Suspicious Activity Detection using YOLOv11

Import Libraries

```
!pip install ultralytics

from ultralytics import YOLO
import cv2
import os
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image
import seaborn as sns
from tqdm.notebook import tqdm
```

Setup and Configuration

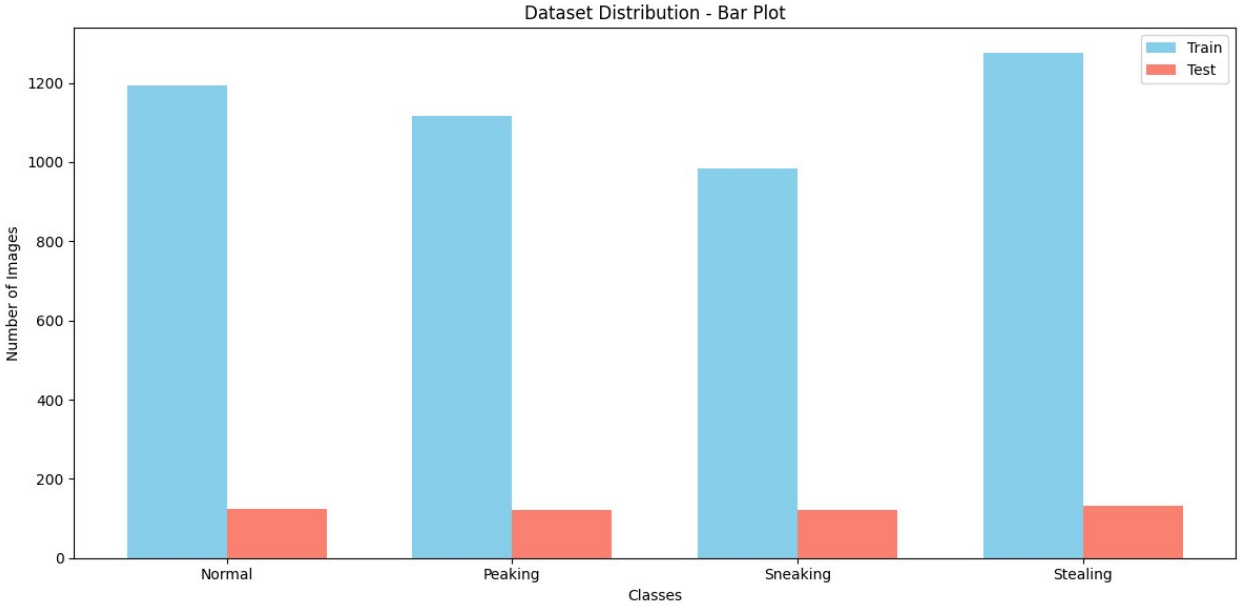
```
print("\n========== SECTION 1: Setup and Configuration ==========")

class Config:
    DATASET_PATH = '/kaggle/input/action-
detectionnormalstealingpeakingsneaking'
    TRAIN_DIR = os.path.join(DATASET_PATH, 'train')
    TEST_DIR = os.path.join(DATASET_PATH, 'test')
    CLASSES = ['Normal', 'Peaking', 'Sneaking', 'Stealing']
    CONF_THRESHOLD = 0.25
    BATCH_SIZE = 16
    IMG_SIZE = 640

model = YOLO('/kaggle/input/yolo11/pytorch/default/1/yolo11l.pt')
print("Model loaded successfully!")


========== SECTION 1: Setup and Configuration ==========
Model loaded successfully!
```

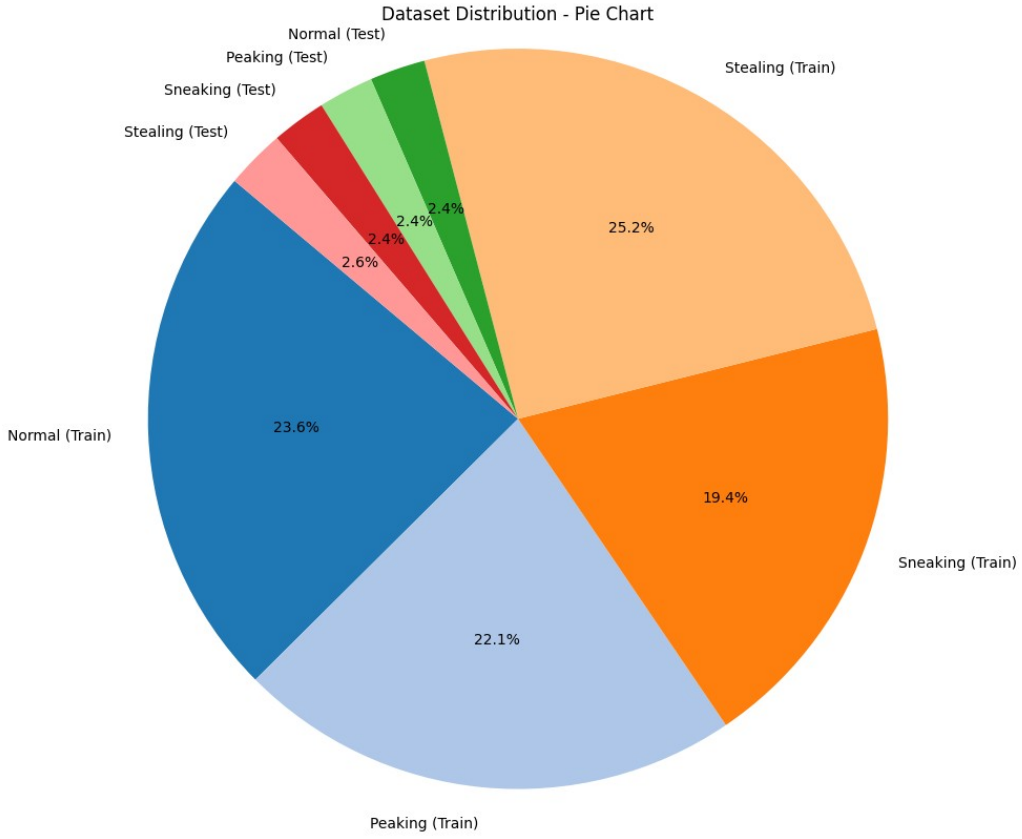
Data Exploration

```
def explore_dataset():
    """Explore and visualize the dataset"""
    class_counts = {}
    total_train_images = 0
    total_test_images = 0

    print("\nDataset Distribution:")

    for class_name in Config.CLASSES:
        train_count = len(os.listdir(os.path.join(Config.TRAIN_DIR,
class_name)))
        test_count = len(os.listdir(os.path.join(Config.TEST_DIR,
```

```
class_name)))
        class_counts[class_name] = {'train': train_count, 'test':
test_count}
        total_train_images += train_count
        total_test_images += test_count
        print(f"{class_name:8} - Train: {train_count:4} images, Test:
{test_count:4} images")

    total_images = total_train_images + total_test_images
    print(f"\nTotal images in dataset: {total_images}")

    plt.figure(figsize=(12, 6))
    x = np.arange(len(Config.CLASSES))
    width = 0.35

    plt.bar(x - width/2, [counts['train'] for counts in
class_counts.values()], width, label='Train', color='skyblue')
    plt.bar(x + width/2, [counts['test'] for counts in
class_counts.values()], width, label='Test', color='salmon')

    plt.xlabel('Classes')
    plt.ylabel('Number of Images')
    plt.title('Dataset Distribution - Bar Plot')
    plt.xticks(x, Config.CLASSES)
    plt.legend()
    plt.tight_layout()
    plt.show()

    pie_labels = [f"{class_name} (Train)" for class_name in
Config.CLASSES] + \
                 [f"{class_name} (Test)" for class_name in
Config.CLASSES]
    pie_sizes = [counts['train'] for counts in class_counts.values()]
+ \
                [counts['test'] for counts in class_counts.values()]
    pie_colors = plt.cm.tab20.colors[:len(pie_sizes)]

    plt.figure(figsize=(12, 8))
    plt.pie(pie_sizes, labels=pie_labels, autopct='%1.1f%%',
startangle=140, colors=pie_colors)
    plt.title('Dataset Distribution - Pie Chart')
    plt.axis('equal')
    plt.tight_layout()
    plt.show()

explore_dataset()


Dataset Distribution:
Normal   - Train: 1193 images, Test:  123 images
```

```
Peaking  - Train: 1117 images, Test:  122 images
Sneaking - Train:  983 images, Test:  121 images
Stealing - Train: 1275 images, Test:  131 images

Total images in dataset: 5065
```

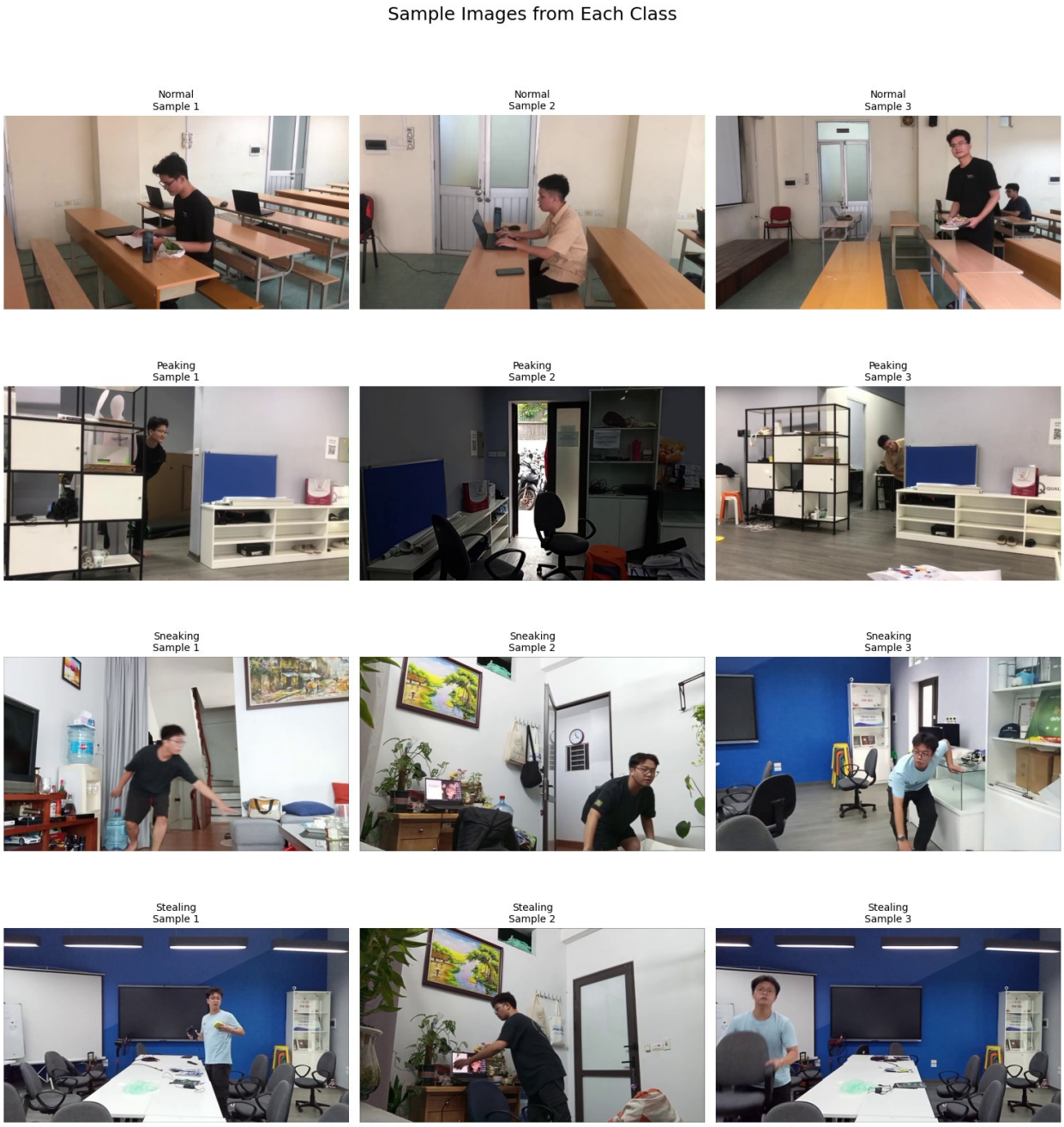




Display sample Images

```
def show_sample_images(num_samples=3):
    """Display sample images from each class"""
    num_classes = len(Config.CLASSES)
    total_images = num_classes * num_samples
    cols = num_samples
    rows = (total_images + cols - 1) // cols

    plt.figure(figsize=(15, rows * 4))

    for idx, class_name in enumerate(Config.CLASSES):
        class_path = os.path.join(Config.TRAIN_DIR, class_name)
        images = os.listdir(class_path)

        for sample_idx in range(num_samples):
            img_path = os.path.join(class_path,
np.random.choice(images))
            img = Image.open(img_path)

            subplot_idx = idx * num_samples + sample_idx + 1
            plt.subplot(rows, cols, subplot_idx)
            plt.imshow(img)
            plt.title(f'{class_name}\nSample {sample_idx + 1}',
fontsize=10)
            plt.axis('off')

    plt.suptitle('Sample Images from Each Class', fontsize=18, y=1.02)
    plt.tight_layout()
    plt.show()

print("\nDisplaying sample images...")
show_sample_images(num_samples=3)
```

```
Displaying sample images...
```



Model Predictions

```
print("\n========== SECTION 3: Model Predictions ==========")

def predict_and_display(image_path,
conf_threshold=Config.CONF_THRESHOLD):
    """Make and display predictions on a single image"""
    img = cv2.imread(image_path)
    img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
```

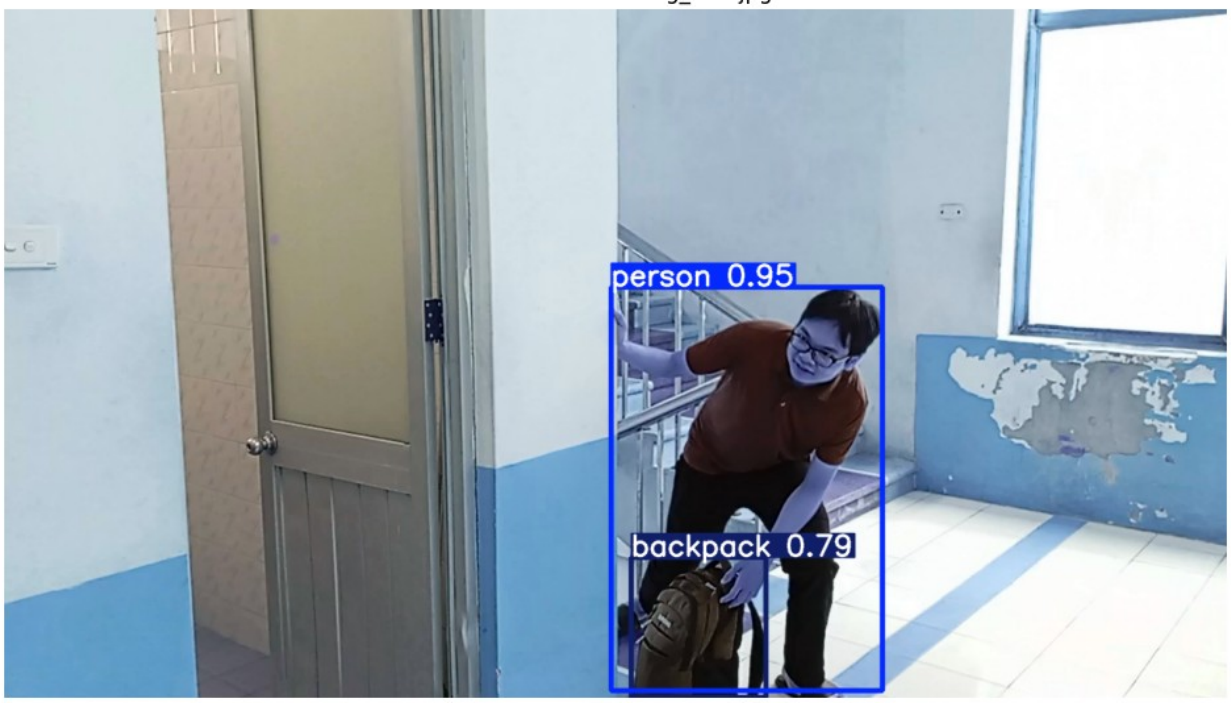
```
    results = model.predict(
        source=img,
        conf=conf_threshold,
        show=False
    )

    plt.figure(figsize=(12, 8))
    for r in results:
        im_array = r.plot()
        plt.imshow(cv2.cvtColor(im_array, cv2.COLOR_BGR2RGB))
        plt.title(f"Predictions: {os.path.basename(image_path)}")
        plt.axis('off')

        for box in r.boxes:
            conf = float(box.conf[0])
            cls = int(box.cls[0])
            cls_name = model.names[cls]
            print(f"Detected {cls_name} (Confidence: {conf:.2f})")

    plt.show()

confidence_thresholds = [0.25, 0.5, 0.75]

print("\nTesting one image per class with different confidence
thresholds...")
for conf in confidence_thresholds:
    print(f"\nConfidence Threshold: {conf}")
    for class_name in Config.CLASSES:
        test_class_path = os.path.join(Config.TEST_DIR, class_name)
        if os.path.exists(test_class_path):
            images = os.listdir(test_class_path)
            if images:
                sample_image = os.path.join(test_class_path,
np.random.choice(images))
                print(f"\nProcessing class '{class_name}' with image
'{os.path.basename(sample_image)}':")
                predict_and_display(sample_image, conf)


========== SECTION 3: Model Predictions ==========

Testing one image per class with different confidence thresholds...

Confidence Threshold: 0.25

Processing class 'Normal' with image 'Normal_122.jpg':

0: 384x640 1 person, 2 backpacks, 1 cup, 31.7ms
Speed: 1.8ms preprocess, 31.7ms inference, 1.4ms postprocess per image
at shape (1, 3, 384, 640)
```

```
Detected backpack (Confidence: 0.79)
Detected person (Confidence: 0.79)
Detected backpack (Confidence: 0.34)
Detected cup (Confidence: 0.29)
```

Predictions: Normal_122.jpg


```
Processing class 'Peaking' with image 'Peaking_109.jpg':

0: 384x640 1 person, 1 backpack, 31.2ms
Speed: 2.0ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.95)
Detected backpack (Confidence: 0.79)
```

Predictions: Peaking_109.jpg

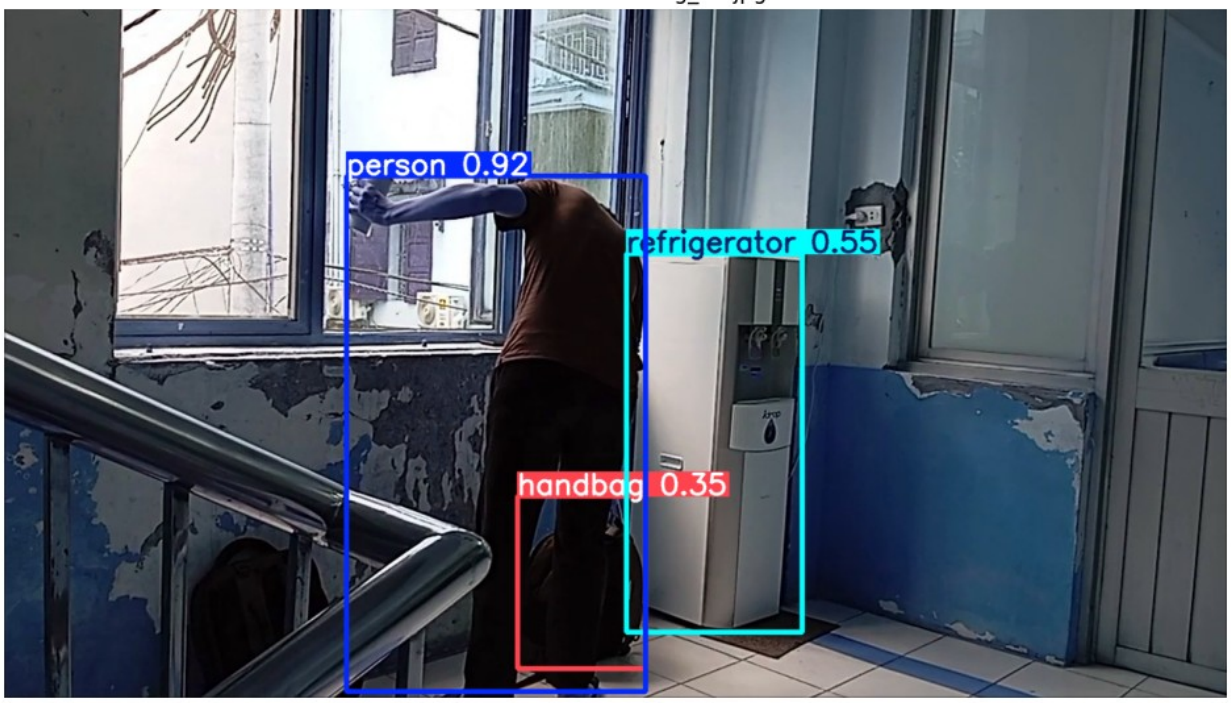



```
Processing class 'Sneaking' with image 'Sneaking_69.jpg':

0: 384x640 1 person, 31.2ms
Speed: 2.2ms preprocess, 31.2ms inference, 1.3ms postprocess per image at shape (1, 3, 384, 640)
Detected person (Confidence: 0.93)
```

Predictions: Sneaking_69.jpg


```
Processing class 'Stealing' with image 'Stealing_56.jpg':

0: 384x640 1 person, 1 handbag, 1 refrigerator, 31.2ms
Speed: 1.6ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.92)
Detected refrigerator (Confidence: 0.55)
Detected handbag (Confidence: 0.35)
```

Predictions: Stealing_56.jpg




```
Confidence Threshold: 0.5

Processing class 'Normal' with image 'Normal_94.jpg':

0: 384x640 1 person, 1 backpack, 31.1ms
Speed: 1.8ms preprocess, 31.1ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.91)
Detected backpack (Confidence: 0.85)
```

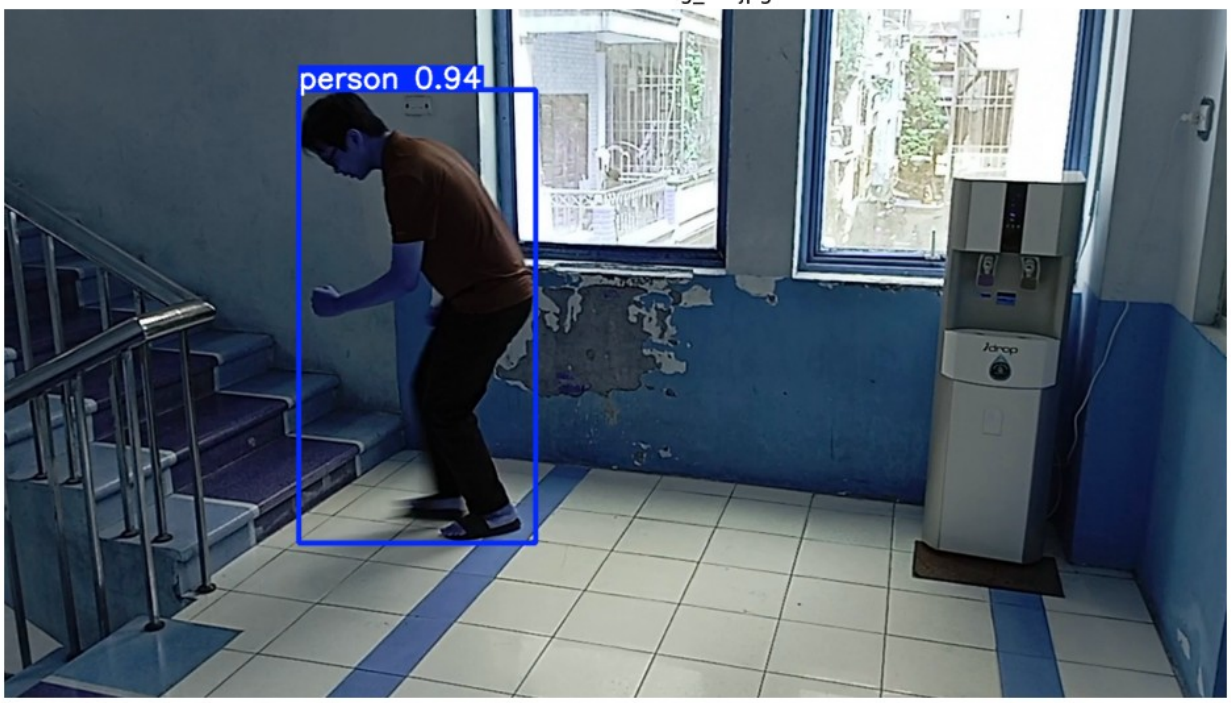
Predictions: Normal_94.jpg


```
Processing class 'Peaking' with image 'Peaking_58.jpg':

0: 384x640 1 person, 1 backpack, 31.1ms
Speed: 1.8ms preprocess, 31.1ms inference, 1.4ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.94)
Detected backpack (Confidence: 0.79)
```

Predictions: Peaking_58.jpg

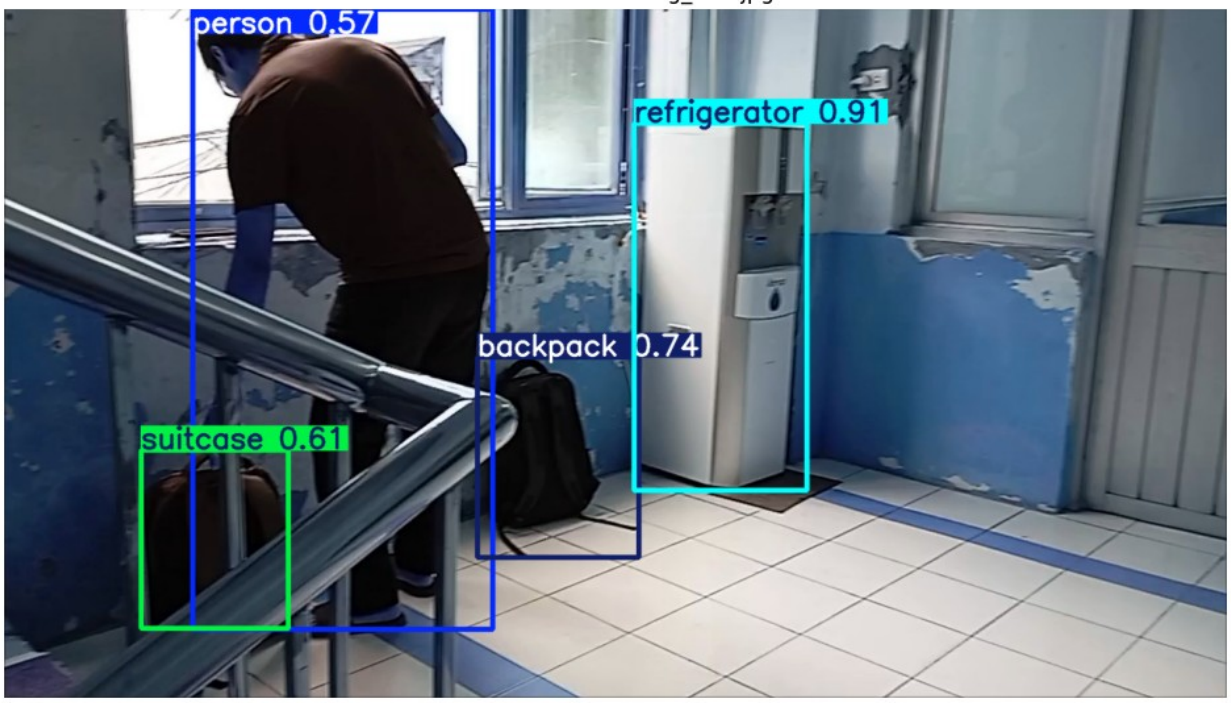

```
Processing class 'Sneaking' with image 'Sneaking_22.jpg':

0: 384x640 1 person, 31.2ms
Speed: 2.2ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.94)
```

Predictions: Sneaking_22.jpg




```
Processing class 'Stealing' with image 'Stealing_107.jpg':

0: 384x640 1 person, 1 backpack, 1 suitcase, 1 refrigerator, 31.2ms
Speed: 1.8ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected refrigerator (Confidence: 0.91)
Detected backpack (Confidence: 0.74)
Detected suitcase (Confidence: 0.61)
Detected person (Confidence: 0.57)
```

Predictions: Stealing_107.jpg

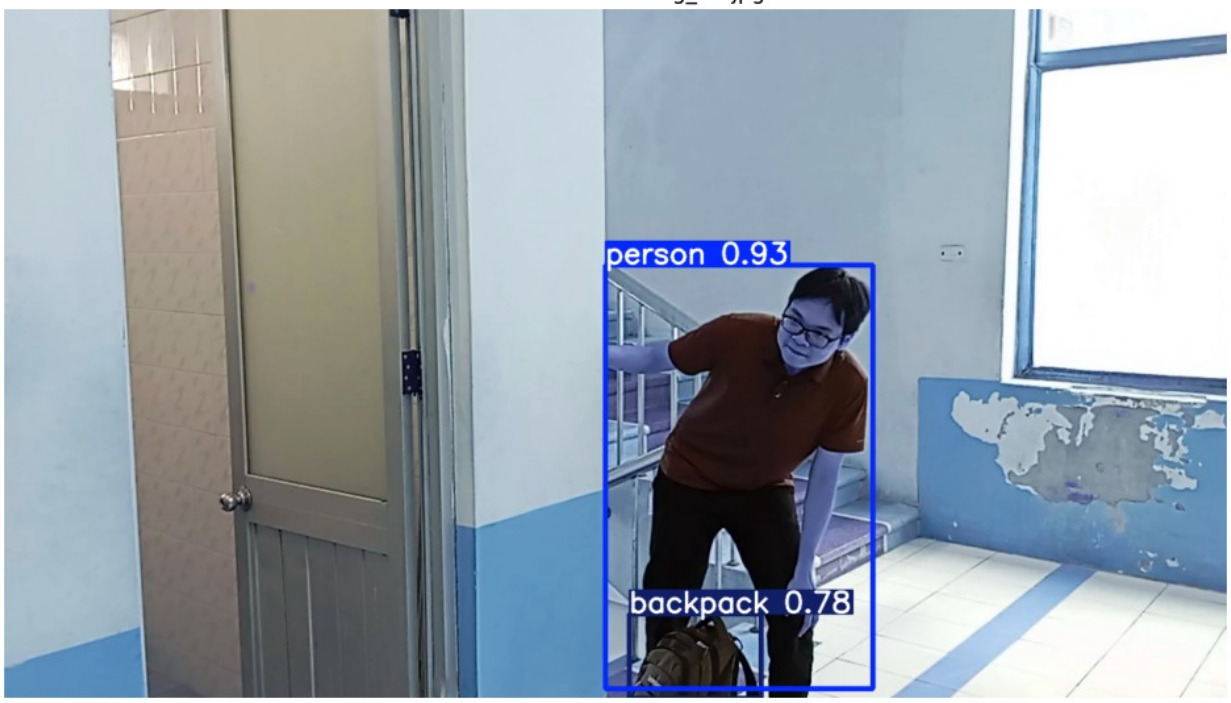



```
Confidence Threshold: 0.75

Processing class 'Normal' with image 'Normal_66.jpg':

0: 384x640 1 person, 1 backpack, 31.2ms
Speed: 2.2ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.91)
Detected backpack (Confidence: 0.86)
```

Predictions: Normal_66.jpg


```
Processing class 'Peaking' with image 'Peaking_63.jpg':

0: 384x640 1 person, 1 backpack, 31.1ms
Speed: 1.7ms preprocess, 31.1ms inference, 1.2ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.93)
Detected backpack (Confidence: 0.78)
```

Predictions: Peaking_63.jpg




```
Processing class 'Sneaking' with image 'Sneaking_46.jpg':

0: 384x640 1 person, 31.2ms
Speed: 1.8ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.93)
```

Predictions: Sneaking_46.jpg


```
Processing class 'Stealing' with image 'Stealing_115.jpg':

0: 384x640 1 person, 1 refrigerator, 31.2ms
Speed: 2.2ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
Detected person (Confidence: 0.91)
Detected refrigerator (Confidence: 0.91)
```

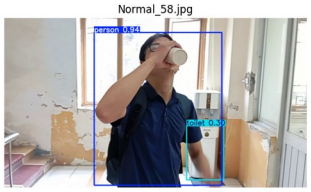
Batch Processing

```
print("\n========== SECTION 4: Batch Processing ==========")

def process_batch(directory, batch_size=Config.BATCH_SIZE):
    """Process multiple images in a batch and display predictions"""
    image_paths = []

    for class_name in Config.CLASSES:
        class_path = os.path.join(directory, class_name)
        if os.path.exists(class_path):
            class_images = os.listdir(class_path)
            image_paths.extend(
                [os.path.join(class_path, img) for img in
class_images[:batch_size]]
            )

    if not image_paths:
        print("No images found for batch processing.")
        return

    results = model(image_paths, conf=Config.CONF_THRESHOLD)

    num_images = len(image_paths)
    grid_cols = 4
    grid_rows = int(np.ceil(num_images / grid_cols))
```

```
    plt.figure(figsize=(20, 5 * grid_rows))

    for idx, r in enumerate(results):
        plt.subplot(grid_rows, grid_cols, idx + 1)
        im_array = r.plot()
        plt.imshow(cv2.cvtColor(im_array, cv2.COLOR_BGR2RGB))
        plt.axis('off')
        plt.title(f"{os.path.basename(image_paths[idx])}")

    plt.tight_layout()
    plt.show()
    print(f"\nProcessed {num_images} images.")

print("\nProcessing a batch of test images...")
process_batch(Config.TEST_DIR, batch_size=8)


========== SECTION 4: Batch Processing ==========

Processing a batch of test images...

0: 384x640 1 person, 1 toilet, 18.2ms
1: 384x640 1 person, 1 backpack, 18.2ms
2: 384x640 1 person, 1 backpack, 18.2ms
3: 384x640 1 person, 2 backpacks, 18.2ms
4: 384x640 1 person, 1 parking meter, 1 backpack, 18.2ms
5: 384x640 1 person, 1 backpack, 1 refrigerator, 18.2ms
6: 384x640 1 person, 1 parking meter, 1 backpack, 18.2ms
7: 384x640 1 person, 2 backpacks, 18.2ms
8: 384x640 1 person, 1 backpack, 18.2ms
9: 384x640 1 person, 1 backpack, 18.2ms
10: 384x640 1 person, 1 backpack, 18.2ms
11: 384x640 1 person, 1 backpack, 18.2ms
12: 384x640 1 person, 1 backpack, 18.2ms
13: 384x640 1 person, 1 backpack, 18.2ms
14: 384x640 1 person, 1 backpack, 18.2ms
15: 384x640 1 person, 1 backpack, 18.2ms
16: 384x640 1 person, 18.2ms
17: 384x640 1 person, 18.2ms
18: 384x640 1 person, 18.2ms
19: 384x640 1 person, 18.2ms
20: 384x640 1 person, 18.2ms
21: 384x640 1 person, 1 backpack, 18.2ms
22: 384x640 1 person, 18.2ms
23: 384x640 1 person, 18.2ms
24: 384x640 1 person, 1 handbag, 1 refrigerator, 18.2ms
25: 384x640 1 person, 1 backpack, 1 refrigerator, 18.2ms
26: 384x640 1 person, 2 backpacks, 18.2ms
27: 384x640 2 persons, 1 backpack, 1 suitcase, 1 refrigerator, 18.2ms
28: 384x640 1 person, 1 backpack, 18.2ms
```

```
29: 384x640 1 person, 1 backpack, 1 refrigerator, 18.2ms
30: 384x640 1 person, 1 backpack, 18.2ms
31: 384x640 2 persons, 1 backpack, 1 suitcase, 1 refrigerator, 18.2ms
Speed: 1.6ms preprocess, 18.2ms inference, 0.7ms postprocess per image
at shape (1, 3, 384, 640)
```

Normal_58.jpg

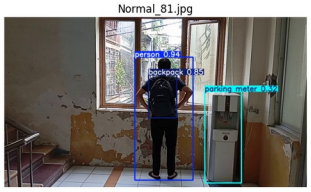


Normal_96.jpg

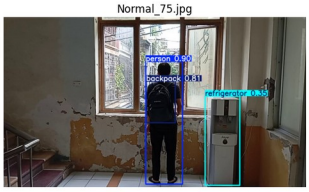
Normal_103.jpg

Normal_55.jpg

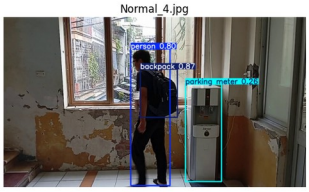
Normal_81.jpg



Normal_75.jpg



Normal_4.jpg



Normal_121.jpg

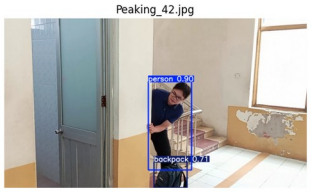
Peaking_79.jpg

Peaking_90.jpg

Peaking_64.jpg

Peaking_111.jpg

Peaking_42.jpg



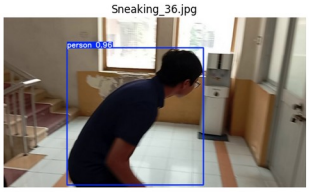
Peaking_65.jpg

Peaking_54.jpg

Peaking_96.jpg

Sneaking_50.jpg

Sneaking_36.jpg

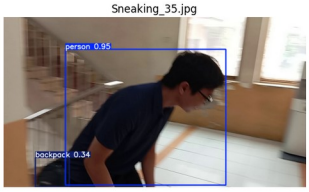


Sneaking_75.jpg

Sneaking_24.jpg

Sneaking_72.jpg

Sneaking_35.jpg



Sneaking_78.jpg

Sneaking_11.jpg

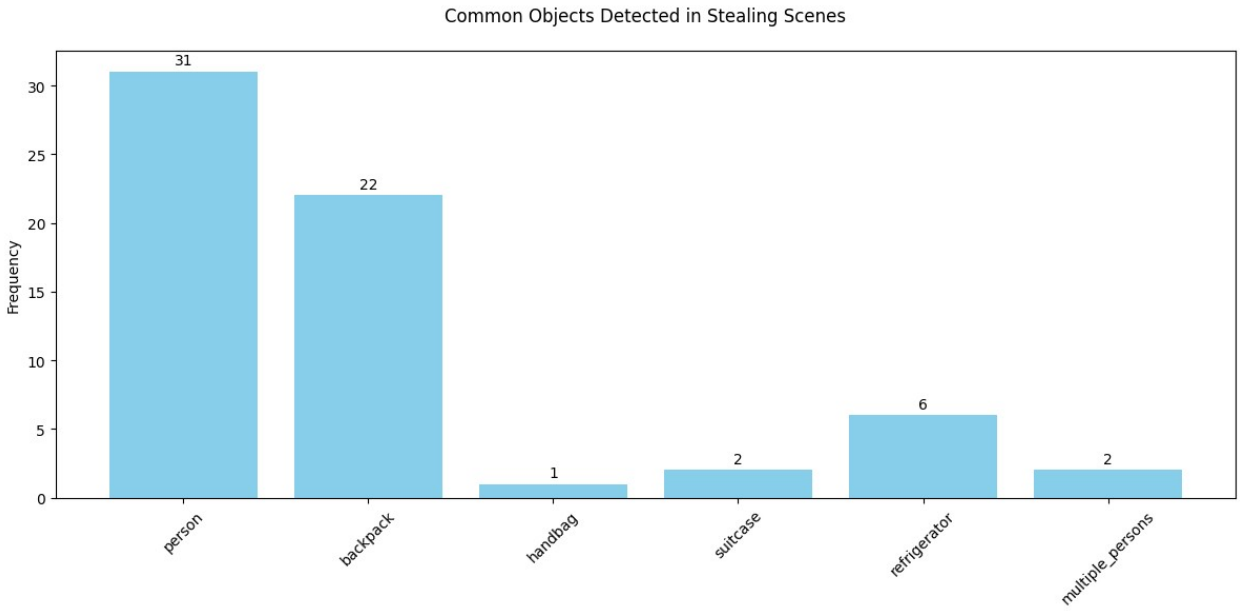
```
Processed 32 images.
```

Analysis

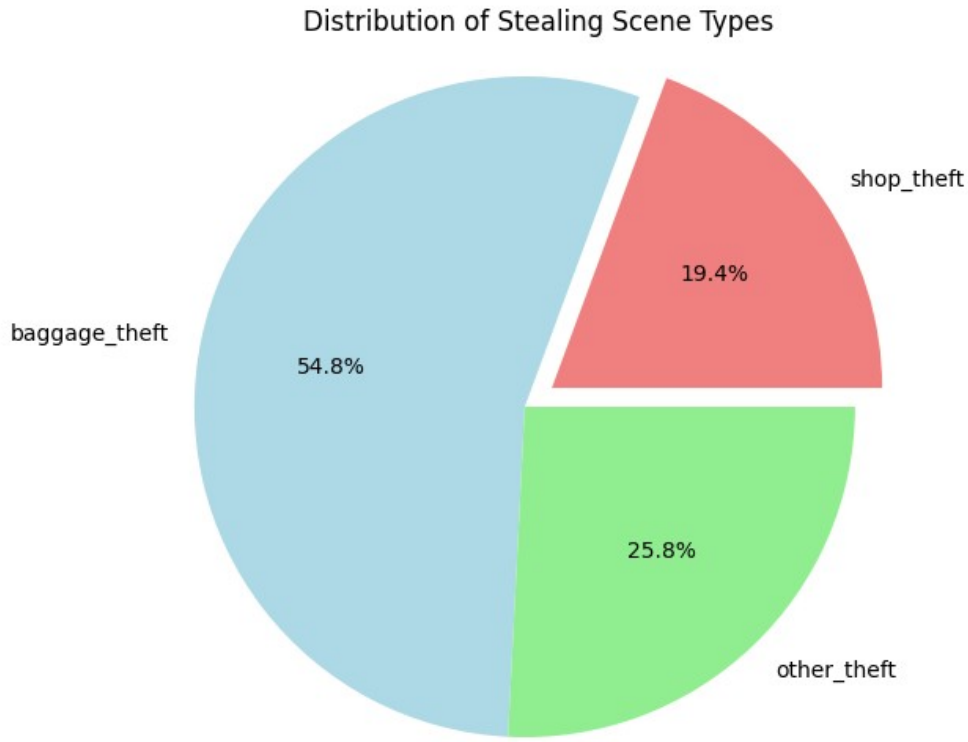
```
import matplotlib.pyplot as plt
import seaborn as sns
from collections import Counter

results = [
    "1 person, 1 toilet",
    "1 person, 1 backpack",
    "1 person, 1 backpack",
    "1 person, 2 backpacks",
    "1 person, 1 parking meter, 1 backpack",
    "1 person, 1 backpack, 1 refrigerator",
    "1 person, 1 parking meter, 1 backpack",
    "1 person, 2 backpacks",
    "1 person, 1 backpack",
    "1 person, 1 backpack",
    "1 person, 1 backpack",
    "1 person, 1 backpack",
    "1 person, 1 backpack",
    "1 person, 1 backpack",
    "1 person, 1 backpack",
    "1 person",
    "1 person",
    "1 person",
    "1 person",
    "1 person",
    "1 person, 1 backpack",
    "1 person",
    "1 person",
    "1 person, 1 handbag, 1 refrigerator",
    "1 person, 1 backpack, 1 refrigerator",
    "1 person, 2 backpacks",
    "2 persons, 1 backpack, 1 suitcase, 1 refrigerator",
    "1 person, 1 backpack",
    "1 person, 1 backpack, 1 refrigerator",
    "1 person, 1 backpack",
    "2 persons, 1 backpack, 1 suitcase, 1 refrigerator"
]

def analyze_stealing_detections():
    detections = {
        'person': 0,
        'backpack': 0,
        'handbag': 0,
```

```
        'suitcase': 0,
        'refrigerator': 0,
        'multiple_persons': 0
    }

    for line in results:
        if 'persons' in line:
            detections['multiple_persons'] += 1
        if 'person' in line:
            detections['person'] += 1
        if 'backpack' in line:
            detections['backpack'] += 1
        if 'handbag' in line:
            detections['handbag'] += 1
        if 'suitcase' in line or 'suitcases' in line:
            detections['suitcase'] += 1
        if 'refrigerator' in line:
            detections['refrigerator'] += 1

    plt.figure(figsize=(12, 6))
    plt.bar(detections.keys(), detections.values(), color='skyblue')
    plt.title('Common Objects Detected in Stealing Scenes', pad=20)
    plt.xticks(rotation=45)
    plt.ylabel('Frequency')
    for i, v in enumerate(detections.values()):
        plt.text(i, v + 0.5, str(v), ha='center')
    plt.tight_layout()
    plt.show()

    print("\nDetection Statistics:")
    total_images = len(results)
    print(f"Total images analyzed: {total_images}")
    for obj, count in detections.items():
        percentage = (count / total_images) * 100
        print(f"{obj}: {count} occurrences ({percentage:.1f}%)")

    print("\nCommon Patterns:")
    backpack_with_person = sum(1 for line in results if 'person' in
line and 'backpack' in line)
    handbag_with_person = sum(1 for line in results if 'person' in
line and 'handbag' in line)
    refrigerator_scenes = sum(1 for line in results if 'refrigerator'
in line)

    print(f"- Person with backpack: {backpack_with_person} scenes")
    print(f"- Person with handbag: {handbag_with_person} scenes")
    print(f"- Scenes with refrigerator: {refrigerator_scenes} scenes")

def classify_stealing_scenes():
```

```
    scene_types = {
        'shop_theft': 0,
        'baggage_theft': 0,
        'other_theft': 0
    }

    for line in results:
        if 'refrigerator' in line:
            scene_types['shop_theft'] += 1
        elif any(item in line for item in ['backpack', 'handbag',
'suitcase', 'suitcases']):
            scene_types['baggage_theft'] += 1
        else:
            scene_types['other_theft'] += 1

    plt.figure(figsize=(10, 6))
    colors = ['lightcoral', 'lightblue', 'lightgreen']
    plt.pie(scene_types.values(), labels=scene_types.keys(),
autopct='%1.1f%%',
            colors=colors, explode=(0.1, 0, 0))
    plt.title('Distribution of Stealing Scene Types')
    plt.axis('equal')
    plt.show()

    print("\nScene Type Analysis:")
    for scene_type, count in scene_types.items():
        print(f"{scene_type}: {count} scenes")

print("\n========== SECTION 5: Detection Analysis ==========")
analyze_stealing_detections()

print("\n========== SECTION 6: Scene Classification ==========")
classify_stealing_scenes()

print("\nAnalysis completed!")


========== SECTION 5: Detection Analysis ==========
```




```
Detection Statistics:
Total images analyzed: 31
person: 31 occurrences (100.0%)
backpack: 22 occurrences (71.0%)
handbag: 1 occurrences (3.2%)
suitcase: 2 occurrences (6.5%)
refrigerator: 6 occurrences (19.4%)
multiple_persons: 2 occurrences (6.5%)

Common Patterns:
- Person with backpack: 22 scenes
- Person with handbag: 1 scenes
- Scenes with refrigerator: 6 scenes

========== SECTION 6: Scene Classification ==========
```




```
Scene Type Analysis:
shop_theft: 6 scenes
baggage_theft: 17 scenes
other_theft: 8 scenes

Analysis completed!
```

Live Test on New Image

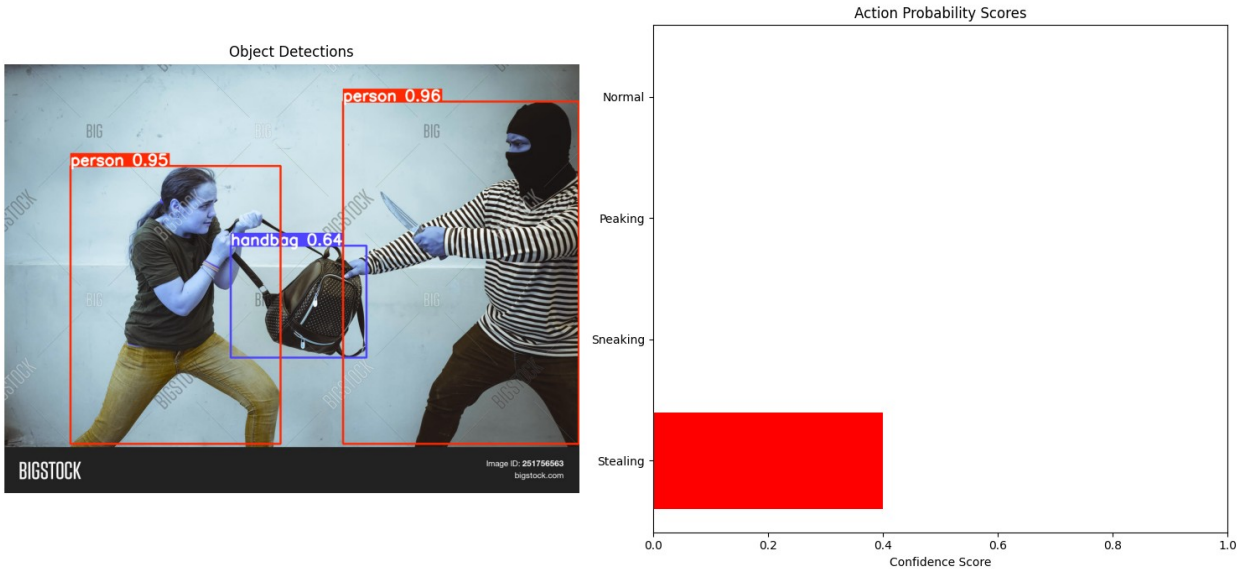
```python
import urllib.request
import os
import numpy as np
import cv2
import matplotlib.pyplot as plt

def detect_action(model, image_path):
    results = model.predict(source=image_path, conf=0.25, save=False)
    result = results[0]

    detections = [
        (model.names[int(box.cls[0])], float(box.conf[0]))
        for box in result.boxes
    ]
```

```
    def classify_action(detections):
        detected_objects = [d[0] for d in detections]

        action_scores = {
            'Stealing': 0.0,
            'Sneaking': 0.0,
            'Peaking': 0.0,
            'Normal': 0.0
        }

        if 'person' in detected_objects:
            if any(obj in detected_objects for obj in ['backpack',
'handbag', 'suitcase']):
                action_scores['Stealing'] += 0.4
            if 'refrigerator' in detected_objects:
                action_scores['Stealing'] += 0.3
            if [conf for obj, conf in detections if obj == 'person']
[0] < 0.6:
                action_scores['Sneaking'] += 0.5
            if len(detected_objects) <= 2:
                action_scores['Peaking'] += 0.5

        if not any(score > 0.3 for score in action_scores.values()):
            action_scores['Normal'] = 0.4

        return action_scores

    action_scores = classify_action(detections)

    plt.figure(figsize=(15, 7))

    plt.subplot(1, 2, 1)
    img = cv2.imread(image_path)
    img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
    plt.imshow(result.plot())
    plt.title('Object Detections')
    plt.axis('off')

    plt.subplot(1, 2, 2)
    actions = list(action_scores.keys())
    scores = list(action_scores.values())
    colors = ['red' if score == max(scores) else 'blue' for score in
scores]

    plt.barh(actions, scores, color=colors)
    plt.title('Action Probability Scores')
    plt.xlabel('Confidence Score')
    plt.xlim(0, 1)
```

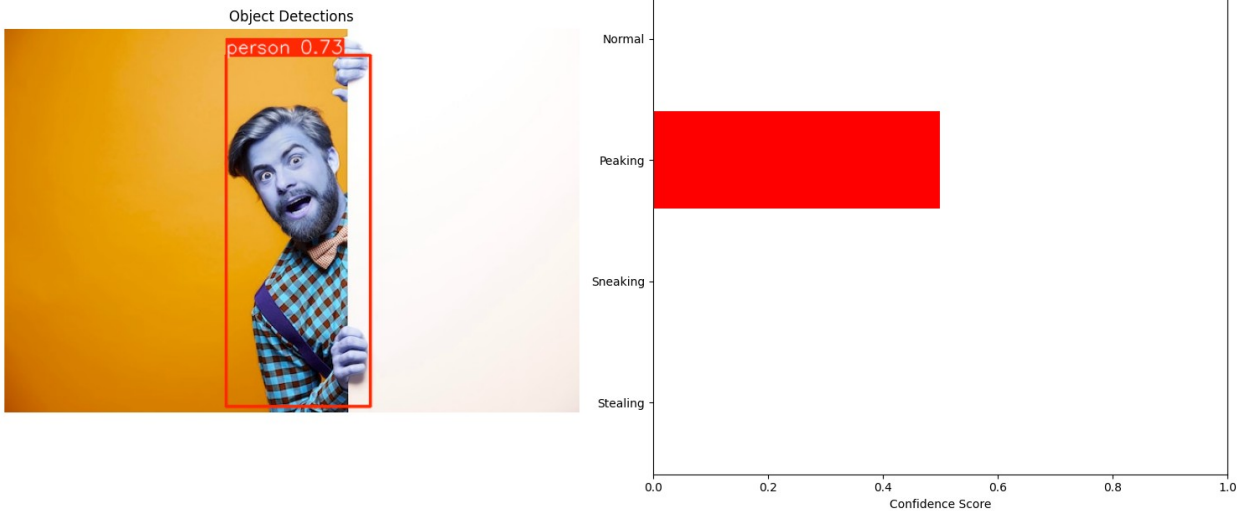
```
    plt.tight_layout()
    plt.show()

    print("\nDetected Objects:")
    for obj, conf in detections:
        print(f"- {obj}: {conf:.2%} confidence")

    print("\nAction Analysis:")
    predicted_action = max(action_scores.items(), key=lambda x: x[1])
    print(f"Predicted Action: {predicted_action[0]}
({predicted_action[1]:.2%} confidence)")
    print("\nAll Action Scores:")
    for action, score in action_scores.items():
        print(f"- {action}: {score:.2%}")

test_urls = {
    'suspicious_action1':
'https://static1.bigstockphoto.com/1/5/2/large1500/251756563.jpg',
    'suspicious_action2':
'https://img.freepik.com/free-photo/portrait-shocked-man-
peeking_329181-19905.jpg',
}

for name, url in test_urls.items():
    try:
        print(f"\nTesting {name}:")
        image_path = f'test_{name}.jpg'

        opener = urllib.request.build_opener()
        opener.addheaders = [('User-Agent', 'Mozilla/5.0')]
        urllib.request.install_opener(opener)

        urllib.request.urlretrieve(url, image_path)
        print("Image downloaded successfully")

        detect_action(model, image_path)

        os.remove(image_path)

    except Exception as e:
        print(f"Error processing {url}: {str(e)}")

print("\nAction detection testing completed!")
```

```
Testing suspicious_action1:
Image downloaded successfully

image 1/1 /kaggle/working/test_suspicious_action1.jpg: 480x640 2
persons, 1 handbag, 38.8ms
```

```
Speed: 2.5ms preprocess, 38.8ms inference, 1.4ms postprocess per image at shape (1, 3, 480, 640)
```




```
Detected Objects:
- person: 96.08% confidence
- person: 95.05% confidence
- handbag: 64.13% confidence

Action Analysis:
Predicted Action: Stealing (40.00% confidence)

All Action Scores:
- Stealing: 40.00%
- Sneaking: 0.00%
- Peaking: 0.00%
- Normal: 0.00%

Testing suspicious_action2:
Image downloaded successfully

image 1/1 /kaggle/working/test_suspicious_action2.jpg: 448x640 1 person, 37.8ms
Speed: 2.1ms preprocess, 37.8ms inference, 1.3ms postprocess per image at shape (1, 3, 448, 640)
```



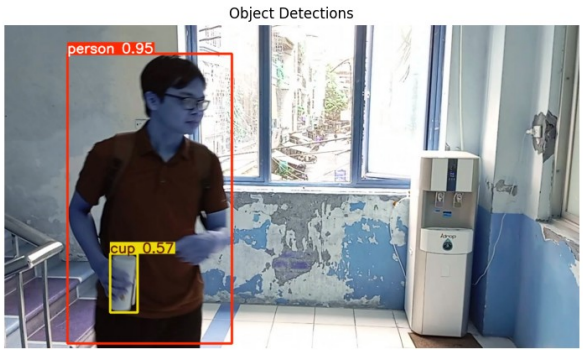

```
Detected Objects:
- person: 72.68% confidence

Action Analysis:
Predicted Action: Peaking (50.00% confidence)

All Action Scores:
- Stealing: 0.00%
- Sneaking: 0.00%
- Peaking: 50.00%
- Normal: 0.00%

Action detection testing completed!
```

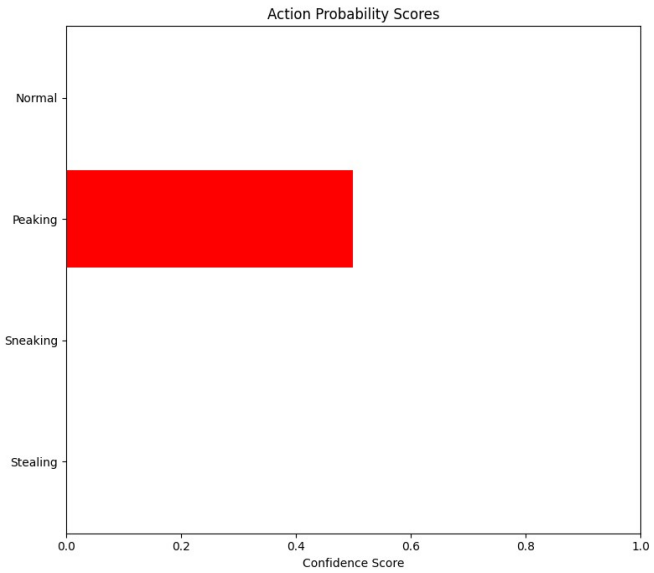
```python
def detect_action(model, image_path):
    results = model.predict(source=image_path, conf=0.25, save=False)
    result = results[0]

    detections = [
        (model.names[int(box.cls[0])], float(box.conf[0]))
        for box in result.boxes
    ]

    def classify_action(detections):
        detected_objects = [d[0] for d in detections]

        action_scores = {
            'Stealing': 0.0,
            'Sneaking': 0.0,
            'Peaking': 0.0,
            'Normal': 0.0
```

```
        }

        if 'person' in detected_objects:
            if any(obj in detected_objects for obj in ['backpack',
'handbag', 'suitcase']):
                action_scores['Stealing'] += 0.4
            if 'refrigerator' in detected_objects:
                action_scores['Stealing'] += 0.3
            if [conf for obj, conf in detections if obj == 'person']
[0] < 0.6:
                action_scores['Sneaking'] += 0.5
            if len(detected_objects) <= 2:
                action_scores['Peaking'] += 0.5

        if not any(score > 0.3 for score in action_scores.values()):
            action_scores['Normal'] = 0.4

        return action_scores

    action_scores = classify_action(detections)

    plt.figure(figsize=(15, 7))

    plt.subplot(1, 2, 1)
    img = cv2.imread(image_path)
    img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
    plt.imshow(result.plot())
    plt.title('Object Detections')
    plt.axis('off')

    plt.subplot(1, 2, 2)
    actions = list(action_scores.keys())
    scores = list(action_scores.values())
    colors = ['red' if score == max(scores) else 'blue' for score in
scores]

    plt.barh(actions, scores, color=colors)
    plt.title('Action Probability Scores')
    plt.xlabel('Confidence Score')
    plt.xlim(0, 1)

    plt.tight_layout()
    plt.show()

    print("\nDetected Objects:")
    for obj, conf in detections:
        print(f"- {obj}: {conf:.2%} confidence")

    print("\nAction Analysis:")
    predicted_action = max(action_scores.items(), key=lambda x: x[1])
```

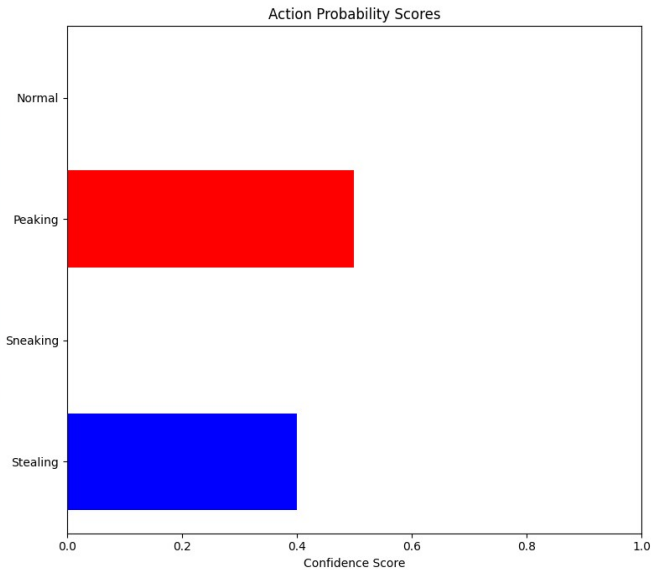
```
    print(f"Predicted Action: {predicted_action[0]}
({predicted_action[1]:.2%} confidence)")
    print("\nAll Action Scores:")
    for action, score in action_scores.items():
        print(f"- {action}: {score:.2%}")

test_paths = {
    'Normal': '/kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Normal/Normal_10.jpg',
    'Peaking': '/kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Peaking/Peaking_10.jpg',
    'Sneaking': '/kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Sneaking/Sneaking_10.jpg',
    'Stealing': '/kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Stealing/Stealing_10.jpg'
}

for action, image_path in test_paths.items():
    try:
        print(f"\nTesting {action}:")
        detect_action(model, image_path)
    except Exception as e:
        print(f"Error processing {image_path}: {str(e)}")

print("\nAction detection testing completed!")
```

```
Testing Normal:

image 1/1 /kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Normal/Normal_10.jpg:
384x640 1 person, 1 cup, 32.0ms
Speed: 1.9ms preprocess, 32.0ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
```

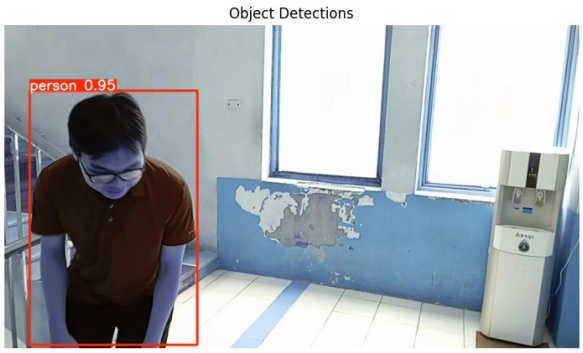


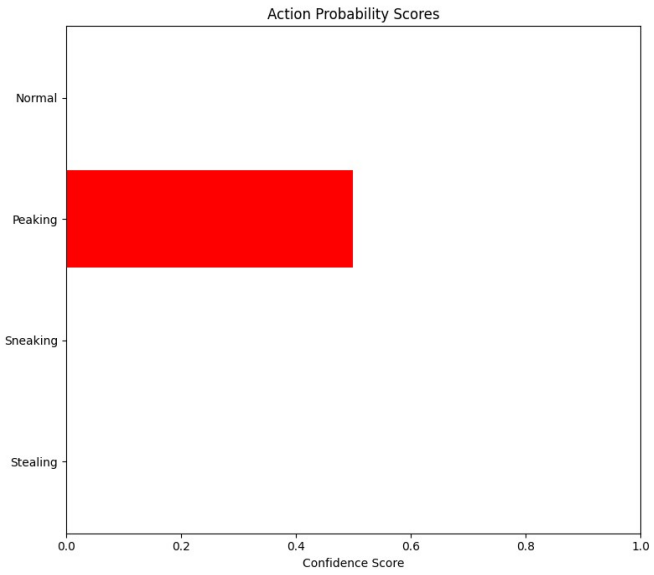



```
Detected Objects:
- person: 95.09% confidence
- cup: 56.65% confidence

Action Analysis:
Predicted Action: Peaking (50.00% confidence)

All Action Scores:
- Stealing: 0.00%
- Sneaking: 0.00%
- Peaking: 50.00%
- Normal: 0.00%

Testing Peaking:

image 1/1 /kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Peaking/Peaking_10.jpg:
384x640 1 person, 1 backpack, 31.2ms
Speed: 2.1ms preprocess, 31.2ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
```

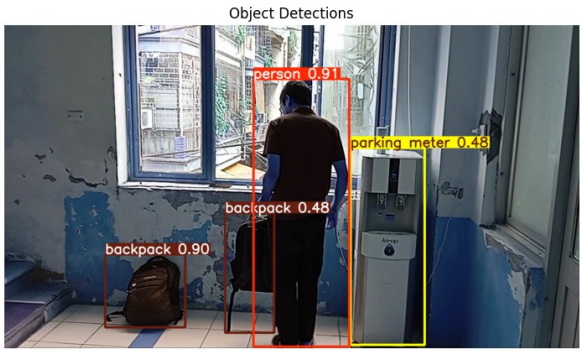


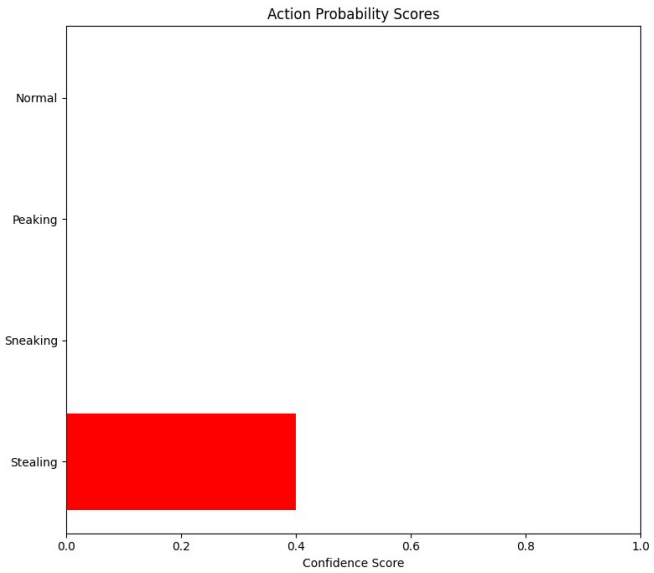

```
Detected Objects:
- person: 86.54% confidence
- backpack: 73.66% confidence

Action Analysis:
Predicted Action: Peaking (50.00% confidence)

All Action Scores:
- Stealing: 40.00%
- Sneaking: 0.00%
- Peaking: 50.00%
- Normal: 0.00%

Testing Sneaking:

image 1/1 /kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Sneaking/Sneaking_10.jpg:
384x640 1 person, 31.1ms
Speed: 1.8ms preprocess, 31.1ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
```






```
Detected Objects:
- person: 95.20% confidence

Action Analysis:
Predicted Action: Peaking (50.00% confidence)

All Action Scores:
- Stealing: 0.00%
- Sneaking: 0.00%
- Peaking: 50.00%
- Normal: 0.00%

Testing Stealing:

image 1/1 /kaggle/input/action-
detectionnormalstealingpeakingsneaking/test/Stealing/Stealing_10.jpg:
384x640 1 person, 1 parking meter, 2 backpacks, 31.3ms
Speed: 2.0ms preprocess, 31.3ms inference, 1.3ms postprocess per image
at shape (1, 3, 384, 640)
```






```
Detected Objects:
- person: 91.24% confidence
- backpack: 89.61% confidence
- parking meter: 47.78% confidence
- backpack: 47.66% confidence

Action Analysis:
Predicted Action: Stealing (40.00% confidence)

All Action Scores:
- Stealing: 40.00%
- Sneaking: 0.00%
- Peaking: 0.00%
- Normal: 0.00%

Action detection testing completed!
```

Thanks !!!