

Material Identification

Image Classification

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Project objective

To develop a **Convolutional Neural Network** that can properly identify material types for warehouse and scrap material handling at Madjek Inc.

Project objective



Reduce time in material
handling processing

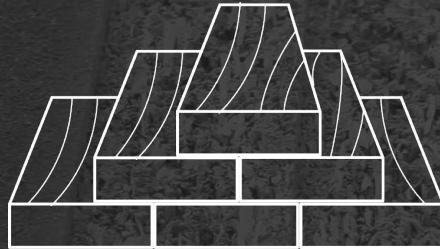


Reduce human error in
material handling

Project objective



Receiving Material
from suppliers

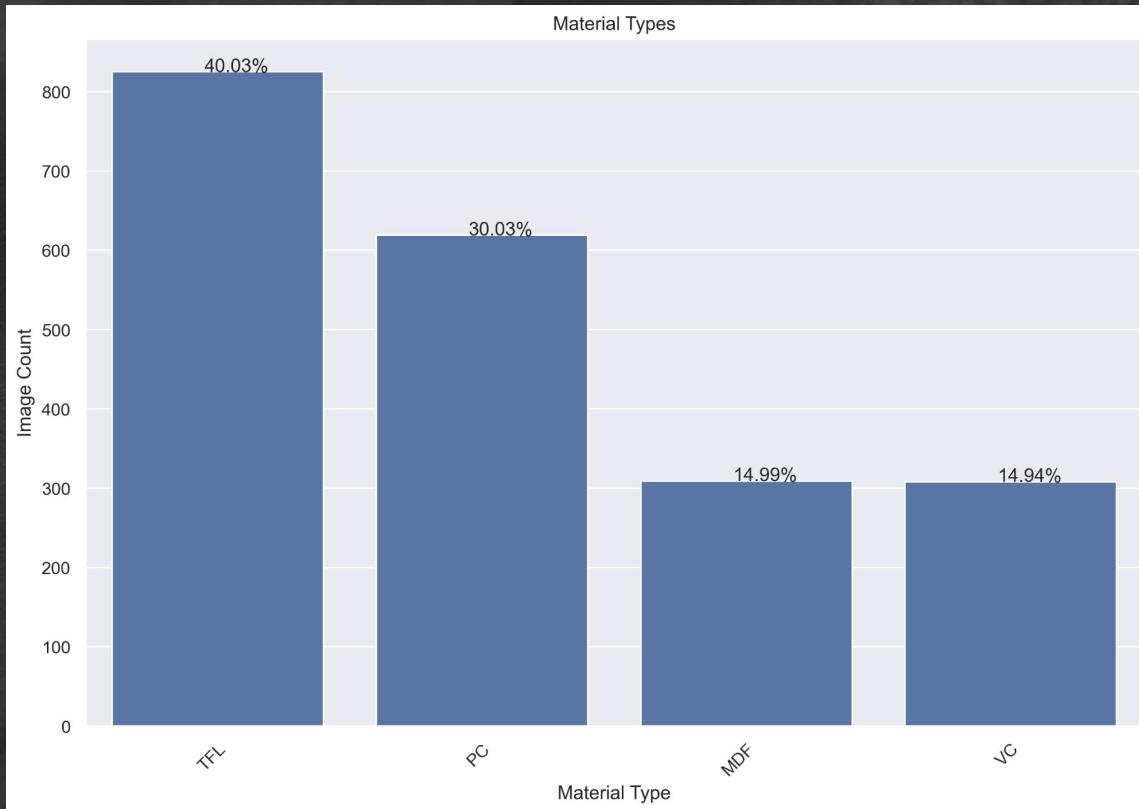


Storing Scrap
in racks



Quality Control
check at machines

Data



- 2064 images in total, divided into 4 classes
- TFL and PC are the most common images as they are the most common materials used in the factory

Data Collection

- Images taken from a variety of viewpoints in varied lighting conditions
- Human identified class of material centered in each image



Data Collection - Cropped

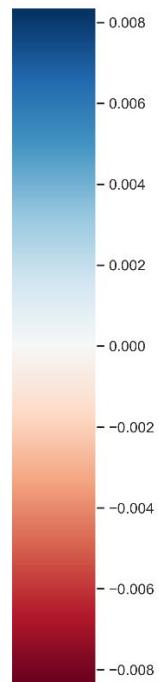
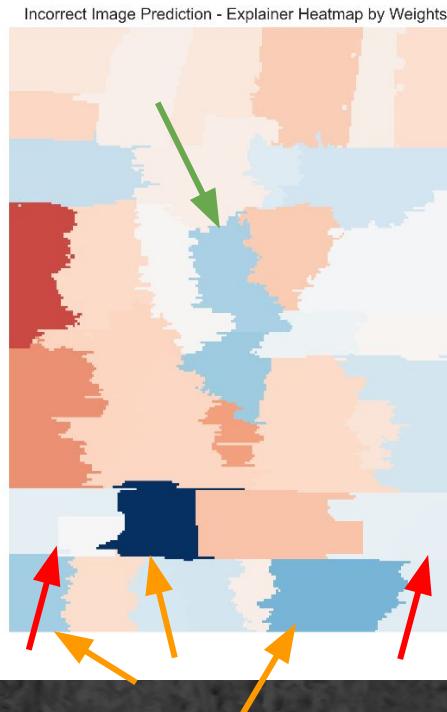
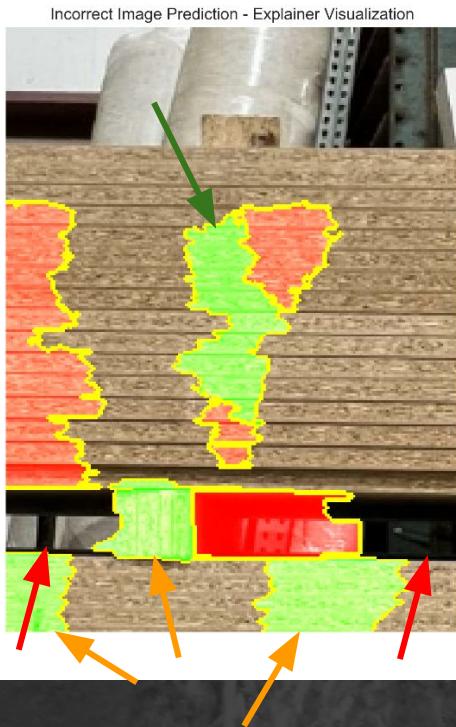
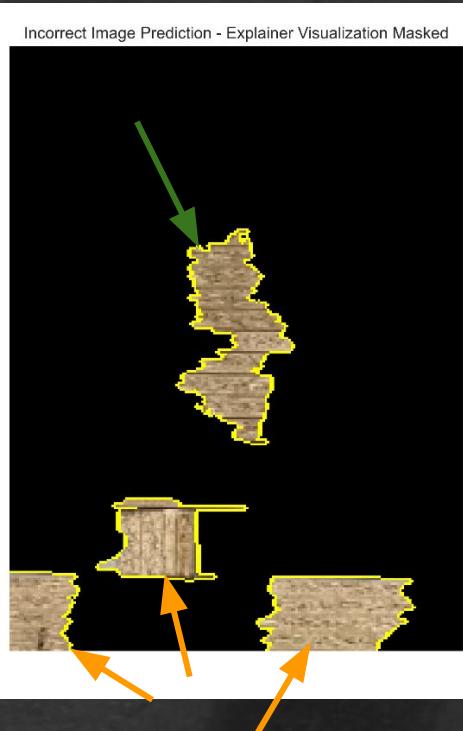
- Images taken from a variety of viewpoints in varied lighting conditions
- Human identified class of material centered in each image



Data

True label: PC

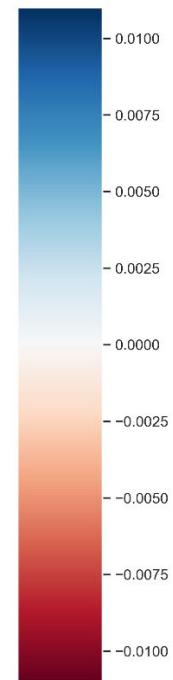
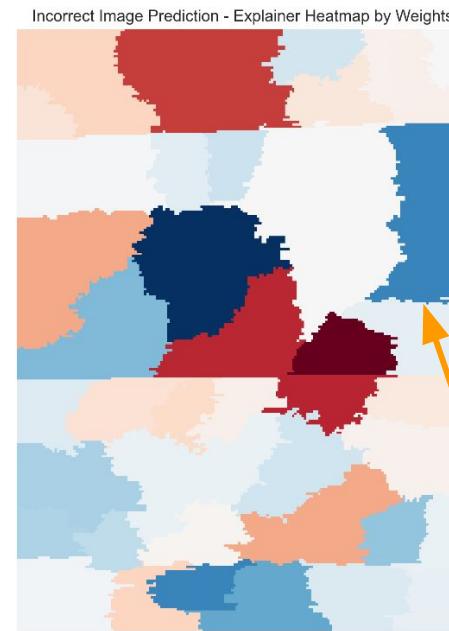
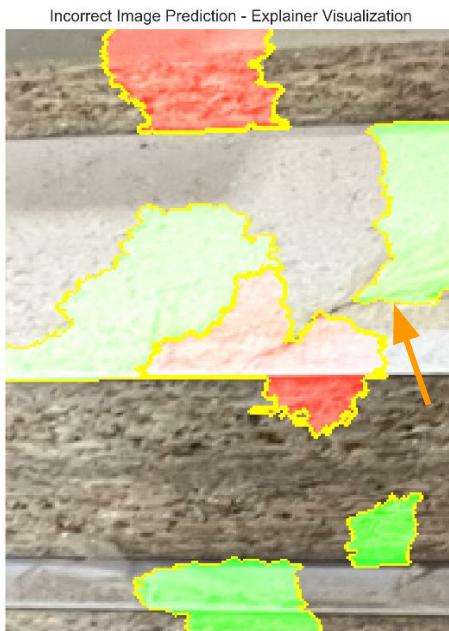
Predicted label: TFL



Data

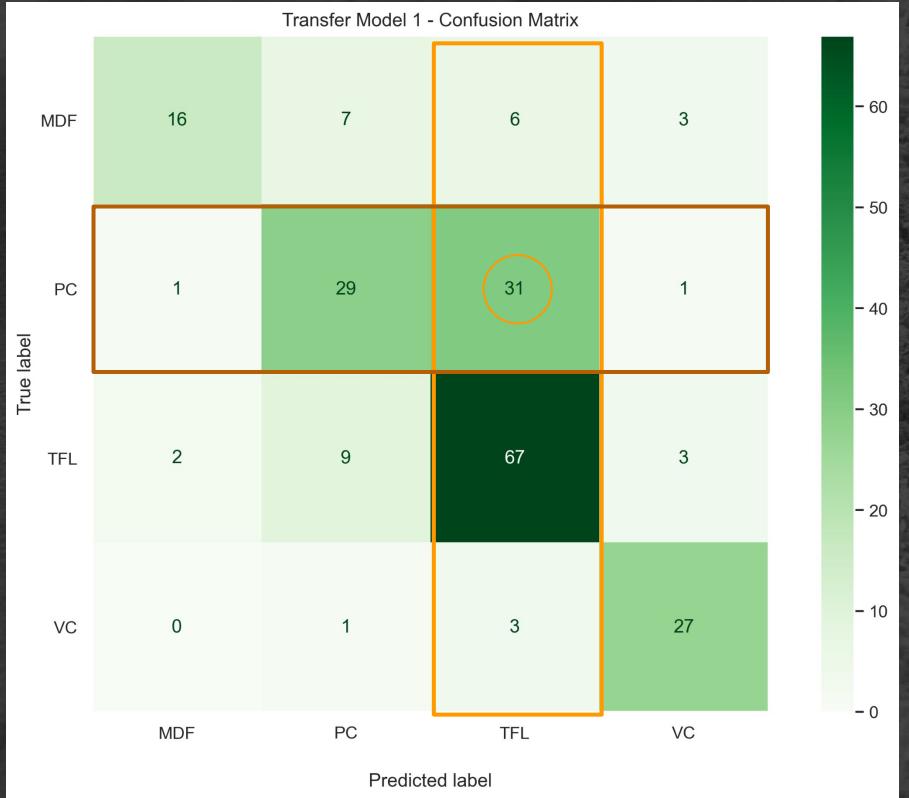
True label: TFL

Predicted label: VC



Dust

Results



Metrics

Total of 210 items in test set

Overall Average Accuracy at 67%

TFL has the most false positives

PC has the most false negatives

Conclusions

Background and dust in images caused noise in classifying images

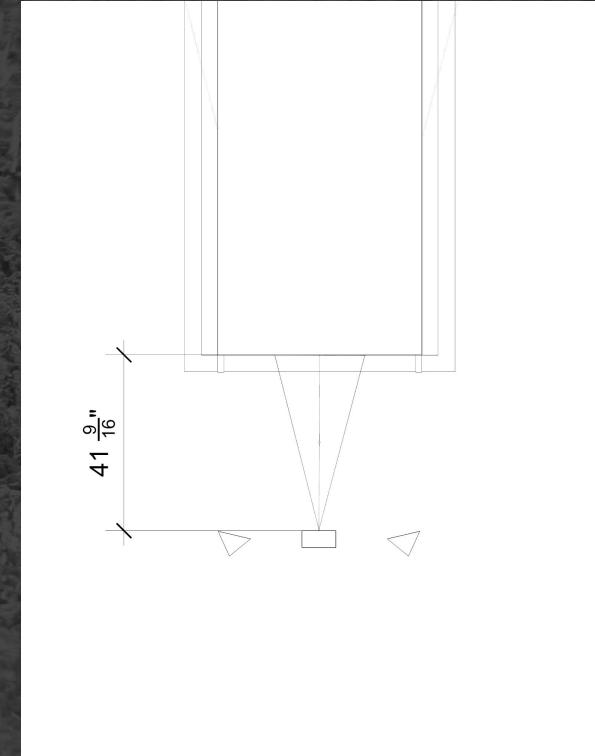
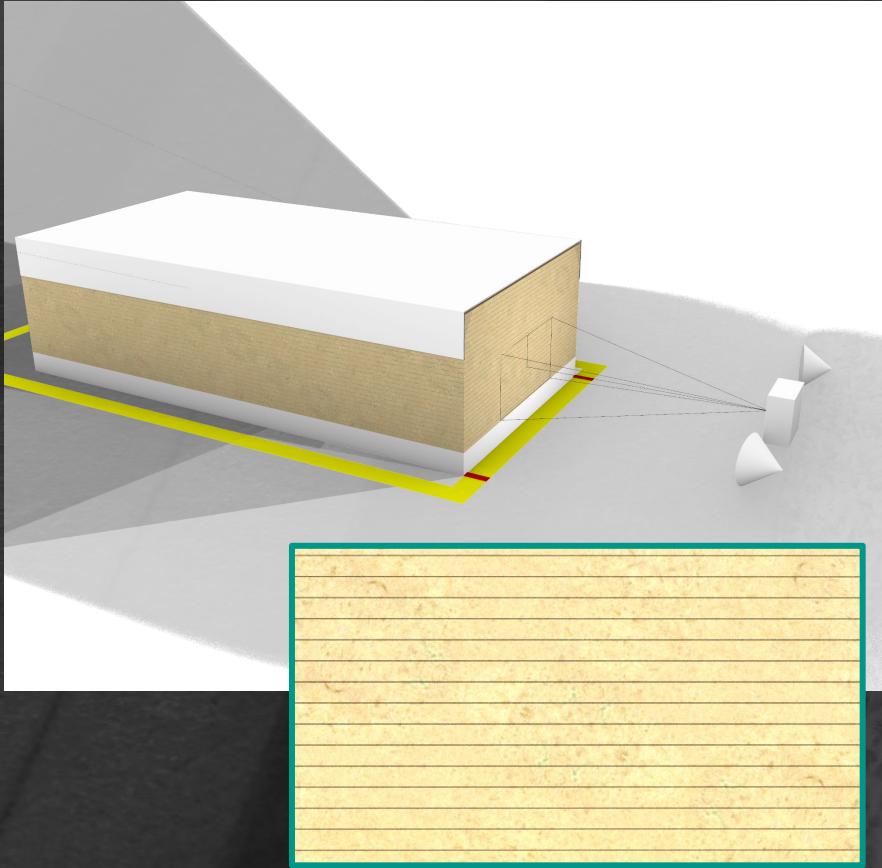
Difficulty predicting the difference between **TFL and PC**

Multiple materials in one image **created issues** in correct predictions

Even with inconsistent data, we were able to come close to required 70% accuracy at the final model's **67% accuracy**

Checks required for the initial production testing period

Recommendations - Data - Warehouse Setup



Camera on
Tripod

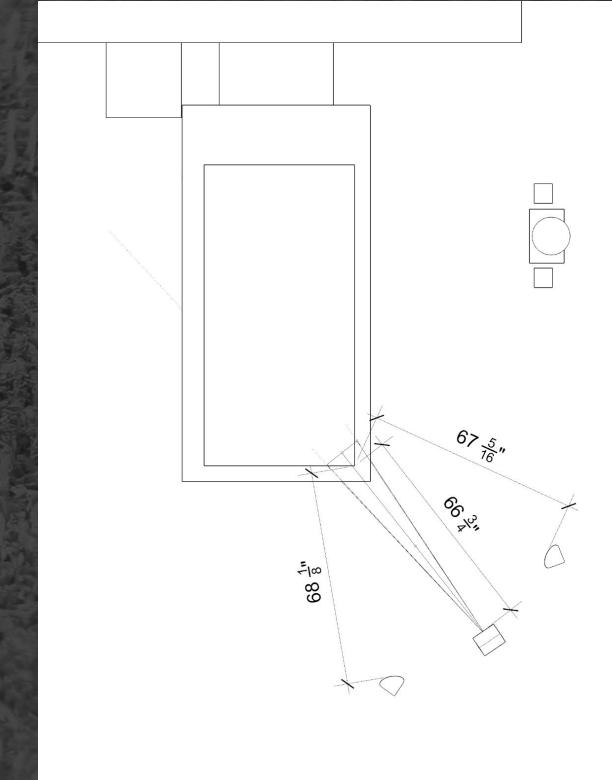
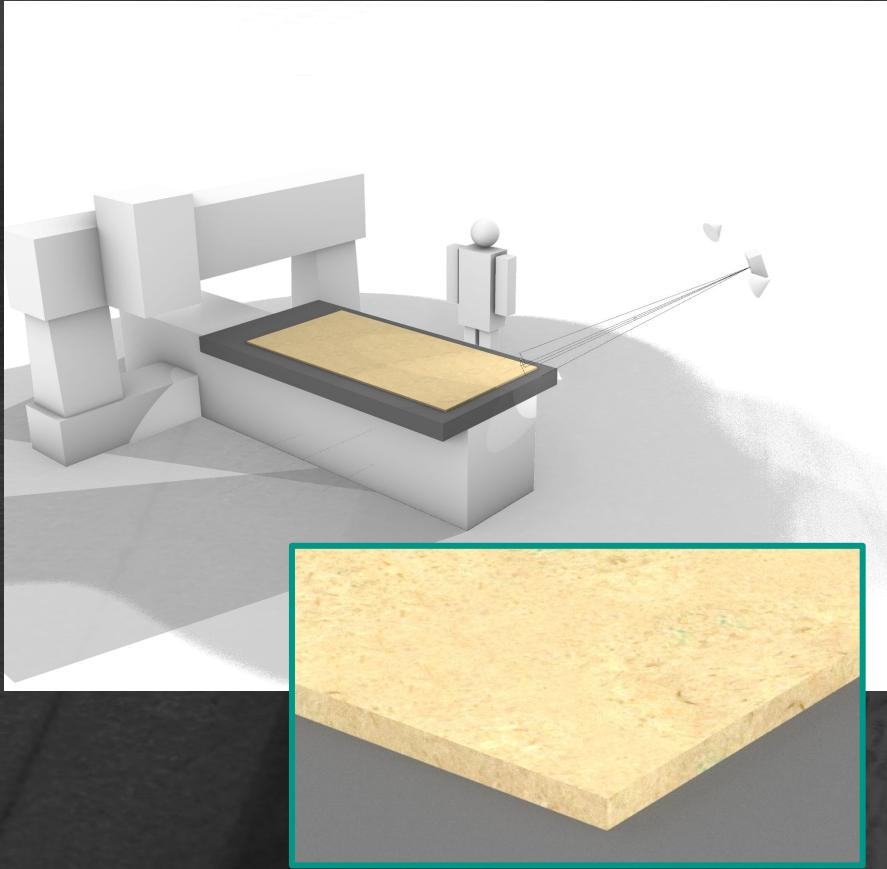
11" High

Backdrop
Paint/Laminate
black

Two light
sources

Work area
indicated on floor

Recommendations - Data - CNC Setup



Camera Hung

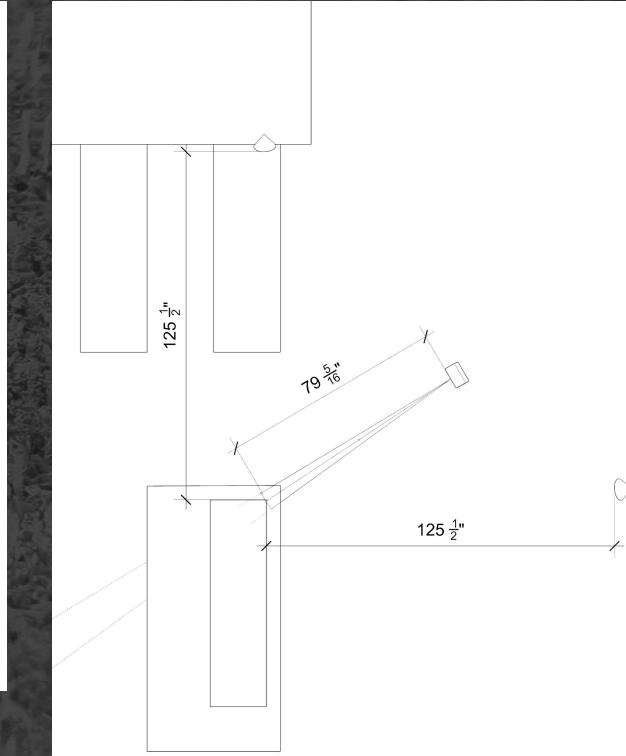
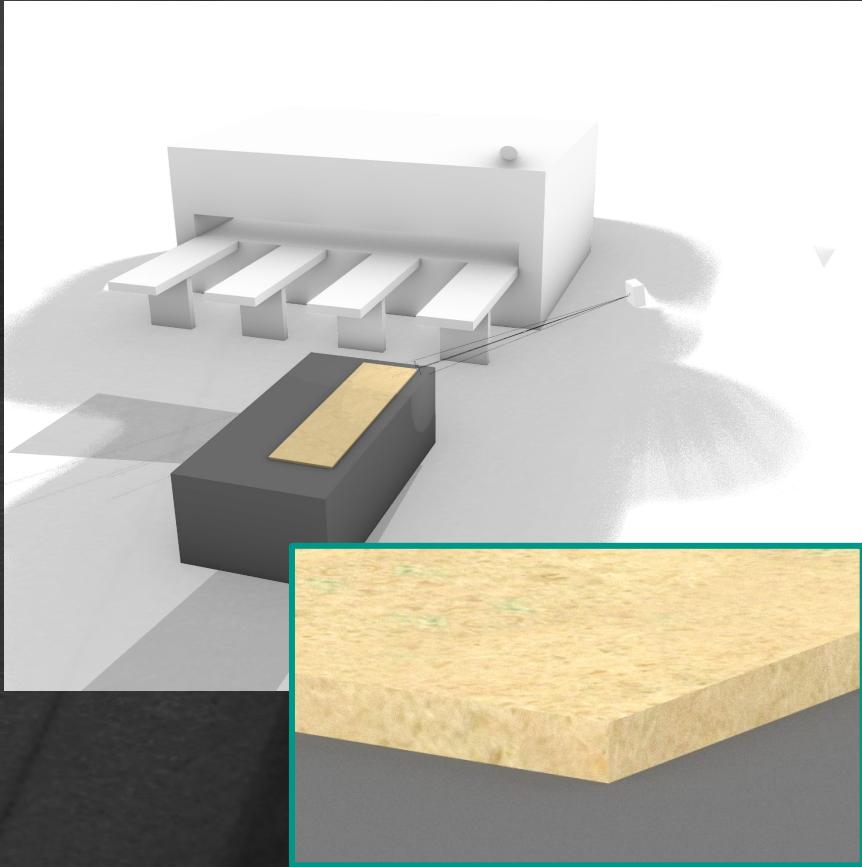
7 ft High

Background Paint/Laminate black

Two light sources

Material at 0,0 on CNC

Recommendations - Data - Panel Saw / Scrap Rack Setup



Camera Hung

7 ft High

Background Paint/Laminate black

Two light sources

Material corner placement on table

Recommendations - Implementation

Model can be **implemented immediately** with human assistance.

Worker can check prediction on a tablet and **correct if** the prediction is **incorrect**.

Human oversight should take place for **90 days** after implementation.

After which accuracy will be assessed again.

Next Steps

1

Increase amount of **data** to train on by gathering 10,000 or 20,000 images

2

Parse image data of product labels for incoming skids of material in the warehouse to provide a more accurate prediction

3

Better accuracy could be obtained by **fine tuning and iterating** on the final model

THANK YOU

APPENDIX

Background

Material Handling

The movement, protection, storage, and control of materials and products throughout manufacturing, warehousing, distribution, consumption and disposal

Retail Store Fixture

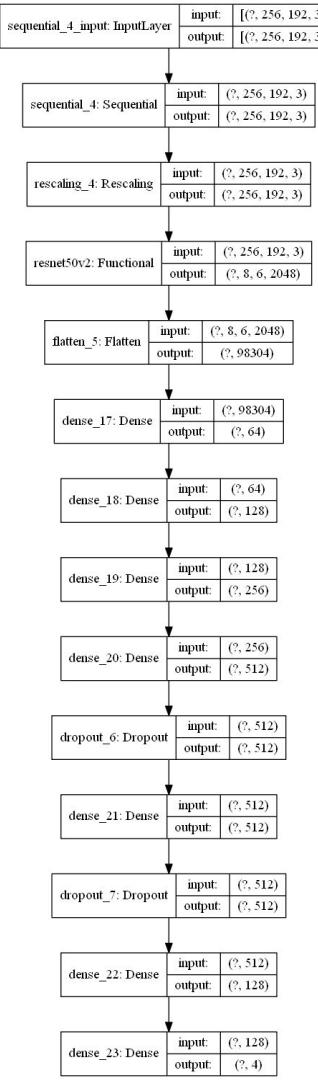
Any piece of equipment or furniture used to display products. The most common type of fixture are shelves, but there are countless types of fixtures like mannequins, display racks, display cases, stall walls, signage holder, and more.

Background

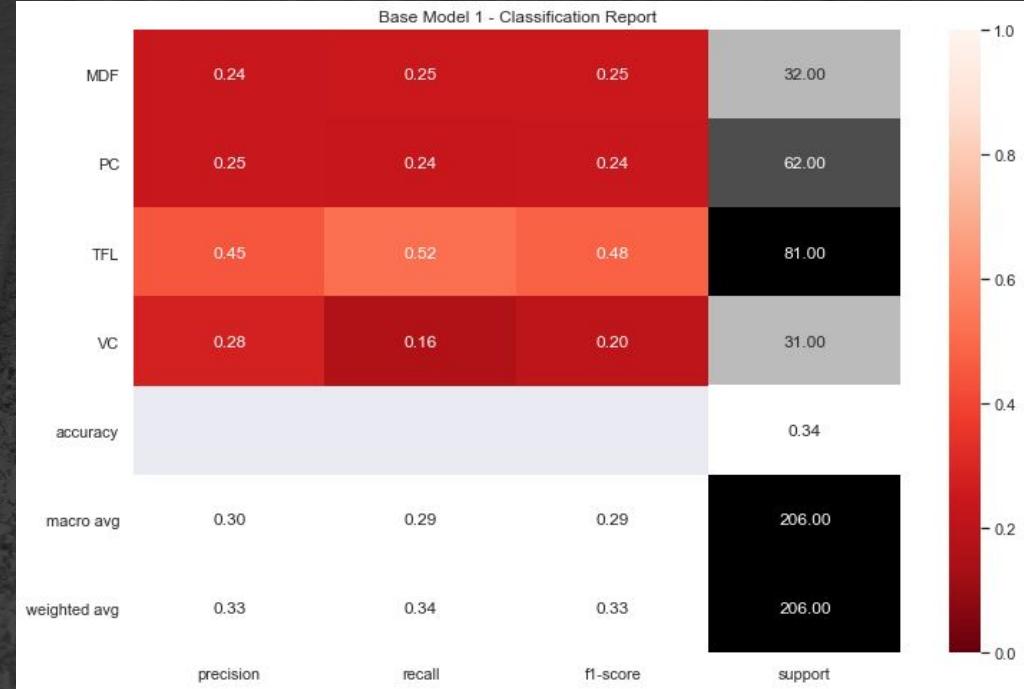
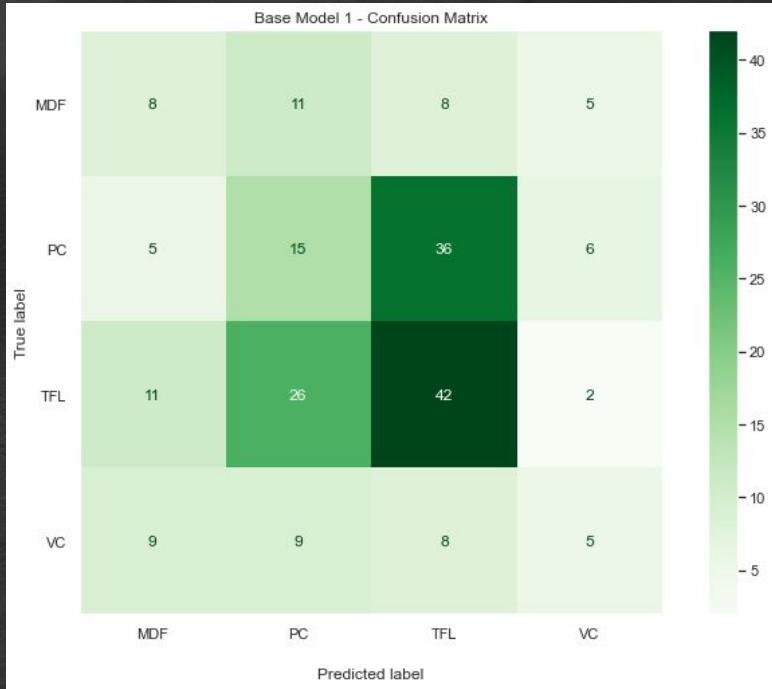


Madjek Inc (a fixture manufacturer) would like to purchase a Panel Storage and Retrieval System to control material handling

Data



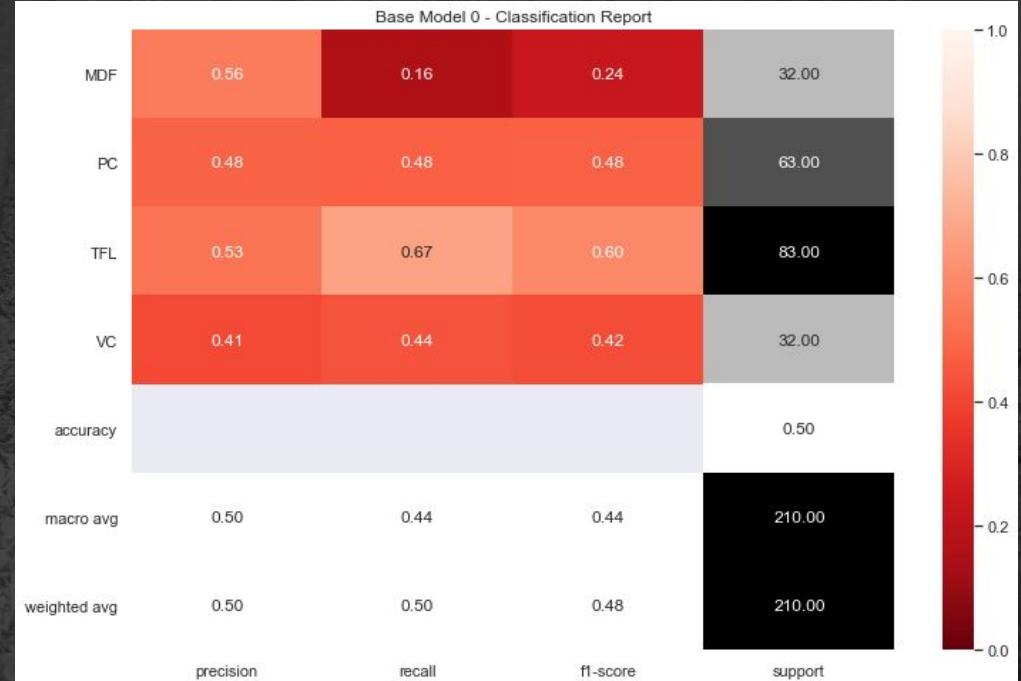
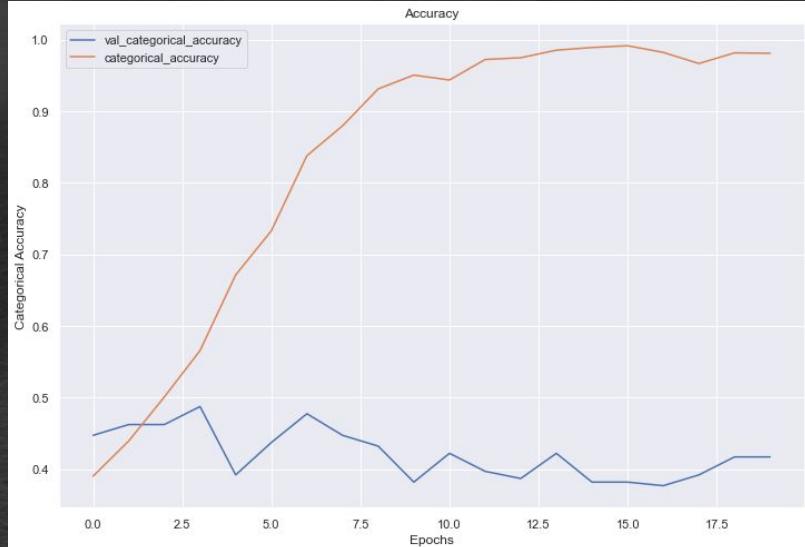
Data



Misprediction between TFL and PC. Widespread mispredictions

Low values in all metrics

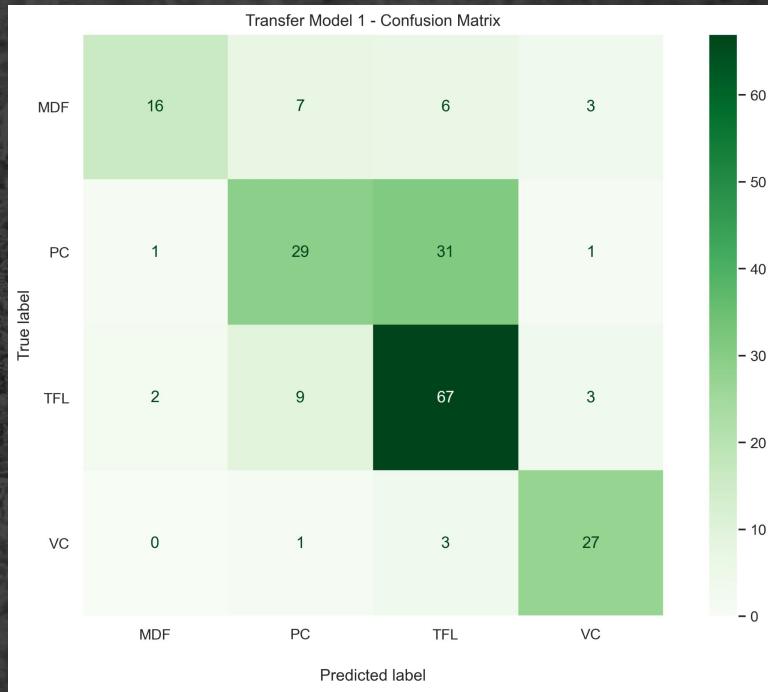
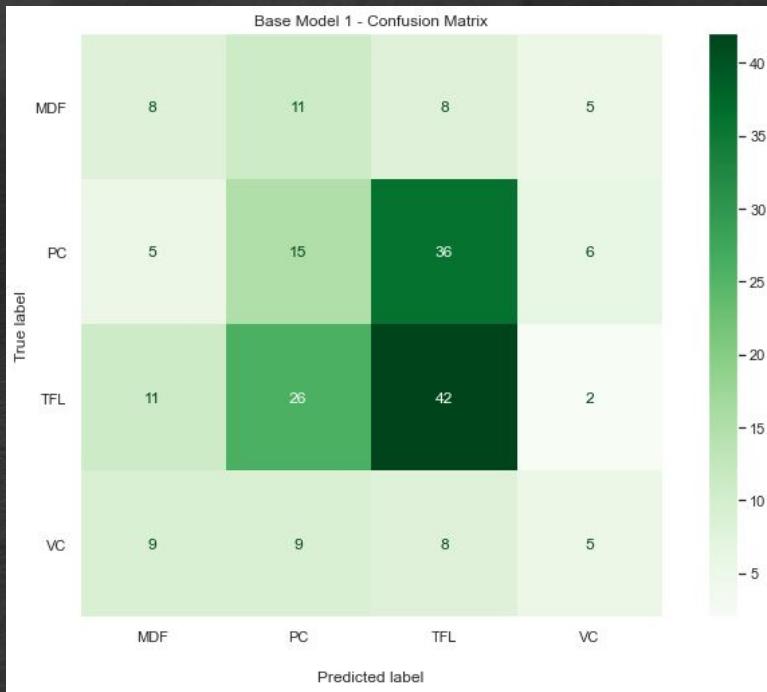
Data



Accuracy Overfitting in Base Model

Accuracy almost equal to percentage of TFL items

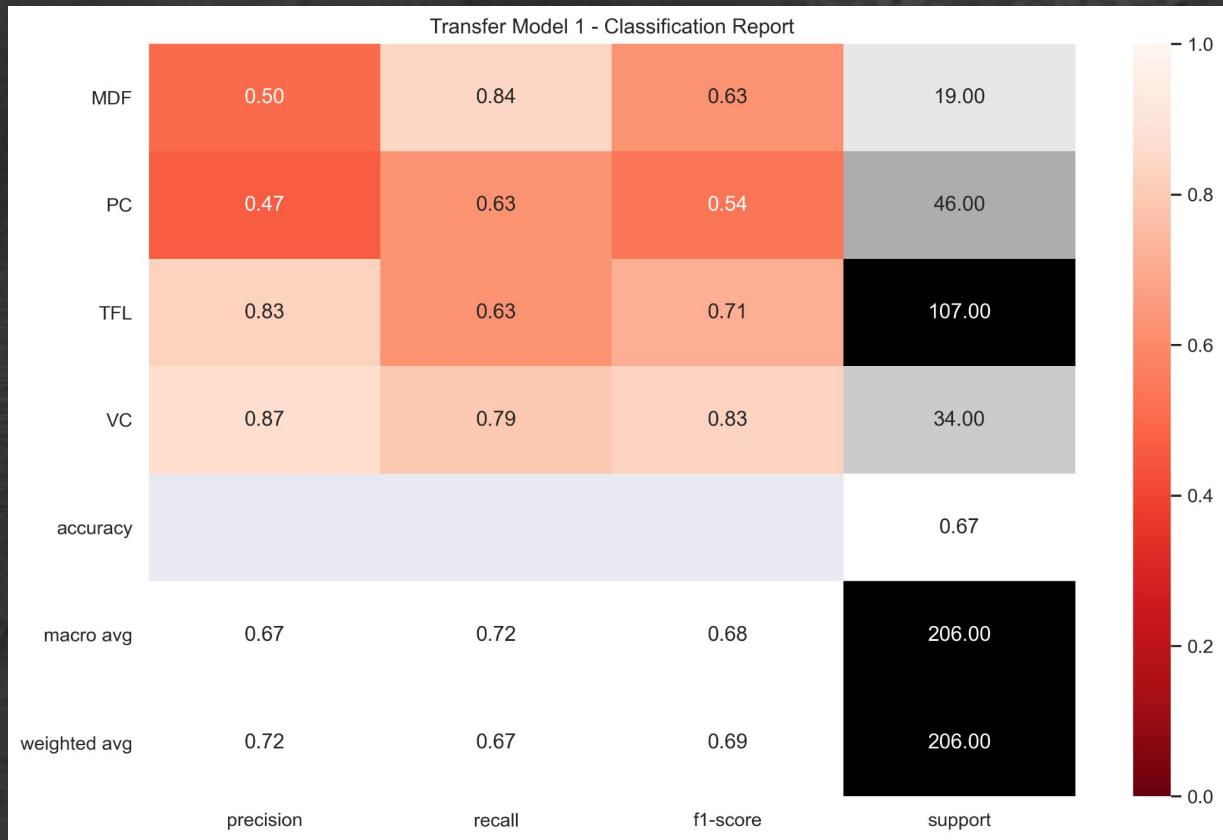
Data



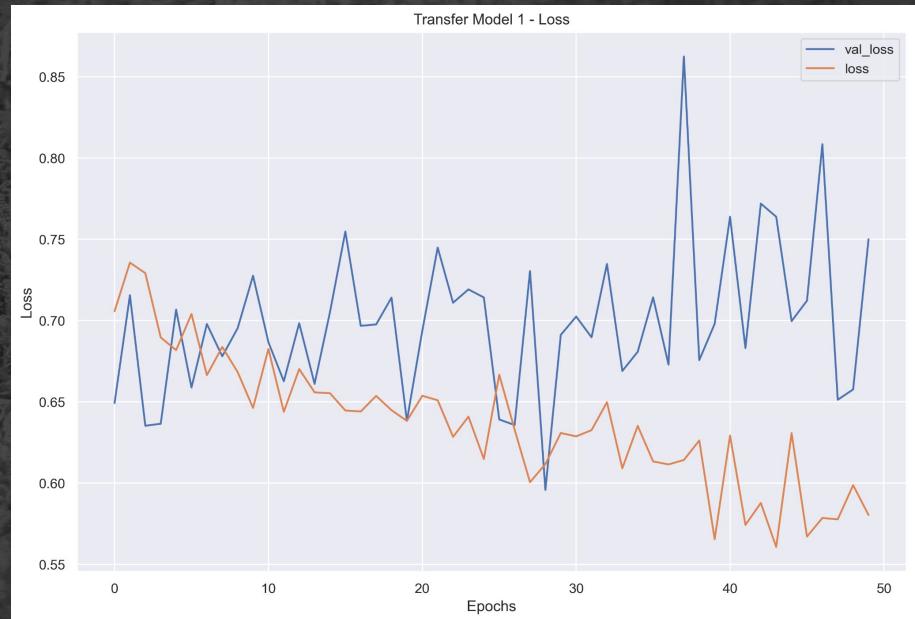
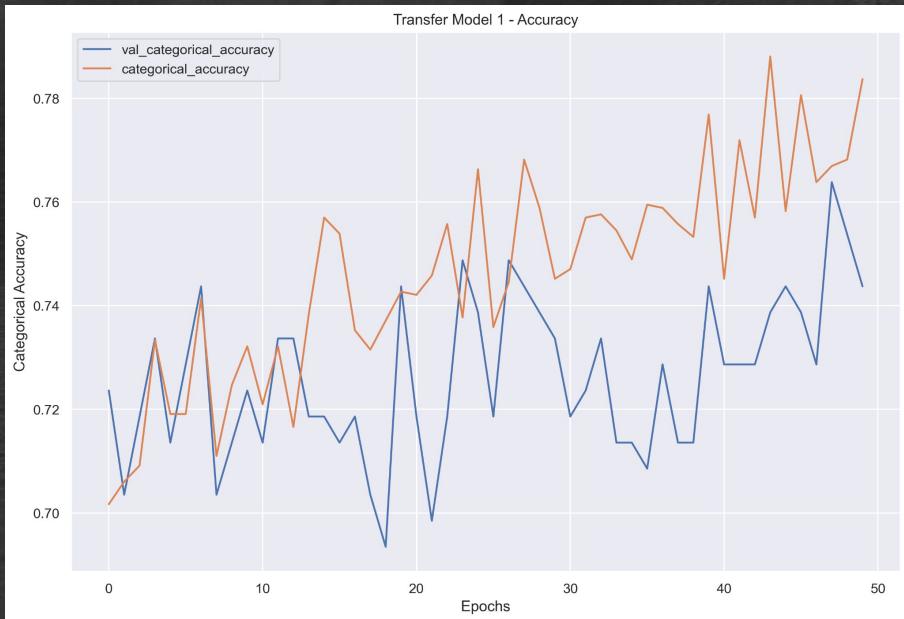
Widespread incorrect predictions

Incorrect predictions between
TFL and PC

Data



Data



Accuracy continuously increasing over epochs and loss decreasing over epochs.

Data - Correct

Correct images show material or similar stacks of materials taking up the whole image frame

Predicted Class 2.0
Class Probabilities
[7.3895621e-04 1.7263006e-02 9.0939170e-01 7.2606310e-02]
Actual Class 2.0



Predicted Class 0.0
Class Probabilities
[0.94563746 0.04523665 0.00280008 0.00632574]
Actual Class 0.0



Predicted Class 2.0
Class Probabilities
[0.00535782 0.05669128 0.9181479 0.01980296]
Actual Class 2.0



Predicted Class 2.0
Class Probabilities
[0.00211949 0.04386708 0.9339769 0.02003648]
Actual Class 2.0



Predicted Class 3.0
Class Probabilities
[2.0396615e-07 8.1974543e-09 3.9274298e-10 9.9999976e-01]
Actual Class 3.0



Predicted Class 3.0
Class Probabilities
[4.7517220e-13 1.2565894e-15 3.2047959e-18 1.0000000e+00]
Actual Class 3.0



Predicted Class 2.0
Class Probabilities
[0.01709751 0.322497 0.63659513 0.02381043]
Actual Class 2.0



Predicted Class 2.0
Class Probabilities
[0.00185509 0.04930112 0.910634 0.03820993]
Actual Class 2.0



Data - Incorrect

Incorrect images show images which have varied issues to be dealt with:

1 - Black TFL not common

2 - Image too close

3 - Image too far away

4 - Image too close

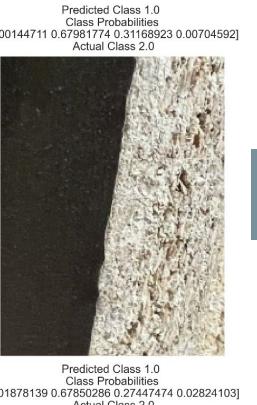
5 - Image too close

6 - Lighting makes material appear to be white TFL

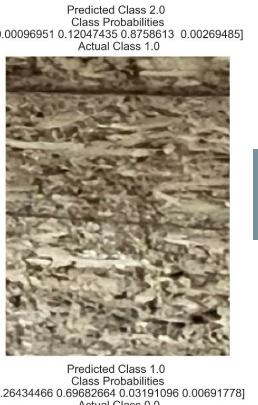
7 - Incorrectly labeled

8 - Other materials in frame

1



2



3



4



5



6



7



8

