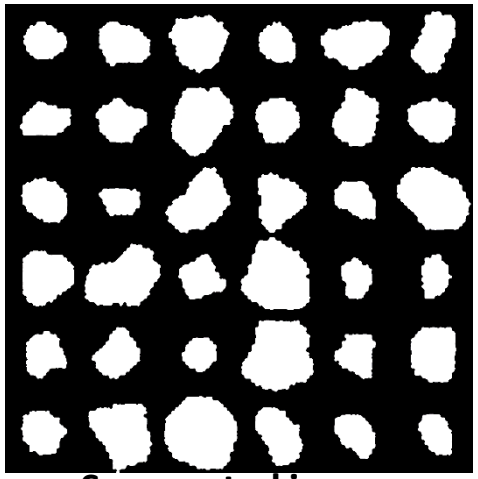
Features

Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%207

FEATURE EXTRACTION – SAND PARTICLES



Original image

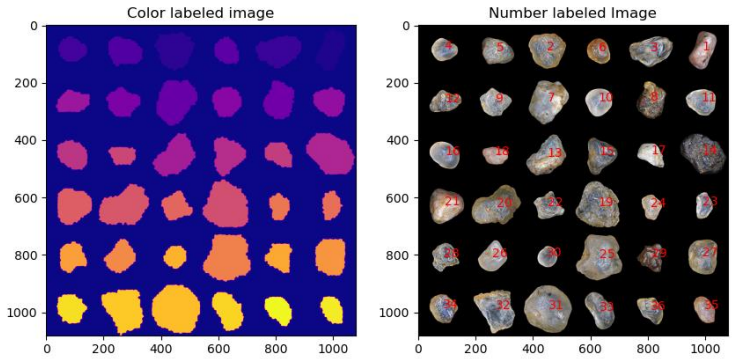


Segmented image

Shown on the left again are the original image and the segmented image of the sand particles.

We can then label each particle of sand individually, with colors or with numbers as shown in the right. The number labels are placed on the centroid of each particle, which is a feature also extracted from it. One particle is counted as one continuous (connected) white patch. In this case, the particles are clearly separated so we are certain that there is no overlapping individual particle.

The image on the right shows the extracted features of each cell, including their area, convex area which is the area of the smallest convex shape that can bound the cell, bounding box area, major and minor axes lengths, and eccentricity which is a measure of roundness.



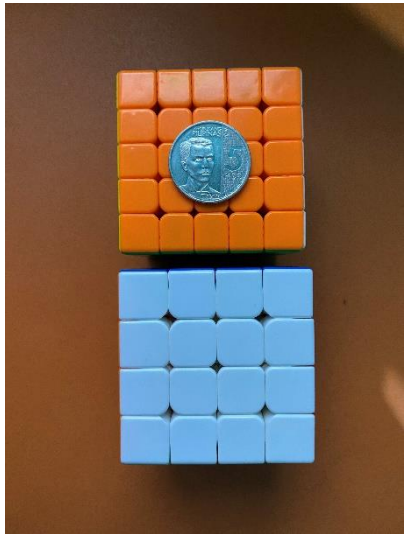
Labeled image

	area	convex_area	bbox_area	major_axis_length	minor_axis_length	eccentricity
1	9586	10610	14768	150.854494	83.519476	0.832754
2	12929	13964	18894	130.874833	128.557389	0.187353
3	12699	13746	18560	160.042932	103.721779	0.761566
4	6405	6783	8888	99.042180	83.443520	0.538689
5	9186	9852	12376	125.933301	95.118094	0.655373
6	6108	6460	8170	98.302815	80.261917	0.577379
7	16181	17102	22896	165.734322	127.043549	0.642185
8	10545	11434	14715	133.786110	102.674592	0.641105
9	8425	9238	12376	113.796896	97.213630	0.519824
10	8279	8716	10815	105.391019	101.016830	0.285107
11	8478	8979	11648	112.855982	97.576858	0.502437
12	6956	7389	9401	119.605346	76.040061	0.771888
13	13608	14829	22952	166.772408	108.401480	0.759937
14	17674	18578	24795	179.166993	126.631527	0.707434
15	10477	11333	15568	129.957109	110.858558	0.521846
16	8348	8833	11128	117.223741	91.225133	0.627999
17	6358	6772	8448	109.278650	76.566098	0.713505
18	4863	5185	6144	96.140885	66.700234	0.720191
19	19763	20899	26880	170.169600	151.792121	0.452026
20	17354	19226	25200	187.853075	122.180847	0.759586
21	11902	12415	15360	129.633512	120.380931	0.371019
22	7346	8105	11440	102.578003	96.351760	0.343090
23	5156	5642	7313	102.236054	65.669492	0.766426
24	5024	5425	6912	94.278308	69.926946	0.670723
25	20530	22268	27555	173.186055	155.492484	0.440332
26	8376	9033	13440	118.248148	93.400483	0.613276
27	11557	12030	13440	135.402512	110.615575	0.576724
28	7348	8144	10450	104.498532	93.788454	0.440995
29	6906	7712	9984	104.086109	90.449086	0.494841
30	4784	5009	6400	81.594059	75.303650	0.385025
31	22205	22934	28560	173.811312	163.627186	0.337273
32	15907	17599	23680	163.668199	130.625059	0.602513
33	10030	10964	14985	148.493109	88.174917	0.804614
34	7898	8596	10918	107.338061	95.123886	0.463287
35	5623	5956	7505	105.636332	68.520620	0.761090
36	6838	7271	9785	115.782187	76.732609	0.748856

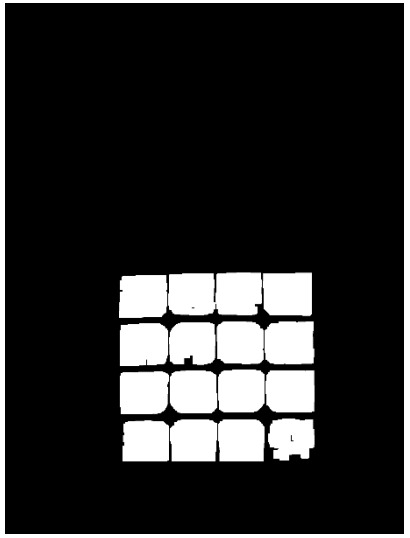
Features

Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%207

FEATURE EXTRACTION – CUBE



Original image

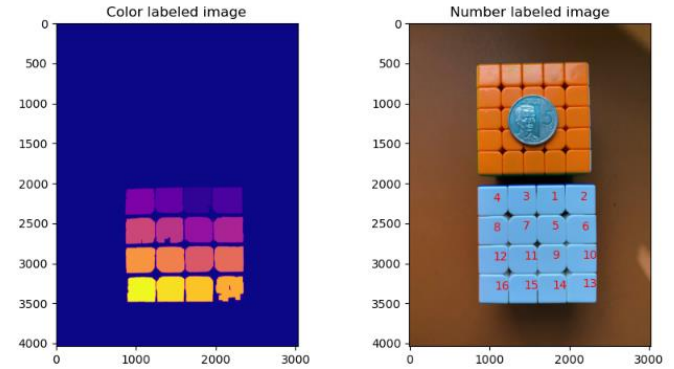


Segmented image

Shown on the left again are the original image and the segmented image of the 4x4x4 Rubik's cube.

We can then label each piece individually, with colors or with numbers as shown in the right. The number labels are placed on the centroid of each blob, which is a feature also extracted from it. One piece is counted as one continuous (connected) white patch. It might seem that the previously segmented (not yet morphed) is better, but it still shows white patches on the orange cube where there is reflection (top left). Thus, it is necessary to use morphological operators to remove them. Note that from ImageJ, the segmented image actually contains the said noise in the orange cube, but they only labeled the white ones, so it was okay that time.

The image on the right shows the extracted features of each cell, including their area, convex area which is the area of the smallest convex shape that can bound the cell, bounding box area, major and minor axes lengths, and eccentricity which is a measure of roundness.



Labeled image

	area	convex_area	bbox_area	major_axis_length	minor_axis_length	eccentricity
1	106819	109602	114100	389.948556	360.472190	0.381401
2	117630	118642	121598	423.651797	368.142999	0.494855
3	106330	108354	112890	393.669876	356.670306	0.423248
4	112917	114834	120048	411.624004	361.887179	0.476510
5	108558	109715	115311	399.364158	353.727160	0.464209
6	115163	117061	121125	418.100504	363.093487	0.495801
7	102265	107226	112752	392.262729	349.625250	0.453407
8	114053	115953	121730	416.743115	359.556599	0.505584
9	109650	110797	116739	396.968677	359.645148	0.423323
10	113503	114881	118770	414.551258	360.484931	0.493794
11	110130	111350	117066	397.257579	361.187322	0.416356
12	113575	114998	119880	414.793920	361.015195	0.492437
13	92246	101706	111331	375.674984	330.104222	0.477381
14	107734	109081	112671	392.865632	360.859871	0.395345
15	107734	109605	114560	393.638524	359.229105	0.408884
16	106118	108048	111741	398.117282	352.349862	0.465514

Features

Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%207

REFLECTION

This activity was very straightforward.

It was fun to see you can automatically extract features from an image after segmenting it cleanly.

This definitely gave me ample idea on how ImageJ extract features from the image since we have done it by parts and explored the mathematics behind them.

SELF-GRADE

- Technical correctness: 35/35
  - I am confident that I understood how to label the original image with colors or with numbers, and to extract features using the cleanly segmented image.
- Quality of presentation: 35/35
  - I have explained each step and idea, and images are clear and concise.
- Self-reflection: 30/30
  - The activity was really fun and straightforward. I gained knowledge behind the ideas on how ImageJ extract features from images.
- Initiative: 10/10
  - I went beyond the expected output by trying the image I used in ImageJ activity.

REFERENCES

[1] Soriano, M. (2023). AP 157 module. Activity 7 - Feature Extraction Part 3 of 3.