4 Results

4.1 Listing of Candidate Algorithms

Because I analyzed a large number of research papers, I figured it would be wise to sort out the best algorithms and only go into detail on those. I prepared a list of criteria and went through all of the papers to see which ones they covered, which ones they improved upon, and which ones they did not include. This list is represented in *Table 3* . A black dot indicates that the feature is used, and a black diamond indicates that the researchers made changes or improvements to it.

Candidate	Preprocessing						Extraction			Classification	
	Grayscale Conversion	ROI Definition	Noise Reduction	Sobel Operator	Canny Edge Detection	Thresholding	Hough Transform	Radon Transform	Clustering	Unsupervised	Supervised
Hajjouji et al. [4]	•	•				•	✦			•	
Wu et al. [62]	•		•		•		•		•		•
Malmir et al. [9]	•	•	•		•		•		•	•	
Gao et al. [63]	•	•			•		•			•	
Tumasov et al. [10]	•					•	•		•	•	
Shang et al. [53]	•					•	•	✦		•	
Gupta et al. [38]	•						•		✦		•
Li et al. [64]	•	•			•		•			•	

• = uses technology ✦ = improved variant

Table 3: Observations of techniques used in research papers

Based on the findings in *Table 3* I have made the following conclusions:

- Grayscale Conversion and Thresholding are widely used
- Edge Detection is often used; Sobel and the derived Canny algorithm are both popular
- The Hough transform is widely used, with various improved methods having been suggested
- Clustering of Hough results is sometimes used, with DBSCAN or k-means clustering

I decided not to go with a supervised approach because this is always done in conjuncture with machine learning. Unsupervised approaches are better suited for cheap end user products because they require less computing resources to function.