

Senior Project – Computer Engineering – 2020

Automated Recycling System Using Computer Vision

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INTRODUCTION:

- 5 massive garbage patches: Great Pacific Garbage Patch – nearly twice the size of Texas
- Harms and kills over 300,000 sea animals every year



- Minimize / reduce waste and pollution
- Allows users to throw away trash without thinking about how to recycle it properly

DESIGN REQUIREMENTS:

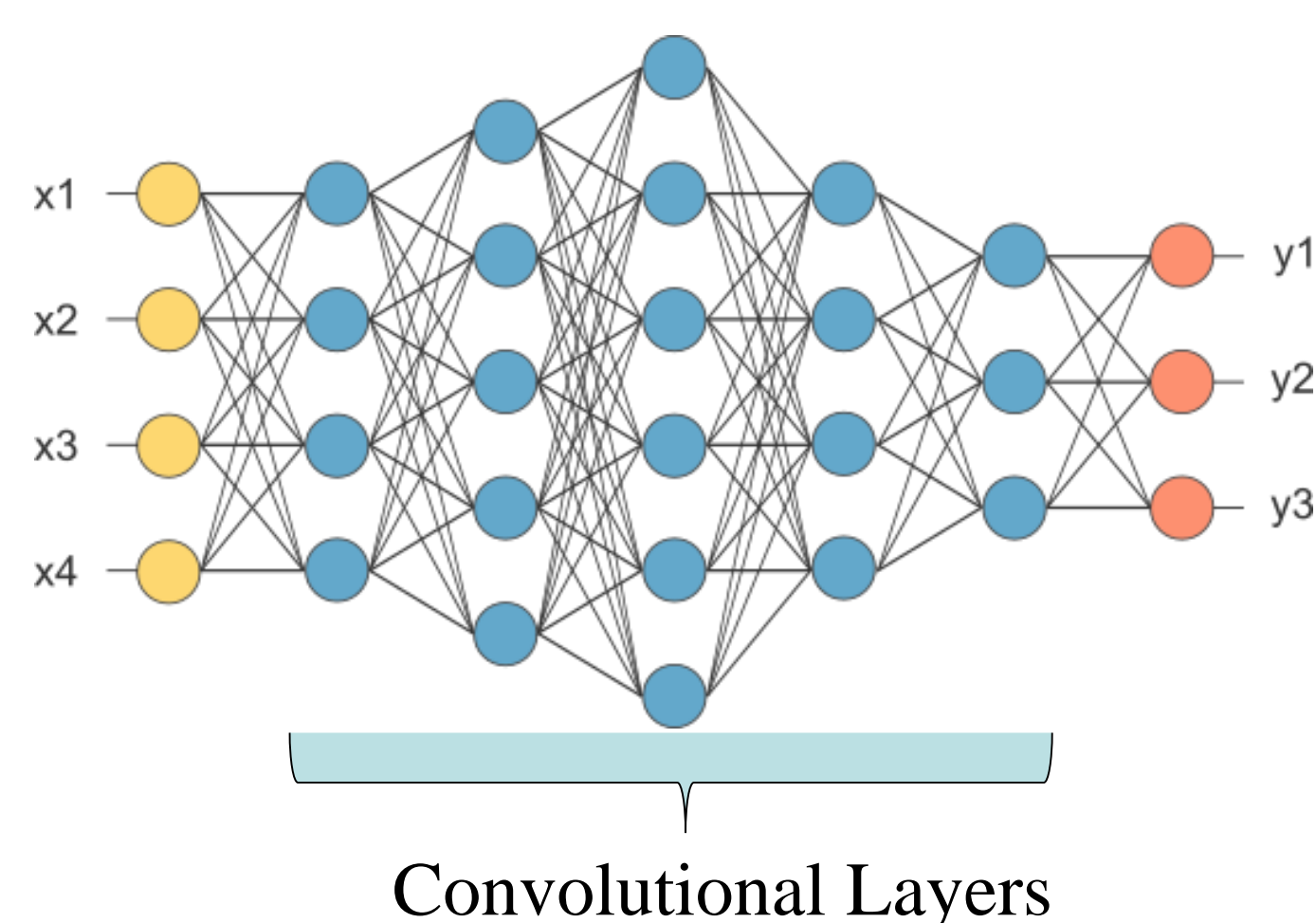
- Classify an object in 1 of 4 classifications in less than 1 second
- Success rate of at least 85% or higher



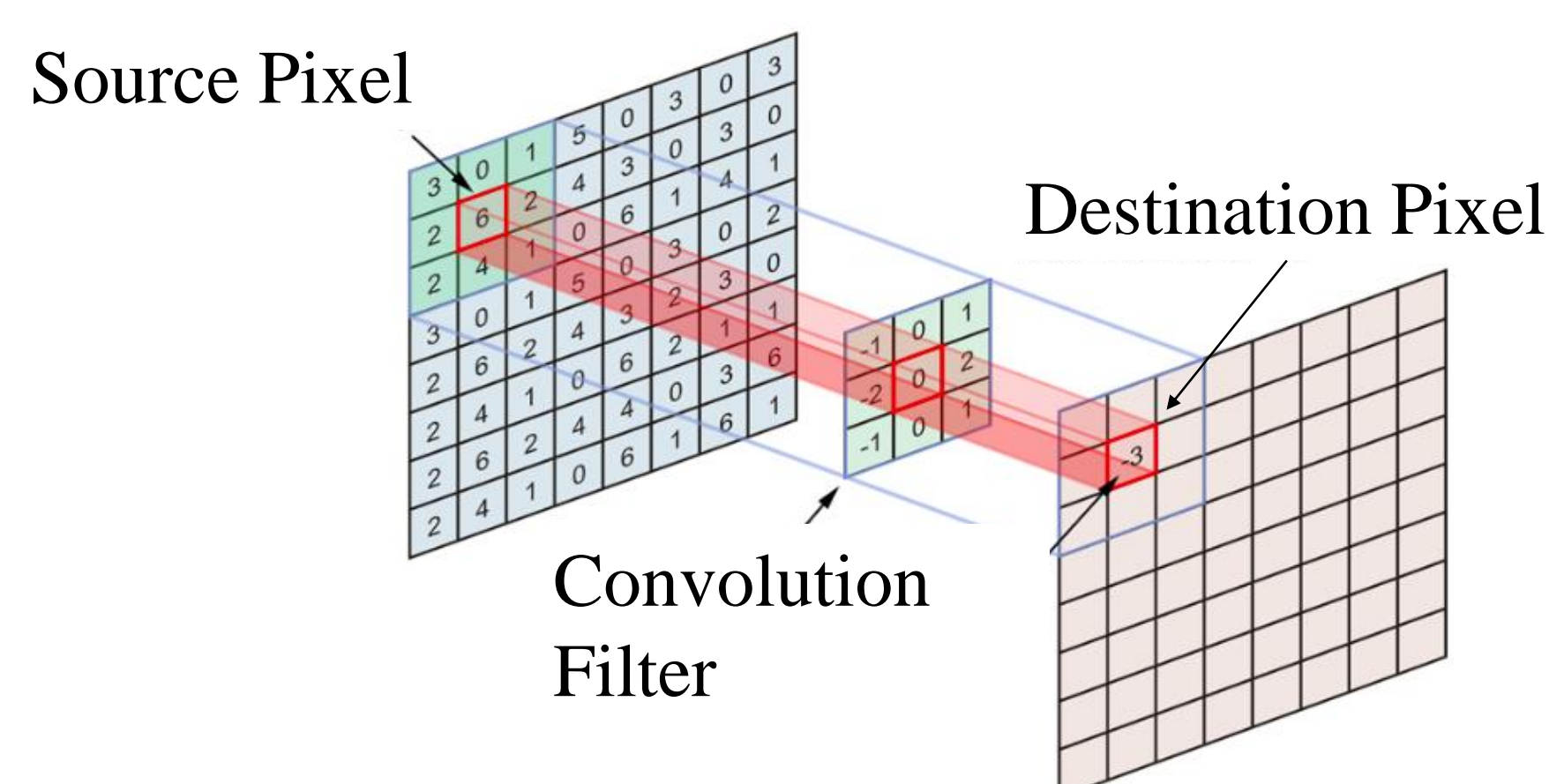
Plastic Paper Glass Metal

METHOD:

- Other methods explored: KNN (K-Nearest Neighbors) and SIFT (Scale-Invariant Feature Transform)
- Why Neural Networks? – Current state-of-the-art technology for image classification (highest success rates)
- Neural Networks:



- Convolutional Layers (Filters):
 - Pattern Detectors – Edges, shapes, textures, colors...



DESIGN:

- Resnet34: Pre-trained CNN
 - Already learned some visual features
 - Usually outperforms non-pretrained CNNs
 - 34 Layers
- Thung's Dataset
 - Total: 2527 Images – Initially 6 classifications: glass, plastic, paper, metal, cardboard and trash
 - Modified: 1987 Images - Training (~75%), Validation (~12.5%), Test (~12.5%)

Thung's Dataset → Resnet34

- Google Colab – Jupyter notebook on google's cloud
 - Provides a dedicated graphics card (GPU)
 - Allows for easy-access to code
- 50 epochs in total – 45 seconds each

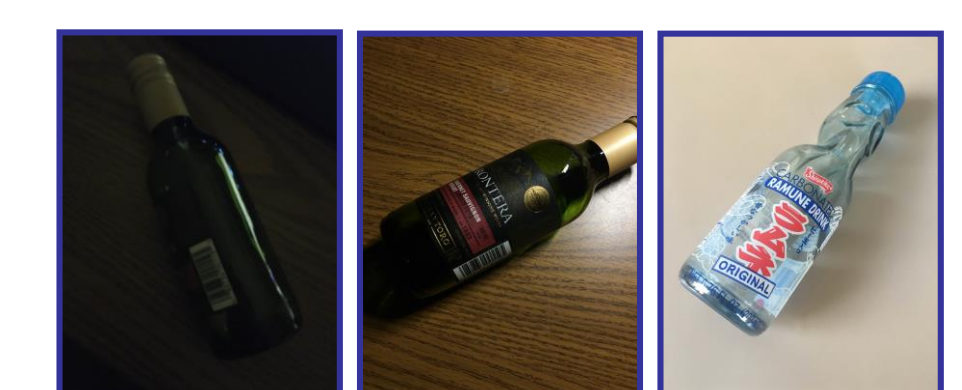
RESULTS:

- Thung's Test Dataset - Success Rate: 86.7%
- "Real" Test Dataset - Success Rate: 68%
- Confusion Matrix – Used to describe the performance of the classifier on test datasets where true values are known

Thung's Test Dataset					"Real" Test Dataset						
Actual	Glass	58	1	0	4	Actual	Metal	11	6	2	0
	Metal	1	48	0	2		Paper	0	14	0	0
	Paper	0	0	73	2		Plastic	0	1	19	0
	Plastic	2	7	14	37		Glass	4	2	7	2
		Glass	Metal	Paper	Plastic			Metal	Paper	Plastic	Glass
		Predicted						Predicted			



Thung's Glass Dataset



"Real" Glass Dataset

CONCLUSIONS:

- Generally, the more photos in the training set, the higher the success rates are.

FUTURE WORK:

- Increase the variation in the test photos to make the system more robust
- Incorporate this model into a physical trashcan
- Add an additional "other" category – outside of the 4 classifications that were defined in my senior project