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**Bài 1:** Detect Pedestrians from image step by step

**Source Code:**

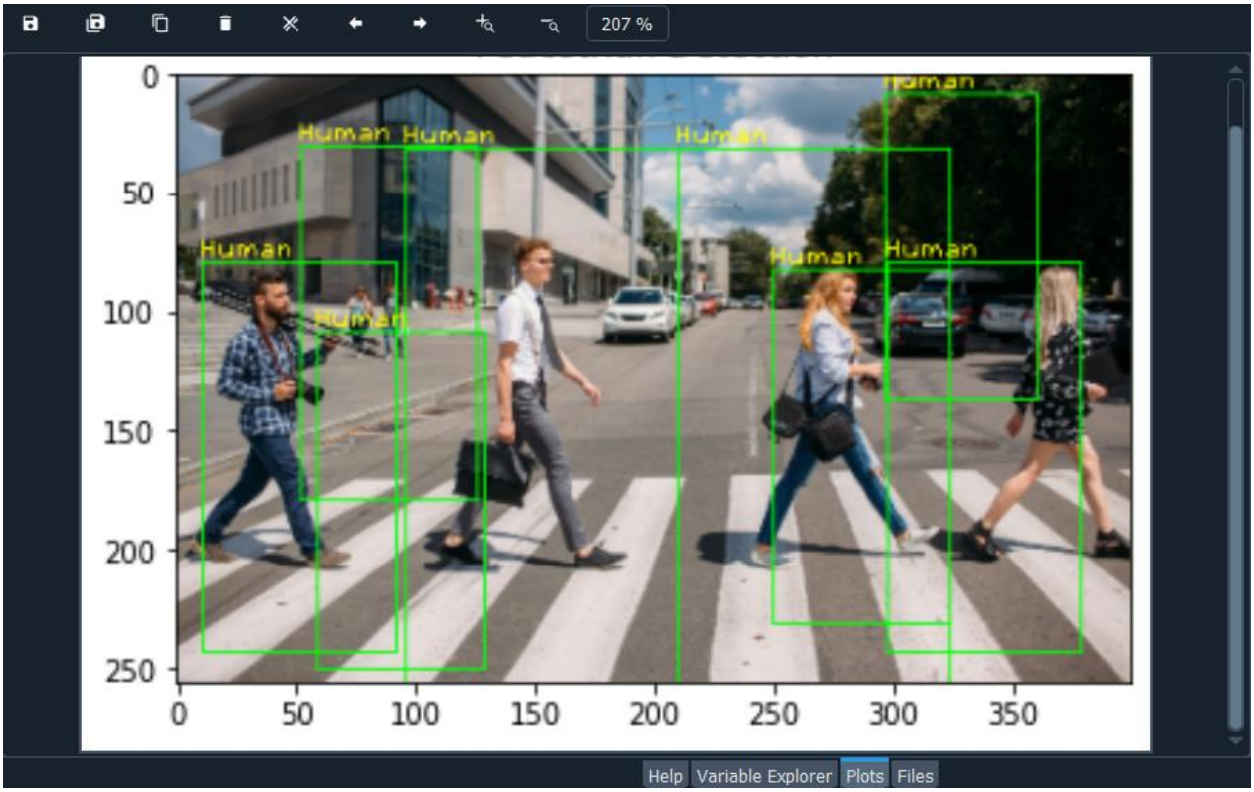
```python
from skimage.feature import hog
from sklearn.svm import LinearSVC
from sklearn.model_selection import train_test_split
from matplotlib import pyplot as plt
from sklearn import metrics
from imutils.object_detection import non_max_suppression
from skimage import color
from skimage.transform import pyramid_gaussian

import joblib
import glob
import os
import cv2
import numpy as np


X = []
Y = []

pos_im_path = "D:/Computer Vision/OpenCV-Practice/Lab5/positive"
neg_im_path = "D:/Computer Vision/OpenCV-Practice/Lab5/negative"

# Load positive features
for filename in glob.glob(os.path.join(pos_im_path, "*.png")):
    fd = cv2.imread(filename, 0)
    fd = cv2.resize(fd, (64, 128))
    fd = hog(
        fd,
        orientations=9,
        pixels_per_cell=(8, 8),
        visualize=False,
        cells_per_block=(2, 2),
    )
    X.append(fd)
    Y.append(1)
```

```
36
37  # Load negative features
38  for filename in glob.glob(os.path.join(neg_im_path, "*.png")):
39      fd = cv2.imread(filename, 0)
40      fd = cv2.resize(fd, (64, 128))
41      fd = hog(
42          fd,
43          orientations=9,
44          pixels_per_cell=(8, 8),
45          visualize=False,
46          cells_per_block=(2, 2),
47      )
48      X.append(fd)
49      Y.append(0)
50
51
52  X = np.float32(X)
53  Y = np.array(Y)
54
55  X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.2)
56
57  print("Train data: ", len(X_train))
58  print("Train Labels (1, 0) ", len(y_train))
59
60  model = LinearSVC()
61  model.fit(X_train, y_train)
62
63  # predict
64  y_pred = model.predict(X_test)
65
66  # confusion matrix and accuracy
67  print(
68      f"Classification report for classifier {model}:\n"
69      f"{metrics.classification_report(y_test, y_pred)}\n"
70  )
71
72  joblib.dump(model, "models.dat")
73  print("Model saved : {}".format("models.dat"))
```

```
# pedestrian detection
modelFile = "models.dat"
inputFile = "input.png"
outputFile = "output.png"
image = cv2.imread(inputFile)
image = cv2.resize(image, (400, 256))
size = (64, 128)
step_size = (9, 9)
downscale = 1.05

# List to store the detections
detections = []
scale = 0
model = joblib.load(modelFile)


def sliding_window(image, window_size, step_size):
    for y in range(0, image.shape[0], step_size[1]):
        for x in range(0, image.shape[1], step_size[0]):
            yield (x, y, image[y: y + window_size[1], x: x + window_size[0]])


for im_scaled in pyramid_gaussian(image, downscale=downscale):
    if im_scaled.shape[0] < size[1] or im_scaled.shape[1] < size[0]:
        break
    for x, y, window in sliding_window(im_scaled, size, step_size):
        if window.shape[0] != size[1] or window.shape[1] != size[0]:
            continue
        window = color.rgb2gray(window)
        fd = hog(
            window,
            orientations=9,
            pixels_per_cell=(8, 8),
            visualize=False,
            cells_per_block=(2, 2),
        )

        fd = fd.reshape(1, -1)
        pred = model.predict(fd)
```

```
            if pred == 1:
                if model.decision_function(fd) > 0.5:
                    detections.append(
                        (
                            int(x * (downscale**scale)),
                            int(y * (downscale**scale)),
                            model.decision_function(fd),
                            int(size[0] * (downscale**scale)),
                            int(size[1] * (downscale**scale)),
                        )
                    )
        scale += 1

clone = image.copy()
clone = cv2.cvtColor(clone, cv2.COLOR_BGR2RGB)
rects = np.array([[x, y, x + w, y + h] for (x, y, _, w, h) in detections])
sc = [score[0] for (x, y, score, w, h) in detections]
print("sc: ", sc)
sc = np.array(sc)
pick = non_max_suppression(rects, probs=sc, overlapThresh=0.5)
for x1, y1, x2, y2 in pick:
    cv2.rectangle(clone, (x1, y1), (x2, y2), (0, 255, 0))
    cv2.putText(clone, "Human", (x1 - 2, y1 - 2), 1, 0.75, (255, 255, 0), 1)

cv2.imwrite(outputFile, clone)

plt.imshow(clone)
plt.title("Pedestrian Detection")

plt.show()

```

**Result:**




**Bài 2:** Detect Pedestrian in Video

**Source Code:**

Ex_1_Pedestrian_Recognition_StepByStep.py | Ex_2_Pedestrian_Recognition_UsingCV2.py

<None> | <None>

```python
import numpy as np
import cv2

hog = cv2.HOGDescriptor()
hog.setSVMDetector(cv2.HOGDescriptor_getDefaultPeopleDetector())
cv2.startWindowThread()

cap = cv2.VideoCapture("video.mp4")
while True:
    ret, frame = cap.read()
    frame = cv2.resize(frame, (640, 480))
    gray = cv2.cvtColor(frame, cv2.COLOR_RGB2GRAY)

    boxes, weights = hog.detectMultiScale(frame, winStride=(8, 8))
    boxes = np.array([[x, y, x + w, y + h] for (x, y, w, h) in boxes])

    for xA, yA, xB, yB in boxes:
        # display the detected boxes in the colour picture
        cv2.rectangle(frame, (xA, yA), (xB, yB), (0, 255, 0), 2)

    cv2.imshow("Pedestrian Detection", frame)
    if cv2.waitKey(1) & 0xFF == ord("q"):
        break

cap.release()
cv2.destroyAllWindows()
```

**Result:**