AMRITA VISHWA VIDYAPEETHAM

DEEMED TO BE UNIVERSITY UNDER SECTION 3 OF THE UGC ACT, 1956

IV Sem B. Tech - Electronics and Communication Engineering

19ECE284 Digital Signal Processing Lab
Term Work

Title: Video Object Tracking

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2021 – 2022 (Even)

Motivation:

The rapid improvement in technology makes video acquisition sensor or devices better in compatible cost. This is the cause of increasing the applications in different areas that can more effectively utilize that digital video. Digital videos are a collection of sequential images with a constant time interval. So there is more information present in the video about the object and background are changing with respect to time. After studying the literature, it is seen that detecting and tracking of objects in a particular video sequence or any surveillance camera is areally challenging task in computer vision application. Video processing is reallytime consuming due to a huge number of data is present in video sequence.The area of video tracking is currently immense interest due to its implication in video surveillance, security, medical equipments, robotic systems. Video tracking offers a context for extraction of significant information such as scene motion ,background subtraction, object classification, interaction of object with back grounded other objects from a scene, human identification, behaviour of human with object and background, etc. Therefore it is seen that there is a wide range of research possibilities are open in relation to video tracking.

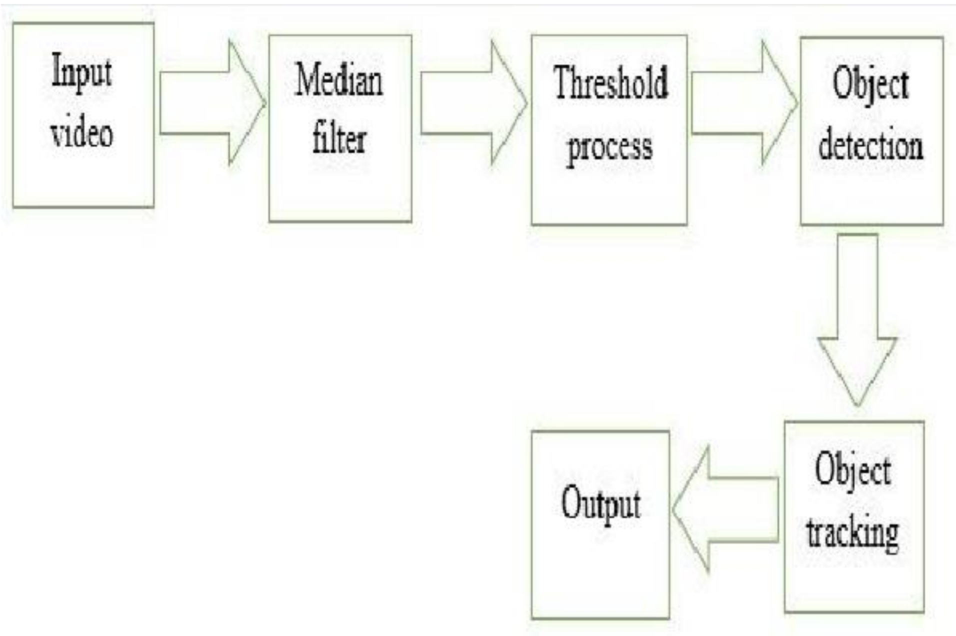
Theory:

The project uses a unique method for tracking and detecting the objects which uses a specific types of algorithm named as Mean shift algorithm and Kernell tracking algorithm. Meanshift algorithm is used to search and find the objects whereas Kernell Tracking algorithm is used to track the objects that has been detected by the Meanshift algorithm. Video tracking can be a time-consuming process due to the amount of data that is contained in video. Adding further to the complexity is the possible need to use object recognition techniques for tracking, a challenging problem in its own right.

Methodology:

Video tracking is the process of locating a moving object (or multiple objects) over time using a camera. It has a variety of uses, some of which are: human-computer interaction, security and surveillance, video communication and compression, augmented reality, traffic control, medical imaging and video editing. The objective of video tracking is to associate target objects in consecutive video frames. The association can be especially difficult when the objects are moving fast relative to the frame rate. Another situation that increases the complexity of the problem is when the tracked object changes orientation over time. For these situations video tracking systems usually employ a motion model which describes how the image of the target might change for different possible motions of the object.

PROCESS OF OBJECT TRACKING VIA BLOCK DIAGRAM



Mean Shift Algorithm:

Mean Shift is a nonparametric and iterative procedure to search a local maximum of a density function.

Let $\{\mathbf{x}_i^*\}_{i=1,2...n}$ be the normalized pixel locations in the region defined as the target model. The region is centered at 0. The function $b: R^2 \rightarrow \{1...m\}$ associates to the index $b\{\mathbf{x}_i^*\}$ of the pixel at location $\mathbf{x}_i^*$ in the quantized feature space. The probability of the feature $u = 1...m$ in the target model is then computed as

$$\hat{q}_u = C\sum_{i=1}^{n} k(\| x_i^* \|^2)\delta[b(\mathbf{x}_i^*) - u] \quad (1)$$

where δ is the Kronecker delta function. The normalization constant

$$C = \frac{1}{\sum_{i=1}^{n} k(\| x_i^* \|^2)} \quad (2)$$

The target candidate is the one that is most similar to the given model in terms of intensity distribution and the similarity of the two distributions are expressed by a metric based on the Bhattacharyya coefficient.

Let $\{\mathbf{x}_i\}_{i=1,2...n_h}$ be the normalized pixel locations of the target candidate, centered at y in the current frame. Using the same kernel profile $k(x)$, but with bandwidth h, the probability of the feature $u = 1...m$ in the target candidate is given by

$$\hat{p}_u(\mathbf{y}) = C_h \sum_{i=1}^{n_h} k(\| \frac{\mathbf{y} - \mathbf{x}_i}{h} \|^2)\delta[b(\mathbf{x}_i) - u] \quad (3)$$

The normalization constant

$$C_h = \frac{1}{\sum_{i=1}^{n_h} k(\| \frac{\mathbf{y} - \mathbf{x}_i}{h} \|^2)} \quad (4)$$

The distance between two discrete distributions is defined as

$$d(\mathbf{y}) = \sqrt{1 - \rho[\hat{\mathbf{p}}(\mathbf{y}), \hat{\mathbf{q}}]} \quad (5)$$

Even though the algorithm has performed great in this case but still it has few drawbacks. For example we have to manually give the position of our object of interest which is not desirable for any real life implementation. Also the window size does not change with the size of the object in the frame being tracked.

Kernel Tracking:

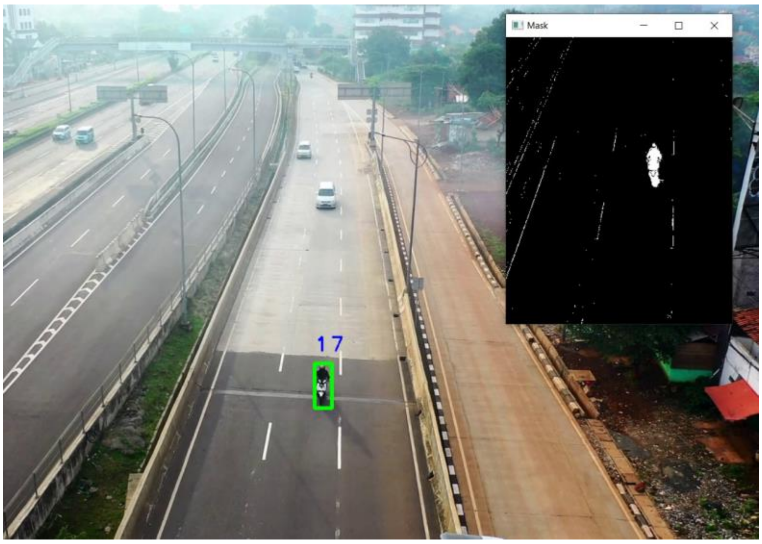
In kernel-based video object tracking, the use of single kernel often suffers from the occlusion. In order to provide more robust tracking performance, multiple inter-related kernels have thus been utilized for tracking in complicated scenarios. This paper presents an innovative method that uses projected gradient to facilitate multiple kernels in finding the best match during tracking under predefined constraints. The adaptive weights are also applied to the kernels in order to efficiently compensate the adverse effect introduced by occlusion. An effective scheme is also incorporated to deal with the scale changing issue during the object tracking. Simulation results demonstrate that the proposed method can successfully track the video object under severe occlusion. Kernel-based video object tracking has recentlybeen widely investigated for better and more robust trackingperformance. Basically, kernel-based tracking is introduced tominimize the difference between the reference colordistribution and the candidate region color distribution inthe current frame. Mean-shift method was applied to thetracking problem to find the most similar location aroundthe local neighborhood area .This is how the tracking is done by Kernal with Meanshift Algorithm. Other information, such asboundary cues, was also utilized to combine with the colorin the kernel-based tracking system.

RESULTS:

Tracking the Number of vehicles passed. (INPUT CODE)

```python
import cv2
from tracker import *

# Create tracker object
tracker = EuclideanDistTracker()

cap = cv2.VideoCapture("highway.mp4")

# Object detection from Stable camera
object_detector = cv2.createBackgroundSubtractorMOG2(history=100, varThreshold=40)

while True:
    ret, frame = cap.read()
    height, width, _ = frame.shape

    # Extract Region of interest
    roi = frame[340: 720,500: 800]

    # 1. Object Detection
    mask = object_detector.apply(roi)
    _, mask = cv2.threshold(mask, 254, 255, cv2.THRESH_BINARY)
    contours, _ = cv2.findContours(mask, cv2.RETR_TREE, cv2.CHAIN_APPROX_SIMPLE)
    detections = []
    for cnt in contours:
        # Calculate area and remove small elements
        area = cv2.contourArea(cnt)
        if area > 100:
            #cv2.drawContours(roi, [cnt], -1, (0, 255, 0), 2)
```

Output:



So from the results we can see that the vehicle which is passed is numbered as 17 ,at the same time the vehicle which is passed is been tracked and been produced as a segmentation file and it also contains the data id file which is shown in output.Based on that ,we can trace the vehicles entry and at the same time id of that vehicle.

INFERENCE:

In this project we have built a new road for tracking the objects by using the kernel tracking with mean shift algorithm. We conclude by saying, the methodology which we used for the above project is quite efficient and has an extra layer of finding the objects quickly and efficiently for emergency as well as for surveillance.

REFERENCES:

1. Athanesious, J. & Suresh, P., 2012. Systematic Survey on Object Tracking Methods in Video. Int. J. Adv. Res. Comput. Eng. Technol. 1, 242–247

- Comaniciu, D., Ramesh, V. & Meer, P., 2003. Kernel-based object tracking. IEEE Trans. Pattern Anal. doi:10.1109/TPAMI.2003.1195991 Mach. Intell. 25, 564–577.

Problem Statement:

- The objective is to detect and track the generic object in real time. In real life, therefore, we require rich information about the surrounding. We need to understand how the objects are moving with respect to the camera. It would also help to recognize the interaction between objects. For example: How many cars have passed in a Lane. In this system, a video target tracking approach was implemented and optimized based on Mean Shift algorithm. Mixture of Gaussian background modeling, erosion and dilation operation of morphology and moving target detection algorithm are introduced to improve video target tracking. Experimental results have shown that the system is stable and fits real-time requirement. It provides users with quick, accurate and intelligent video target tracking services.