1 Methodology

In this section we describe the techniques we considered and brainstormed during the project and those that are implemented.

Task	Subtask	Techniques	Implmentation
Image Processing	Background Model	Finding median for each pixel and each channel	✓
		Finding median of neighbourhood for each pixel and each channel	✓
		Probabilistic Modeling of background	
	Thresholding	Finding minimum of bimodal distribution	✓
		Otsu's method for thresholding	
		Using Gradient magnitude of image	
Feature Extraction	Global Descriptors	• Area • Perimeter • Compactness • Rectangularity • Elongation	✓
	Moments	• Hu's Invariant moments (7 features) • Complex moments (6 features)	✓
Classification	-	Multivarate Gaussian Model	✓
		Linear Discriminant	

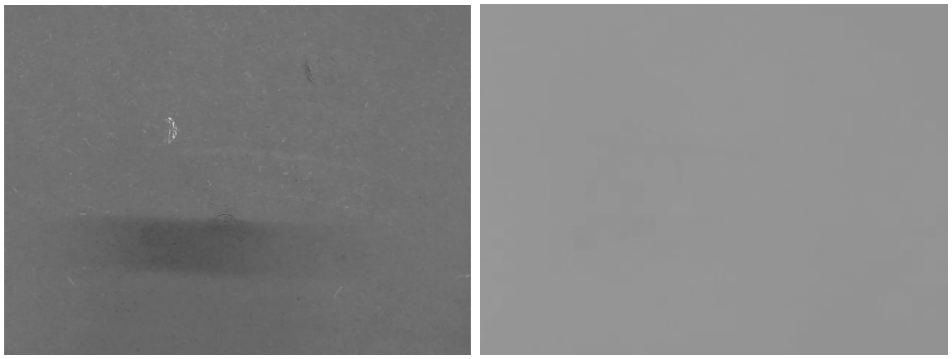
Background Modelling

In this coursework, since a background image is not readily available, we have to model it. Noting that images varies in illumination, we have to make the images comparable by normalising it first, using the following formula.

$$P_{r,c}(R', G', B') = (\frac{R}{\sqrt{(R^2 + G^2 + B^2)}}, \frac{G}{\sqrt{(R^2 + G^2 + B^2)}}, \frac{B}{\sqrt{(R^2 + G^2 + B^2)}})$$

With objects scattered around randomly in the images, we find the median of all image pixels for each channel separately in order to reconstruct the background.

The outcome of the background with and without normalisation is shown in Figure 1.



(a) Background model without normalisation

(b) Background model after normalisation

Figure 1: Background model generated from all 14 images

The sample images with their background removed is shown in **??**. It is evident that the background removal process removed the background - making the images appearing black. However, it also inevitably reduce the intensity for the bottom half of each images, such that the objects are no longer salient to our eyes. This is because the background we modelled have a lower intensity at the bottom, possibly due to presence of shadow in all 14 images.

Nevertheless, the historgram is still bimodal, which is essential for thresholding to be effective.

Segmentation

1.1 Classification