Towards a Generalized Approach to Segmentation & Counting

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Introduction

Aim: To develop an algorithm capable of performing the same set of segmentation operations on all input images and count the number of resulting objects with acceptable levels of accuracy.

Methodology

Pre-processing

Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Segmentation

Thresholding

Binary Erosion & Watershed

Counting

Labeling

Pre-processing

Conversion to 8-bit

For faster image processing; no significantly noticeable differences among 16-bit or 32-bit.

Background Subtraction Input parameters required:

Rolling ball radius

Light/Dark background

🕌 Subtract Background	×	
Rolling ball radius: 50.0 pixe	ls	
Light background		
Create background (don't subtract)		
Sliding paraboloid		
Disable smoothing		
Preview		
OK Cancel H	lelp	

Contrast Stretching

Segmentation

🛓 Threshold	×	
58.44 %	▶ 0 123	
Default 💌 B	&W 🔻	
🗖 Dark background 🗐 Stack histogram		
🗖 Don't reset range		
Auto Apply R	eset Set	
▲ Binary Options	X	
Binary Options	~	
Iterations (1-100):		
Black background		
Pad edges when eroding		
EDM output:	Overwrite 💌	
Do:	Nothing 👻	
Preview M	Nothing	
	Erode Dilate	
OK C	Open	
	Close	
	Dutline Fill Holes	
	Skeletonize	

Thresholding

"Auto" for all images – in an attempt to generalization.

Huang – Circular, reflective objects

Mean – Vertical, rectangular objects

Default

Binary Erosion

Sometimes iterative. Coupled with Despeckle & Outlier Removal.

Watershed

Counting & Labeling

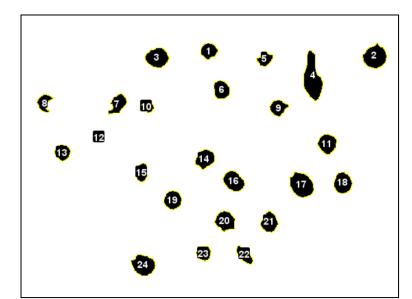
Final step of the generalized algorithm.

Particle analysis automated via run("Analyze Particles... ") macro after successful completion of all pre-processing and segmentation operations.

🕌 Analyze Particles 🛛 🕹	,
Size (inch^2): 0-Infinity Pixel units Circularity: 0.00-1.00	
Show: Nothing	
✓ Display results	
Clear results 🔽 Include holes	
🗌 Summarize 🔽 Overlay	
🔽 Add to Manager 🛛 🗌 Composite ROIs	
OK Cancel Help	

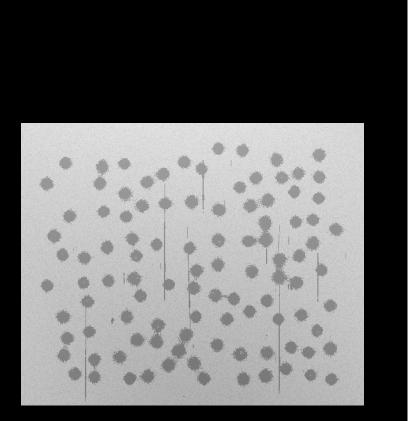
Processed image: yeast2.tif





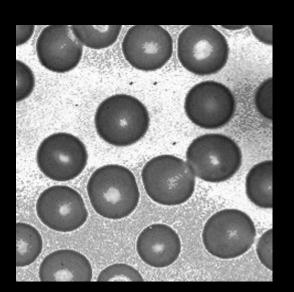
Conversion to 8-bit Background Subtraction Contrast Enhancement Thresholding Binary Erosion <u>Fill Holes</u> Counting & Labeling

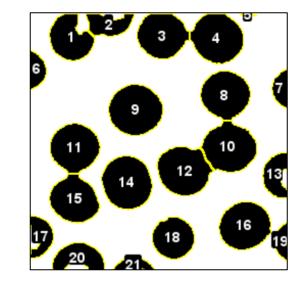
Processed image: spots.tif



Conversion to 8-bit Background Subtraction Contrast Enhancement Thresholding Binary Erosion & <u>Outlier</u> Removal

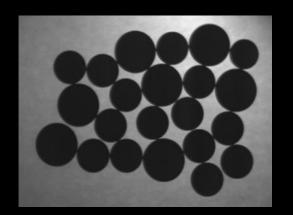
Processed image: cells.tif

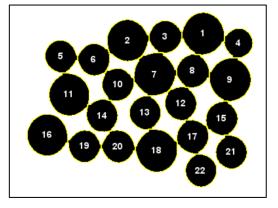




Conversion to 8-bit **Background Subtraction** Contrast Enhancement Thresholding Binary Erosion & Outlier **Removal** <u>Watershed</u> Counting & Labeling

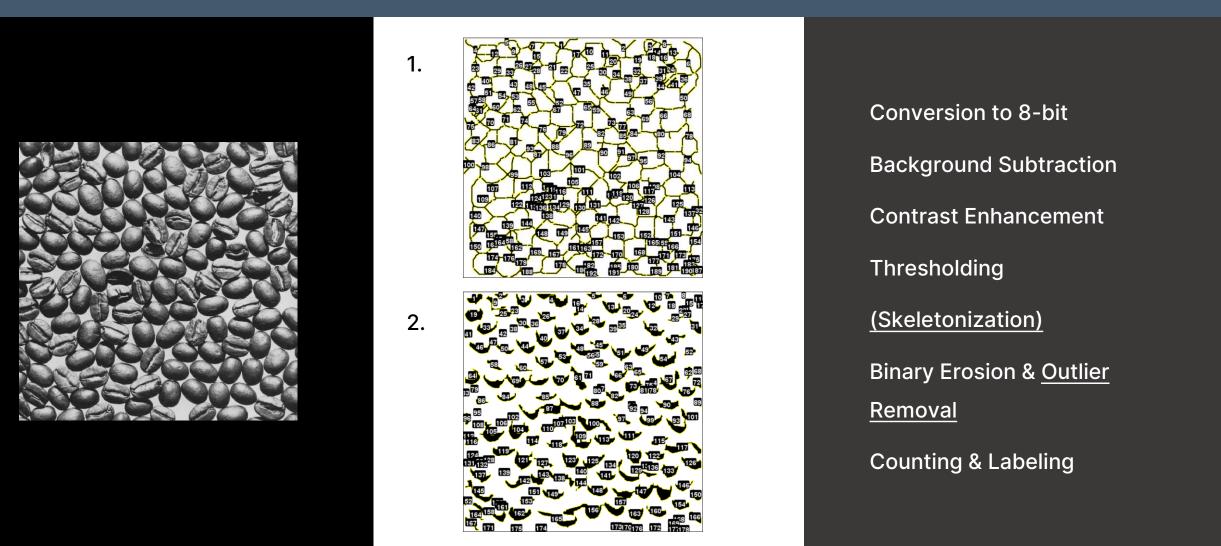
Processed image: objects.tif





Conversion to 8-bit Background Subtraction Contrast Enhancement Thresholding Binary Erosion & Outlier **Removal** <u>Watershed</u> Counting & Labeling

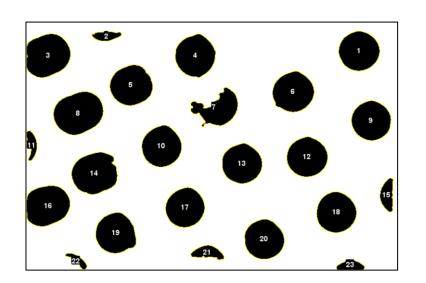
Processed image: coffee.tif



Processed image: oreos.jpg



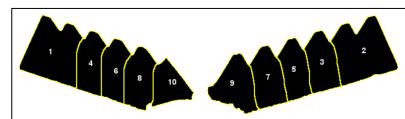
Source: Photography by Cody Guilfoyle Photography for IKEA



Conversion to 8-bit **Background Subtraction** Contrast Enhancement Thresholding **Fill Holes** Binary Erosion, <u>Despeckle</u> & **Outlier Removal** Counting & Labeling

Processed image: toblerone.jpg





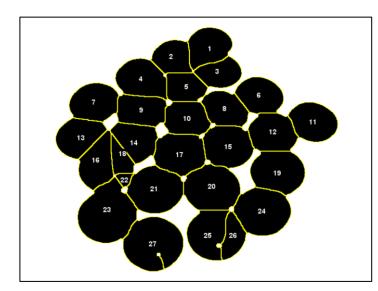
Source: Evan Amos (Wikimedia Commons)

Conversion to 8-bit **Background Subtraction Contrast Enhancement** Thresholding **Fill Holes** Binary Erosion, **Despeckle** & **Outlier Removal** Watershed

Processed image: m&ms.jpg



Source: Scott Ehardt (Wikimedia Commons)

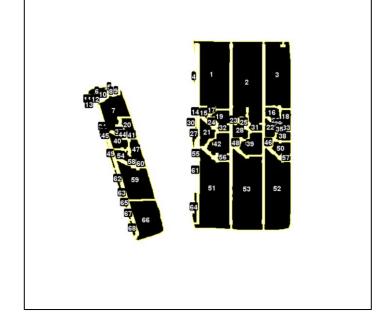


Conversion to 8-bit **Background Subtraction Contrast Enhancement** Thresholding **Fill Holes** Binary Erosion & Outlier Removal **Watershed**

Processed image: kitkat.jpg



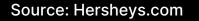


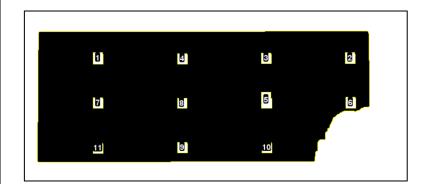


Conversion to 8-bit Background Subtraction Contrast Enhancement Thresholding **Fill Holes** Binary Erosion, <u>Despeckle</u> & **Outlier Removal Watershed**

Processed image: hersheys.jpg







Conversion to 8-bit
Background Subtraction
Contrast Enhancement
Thresholding
<u>Iterative</u> Binary <u>Closure</u> & Erosion
Counting & Labeling

Conclusion & Future Work

Improving the algorithm to perform same operations on all images with better accuracy.

- Wand (tracing) tool for auto-selecting required objects
- Implementing a uniform dark or bright background for all images
- Finding a better "Fill Holes" alternative (not Dilation)
- Further developing with MatLab

Further reading

https://saadudd.in/projects-

dir/Towards%20a%20Generalized%20Approach%20to%20Segmentation%20&%2 0Counting-report.pdf

Thank you.