Vehicle Damage Detection

Group 3:

Background

Project:

- Car Damage Detection
- 3 labels: Minor, Moderate, Severe
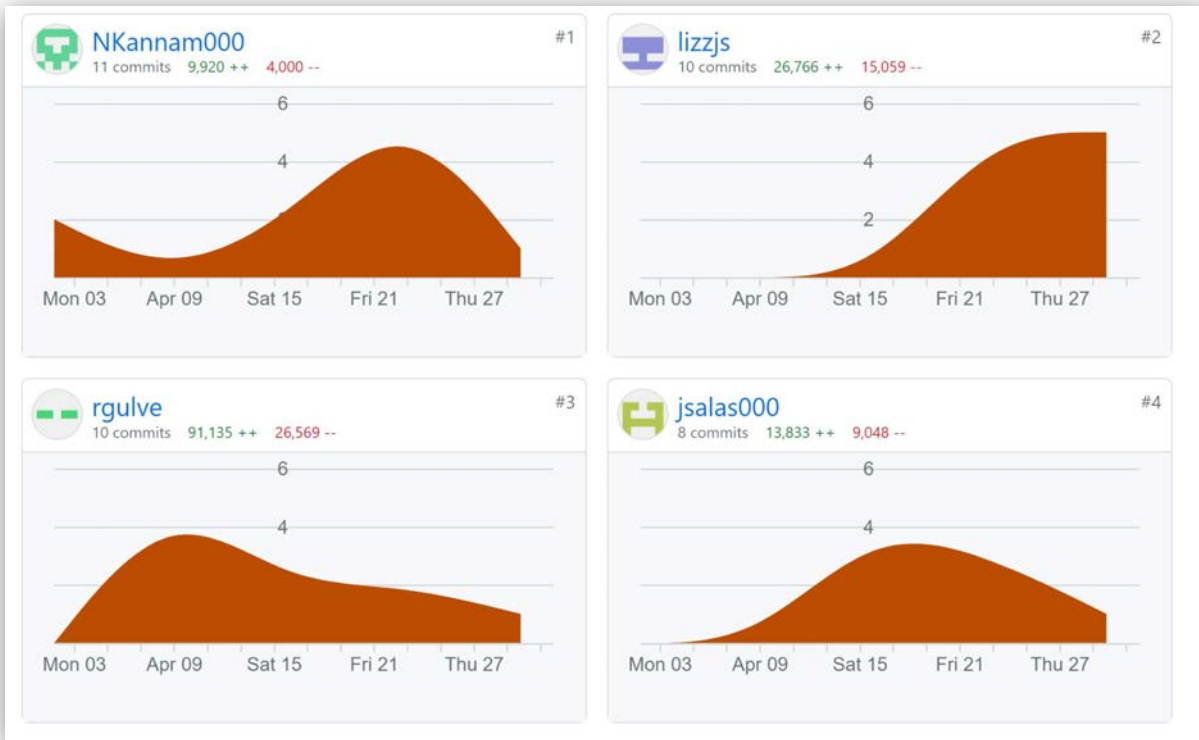- Currently working with 8000 images

Summary of last week's meeting:

- Data Augmentation
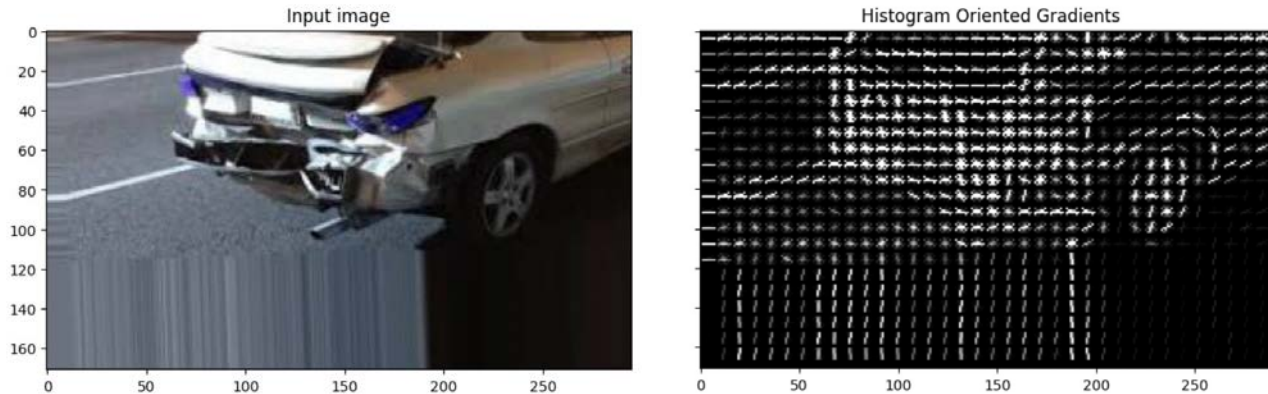- EDA

Goals:

- Try different feature extraction/selection methods
- Run Machine Learning Baseline Models
- Research/Explore Deep Learning

Contributions

HOG Feature Extraction

Histogram of Oriented Gradients, a feature descriptor technique that computes the gradient magnitude and orientation for each pixel in an image.
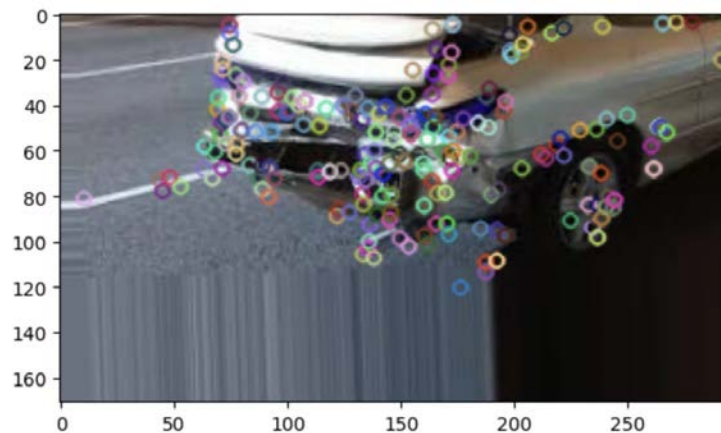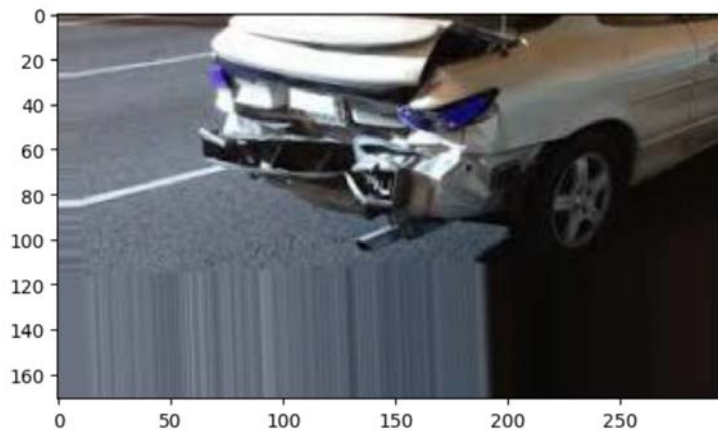

- Random Forest
- GridSearch

```
print("Accuracy for Random Forest: ",accuracy_score(y_test,pred))
```

Accuracy for Random Forest: 0.47183098591549294

SIFT


```
Testing
Accuracy for Random Forest:   0.5138339920948617
Classification Report:
               precision    recall  f1-score   support

           0       0.53      0.70      0.60        83
           1       0.37      0.15      0.22        85
           2       0.55      0.69      0.61        85

    accuracy                           0.51       253
   macro avg       0.48      0.52      0.48       253
weighted avg       0.48      0.51      0.48       253
```
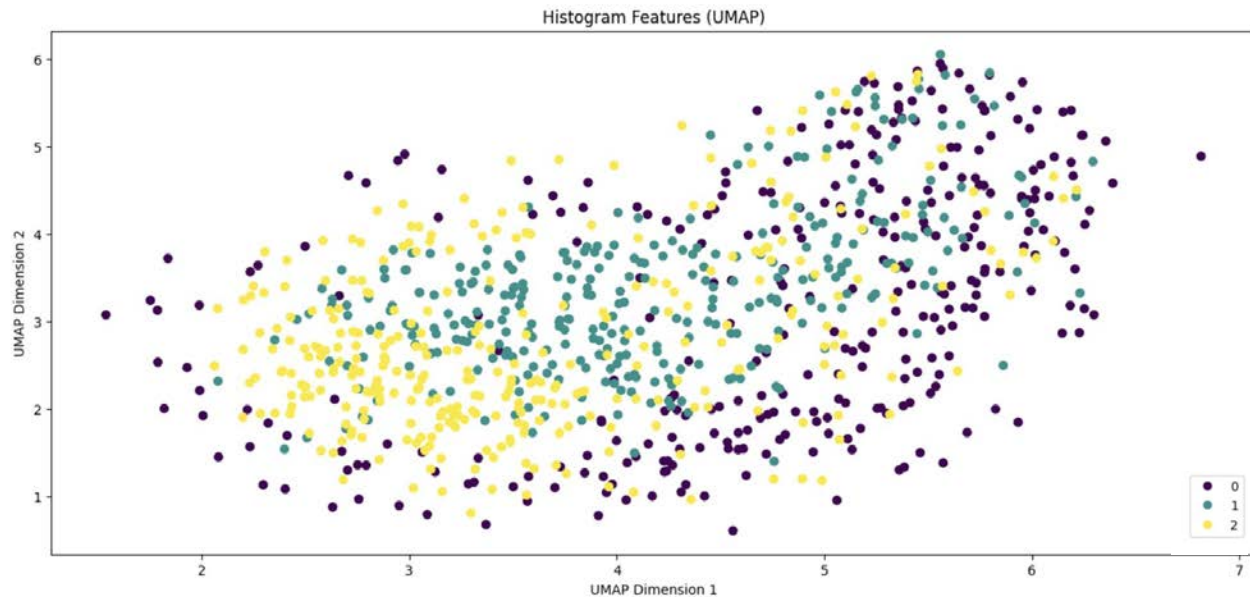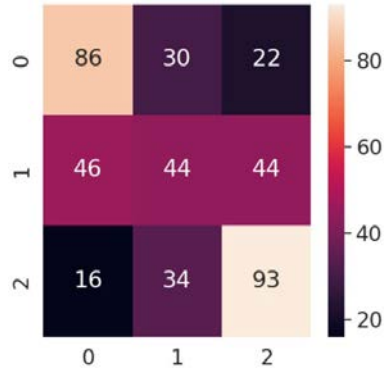
- Random Forest model
- Grid Search

SIFT

Histogram Features (UMAP)

Texture Feature

Gray-Level Co-Occurrence Matrix (GLCM)

```
Accuracy =  0.5277108433734939
Accuracy =                 precision    recall  f1-score    support

      minor       0.57      0.61      0.59       138
   moderate       0.42      0.42      0.42       134
     severe       0.59      0.55      0.57       143

   accuracy                           0.53       415
  macro avg       0.53      0.53      0.53       415
weighted avg      0.53      0.53      0.53       415
```
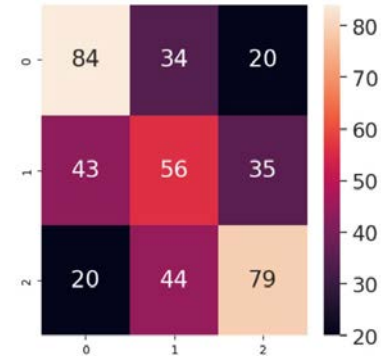
```
Accuracy =  0.5373493975903615
Accuracy =                 precision    recall  f1-score    support

      minor       0.58      0.62      0.60       138
   moderate       0.41      0.33      0.36       134
     severe       0.58      0.65      0.62       143

   accuracy                           0.54       415
  macro avg       0.52      0.53      0.53       415
weighted avg      0.53      0.54      0.53       415
```
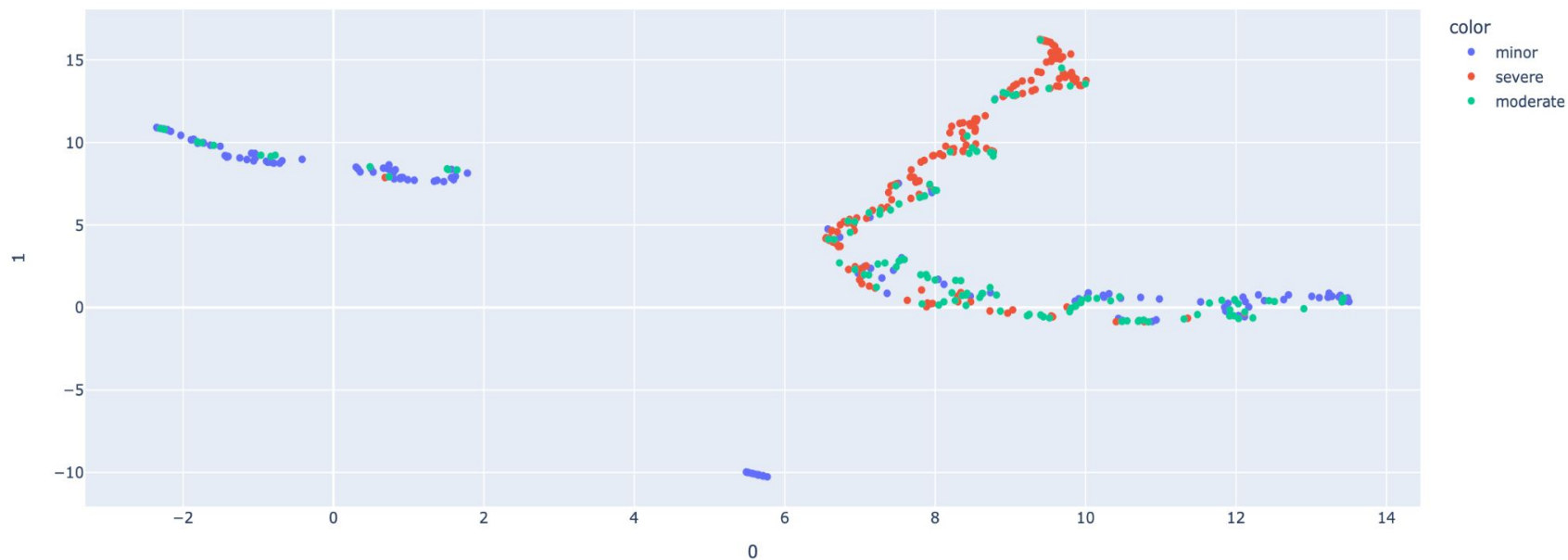

- Random Forest
- Random GridSearch

Gray-Level Co-Occurrence Matrix (GLCM)

2D-UMap

Texture Feature

Gabor

```
Accuracy =  0.4819277108433735
Accuracy =                 precision   recall  f1-score   support

       minor       0.57      0.55      0.56       138
    moderate       0.39      0.40      0.40       134
      severe       0.49      0.49      0.49       143

    accuracy                           0.48       415
   macro avg       0.48      0.48      0.48       415
weighted avg       0.48      0.48      0.48       415
```
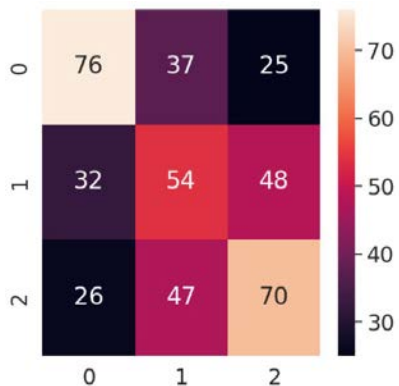
```
Accuracy =  0.4939759036144578
Accuracy =                 precision   recall  f1-score   support

       minor       0.56      0.61      0.58       138
    moderate       0.38      0.30      0.33       134
      severe       0.51      0.57      0.54       143

    accuracy                           0.49       415
   macro avg       0.48      0.49      0.48       415
weighted avg       0.48      0.49      0.49       415
```
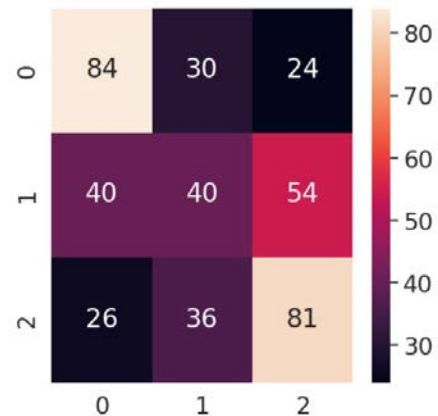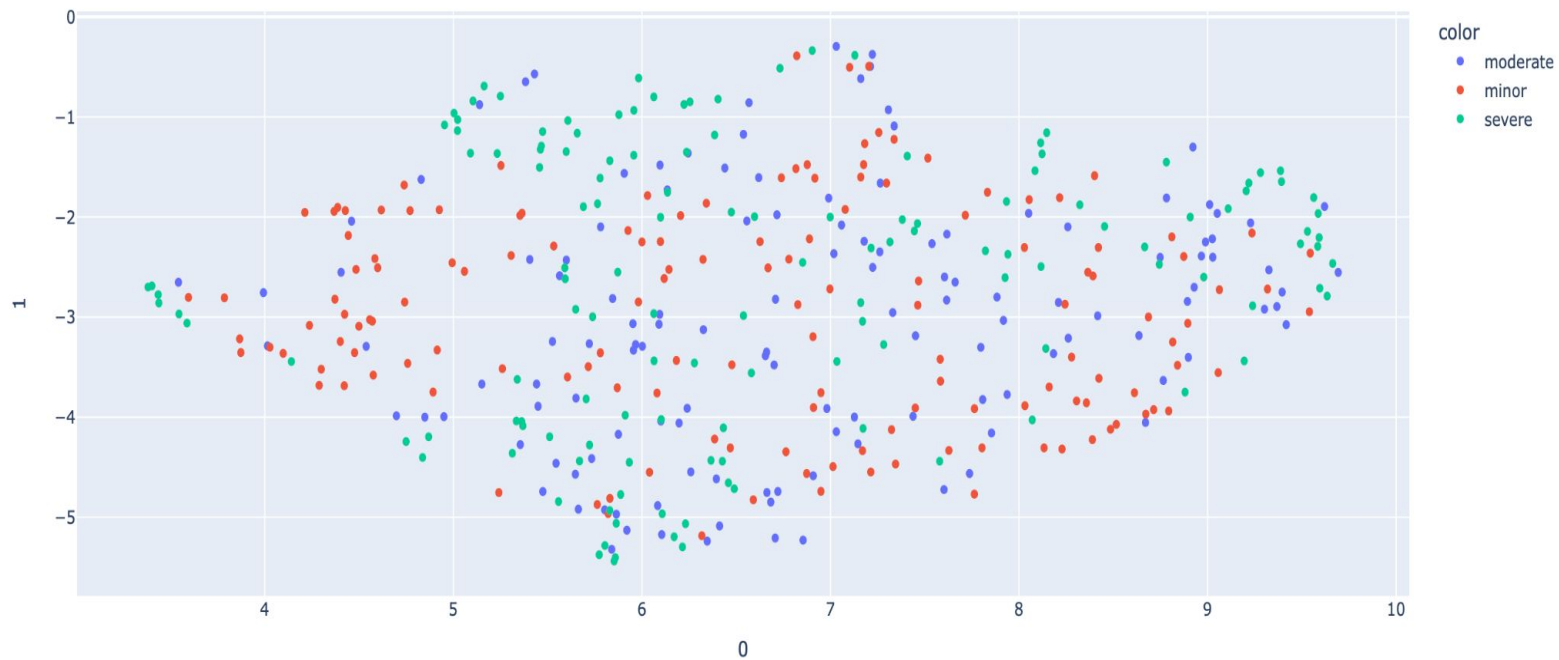

- Random Forest
- Random GridSearch

Gabor

2D-UMap

Edge Detection

Edge detection is an image processing technique for finding the boundaries of objects within images. It mainly works by detecting discontinuities in brightness.

Canny edge detector is an edge detection operator that uses multi-stage algorithm to detect a wide range of edges in images.

Edge Detection general process:
1. Filtering out noise using Gaussian blur algorithm.
2. Finding the strength and direction of edges using Sobel Filters.
3. Isolating the strongest edges and thin them to one-pixel wide lines by applying non-maximum suppression.
4. Using hysteresis to isolate the best edges
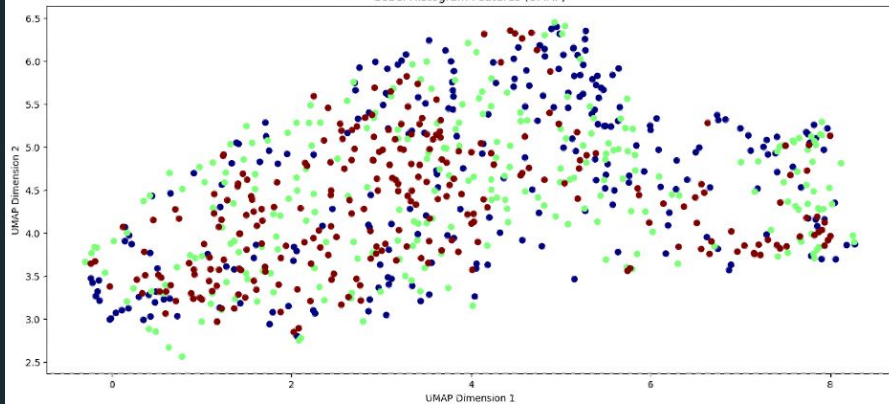
Canny edge detection algorithm process:
1. Noise reduction;
2. Gradient calculation;
3. Non-maximum suppression;
4. Double threshold;
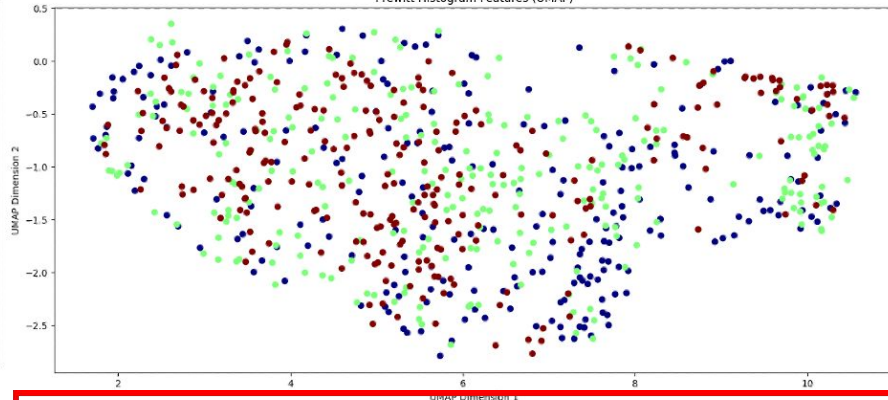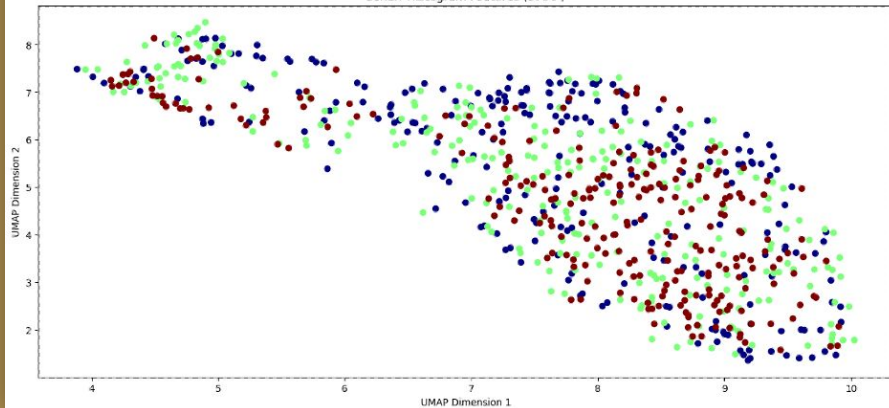5. Edge Tracking by Hysteresis
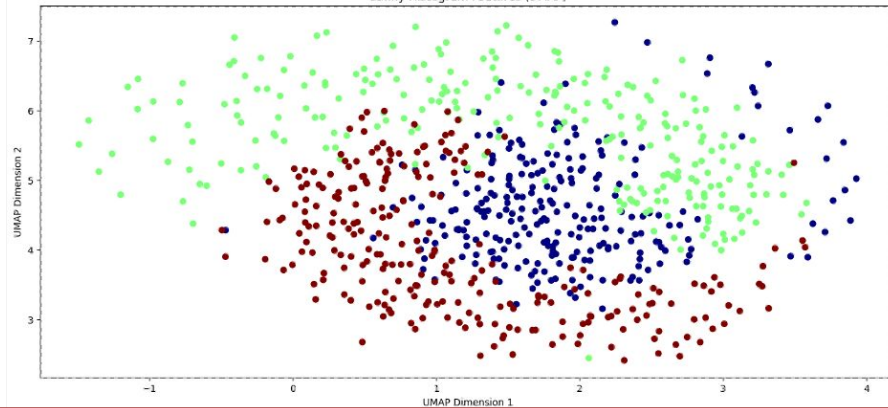
Edge Filters on Test Image
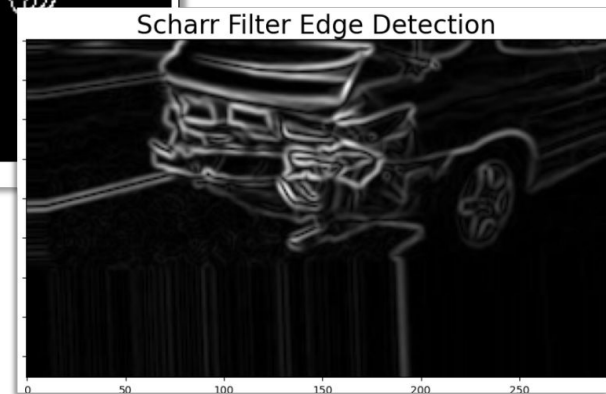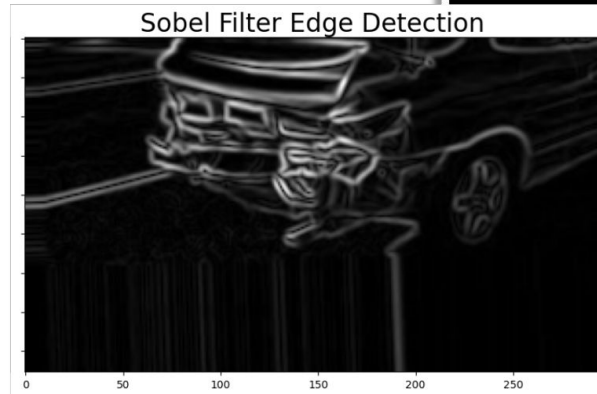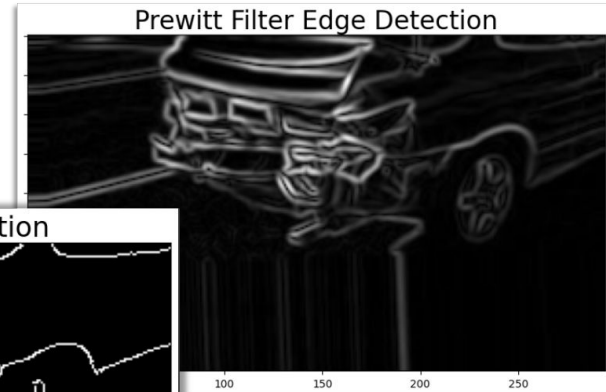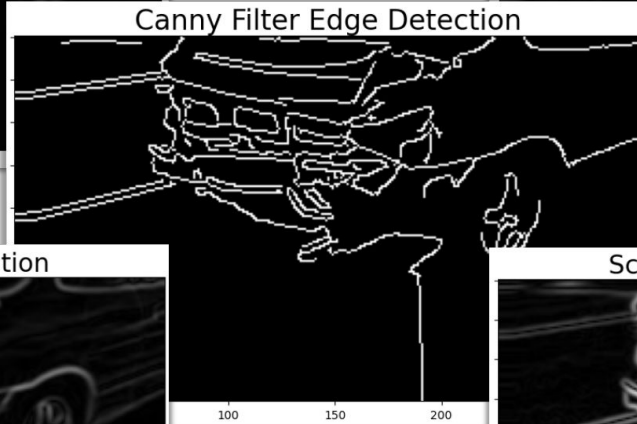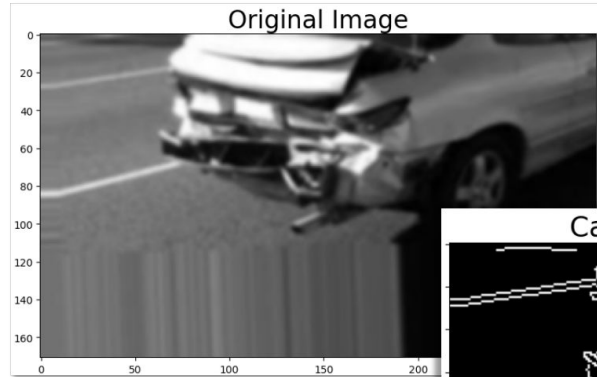
UMAP

Preliminary ML Results for Canny Edge Detection

```
LogReg
                precision    recall  f1-score   support

           0        0.53      0.35      0.42        80
           1        0.47      0.36      0.41        78
           2        0.35      0.59      0.44        70

    accuracy                            0.43       228
   macro avg        0.45      0.43      0.42       228
weighted avg        0.46      0.43      0.42       228

RF
                precision    recall  f1-score   support

           0        0.57      0.36      0.44        80
           1        0.36      0.42      0.39        78
           2        0.38      0.47      0.42        70

    accuracy                            0.42       228
   macro avg        0.44      0.42      0.42       228
weighted avg        0.44      0.42      0.42       228
```

```
SVM
                precision    recall  f1-score   support

           0        0.55      0.60      0.57        80
           1        0.48      0.19      0.28        78
           2        0.45      0.70      0.54        70

    accuracy                            0.49       228
   macro avg        0.49      0.50      0.46       228
weighted avg        0.50      0.49      0.46       228

GNB
                precision    recall  f1-score   support

           0        0.49      0.44      0.46        80
           1        0.40      0.22      0.28        78
           2        0.39      0.64      0.49        70

    accuracy                            0.43       228
   macro avg        0.43      0.43      0.41       228
weighted avg        0.43      0.43      0.41       228
```

ML Hypertuning Results