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Automatic Identification of moving Objects in a Scene using Corners features

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Abstract: *This Paper presents an automated method to identify the moving objects. The proposed method is a combination of Corner Detectors, Area Based Tracking, K – Means clustering. The Corner Detectors used in this are Moravec, Trajkovec 4 and 8 neighbour, Harris Plessey. NACM as a area based matching, K – means clustering for identifying the location of the object.*

Keywords: *Area Based Tracking, Automatic tracking, Corner Detectors, K mean clustering, Moravec.*

I. Introduction

Automatic Identification of moving objects is an active research topic in Computer Vision and its interest has been growing during last decade. There are some of the proposed methods for automatic identification of objects, like template based matching, in which they will be storing the template of the images which has to be track. So accordingly when we get the frames, the template will be taken by the database and matched with the respective frame. If it finds the match then identification is over. It's a database oriented method, this is the main drawback of this method.

To overcome all of these kinds of problems, we came up with this new approach. It's a combination of Corner Detectors, Area Based Tracking, and K-means clustering. Initially we will be applying the Moravec corner detectors to the first frame, let it be frame1. Then now use the area based tracking method. The main logic of identifying the object lies here. Here we are going to use each corner points which are obtained from the corner detection as an initial point of tracking. And we will be tracking each point in the next frames. The corner point which got max correlation value will be retained for the next frame else discarded. By repeating these steps for around 50 frames, we will be left out only with the corner points which are present on the moving object. Now apply K – means [1] clustering method to get the cluster centre of the left over corner points. Then we obtain a cluster centre which is point present on the moving object. .

II. Corner Detection Algorithm

Many different interest point detectors have been proposed with a wide range of definitions for what points in an image are interesting. Some detectors find points of high local symmetry; others find areas of highly varying texture, while others locate corner points. Corner points are interesting as they are formed from two or more edges and edges usually define the boundary between two different objects or parts of the same object.

2.1 Steps to Obtain Corner Features

All of the Corner detection method [6] follows the same general steps for detecting corners.

2.1.1. Apply Corner Operator: This step takes as input the image and typically a few parameters required by the corner operator. For each pixel in the input image, the corner operator is applied to obtain a *cornerness measure* for this pixel. The cornerness measure is simply a number indicating the degree to which the corner operator believes this pixel is a corner. The output of this step is a *cornerness map*. Since for each pixel in the input image the corner operator is applied to obtain a cornerness measure, the cornerness map has the same dimensions as the input image and can by thought of as a processed version of the input image.

2.1.2. Threshold Cornerness Map: Interest point corner detectors define corners as local maximum in the cornerness map. However, at this point the cornerness map will contain many local maximum that have a relatively small cornerness measure and are not true corners. To avoid reporting these points as corners, the cornerness map is typically thresholded. All values in the cornerness map below the threshold are set to zero. Choosing the threshold is application dependent and often requires trial and error experimentation.

2.1.3. Non-maximal Suppression: The thresholded cornerness map contains only non-zero values around the local maximums that need to be marked as corner points. To locate the local maxima, *non-maximal suppression* is applied. For each point in the thresholded cornerness map, non-maximal suppression sets the cornerness measure for this point to zero if its cornerness measure is not larger than the cornerness measure of all points within a certain distance. After non-maximal suppression is applied, the corners are simply the non-zero points remaining in the cornerness map.

2.2 Moravec corner operator

Moravec operator considers points where there is a large intensity variation in every direction and is recognized as a corner. The cornerness of each pixel in the image is the minimum intensity value found over the eight shift directions.Moravec is a vital low-level processing step that allows one to determine the existence and location of objects in a sequence of still images or in a video.

Moravec operator has some disadvantages, it is not rotationally invariant, it is considered to have a noise response, and is susceptible to reporting false corners along edges and at isolated pixels so is sensitive to noise. In the similar way we can obtain corner points using Harris Plessey, Trajkovec 4 & Trajkove 8 corner detectors[6]. Get the corner points which have been generated, and in the further step we need to track each of the corner points in the consecutive frames for identifying the moving object using area based tracking.

III. Area Based Tracking

For each feature point f1 in image I1, a search area of size W is considered surrounding the corresponding location of f1 in image I2. The feature points that fall inside the window W are only considered for the computation of matching score. The feature points that have the highest matching score are considered for further processing. A large number of correlation methods are employed to calculate the matching score. The matching score is computed between the window of size w1 surrounding f1 in I1 and a window of the same size surrounding each feature point within

Various methods used for the computation of correlation factor[5] (CF) in this study we are using conventional Normalised Area Correlation approach, Brunelli Messelodi Method-1 which are based on the estimation of the correlation coefficient of two binormal variables. The correlation factor between two images, *f(x,y)* and *g(x,y)* of size NxN, is computed using the above methods as given in equations

$$CF(m,n) = \frac{\sum_{x\in M}\sum_{y\in N} f'(x,y)g'(x,y)}{\left(\sum_{x\in M}\sum_{y\in N}(f'(x,y))^2 \times \sum_{x\in M}\sum_{y\in N}(g'(x,y))^2\right)^{1/2}}$$

Here $f'(x,y) = ((f(x,y) - \bar{f})$ and $g'(x,y) = (g(x,y) - \bar{g})$ are known as the centralized versions of *f(x,y)* and *g(x,y)* and are the average of the windows surrounding *f(x,y)* and *g(x,y)*.

After the computation, find out the corner points which has got max correlation value. And retain the corner points which has got max correlation .This process will continue for the first 50 frames of the video. And at the end of the 50 frame we will be having the corner points which are present on the moving object.

Now use the K- mean clustering method for identifying the initial location of the moving object. Since we will be left with all the particles which are present on the moving object, by applying K mean we can get the location which has max corner points converged in the area.

IV. K-Mean Clustering

It is an unsupervised clustering algorithm. "*K*" stands for number of clusters, it is typically a user input to the algorithm; some criteria can be used to automatically estimate *K*. *K*-means [1] algorithm is iterative in nature. It converges, however only a local minimum is obtained.

Algorithm: K –MEANS ALGORITHM
Input: Set of feature values.
Output: Clusters of feature values**.**

- **Step1:** Place K points into the space represented by the objects that are being clustered. These points represent initial group centroids.
- **Step2:** Assign each object to the group that has the closest centroid.
- **Step3:** When all objects have been assigned, recalculate the positions of the K centroids.
- **Step4:** Repeat Steps 2 and 3 until the centroids no longer move. This produces a separation of the objects into groups from which the metric to be minimized can be calculated.

V. Results and Analysis

The Fig 4 shows the result for the Automatic Identification of the Object. In the Fig 4 the first image shows the corner points generated for the frame 1 and the threshold point for selecting the corner point is 0.3*max_Corner_strength, in the second image we will be tracking each and every corner points using area based tracking for identification of the moving object. After N frames where N < totalFrames we will be left out with only the corner points present on the object. Now using K mean cluster get the cluster center of the remaining corner points. In Fig 4 , the second image shows the identified moving object in the video after 50 frames Fig 4,5,6,7 shows the Object Identification by using different Corner Operators.

The Table 1 shows the result for different corner detectors and their time to identify the moving object. From the table we can observe that the result for moravec corner detector with a threshold of 0.3 it will generate 19 corner points for the referred video and time taken to identify is 19.32 Milli sec and for the threshold value of 0.2 its generating 32 corner points and time to identify object is 38.65 Milli sec. So for the grater threshold we will get less corner points but the accuracy of identifying the object will be less.

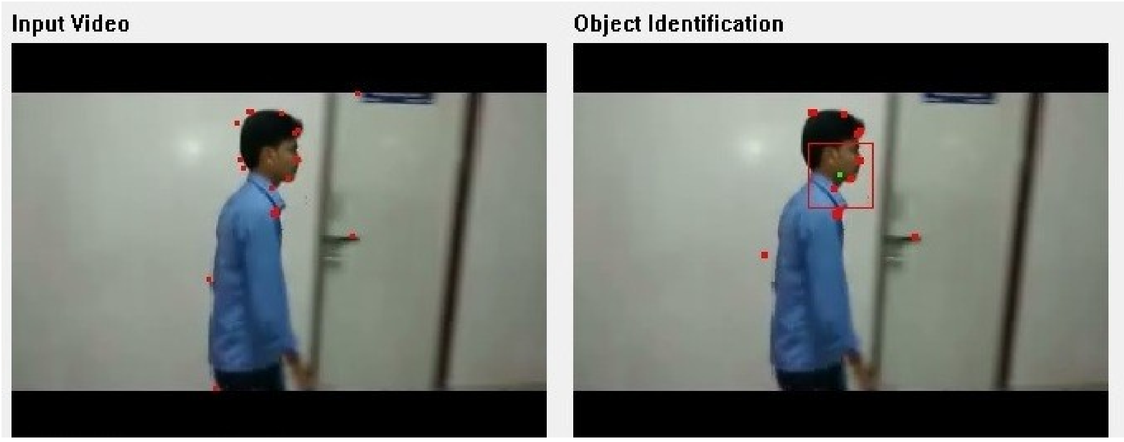

Fig 4: Automatic Identification of Object using Moravec Corner Detector

Fig 5: Automatic Identification of Object using Harris Plessey Corner Detector

Fig 6: Automatic Identification of Object using Trajkovic-4 Corner Detector

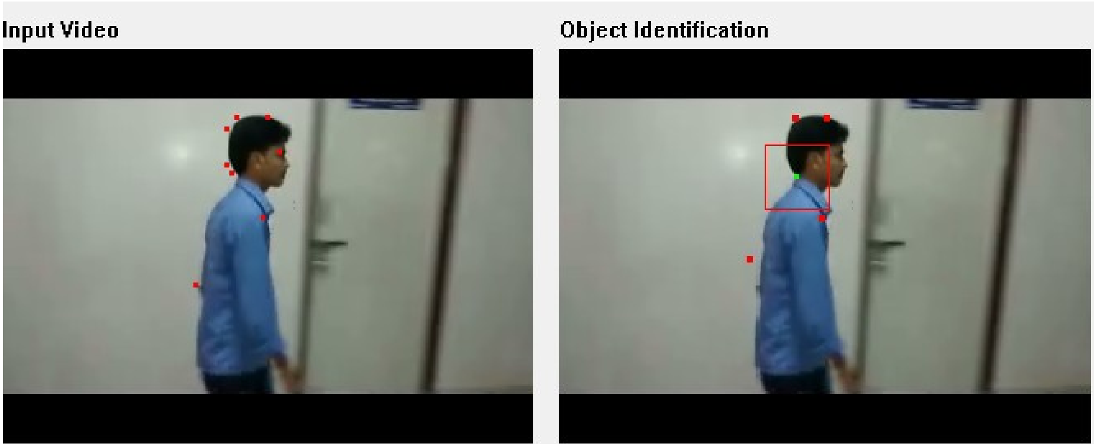

Fig 7: Automatic Identification of Object using Trajkovic-8 Corner Detector

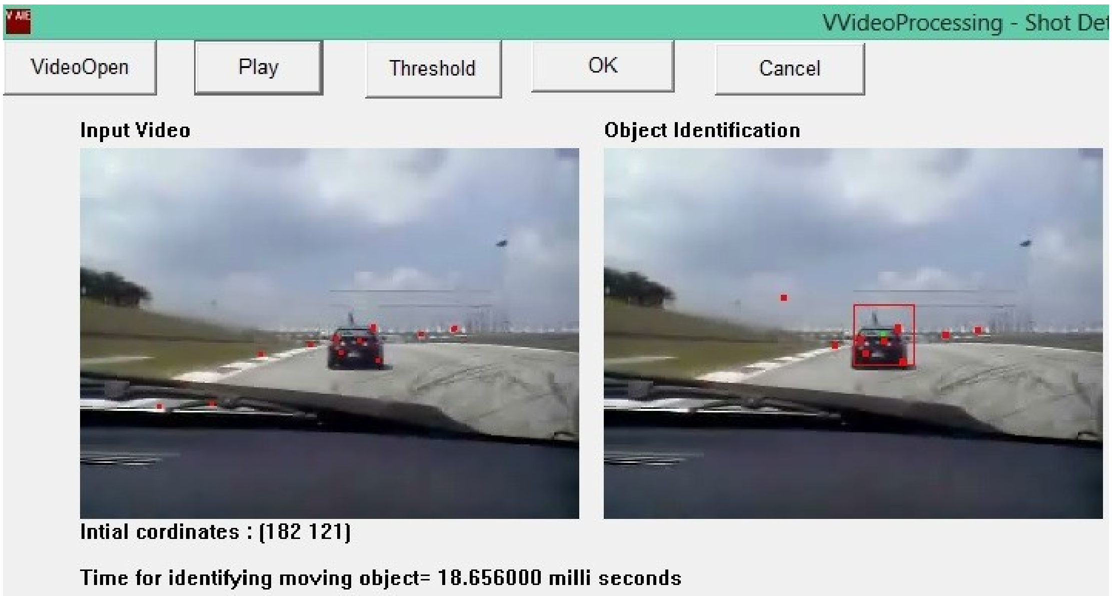

Fig 8: Automatic Identification and Tracking of Object using Moravec Corner Detector

Table 1: Timing and accuracy analysis of all corner detectors

Corner Detector	Number of corner points (threshold * max)	Time taken to identify in Milli seconds
Moravec	19(0.3)	19.32
Harris	21(0.3)	18.65
Trajkovic 4	6(0.5)	10.10
Trajkovic 8	9(0.4)	13.28

VI. Conclusion

The paper gives a new method for identifying the moving object where the condition is that both the object and camera will be moving. For a stationary camera the selection criteria for the corner points will be opposite to the constraints of moving camera. The main problem in the method is with the increase in the corner points time to identify the object will also increase and even it will decrease the accuracy if we select less number of corner points, so it's best to go with the threshold value of 0.3 to select the number of corner points.

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