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Object Detection and Identification in Surveillance Images using Image Processing

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Abstract — The goal of object detection and identification in surveillance images using image processing is to detect a particular part of the image from surveillance camera like an object's position, movement, and its sequence. Object tracking and recognition deal with recognizing the image of video which can differ in color, range, size, illumination changes with time and some cluttered images. As this paper has been surveying and an algorithm has been proposed and implemented, the identified object has freed from the shadow, clutter, illumination changes were detected and eliminated appropriately.

Keywords—Background Subtraction, Illumination, Shadow, Surveillance Image

I. INTRODUCTION

Object detection and identification play a major role in image processing. This object detection and identification technique are used in many fields like traffic control, railway platform monitoring for passenger safety, work place surveillance, and in crowded places to overcome risks and for security issues. Object detection plays a major role in target tracking, behavior understanding over a sequence of image, and locating object or multiple objects over time. There are three key steps for object tracking in video sequence includes detecting interesting moving objects, tracking an object in each and every frame, and to analyze their behavior in each and every frame over time. After tracking objects behavior, the object is been identified with existing frame sequence to match its accuracy. There are various reasons where an object cannot be identified properly due to change in weather conditions, climatic issues, part of the object is invisible during tracking, or object gets cluttered by another object. To avoid these issues, an image from a video sequence is been tested and tracked in each and every sequence of video. The main methodology in object detection and identification is background subtraction. This is the process of extracting object alone from its background and tracking object from an image captured in static camera. There is two sequences of video captured where one is from the static camera where the background is fixed and another is from the dynamic camera where the camera is fully rotating to get a sequence of images in that background will be changing from each and every sequence to obtain the 3D angle of an image.

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Tracking becomes difficult where there is variability in illumination, background motion captured in dynamic camera, complex object shapes, partial and full object occlusions, and images with background clutter and camouflage. To detect an object from captured sequence the image has to undergo preprocessing techniques and then the appropriate algorithm has to be applied to detect objects behavior. In the preprocessing techniques image is been detected and taken from sequence then it is been tracked appropriately from each frame and it is been tracked. To overcome this illumination and clutter issues this paper has been surveyed.

II. OBJECT DETECTION AND IDENTIFICATION

Object detection in video, visual features and motion information are used to detect objects. These are analyzed by using statistical analysis of visual features and temporal analysis of motion information by using mean ship, kandane feature extraction algorithm [1]. These features include color, texture, shape, and movement, etc., Background subtraction is a commonly used the technique in object detection. Foreground object will be subtracted from a static background based on a pixel by pixel [1]. Some of the challenges faced are it is difficult to identify if all pixel images with the same color values [2]. Change in illumination part does not guarantee that color will remain for the same kind of object in various scenes to detect it. If there is a change in the background often it is difficult to detect object position from one sequence to another. Some other challenges include occlusions, clutter, noise, weather conditions.

A. Face Detection Algorithm

Viola Jones algorithm is used to detect people face exactly and to track them and to classify whether the detected object is human or another object kind. It used HAAR surf feature algorithm to get a pattern of interest points and image in N X N size [3]. To compensate different lighting conditions of image mean and variance are used in a normalized way to get in handy. If the variance calculated is less then that image is in consideration to match with the database [3]. But this is considered to be more cost-efficient to implement. But it is considered to be more cost efficient. It works effectively in matching faces one another with databases.

B. Object Detection and Tracking Algorithm

In video surveillance, object detection means tracking the object and its behavior and understanding over a sequence of images.

Background subtraction is a very popular approach of object detection where object tracked over a static background. Detection done based on interest points collected using surf algorithm and object is tracked [1, 4]. It is used in traffic monitoring, in airports, railway stations, in the workplace, etc. in a single camera, there is difficulty in tracking whereas many challenges in tracking involve occlusions, illumination, cluttering and shadow of another object in tracking object makes look like another object. To overcome, this issues multi-camera, which mostly gives 3D as well as 2D information on objects still issues are there as of single camera issues was reduced [4].

Image collected will be segmented and then tracked then clustered back to gain its originality [5].

YOLO - You Only Look Once the algorithm is the real-time tracking algorithm that is considered to be that human glance at the image once to that they can detect what object is there in that image. Same as that YOLO algorithm detects an object and classifies the image [11]. It first generates potential bounding boxes across images then processing was done. In bounding boxes, elimination done on duplicates these operations on the image makes each object individually to track it. The image will be divided into cells and it is been tracked [11]. If there is no object in the cell that portion of the image will not be in consideration. YOLO works in bounding boxes only, if any loss occurs in the image it becomes difficult to track.

C. Vehicle detection and tracking Algorithm

Vehicle detection process which tracks vehicle on road, counts the number of vehicle, the average speed of each individual vehicle, traffic analysis and categorizing vehicles objectives and may be implemented under different environments changes [6]. It is used to detect the type of vehicle and it was done by advanced background subtraction methods, feature-based surf algorithms, frame differencing and motion-based methods for vehicle tracking. The complex foad scenes will be removed by advanced background technique which extract a foreground object[4, 6]. It uses filtering method based on histogram which collects information from a sequence of videos, which eventually works on shadow detection for edge and corner detection of vehicles and handles occlusions in detection [7]. Frame differencing works on differencing the same image from two different frames and recognize them [6]. Those approaches mainly used in traffic surveillance for moving vehicle tracking.

D. Foreground Detection Algorithm

As background subtraction is efficiently used when there is static background, where as when there is a change in the background frequently i.e., dynamic background morphological operation of Kalman Filter algorithm is used [10]. It does not require any initialization of position of object in its first frame or training on a training data sample. Each object is tracked based on its attributes like centroid, the dimension of the image, the three highest peak of its converted image of gray value from histogram [10]. If object movements between two consecutive frames of video are estimated we can tell it as pseudo motion in background pixels of the frame [7].

An object that we are tracking will be detected accurately and strengths and evaluate this object accurately [10]. There are nine evaluation techniques in background subtraction such as noise removal, shade, shadow mask, annotations, occlusions, cluttering, illumination and weather conditions makes image look different in this shadow makes image look different [7] and recognize as different object this problem has been overcome to remove shadow from image and track it exactly. This makes us provide a precise in-depth evaluation.

E. Restoration of Unevenly Illuminated Images

This illumination problem in image arises under three conditions include normal, under and over exposure of the image to bright light or shade. These are overcome by three components generalized Gaussian mixture model (3GGMM) algorithm [9]. It fit the histogram of the unevenly illuminated image and categorizes under three exposure states [12]. Image restoration methods used to get back the image using a multi-scale retinex algorithm, which maps the tone of the skin in an illuminated image section. CHIR algorithm [9] is compared to evaluate the effectiveness of the proposed method that how the image has been getting back after illumination changes have occurred. The images which are same collected from a different sequence of video are illuminated with the difference in shades and in their brightness with multiple lights, lit by a skylight, artificial illumination and spot light using commercial premises and galleries [12]. It mainly focuses light on the object. Shadow is removed before it getting tracked by some shadow removal techniques include fast Fourier, fast RCNN algorithm [12]. Then it applies filtration for images, so the difference occurs between filtered and unfiltered shows that how much the image illuminated.

F. Shadow Detection and Removal

Detection and Removal of shadow from single images in natural scenes. This was done by region based approach if any illumination detected on the segmented region (shown in Fig.5) it will be solved by building a graph of segments, which differentiates shadow and non-shadow regions [13]. For the shadow region, a shadow coefficient was done for each part of the pixels of the image. Using the shadow co-efficient the ratio is calculated by relighting each pixel with both direct light and environment light and generate imge to recover from shadow[13]. Shadows will be dark, some of the images at rare case it will be projected dark so to differentiate the ratio between gray of shadow and RGB scale of the image is taken into consideration. There will be some RGB color space between images. Shadow detection procedure provides binary value 0 and 1 [13]. However 1 represents the presence of shadow for the image, and 0 represents a non-shadow region (shown in Fig.7).

G. Image Enhancement

After Shadow or any illumination has been detected and it will be removed using the corresponding algorithm. The removal of shadow or illumination leads to loss of image quality. To gain its image quality without loss of object shape and its scale, image enhancement technique has been used (shown in Fig.8). Histogram equalization has been used to enhance the shadow removed image to retain its almost accuracy in its image quality.

III. SUMMARY OF EXISTING ALGORITHM

A. *Detect Interest Points*

Interest points are which points are identified using an algorithm which is used to detect objects behavior. As this detectSURFFeatures algorithm used to return interest points based on location, Laplacian, scale, and metric value. Sign of Laplacian which always return value 1 or -1 based on its metric (shown in Fig.2) is elaborated in Table 1. This helps to detect objects exactly even when there is a change in its geometrical position. It is used to compare objects from various frame sequence.

Table-I: Values returned by DetectSURF algorithm

Pixel Position	Location [X,Y]	Scale	Metric	Orientation
1	[71.017, 195.511]	2.133	36873.836	1.778
2	[115.526 , 219.060]	4.133	29567.303	5.059
8	[45.951, 207.765]	3.066	23537.939	1.851
19	[653.383, 389.245]	2	23210.711	6.230
20	[655.343, 388.327]	4	22388.115	6.257

B. *Object Detection*

Object detection deals with identifying an object in an image using detect surf features algorithm. This surf features algorithm select the strongest point and metrics in an image object. The extract features algorithm returns corner points which helps in finding a center hood and neighboring points of an object found using detect points. Match features return the indices of matching points in an image (in Fig.3).

C. *Background Subtraction*

Background subtraction deals with removing background object by providing input with the static background which in return centroid, area, major and minor axis length of an object as sample values shown in Table 2. It uses median filtration techniques for minimizing the error rate and gets its accuracy.

IV. EXPERIMENTAL RESULTS

A. *Image Processing in Surviellance*

Image processing plays a major role in real-time surveillance in traffic monitoring, workplace safety, in industries, outdoor and indoor monitoring. It is widely used in crime reduction and image analysis tools are used in the forensics field. Using the image processing techniques, the particular object of the image is been identified and tracked by its behavior. Mainly in traffic surveillance, image processing technique is widely used to track vehicle, human movement, object identification in various perspectives (in Fig.4).

B. *Background Subtraction with Illumination And Shadow Detection*

Background Subtraction is one of the major technique in object detection where the captured image from a sequence of a static camera. There are two inputs in this algorithm a separate background image and an image with both object and background shown in Fig.1. Both the images are compared and the background is removed and the foreground object is detected [10]. The output will be of the binary image of the foreground object without background. Then the object is been detected using various algorithms.

Shadow is the major issue in object detection and identification, because of the shadow the detected object may be identified wrongly as some other object. Sometimes, when there is the focus of light on a single object from the opposite side and that object will be shadowed opposite side without any outliers that time one single object will be detected twice as two objects in the frame which makes our manipulation wrong in the frame [13]. To avoid these issues shadow is being removed and the object is been detected over its behavior.

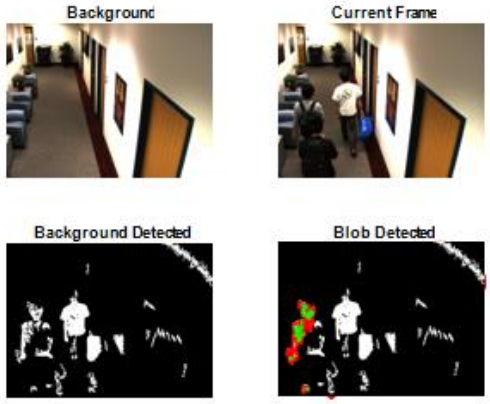

Fig.1 Removal of Background from a video sequence image

Table-II: Values returned by Background Subtraction Algorithm

Pixel Pos	Centroid	Major Axis Length	Minor Axis Length	Solidity
1	[4.466,513.511]	13.135	5.801	0.703
2	[2.590,530.772]	8.168	3.916	0.880
8	[9.575,488.909]	10.150	4.912	0.835
19	[15,434]	1.154	1.154	1
20	[27.680,483.61]	24.685	14.601	0.732

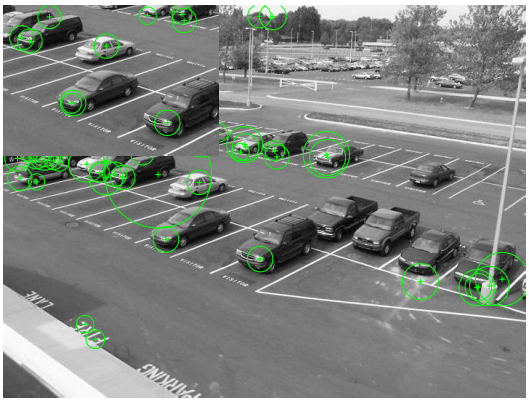

Fig.2 Detecting and matching part of image with original image captured image

Fig.3 Matching Points

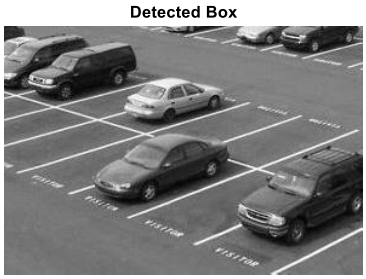

Fig.4 Detected Object

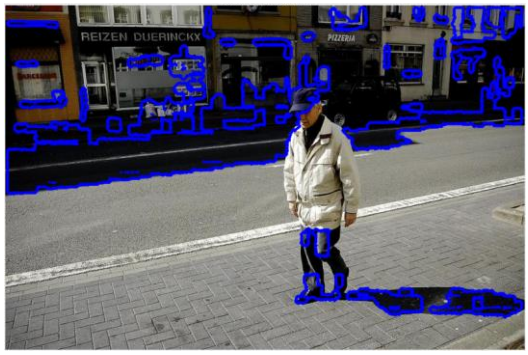

Fig.5 Detecting Shadow regions

V. ILLUMINATION AND CLUTTER DETECTION

A. *Proposed System*

As my proposed work is to detect and identify the shape of an object from a captured sequence of images from the static or dynamic camera. While detecting some part of images will be illuminated due to the focus of light at night time, climatic conditions, weather changes over time, and some part of the image will be cluttered over another object of the image that time difficulty arises in detecting an object. Some places the captured image may have both illumination and cluttery part together there will be an issue in detecting object shape and its behavior. My proposed work is to detect and remove both illuminated and cluttered part of the object and to identify its behavior over a period of time in surveillance.

Fig.6 Detected Shadow in image

B. *Algorithm and Discussion*

Algorithm 1 – Illumination and Clutter detection algorithm

Input**:** input image converted into Gray scale from RGB and RGB to HSV

Steps**:**

1. Convert RGB image to Grayscale
   Img1 = rgb2gray(‘image_object.jpg’);

2. Convert RGB image to HSV and find corresponding rounded Hue Saturation Value.
   Img2 = rgb2hsv(‘image_bg.jpg’);
   Img3 = rgb2hsv(img1);
   [Bg_hsv]=round(img2);
   [Cur_Frame_hsv]=round(img3);

3. Detect interest points from the converted gray scale image
   p1=detectSURFFeatures(img1);

4. Find corresponding bit Exor values for the object image and it corresponding background image to eliminate the background.
   Out = bitxor(Bg_hsv,Cur_Frame_hsv);

5. Detect foreground from an image by removing background by comparing both the foreground object image and background image.

```
for i=1:row
    for j=1:col
        if Out(i,j) >0
            BinaryImage(i,j)=1;
        else
BinaryImage(i,j)=0;
        end;  end; end;
```

6. Visualize it in binary format so that detected foreground has been more focused and apply median filtration to remove noise from the image.

```
STATS=regionprops(l,'all');
cc=[];
removed=0;
for i=1:num
    dd=STATS(i).Area;
    if (dd < 500)
            L(l==i)=0;
            removed = removed + 1;
            num=num-1;
   end
end
```

7. Mark boundaries for foreground object to view extracted foreground object

```
[l2 n2]=bwlabel(l);
[B,L,N,A] = bwboundaries(l2);
```

8. Apply median filtration for each RGB color range in an image and find shadow ratio.

```
r = medfilt2(double(im(:,:,1)), [3,3]);
g = medfilt2(double(im(:,:,2)), [3,3]);
b = medfilt2(double(im(:,:,3)), [3,3]);
s_ratio = ((4/pi).*atan(((b-g))./(b+g)));
```

Fig.7 Shadow Removed from image

9. If any object in the image is seems cluttered, illuminated or been shadowed find shadow mask (Fig.6) from calculated median filtered value.

```
s_mask = s_ratio>0.2;
figure, imshow(s_mask, []);
```

10. Obtained shadow mask is greater than 0.2 then plot which is having higher threshold value and plot on image to remove it.

```
s_mask = bwareaopen(s_mask, 100);
[x,y]=find(imdilate(s_mask,strel('disk',2))-s_mask);
```

11. To detect illumination from image find threshold value for gray scale.

```
level = graythresh(b);
imshow(level);
```

12. Convert to binary scale and eliminate detected threshold value and detect object without illumination.

```
d=im2bw(I3,level);
bw = bwareaopen(d, 50);
imshow(bw);
```

return detected an object from image.

13. After removing shadow or illumination from the image, the image has been enhanced using median filtration and histogram equalization technique.

Fig.8 Enhanced Image after removal of shadow

VI. CONCLUSION

I would like to conclude that this paper has reviewed and proposed an algorithm for removing shadow and illumination from an image and the corresponding results have been experimentised and analysed using the appropriate software.

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