Dataset_analysis

December 28, 2024

[1]:
```
import os
import matplotlib.pyplot as plt
from collections import Counter
import numpy as np
import matplotlib.image as mpimg
```

[2]:
```
dataset_path = "D:/Acadamics and University/Python/Intelligent Systems/Project␣
↪2/Welding Dataset/"
```

[3]:
```
# class counts from labels
def get_class_counts(label_folder):
    class_counts = Counter()

    for label_file in os.listdir(label_folder):
        if label_file.endswith('.txt'):
            label_file_path = os.path.join(label_folder, label_file)
            with open(label_file_path, 'r') as f:
                lines = f.readlines()
                for line in lines:
                    parts = line.strip().split()
                    if len(parts) > 0:
                        # The first part is the class ID
                        class_id = int(parts[0])
                        # Map class ID to the actual class name
                        if class_id == 0:
                            class_name = 'bad weld'
                        elif class_id == 1:
                            class_name = 'good weld'
                        elif class_id == 2:
                            class_name = 'defect'
                        else:
                            continue  # Skip if the class ID is unknown

                        class_counts[class_name] += 1
    return class_counts
```

[4]:
```python
# analyze the dataset
def analyze_dataset(base_folder):
    total_counts = Counter()
    class_names = ['good weld', 'bad weld', 'defect']

    split_counts = {}
    for split in ['train', 'test', 'valid']:
        label_folder = os.path.join(base_folder, split, 'labels')
        split_counts[split] = get_class_counts(label_folder)
        total_counts.update(split_counts[split])

    # Print the total counts and percentage distribution
    total_labels = sum(total_counts.values())
    print(f"\nTotal counts: {total_counts}")

    for class_name in class_names:
        count = total_counts.get(class_name, 0)
        percentage = (count / total_labels) * 100 if total_labels > 0 else 0
        print(f"{class_name}: {count} samples ({percentage:.2f}%)")

    # Plotting the distribution
    plot_class_distribution(total_counts)
    plot_split_distribution(split_counts)
    plot_class_percentage(total_counts)
    plot_split_percentage(split_counts)
```

[5]:
```python
# plot the class distribution (Bar plot)
def plot_class_distribution(total_counts):
    class_names = ['good weld', 'bad weld', 'defect']
    counts = [total_counts.get(class_name, 0) for class_name in class_names]

    plt.figure(figsize=(8, 6))
    plt.bar(class_names, counts, color=['green', 'red', 'blue'])
    plt.title('Class Distribution in Dataset')
    plt.xlabel('Class')
    plt.ylabel('Count')
    plt.tight_layout()
    plt.show()
```

[6]:
```python
# plot the class percentage distribution (Pie chart)
def plot_class_percentage(total_counts):
    class_names = ['good weld', 'bad weld', 'defect']
    counts = [total_counts.get(class_name, 0) for class_name in class_names]

    plt.figure(figsize=(8, 8))
    plt.pie(counts, labels=class_names, autopct='%1.1f%%', startangle=90,␣
 ↪colors=['green', 'red', 'blue'])
```

```
    plt.title('Class Percentage Distribution')
    plt.tight_layout()
    plt.show()
```

[7]:
```
# plot the distribution per split (train, test, valid) - Bar plot
def plot_split_distribution(split_counts):
    splits = ['train', 'test', 'valid']
    class_names = ['good weld', 'bad weld', 'defect']

    split_data = {split: [split_counts[split].get(class_name, 0) for class_name␣
 ↪in class_names] for split in splits}

    fig, ax = plt.subplots(figsize=(10, 6))
    bar_width = 0.2
    index = range(len(splits))

    for i, class_name in enumerate(class_names):
        ax.bar([x + i * bar_width for x in index], [split_data[split][i] for␣
 ↪split in splits], bar_width, label=class_name)

    ax.set_xlabel('Data Split')
    ax.set_ylabel('Count')
    ax.set_title('Class Distribution per Data Split (train, test, valid)')
    ax.set_xticks([x + bar_width for x in index])
    ax.set_xticklabels(splits)
    ax.legend()
    plt.tight_layout()
    plt.show()
```

[8]:
```
# plot the percentage distribution per split (Pie charts)
def plot_split_percentage(split_counts):
    splits = ['train', 'test', 'valid']
    class_names = ['good weld', 'bad weld', 'defect']

    for split in splits:
        counts = [split_counts[split].get(class_name, 0) for class_name in␣
 ↪class_names]
        total = sum(counts)

        plt.figure(figsize=(8, 8))
        plt.pie(counts, labels=class_names, autopct='%1.1f%%', startangle=90,␣
 ↪colors=['green', 'red', 'blue'])
        plt.title(f'{split.capitalize()} Split Percentage Distribution')
        plt.tight_layout()
        plt.show()
```

[9]:
```
#  count the number of images in each subset
def count_images_in_subsets(base_folder):
    subsets = ['train', 'test', 'valid']
    image_counts = {}

    for subset in subsets:
        image_folder = os.path.join(base_folder, subset, 'images')
        image_files = [f for f in os.listdir(image_folder) if f.endswith(('.
 ↪jpg', '.png', '.jpeg'))]  # Adjust for image formats
        image_counts[subset] = len(image_files)

    return image_counts
```

[10]:
```
#  plot the number of images in each subset and their percentage
def plot_image_distribution(base_folder):
    # Get the image counts in each subset (train, test, valid)
    image_counts = count_images_in_subsets(base_folder)

    total_images = sum(image_counts.values())

    plt.figure(figsize=(8, 6))
    plt.bar(image_counts.keys(), image_counts.values(), color=['green', 'red',␣
 ↪'blue'])
    plt.title('Number of Images in Each Subset (train, test, valid)')
    plt.xlabel('Subset')
    plt.ylabel('Number of Images')
    plt.tight_layout()
    plt.show()

    percentages = [count / total_images * 100 for count in image_counts.
 ↪values()]

    plt.figure(figsize=(8, 8))
    plt.pie(percentages, labels=image_counts.keys(), autopct='%1.1f%%',␣
 ↪startangle=90, colors=['green', 'red', 'blue'])
    plt.title('Percentage of Images in Each Subset (train, test, valid)')
    plt.tight_layout()
    plt.show()
```

[11]:
```
#  bounding box distributions and image resolutions
def plot_bbox_distribution(label_folder):
    bbox_sizes = []

    for label_file in os.listdir(label_folder):
        if label_file.endswith('.txt'):
            label_file_path = os.path.join(label_folder, label_file)
            with open(label_file_path, 'r') as f:
```

```
                lines = f.readlines()
                for line in lines:
                    parts = line.strip().split()
                    if len(parts) > 4:
                        x_center, y_center, width, height = map(float, parts[1:
↪5])
                        bbox_sizes.append((width, height))

    widths, heights = zip(*bbox_sizes)

    fig, ax = plt.subplots(figsize=(8, 6))
    ax.scatter(widths, heights, alpha=0.5)
    ax.set_xlabel('Bounding Box Width')
    ax.set_ylabel('Bounding Box Height')
    ax.set_title('Bounding Box Distribution (Width vs Height)')
    plt.tight_layout()
    plt.show()
```

[12]:
```
# Plot image size distribution

def plot_image_size_distribution(image_folder):
    image_sizes = []

    for image_file in os.listdir(image_folder):
        if image_file.endswith(('.jpg', '.png', '.jpeg')):  # Adjust for your␣
↪image formats
            image_path = os.path.join(image_folder, image_file)
            img = mpimg.imread(image_path)
            image_sizes.append(img.shape[:2])  # Get (height, width)

    heights, widths = zip(*image_sizes)

    fig, ax = plt.subplots(figsize=(8, 6))
    ax.scatter(widths, heights, alpha=0.5)
    ax.set_xlabel('Image Width')
    ax.set_ylabel('Image Height')
    ax.set_title('Image Size Distribution (Width vs Height)')
    plt.tight_layout()
    plt.show()
```

[13]:
```
# Plot class-wise bounding box size distribution
def plot_classwise_bbox_size_distribution(label_folder):
    class_bbox_sizes = {'good weld': [], 'bad weld': [], 'defect': []}

    for label_file in os.listdir(label_folder):
        if label_file.endswith('.txt'):
            label_file_path = os.path.join(label_folder, label_file)
```

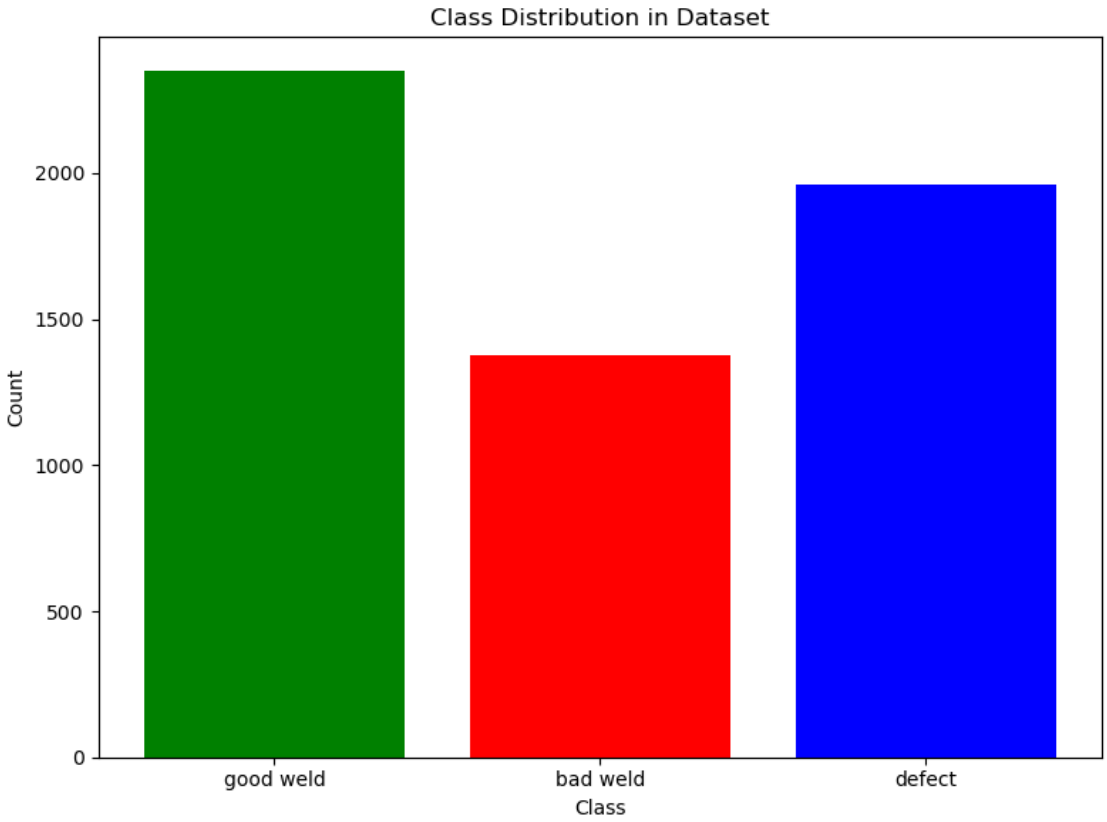
```
            with open(label_file_path, 'r') as f:
                lines = f.readlines()
                for line in lines:
                    parts = line.strip().split()
                    if len(parts) > 4:
                        class_id = int(parts[0])  # First part is class ID
                        x_center, y_center, width, height = map(float, parts[1:
↪5])
                        if class_id == 0:
                            class_bbox_sizes['bad weld'].append((width, height))
                        elif class_id == 1:
                            class_bbox_sizes['good weld'].append((width,␣
↪height))
                        elif class_id == 2:
                            class_bbox_sizes['defect'].append((width, height))

    fig, ax = plt.subplots(figsize=(8, 6))
    for class_name, bbox_sizes in class_bbox_sizes.items():
        widths, heights = zip(*bbox_sizes)
        ax.scatter(widths, heights, alpha=0.5, label=class_name)

    ax.set_xlabel('Bounding Box Width')
    ax.set_ylabel('Bounding Box Height')
    ax.set_title('Class-wise Distribution of Object Sizes (Bounding Boxes)')
    ax.legend()
    plt.tight_layout()
    plt.show()
```

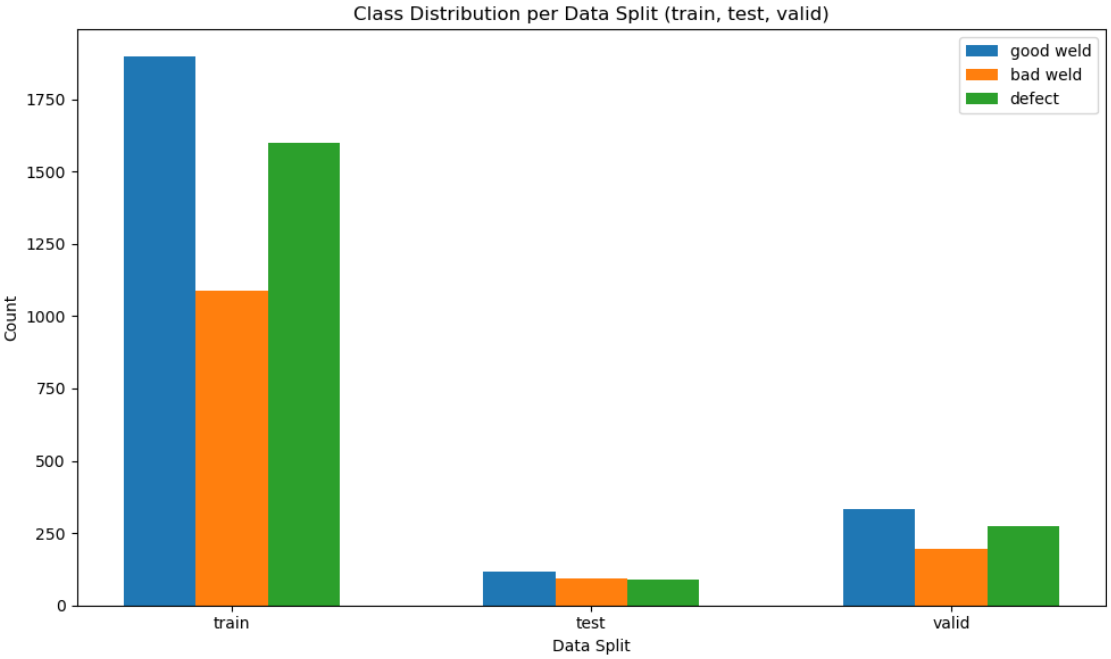
[14]:
```
# Plot correlation of class vs image resolution

def plot_class_vs_image_quality(image_folder, label_folder):
    class_image_sizes = {'good weld': [], 'bad weld': [], 'defect': []}

    for label_file in os.listdir(label_folder):
        if label_file.endswith('.txt'):
            label_file_path = os.path.join(label_folder, label_file)
            with open(label_file_path, 'r') as f:
                lines = f.readlines()
                image_file_name = label_file.replace('.txt', '.jpg')
                image_path = os.path.join(image_folder, image_file_name)
                img = mpimg.imread(image_path)
                image_width, image_height = img.shape[1], img.shape[0]

                for line in lines:
                    parts = line.strip().split()
                    if len(parts) > 0:
                        class_id = int(parts[0])
```

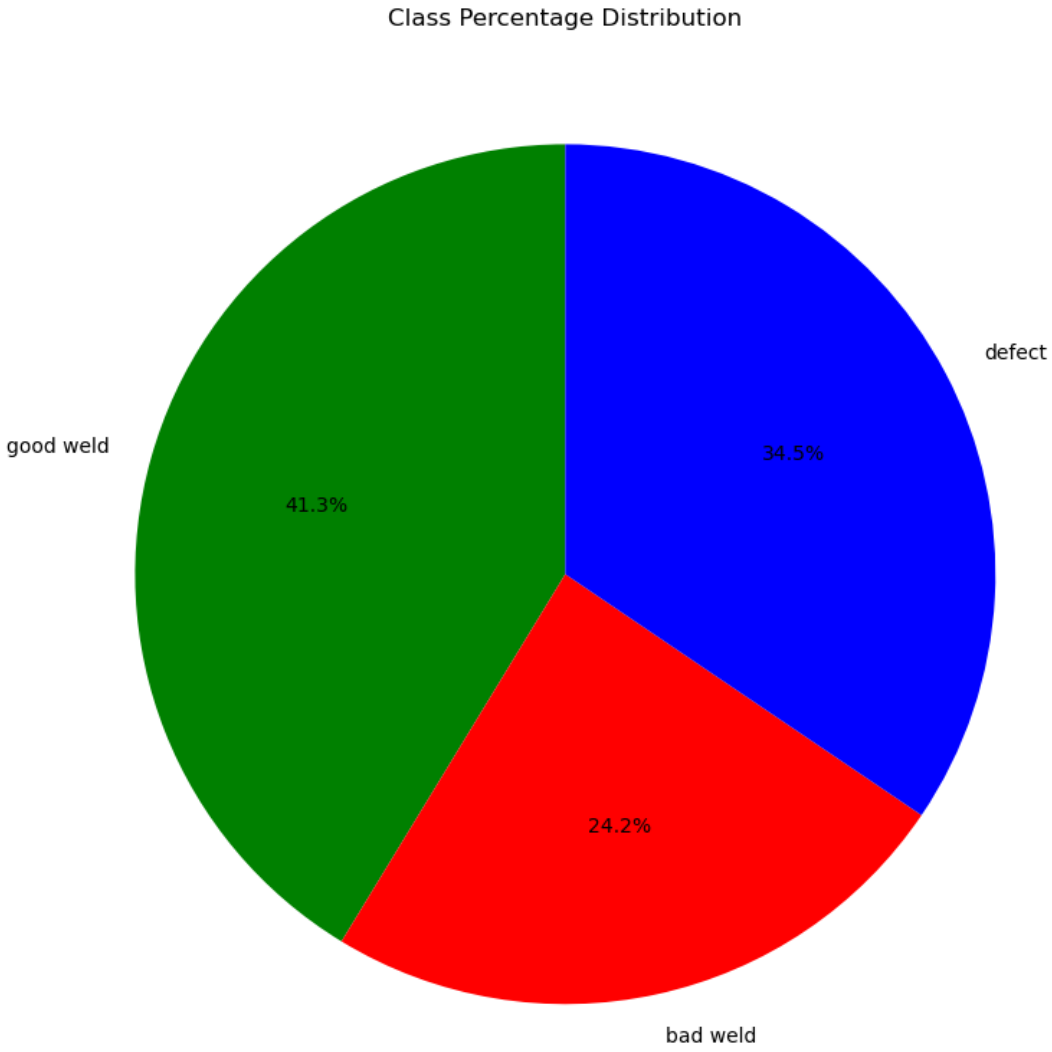
```
                        if class_id == 0:
                            class_image_sizes['bad weld'].append((image_width,␣
↪image_height))
                        elif class_id == 1:
                            class_image_sizes['good weld'].append((image_width,␣
↪image_height))
                        elif class_id == 2:
                            class_image_sizes['defect'].append((image_width,␣
↪image_height))

    fig, ax = plt.subplots(figsize=(8, 6))
    for class_name, image_sizes in class_image_sizes.items():
        widths, heights = zip(*image_sizes)
        ax.scatter(widths, heights, alpha=0.5, label=class_name)

    ax.set_xlabel('Image Width')
    ax.set_ylabel('Image Height')
    ax.set_title('Correlation Between Classes and Image Quality (Resolution)')
    ax.legend()
    plt.tight_layout()
    plt.show()
```

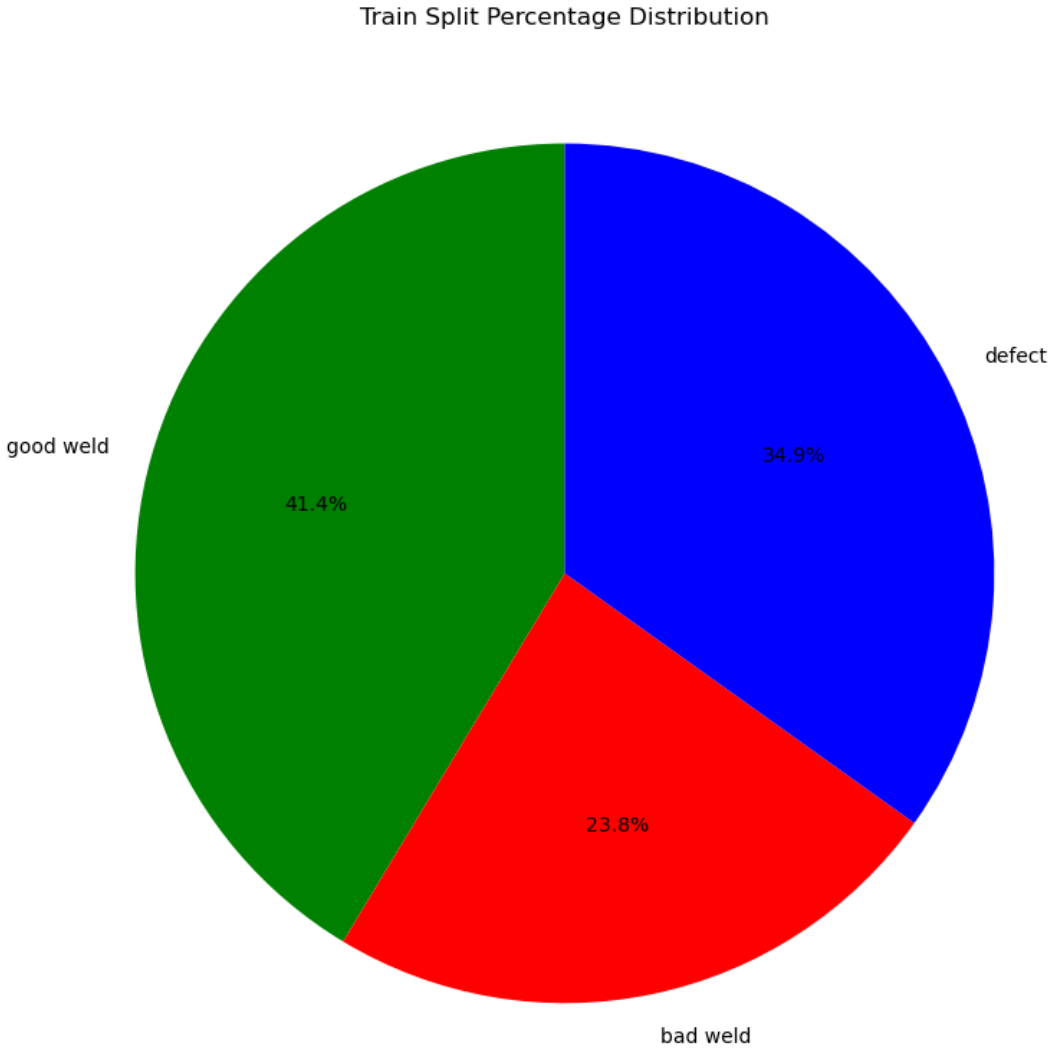
[15]:
```
image_folder = os.path.join(dataset_path, 'train', 'images')
label_folder = os.path.join(dataset_path, 'train', 'labels')


analyze_dataset(dataset_path)
plot_image_distribution(dataset_path)
plot_bbox_distribution(label_folder)
plot_image_size_distribution(image_folder)
plot_classwise_bbox_size_distribution(label_folder)
plot_class_vs_image_quality(image_folder, label_folder)
```

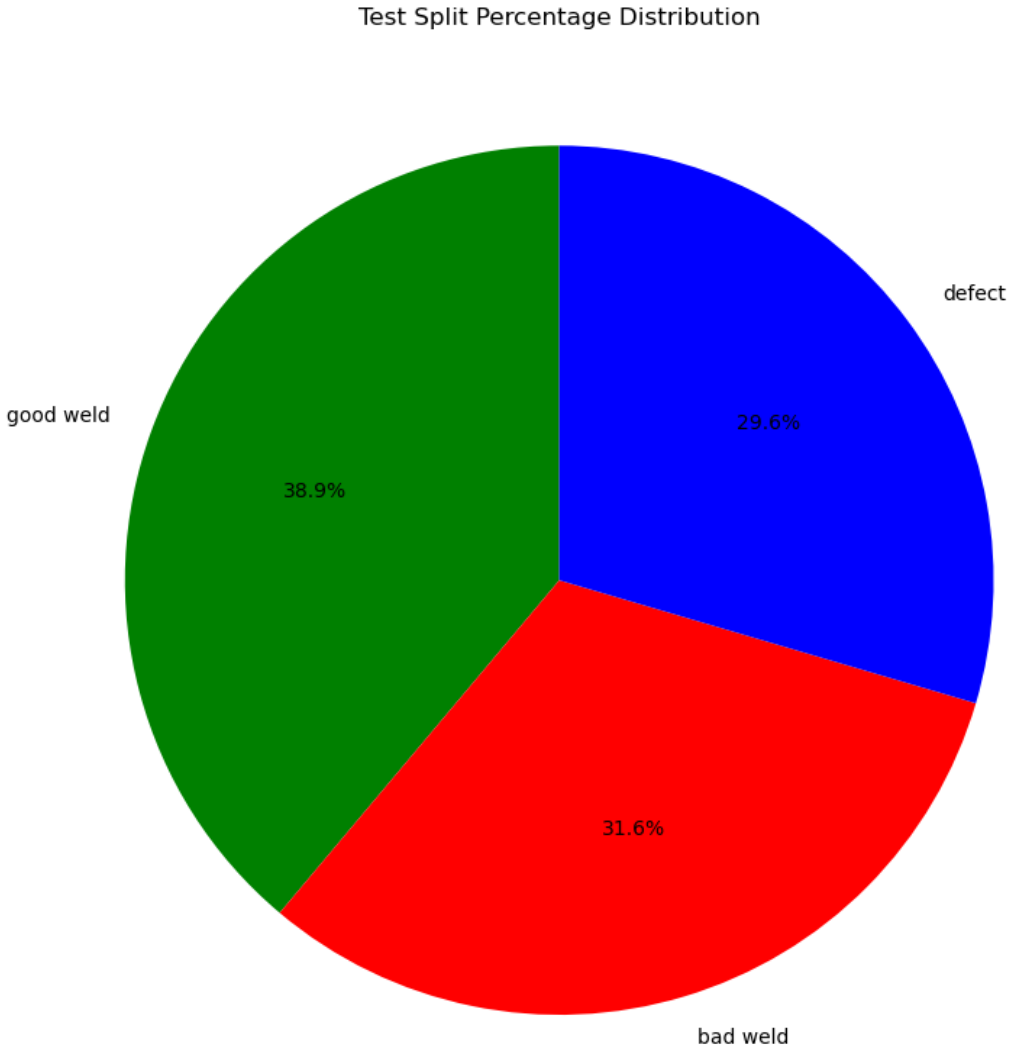
```
Total counts: Counter({'good weld': 2348, 'defect': 1960, 'bad weld': 1378})
good weld: 2348 samples (41.29%)
bad weld: 1378 samples (24.23%)
defect: 1960 samples (34.47%)
```

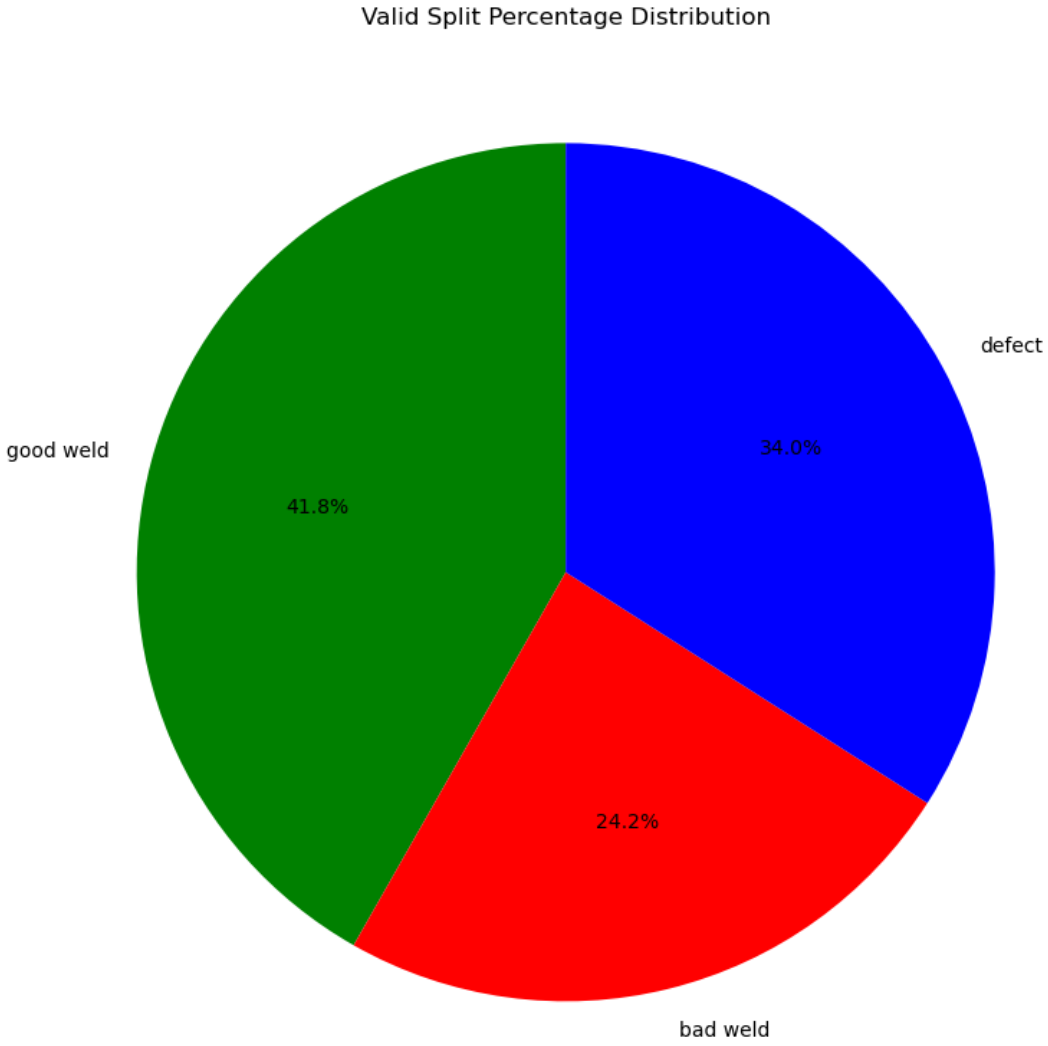

Class Distribution in Dataset
Count
2000
1500
1000
500
0
good weld
bad weld
defect
Class

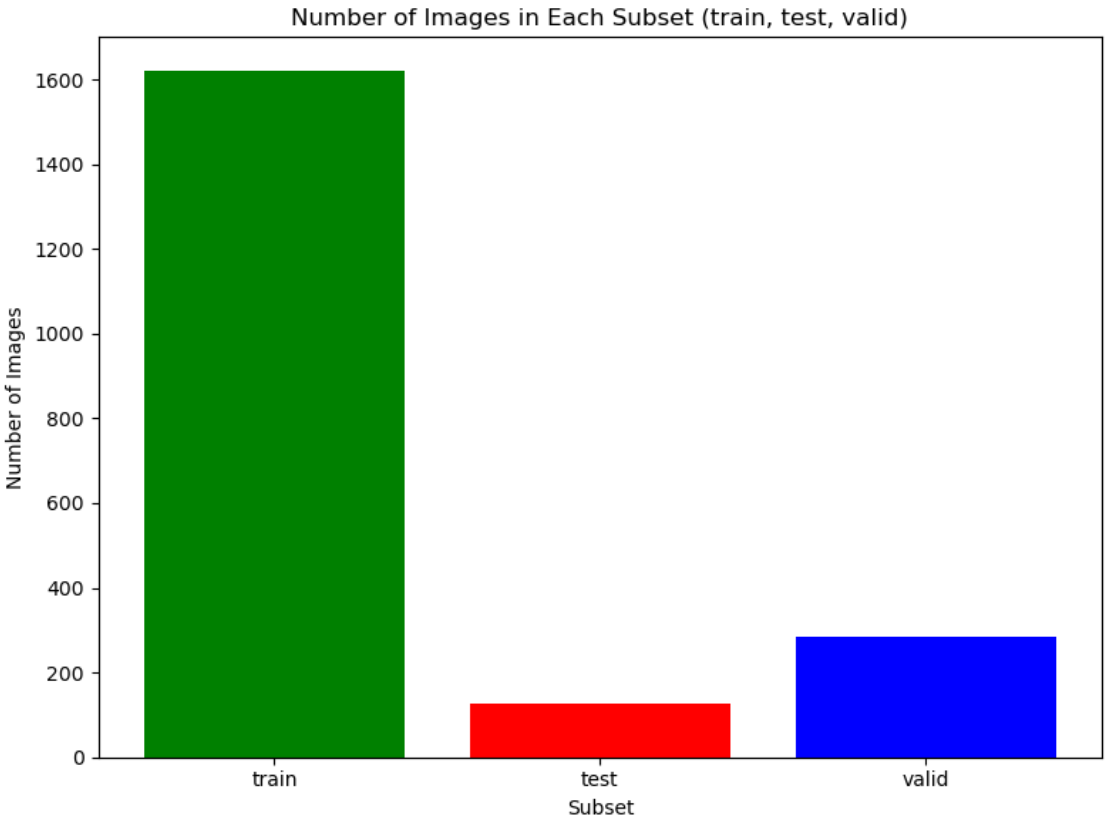

Class Distribution per Data Split (train, test, valid)
good weld
bad weld
defect
Count
1750
1500
1250
1000
750
500
250
0
train
test
valid
Data Split

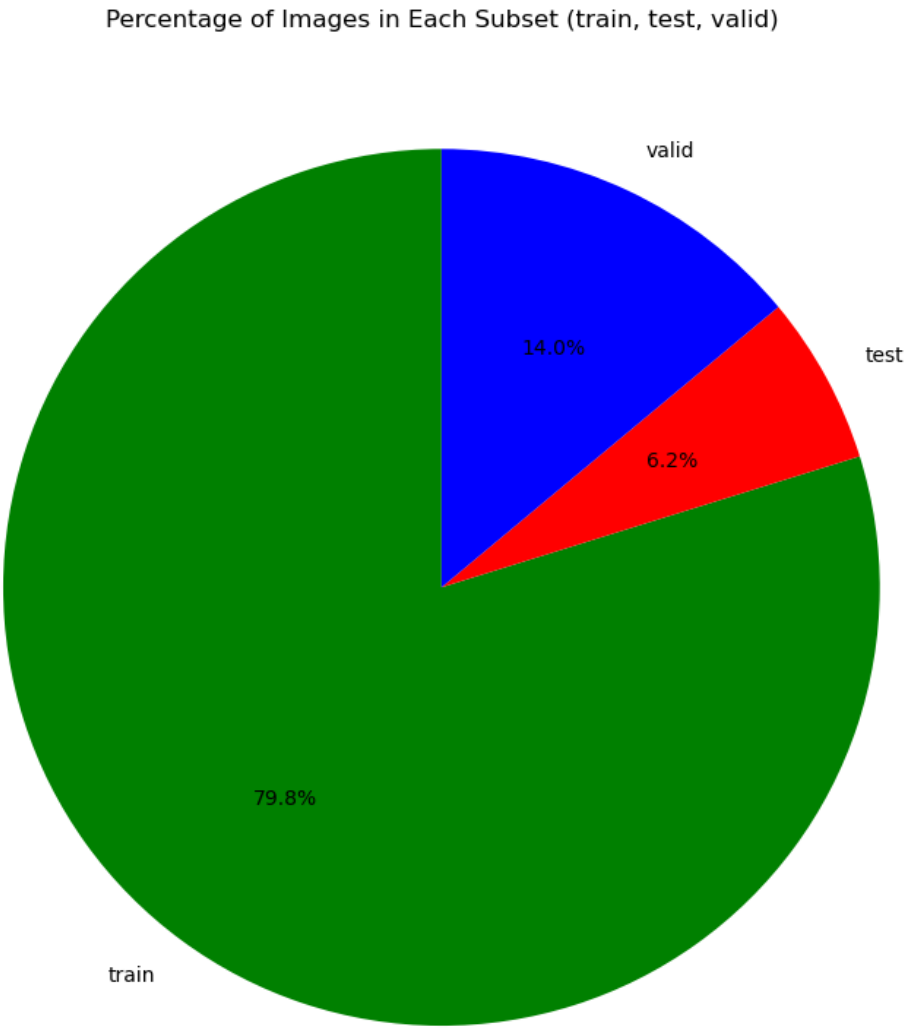

Class Percentage Distribution
defect
34.5%
good weld
41.3%
24.2%
bad weld

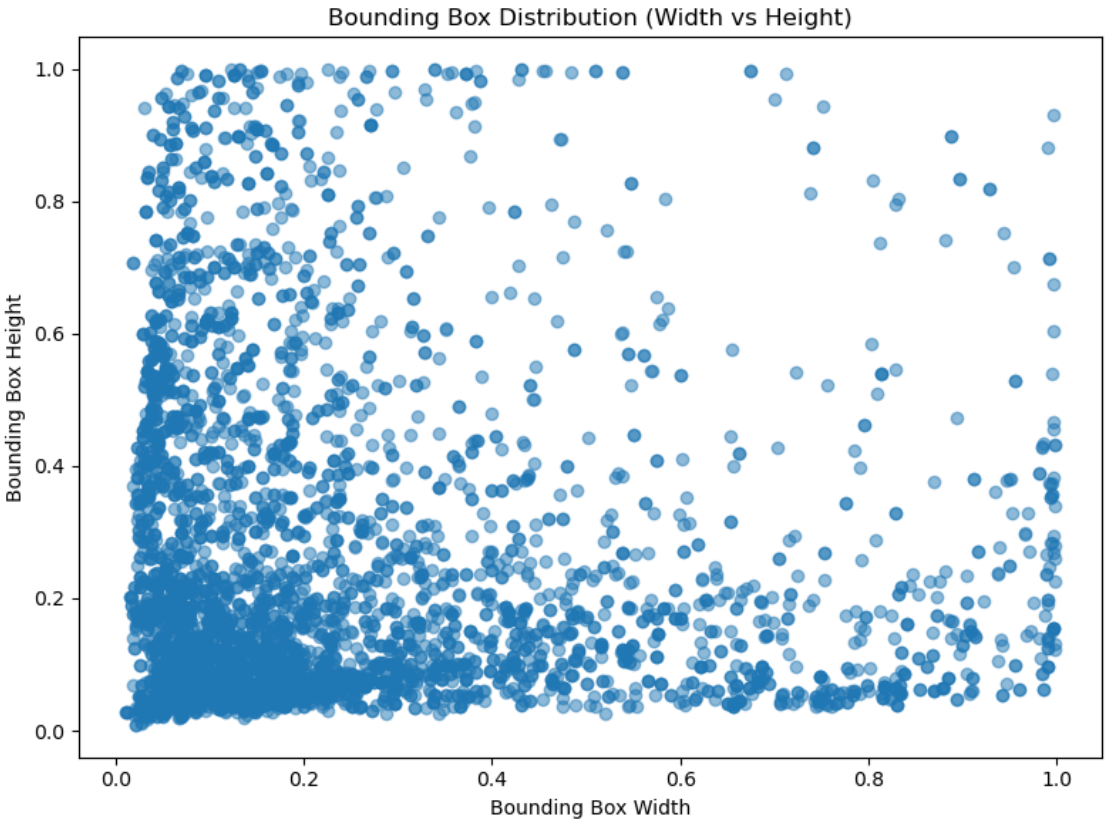

Train Split Percentage Distribution
defect
34.9%
good weld
41.4%
23.8%
bad weld


Test Split Percentage Distribution
defect
29.6%
good weld
38.9%
31.6%
bad weld


Valid Split Percentage Distribution
defect
34.0%
good weld
41.8%
24.2%
bad weld


Number of Images in Each Subset (train, test, valid)
Number of Images
0
200
400
600
800
1000
1200
1400
1600
train
test
valid
Subset


Percentage of Images in Each Subset (train, test, valid)
valid
14.0%
test
6.2%
79.8%
train


Bounding Box Distribution (Width vs Height)
Bounding Box Height
Bounding Box Width
0.0
0.2
0.4
0.6
0.8
1.0

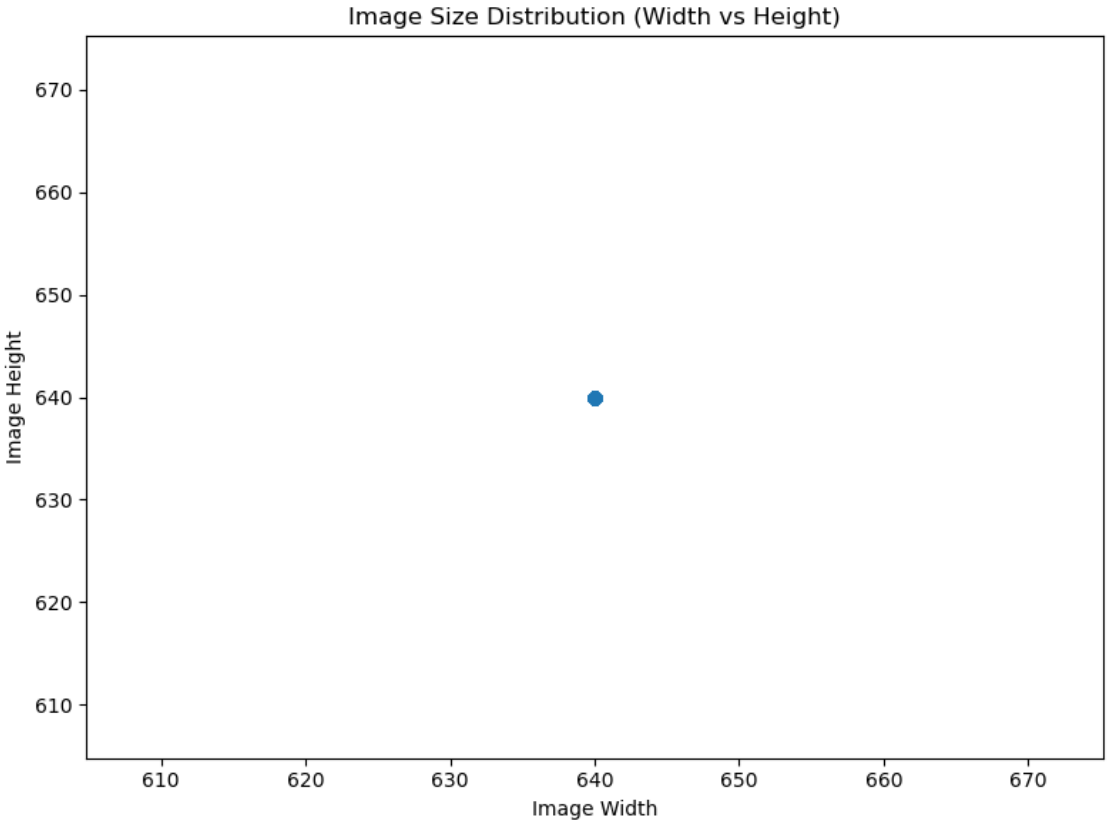
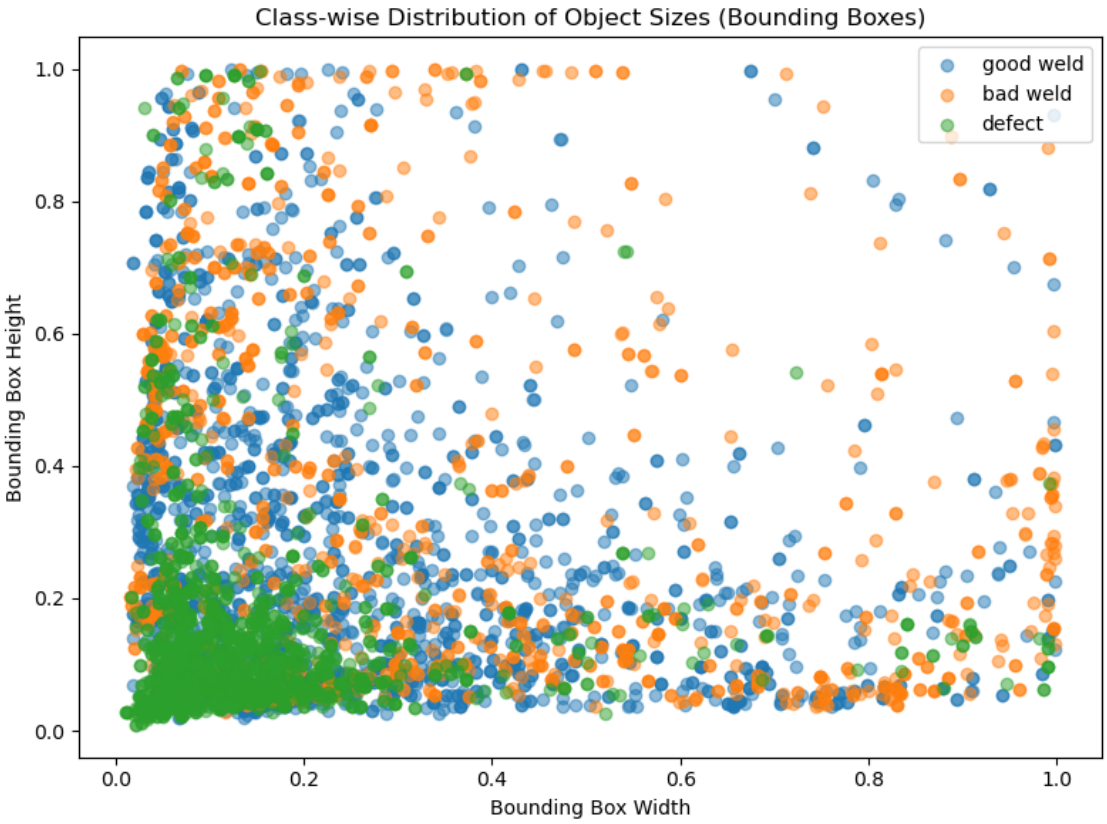
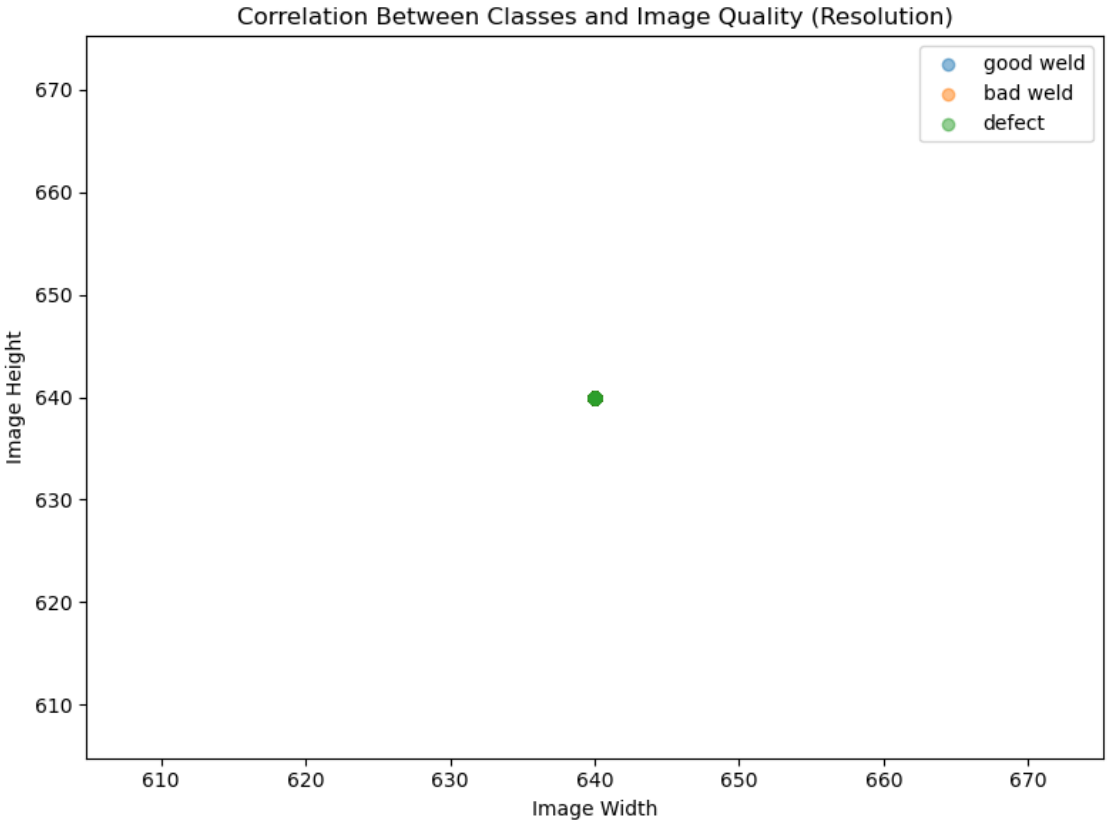


Image Size Distribution (Width vs Height)
Image Height
Image Width
670
660
650
640
630
620
610
610
620
630
640
650
660
670


Class-wise Distribution of Object Sizes (Bounding Boxes)
good weld
bad weld
defect
Bounding Box Height
Bounding Box Width
0.0
0.2
0.4
0.6
0.8
1.0


Correlation Between Classes and Image Quality (Resolution)
good weld
bad weld
defect
Image Height
Image Width
610
620
630
640
650
660
670