Image Analysis

Identifying trash from recycling material

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Outline

- Problem definition
- Data
- Method
- Results
- Further considerations

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Problem definition

- Major part of sorting is being made by hands
- Multiple workers needed to do the job
- The full process of recycling is expensive

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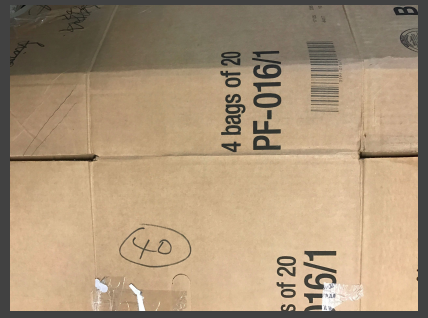
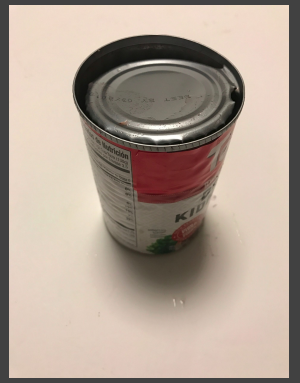
Data

- 2527 images in 6 categories
- 501 images of glass, 594 paper, 403 cardboard, 482 plastic, 410 metal, 137 trash
- Divided 80/20 for every categories





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Method

- Building a basic CNN --> poor result (~20% accuracy)
- Using data augmentation --> poor result (~20% accuracy)
- Adding dropout layers --> poor result (~20% accuracy)
- Using support vector machines -->

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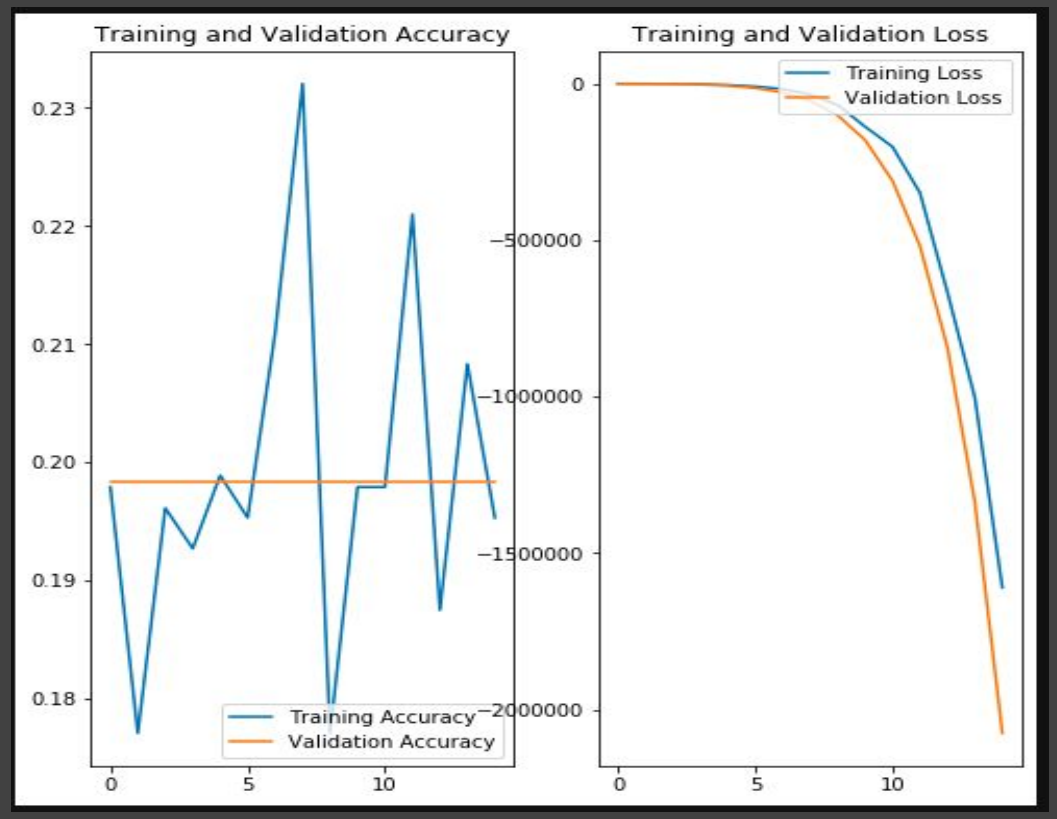
Model - CNN

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_6 (Conv2D)            (None, 300, 300, 32)      896
_________________________________________________________________
max_pooling2d_6 (MaxPooling2 (None, 150, 150, 32)      0
_________________________________________________________________
conv2d_7 (Conv2D)            (None, 150, 150, 64)      18496
_________________________________________________________________
max_pooling2d_7 (MaxPooling2 (None, 75, 75, 64)        0
_________________________________________________________________
conv2d_8 (Conv2D)            (None, 75, 75, 32)        18464
_________________________________________________________________
max_pooling2d_8 (MaxPooling2 (None, 37, 37, 32)        0
_________________________________________________________________
flatten_2 (Flatten)          (None, 43808)             0
_________________________________________________________________
dense_4 (Dense)              (None, 64)                2803776
_________________________________________________________________
dropout (Dropout)            (None, 64)                0
_________________________________________________________________
dense_5 (Dense)              (None, 32)                2080
_________________________________________________________________
dropout_1 (Dropout)          (None, 32)                0
_________________________________________________________________
dense_6 (Dense)              (None, 6)                 198
=================================================================
Total params: 2,843,910
Trainable params: 2,843,910
Non-trainable params: 0
_________________________________________________________________
```




```
Epoch 15/15
3/3 [==============================] - 194s 65s/step - loss: -1610452.2083 - accuracy: 0.1953 - val_loss: -2075525.6562 - val_accuracy: 0.1984
```

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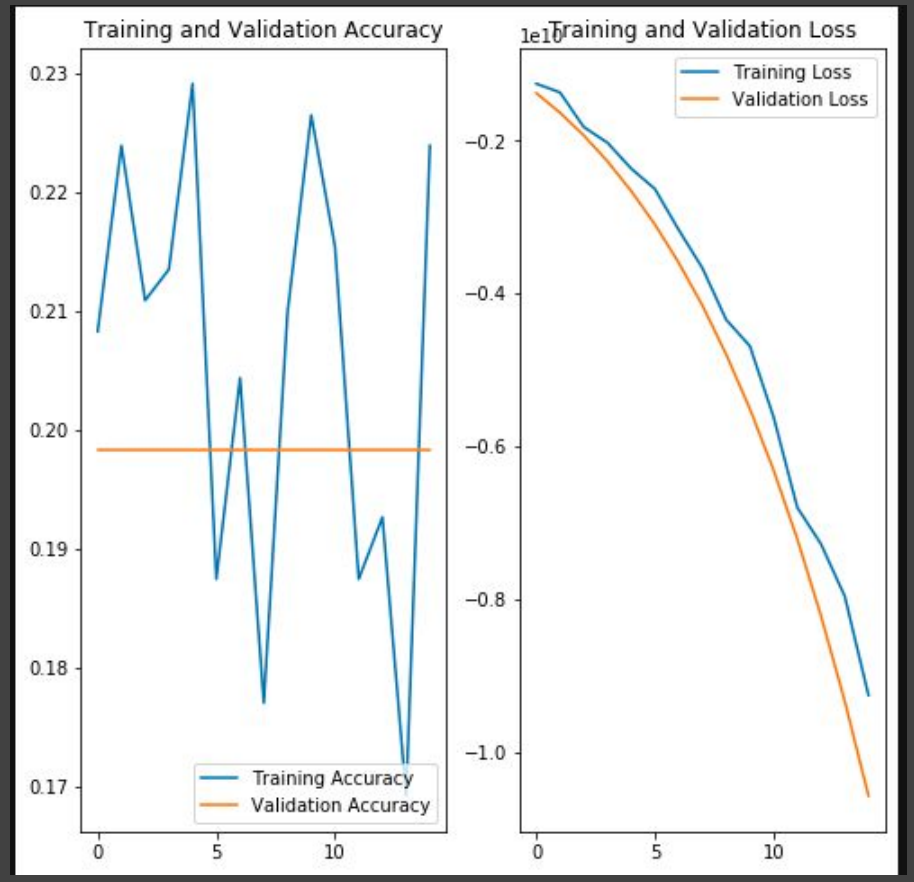
Model - CNN + Data Augmentation




```
Epoch 15/15
3/3 [==============================] - 11s 4s/step - loss: -196010832.0000 - accuracy: 0.2109 - val_loss: -234589268.0000 - val_accuracy: 0.1988
```

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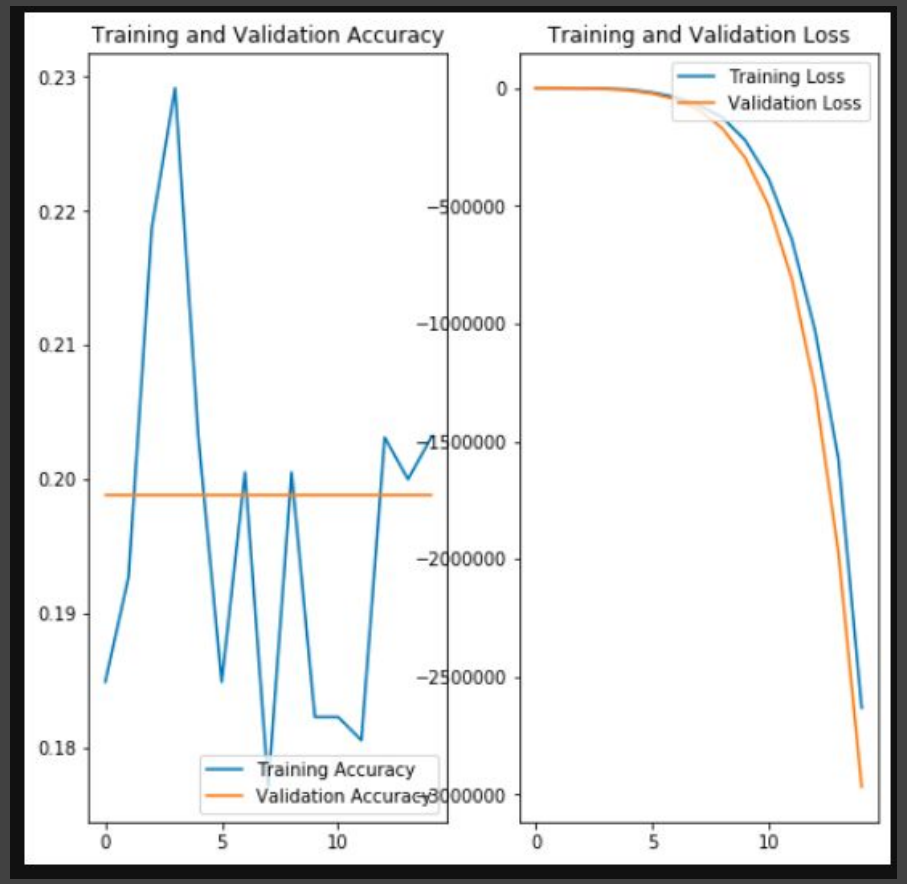
Model - CNN + Dropout layers

Layer (type)	Output Shape	Param #
conv2d_3 (Conv2D)	(None, 150, 150, 16)	448
max_pooling2d_3 (MaxPooling2	(None, 75, 75, 16)	0
dropout (Dropout)	(None, 75, 75, 16)	0
conv2d_4 (Conv2D)	(None, 75, 75, 32)	4640
max_pooling2d_4 (MaxPooling2	(None, 37, 37, 32)	0
conv2d_5 (Conv2D)	(None, 37, 37, 64)	18496
max_pooling2d_5 (MaxPooling2	(None, 18, 18, 64)	0
dropout_1 (Dropout)	(None, 18, 18, 64)	0
flatten_1 (Flatten)	(None, 20736)	0
dense_2 (Dense)	(None, 512)	10617344
dense_3 (Dense)	(None, 1)	513

Total params: 10,641,441
Trainable params: 10,641,441
Non-trainable params: 0



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```
Epoch 15/15
3/3 [==============================] - 13s 4s/step - loss: -2631505.6667 - accuracy: 0.2031 - val_loss: -2966849.1875 - val_accuracy: 0.1988
```

Further considerations

- Data augmentation did not improve -> need more different images, use colors
- CNN model did not have good accuracy -> try another architecture, use another method (i.e.: support vector machines), change hyperparameters
- Experiments took time and crashed often -> use GPU, more hardware resources, a different optimizer

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Conclusion

- Detecting trash from recycling material is an environmentally good problem that needs further analysis
- It is a project that need further ressources
- Images gathering is important and CNN might not always be the best choice for computer vision

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Q&A

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Thank You!