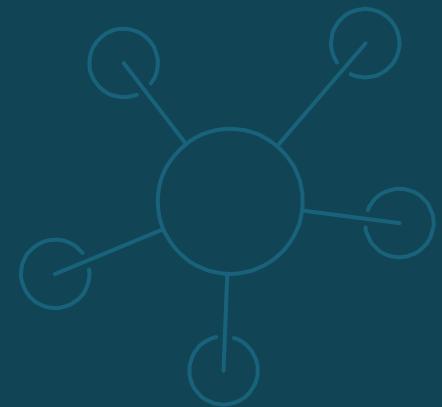




Money Recognition

ITCS 4152/5152 Group 13





Meet the team!

Robert Wilk

Data Collection, Research, Model Training

Fausto German Jimenez

Data Collection, Research, Model Creation, Model Training

Benjamin Gambill

Data Collection, Research, Model Creation

Joshua Wygal

Data Collection, Research, Real-time Detection

Soji Ademiluyi (had to drop the class due to health issues)

Data Collection, Research

1

Problem and Motivation

Why money recognition?



Problem and Motivation

Problem

Create a model that can recognize U.S. Currency and give a value of the currency detected.

Motivation

This model can be beneficial to banks and people with special needs. The model can serve as a physical currency calculator. In future work, it could be extended to work as a counterfeit currency detector.

2

The Dataset



The Dataset

- Each team member collected an average of 213 images, plus 106 images from Soji, for a total of 957 images.
- The currencies in each picture were then labeled accordingly using CVAT, and an XML (Pascal VOC 1.0) file was exported for each one of the pictures.
- 11 labels: Penny, Nickel, Dime, Quarter, OneBill, TwoBill, FiveBill, TenBill, and TwentyBill, FiftyBill, and HundredBill
- All of the images were aggregate then split into training and testing sets of 765 and 192 images respectively (80/20 split).



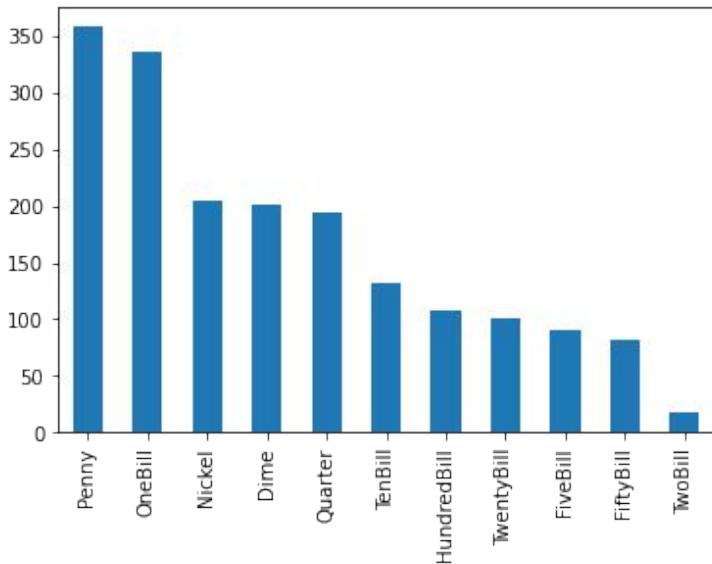
Sample Images: Version 1



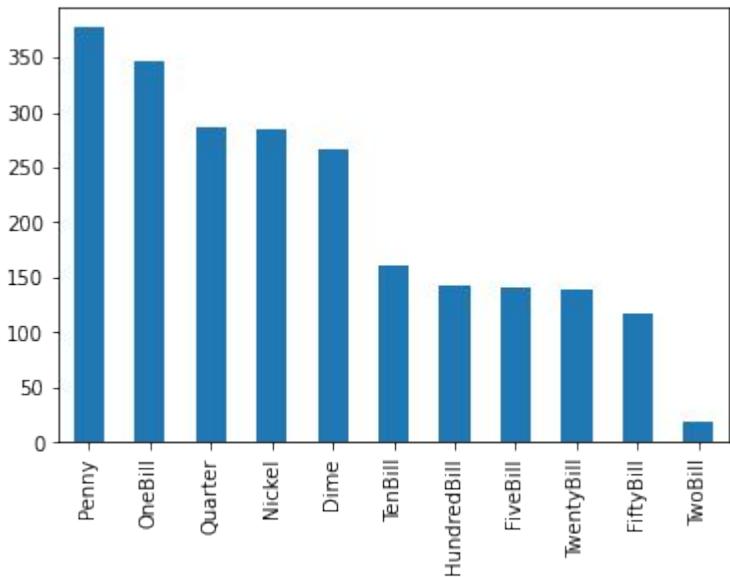


Label Distribution

Original Distribution



After Collecting More Data





Sample Images: Version 2





Data Augmentation

- Random Scaling
- Random RGB to Grayscale
- Random Brightness Adjustment
- Random Contrast Adjustment

```
# Data Augmentation Options
pipeline_config.train_config.data_augmentation_options[0].random_image_scale.min_scale_ratio = 0.9
pipeline_config.train_config.data_augmentation_options[0].random_image_scale.max_scale_ratio = 2.2
pipeline_config.train_config.data_augmentation_options[0].random_rgb_to_gray.probability = 0.5
pipeline_config.train_config.data_augmentation_options[0].random_adjust_brightness.max_delta = 0.2
pipeline_config.train_config.data_augmentation_options[0].random_adjust_contrast.min_delta = 0.7
pipeline_config.train_config.data_augmentation_options[0].random_adjust_contrast.max_delta = 0.7
```

3

Methodology

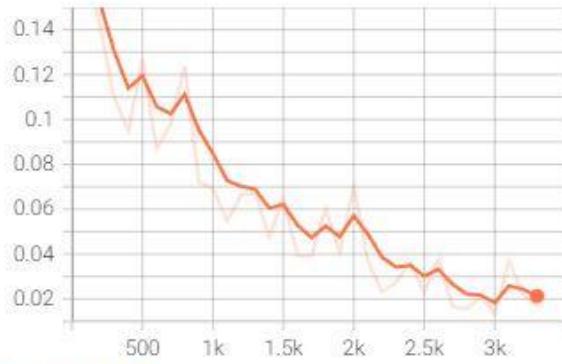


Methodology

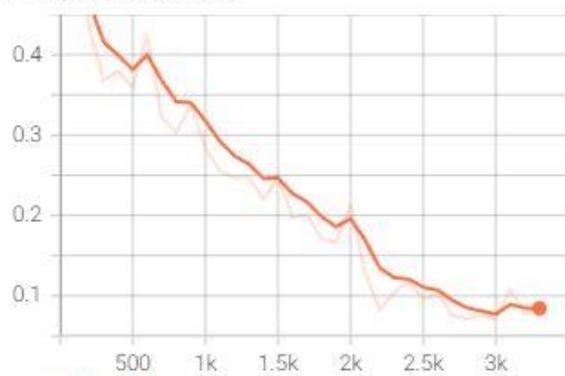
- We used transfer learning with the pretrained model ssd_mobilenet_v2_fpnlite_640x640_coco17_tpu-8
- We had tried 6 other pretrained models but none of them were able to achieve better results than this one
- This pretrained model uses weighted sigmoid focal cross entropy loss for classification, weighted smooth L1 loss for localization, and uses convolutional layers
- Our model was headless(only used the pretrained model)
- Used a batch size of 10 for training
- 5000 training steps

Loss During Training

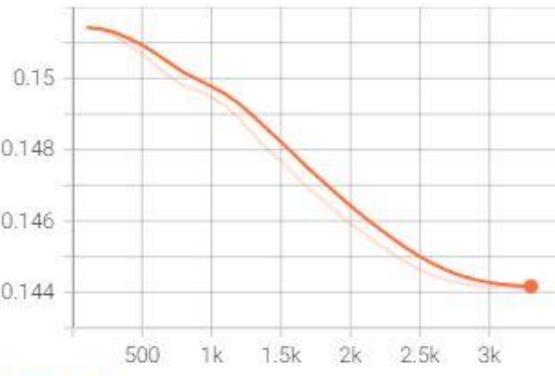
Loss/localization_loss
tag: Loss/localization_loss



Loss/classification_loss
tag: Loss/classification_loss



Loss/regularization_loss
tag: Loss/regularization_loss



Name	Smoothed	Value	Step	Time
train	0.02133	0.01675	3.3k	Thu Apr 21

Name	Smoothed	Value	Step	Time
train	0.08437	0.08388	3.3k	Thu Apr 21

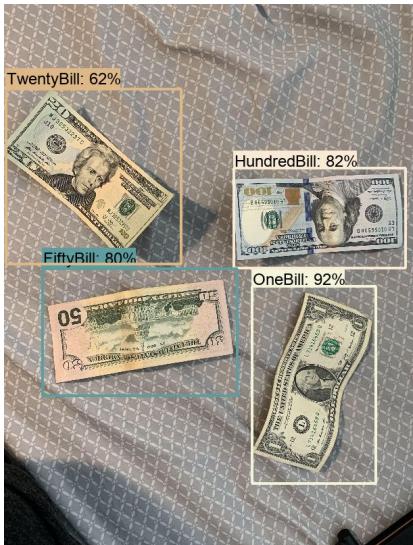
Name	Smoothed	Value	Step	Time
train	0.1442	0.1441	3.3k	Thu Apr 21

4

Results & Demo

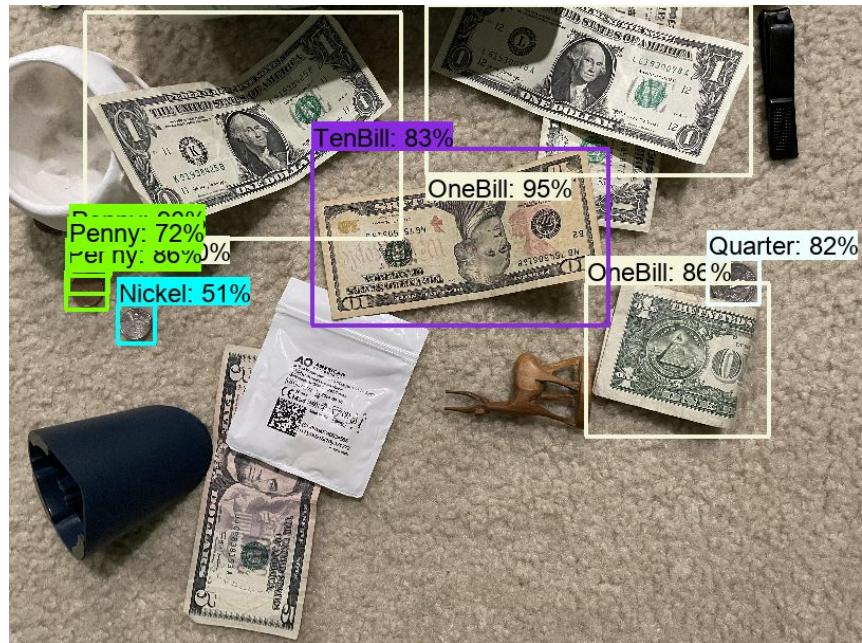


Currency Detection





Side-by-Side Comparison





Results and Interesting Observations

- Average precision of 0.74 at 75% IoU
- Average recall of 0.80 at IoU between 50% and 95%
- Some things that we've noticed is that the model confuses rare coins as other types of coins. For example, the rare nickels in our dataset are being detected as dimes when on the tails side but detected as quarters when on the heads side.
- When currency is somewhat covered, unseen, or overlapping with other currency, the model will sometimes not recognize some bills or coins or may detect more currency than actually exists.

5

Conclusion



Conclusion

- We were able to create a model which could locate and classify U.S. currency in images
- Slight improvements to localization accuracy can be made by fixing some small labeling mistakes in a couple of the images in our dataset
- Classification accuracy improvements are possible if we add more images to our dataset that show the currency in greater detail and in better lighting
- Additionally, we need more images with our rare coins and bills so that the model can classify those more accurately

THANKS!

Any questions?