**Lab03**

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Use the **template matching** program we used in class as a guideline (in any programming language) to process each frame of the movie file “building.avi”. Namely, read the first image of the movie and let the user pick a template to track. Then use the method of “normalized cross correlation” to track that template to each subsequent image in the movie.

1. Draw a rectangle indicating the location of the matched template on each image. Create an output movie file showing the locations of the matched template on each image.

***Answer*:** See attached files for movie output

1. Experiment with the choice of template that you extract from the first image. Try the corner of the window (point 1), the edge of the roof (point 2), the middle of the wall (point 3), and the sign next to the door (point 4). Which point seems to allow the best tracking, and why? (Note - the match may not be correct in every single image, no matter which point you pick.)

***Answer:*** It looks like point 4 is best place to track since it’s most unique and code get’s least confused with it. Window corner gets confused with other window corners. Same with edge of the roof. Surprisingly, the middle of the wall also tracked quite well.



**4**

**3**

**1**

**2**

1. When the template is matched correctly, approximately what correlation scores do you see?

For correct matching, I see max correlation scores of 0.99. Typically within the range of 0.94 – 0.99.

Here is my code Just in case:

# -\*- coding: utf-8 -\*-

"""

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"""

import cv2

import numpy as np

import sys

# Open the video file

cap = cv2.VideoCapture("C:\\Users\\zezva\\Desktop\\building.avi")

# Check if the video opened successfully

if not cap.isOpened():

    print("Error: Could not open video.")

    sys.exit()

# Read the first frame

ret, frame = cap.read()

if not ret:

    print("Error: Could not read the first frame.")

    cap.release()

    sys.exit()

# Convert the first frame to grayscale

gray\_frame = cv2.cvtColor(frame, cv2.COLOR\_BGR2GRAY)

# Display the first frame and let the user select a point

cv2.imshow('Select Template', gray\_frame)

x, y, w, h = cv2.selectROI('Select Template', gray\_frame, fromCenter=False, showCrosshair=True)

cv2.destroyAllWindows()

# Ensure valid ROI selection

if w == 0 or h == 0:

    print("Error: Invalid ROI selection.")

    cap.release()

    sys.exit()

# Extract the template

template = gray\_frame[int(y):int(y+h), int(x):int(x+w)]

template\_h, template\_w = template.shape

# Create a VideoWriter object to save the output video

out = cv2.VideoWriter('mymovie.avi', cv2.VideoWriter\_fourcc(\*'XVID'), 20.0, (frame.shape[1], frame.shape[0]))

# Function to draw a rectangle around the matched area

def draw\_rectangle(frame, top\_left, bottom\_right):

    cv2.rectangle(frame, top\_left, bottom\_right, (0, 0, 255), 2)  # Red rectangle

# Process each frame

frame\_count = 0

while True:

    ret, frame = cap.read()

    if not ret:

        print("End of video or failed to read frame.")

        break

    gray\_frame = cv2.cvtColor(frame, cv2.COLOR\_BGR2GRAY)

    # Perform template matching

    res = cv2.matchTemplate(gray\_frame, template, cv2.TM\_CCOEFF\_NORMED)

    min\_val, max\_val, min\_loc, max\_loc = cv2.minMaxLoc(res)

    # Get the top left corner of the matched area

    top\_left = max\_loc

    bottom\_right = (top\_left[0] + template\_w, top\_left[1] + template\_h)

    # Draw a rectangle around the matched area

    draw\_rectangle(frame, top\_left, bottom\_right)

    # Save the frame to the output video

    out.write(frame)

    # Display the frame with the rectangle

    cv2.imshow('Tracking', frame)

    frame\_count += 1

    print(f"Processed frame {frame\_count} - Max correlation score: {max\_val}")

    if cv2.waitKey(1) & 0xFF == ord('q'):

        break

# Release everything when job is finished

cap.release()

out.release()

cv2.destroyAllWindows()

print("Video processing complete.")

Sample output for correlation scores:

runfile('C:/Users/zezva/Desktop/CSCI507-LAB#3-3.py', wdir='C:/Users/zezva/Desktop')

Processed frame 1 - Max correlation score: 0.9956074357032776

Processed frame 2 - Max correlation score: 0.9909720420837402

Processed frame 3 - Max correlation score: 0.9908495545387268

Processed frame 4 - Max correlation score: 0.9879068732261658

Processed frame 5 - Max correlation score: 0.9922354221343994

Processed frame 6 - Max correlation score: 0.9890696406364441

Processed frame 7 - Max correlation score: 0.98606938123703

Processed frame 8 - Max correlation score: 0.992961049079895

Processed frame 9 - Max correlation score: 0.9867303967475891

Processed frame 10 - Max correlation score: 0.9942453503608704

Processed frame 11 - Max correlation score: 0.9884640574455261

Processed frame 12 - Max correlation score: 0.9911030530929565

Processed frame 13 - Max correlation score: 0.9951488375663757

Processed frame 14 - Max correlation score: 0.9916402697563171

Processed frame 15 - Max correlation score: 0.9925581216812134

Processed frame 16 - Max correlation score: 0.989090621471405

Processed frame 17 - Max correlation score: 0.9926208257675171

Processed frame 18 - Max correlation score: 0.9923107028007507

Processed frame 19 - Max correlation score: 0.9890871047973633

Processed frame 20 - Max correlation score: 0.989176332950592

Processed frame 21 - Max correlation score: 0.9871498942375183

Processed frame 22 - Max correlation score: 0.9907287359237671

Processed frame 23 - Max correlation score: 0.9944791197776794

Processed frame 24 - Max correlation score: 0.9908310770988464

Processed frame 25 - Max correlation score: 0.9931696057319641

Processed frame 26 - Max correlation score: 0.9916083812713623

Processed frame 27 - Max correlation score: 0.9909360408782959

Processed frame 28 - Max correlation score: 0.9927656650543213

Processed frame 29 - Max correlation score: 0.9899799823760986

Processed frame 30 - Max correlation score: 0.9864555597305298

Processed frame 31 - Max correlation score: 0.9916238784790039

Processed frame 32 - Max correlation score: 0.9878840446472168

Processed frame 33 - Max correlation score: 0.9927321076393127

Processed frame 34 - Max correlation score: 0.9920399188995361

Processed frame 35 - Max correlation score: 0.989408016204834

Processed frame 36 - Max correlation score: 0.9909771680831909

Processed frame 37 - Max correlation score: 0.9890813231468201

Processed frame 38 - Max correlation score: 0.990885317325592

Processed frame 39 - Max correlation score: 0.9901068210601807

Processed frame 40 - Max correlation score: 0.9866614937782288

Processed frame 41 - Max correlation score: 0.9870087504386902

Processed frame 42 - Max correlation score: 0.9865188002586365

Processed frame 43 - Max correlation score: 0.9925233721733093

Processed frame 44 - Max correlation score: 0.9894925355911255

Processed frame 45 - Max correlation score: 0.9885688424110413

Processed frame 46 - Max correlation score: 0.9871740341186523

Processed frame 47 - Max correlation score: 0.9865685701370239

Processed frame 48 - Max correlation score: 0.9901403188705444

Processed frame 49 - Max correlation score: 0.9897663593292236

Processed frame 50 - Max correlation score: 0.989459753036499

Processed frame 51 - Max correlation score: 0.9881475567817688

Processed frame 52 - Max correlation score: 0.990161657333374

Processed frame 53 - Max correlation score: 0.9863944053649902

Processed frame 54 - Max correlation score: 0.987598180770874

Processed frame 55 - Max correlation score: 0.9870626330375671

Processed frame 56 - Max correlation score: 0.9864164590835571

Processed frame 57 - Max correlation score: 0.7155341506004333

Processed frame 58 - Max correlation score: 0.7552588582038879

Processed frame 59 - Max correlation score: 0.7097023725509644

Processed frame 60 - Max correlation score: 0.7422312498092651

Processed frame 61 - Max correlation score: 0.8082722425460815

Processed frame 62 - Max correlation score: 0.8002481460571289

Processed frame 63 - Max correlation score: 0.7950363755226135

Processed frame 64 - Max correlation score: 0.7916957139968872

Processed frame 65 - Max correlation score: 0.7849764227867126

Processed frame 66 - Max correlation score: 0.7806409001350403

Processed frame 67 - Max correlation score: 0.7936215996742249

End of video or failed to read frame.

Video processing complete.