

# Digital Image Processing Final Project

**Group 10**

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# Initial Images



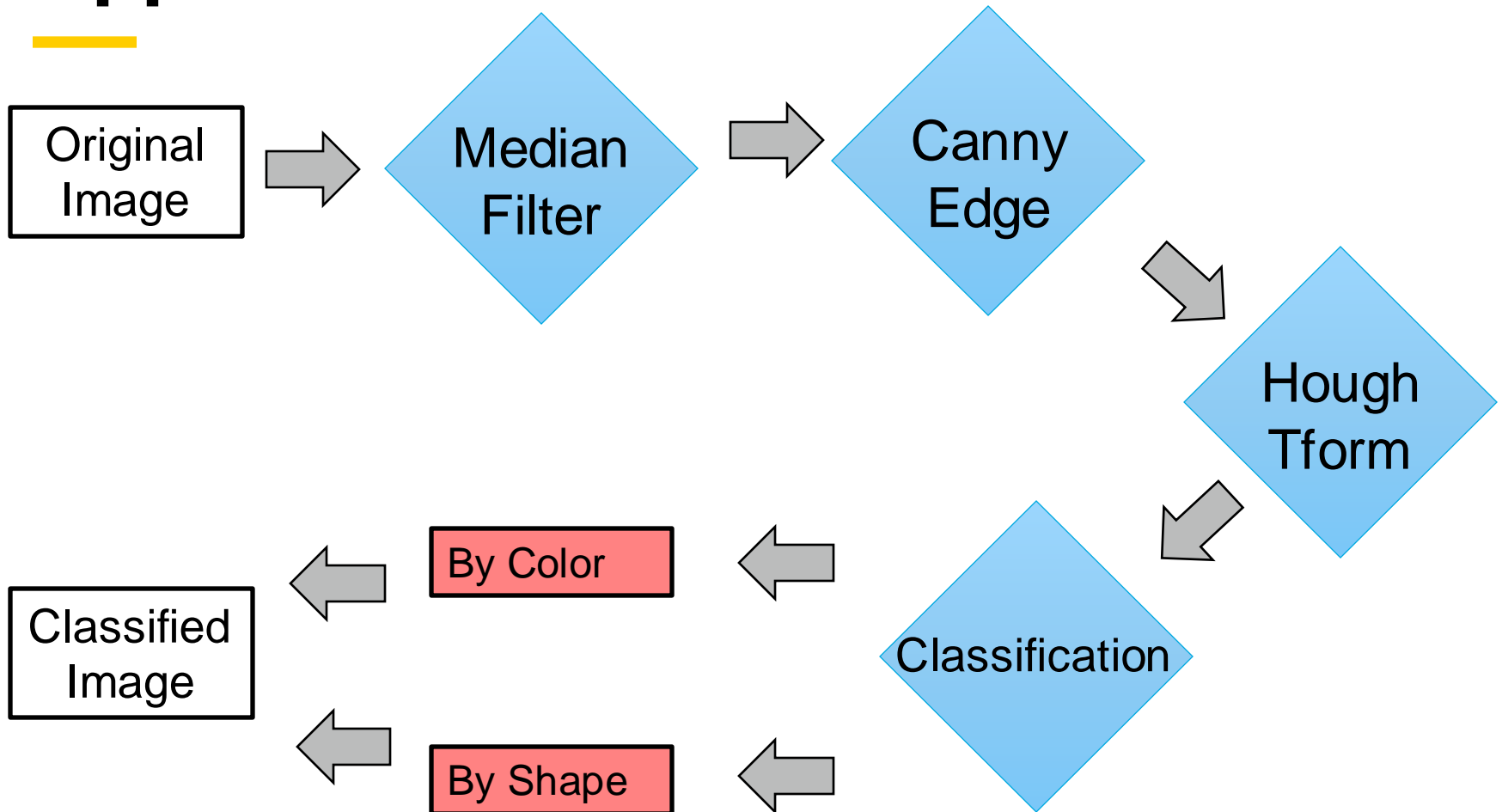
$M = 44 \text{ kg/kmol}$   
 $\text{m}^2/\text{s}^2 = \text{J/kg}$

2.  $\frac{dE_{cv}}{dt} = \dot{Q} - \dot{W} + \dot{m} \left( h_1 - h_2 + \frac{1}{2}(V_1^2 - V_2^2) + g(z_1 - z_2) \right)$   
 $0 = \dot{m} \left( h_1 - h_2 + \frac{1}{2}(V_1^2 - V_2^2) \right)$   
 $h_2 = h_1 + \frac{1}{2}(V_1^2 - V_2^2)$   
 $h_2 = 699.932 \text{ kJ/kg} + \frac{1}{2} \left( (60.853 \text{ m/s})^2 - (450 \text{ m/s})^2 \right) (0.001)$   
 $h_2 = 600.533 \text{ kJ/kg} = 423.468 \text{ kJ/kmol}$   
 $690 \text{ K} - 680 \text{ K} = 10 \text{ K}$   
 $26631 - 26613 = 26623 - 266138$   
 $T_2 = 685 \text{ K}$

3. Steam (superheated vapor)  
 $T_1 = 400^\circ\text{C}$   
 $P_1 = 800 \text{ kPa}$   
 $V_1 = 10 \text{ m/s}$   
 $A_1 = 800 \text{ cm}^2$   
 $\dot{Q} = -22.5 \text{ kW} = -22.5 \text{ kJ/s}$   
 $0 = \dot{Q} + \dot{m} \left( h_1 - h_2 + \frac{1}{2}(V_1^2 - V_2^2) \right)$   
 $-\dot{Q} = \dot{m} \left( h_1 - h_2 + \frac{1}{2}(V_1^2 - V_2^2) \right)$   
 $V_1 = \frac{RT_1}{P_1} = \frac{(0.4615 \text{ kJ/kg}\cdot\text{K})(673.15 \text{ K})}{800 \text{ kPa}} = 0.3883 \text{ m}^3/\text{kg}$   
 $R_{\text{steam}} = 0.461 \text{ kJ/kg}\cdot\text{K}$   
 $h_1 = 3267.7 \text{ kJ/kg}$   
 $400 - 300 = 375 - 300$   
 $3273.9 - 3067.1 = h_2 - 3067.1$   
 $h_2 = 3222.2 \text{ kJ/kg}$   
 $V_2 = \sqrt{\left( \frac{\dot{Q}}{\dot{m}} + h_1 - h_2 \right)^2 + V_1^2} = \sqrt{\left( \frac{-22.5 \text{ kJ/s}}{2.06 \text{ kg/s}} + 3267.7 \text{ kJ/kg} - 3222.2 \text{ kJ/kg} \right)^2 + (10 \text{ m/s})^2}$   
 $V_2 = 262.99 \text{ m/s}$   
 $V_2 = \frac{RT_2}{P_2} = \frac{(0.461 \text{ kJ/kg}\cdot\text{K})(648.15 \text{ K})}{400 \text{ kPa}} = 0.7478 \text{ m}^3/\text{kg}$   
 $\dot{m} V_2 = V_2 \dot{m} = 2.06 \text{ kg/s} (0.7478 \text{ m}^3/\text{kg}) = 1.541 \text{ m}^3/\text{s}$   
 $V_2 = 1.541 \text{ m}^3/\text{s}$

4. adiabatic diffuser Air enters steadily (steady flow)  
 $P_1 = 80 \text{ kPa}$   
 $T_1 = 127^\circ\text{C}$   
 $\dot{m} = 5400 \text{ kg/hr}$   
 $V_1 = 230 \text{ m/s}$   
 $P_2 = 100 \text{ kPa}$   
 $V_2 = 30 \text{ m/s}$   
 $R = 0.287 \text{ kPa}\cdot\text{m}^3/\text{kg}\cdot\text{K}$

# Approach Overview



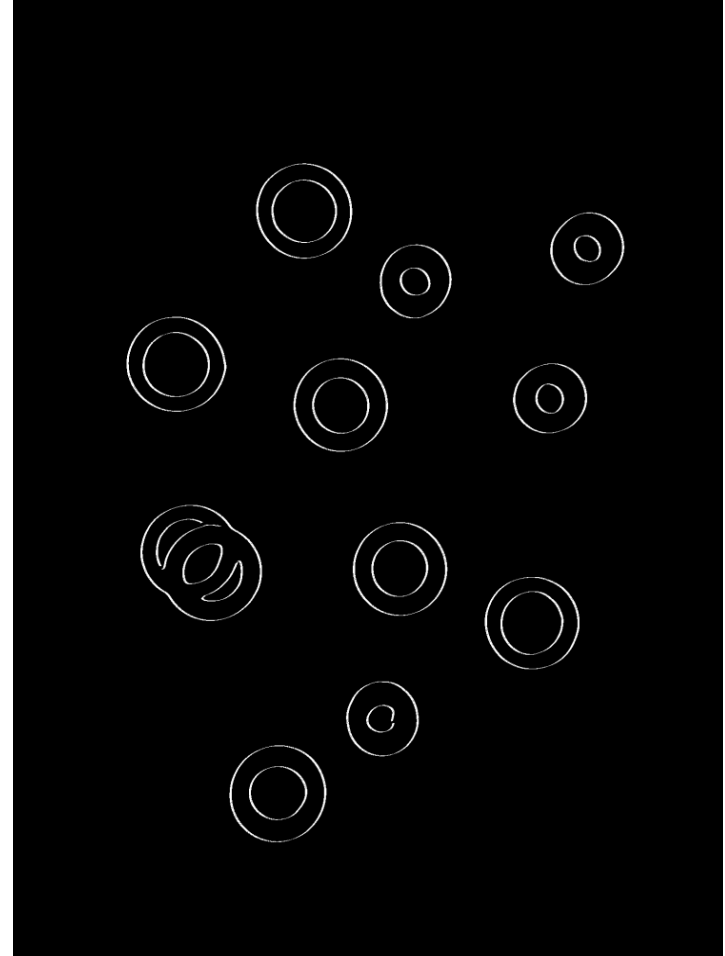
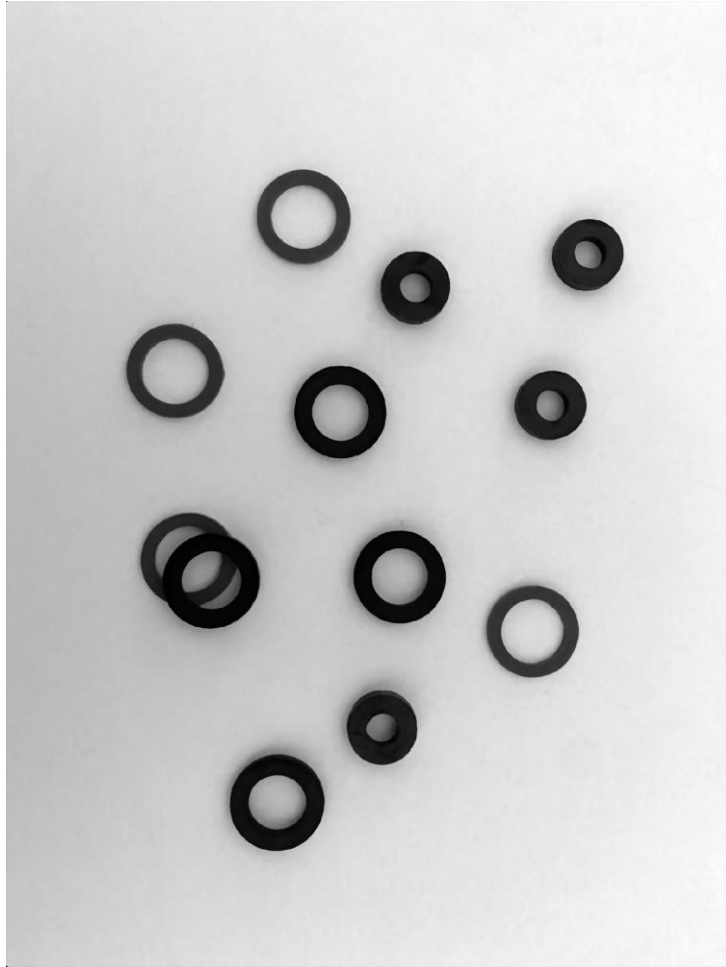
# Median Filtering

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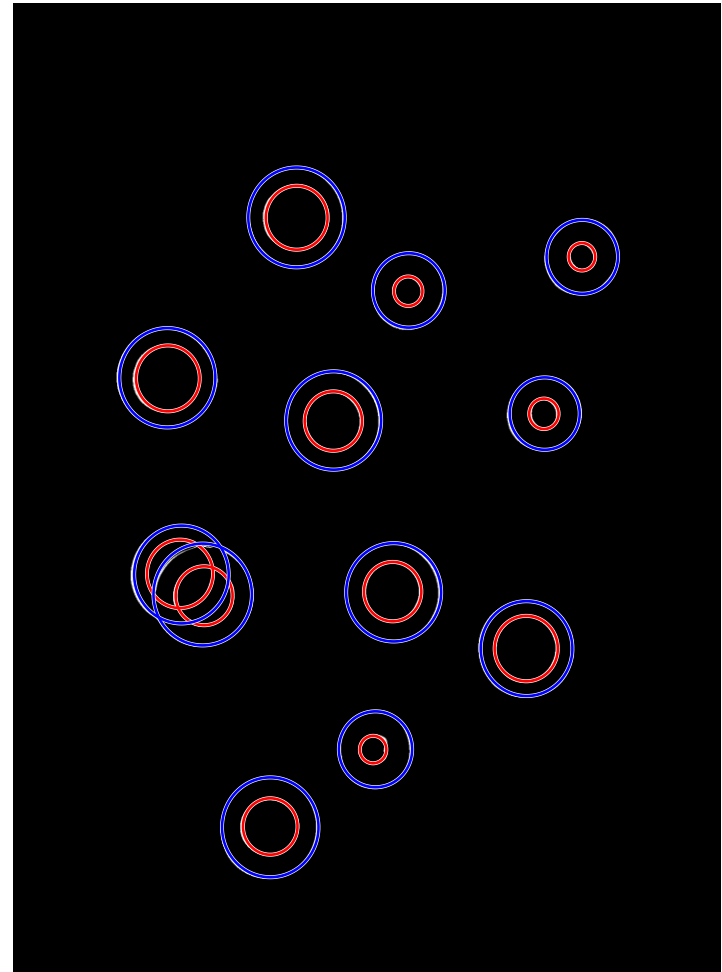
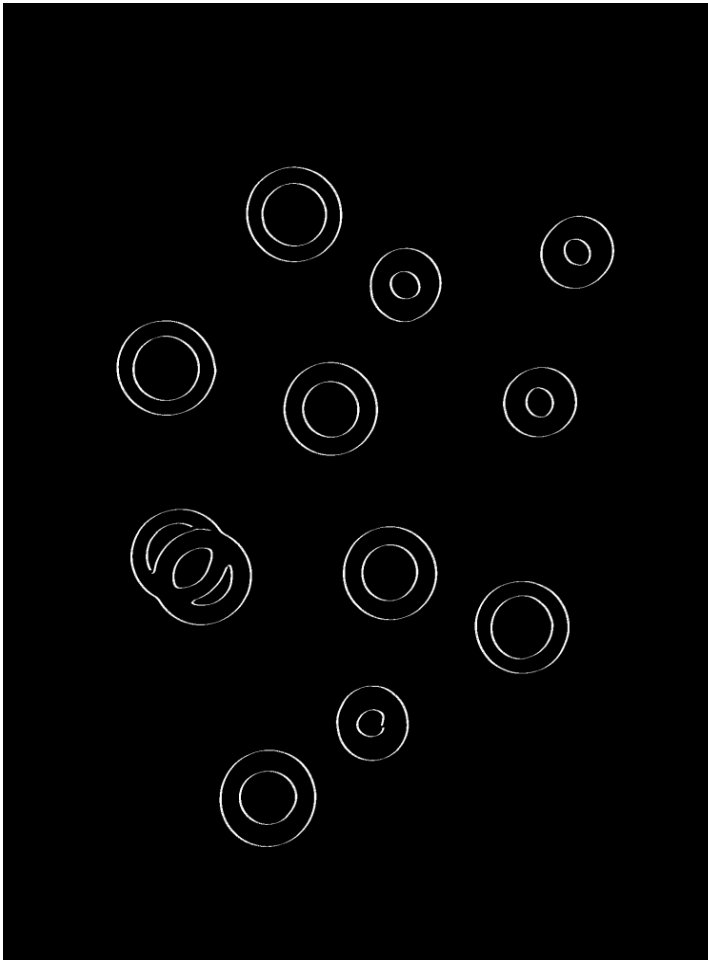
# Canny Edge Detection

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# Circular Hough Transform

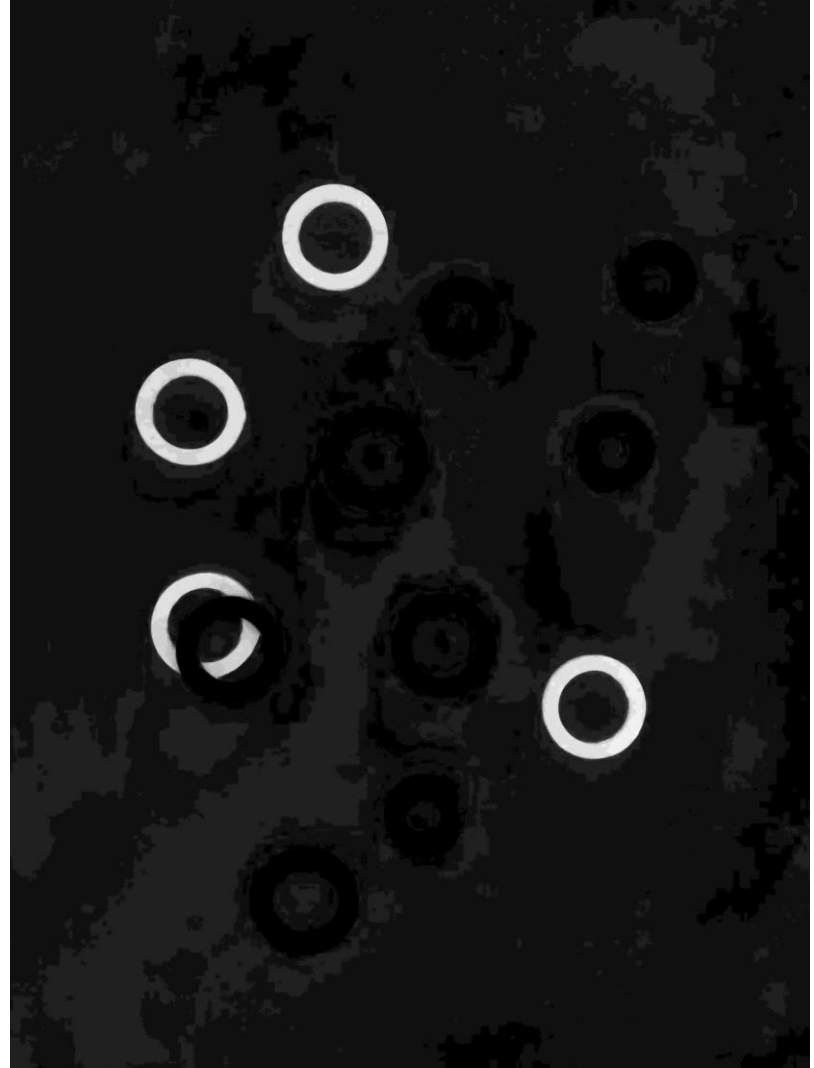
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# Color Classification

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- Only kept Red & Blue Channels
- Provided maximum color contrast

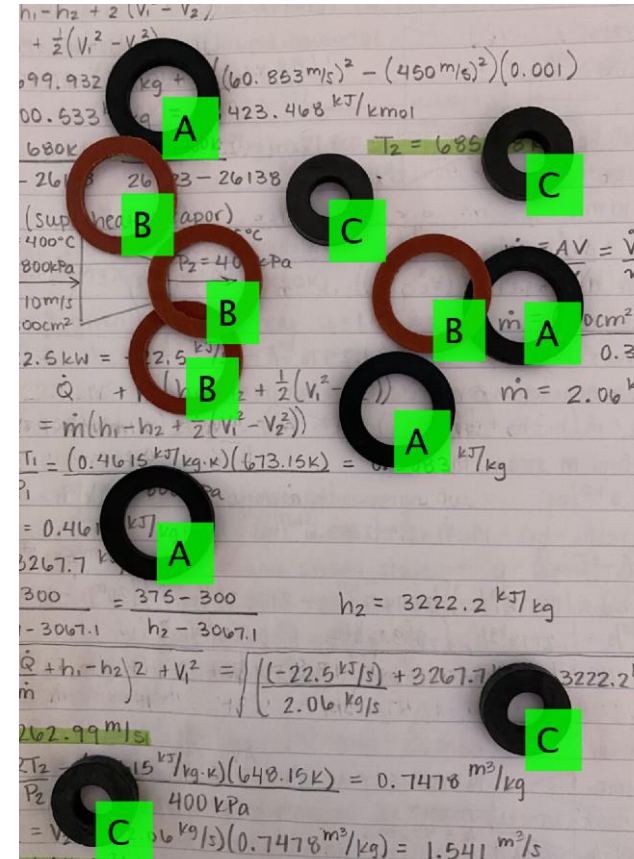
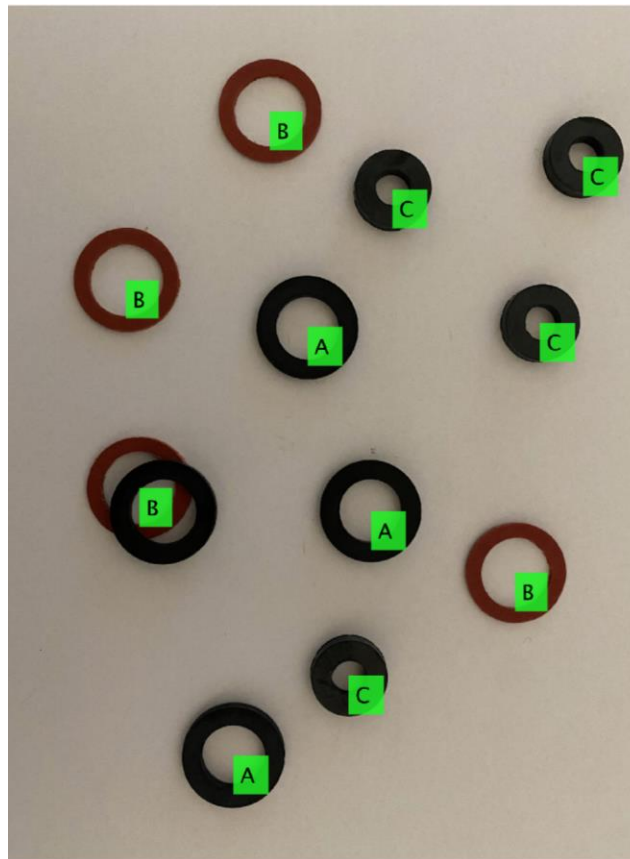
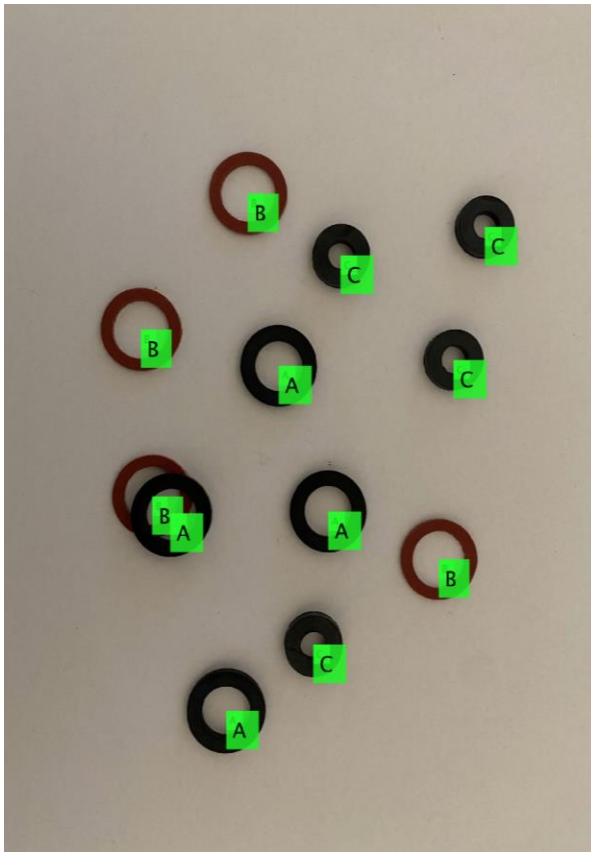




# Results

- 93% accurate across all images

		Type		
		A	B	C
Classification	A	21	0	2
	B	0	24	0
	C	2	0	22
None		1	0	0





# Conclusions

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- Performance: works 97.2% for solid background.
- Issues encountered:
  - Generalization of the algorithm
  - Difficulty to locate the pixels in washer annulus in challenging background.
  - High contrast dependent
- Insights: overall contrast and background scales influence object segmentation.

**IOWA**

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**Thank You!**