Image Based Real Time Object Detection and Recognition in Image Processing

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Abstract—
Object detection is the process of finding real-world objects such as faces, bicycles, and buildings in images or videos. Object detection algorithms typically use extracted features and learning algorithms to recognize occurrences of an object category. It is used in applications such as surveillance, image retrieval, security, and automated vehicle parking systems. Object detection and tracking mainly for human and vehicle is presently most active research topic. In this paper we review recent technologies for each phase of the object detection. Video surveillance has many other applications like unimaginative detection, abnormal behavior analysis of the person, person identification, traffic management. There are mainly four different techniques for object detection, feature based detection, region based detection outline based detection illustrations and model based detection. Object detection is the process of finding of real-world objects such as faces, bicycles, and buildings in images or videos. Object detection algorithms typically use extracted features and learning algorithms to recognize instances of an object category.

Index Terms—
Object detection, object tracking, object recognition

I. INTRODUCTION
An object detection and recognition system can identify objects in the real world with the help of an image of the world. Human perform detection and recognize fluently and suddenly. It is useful for the quality control and inspection task in industry. Several method have been proposed to recognize object in real time. Real time visual tracking and detection of object is exciting task with many practical application: person’s identification, video surveillance system, traffic controlling, video compression, target detection and tracking.

You can recognize objects using a variation of models, including:
I. Extracted features and enhanced learning algorithms
II. Bag-of-words models with features such as SURF and MSER
III. Gradient-based and derivative-based matching methodologies
IV. Viola-Jones algorithm
V. Template matching
VI. Image segmentation and blob analysis

Tracking object in a video sequence is an area of constant development which has a wide area of application from surveillance monitoring system to wildlife monitoring and tracking without the aid of human intervention. This paper explain what the different steps involves in tracking objects, be it humans or wildlife or cars in video and what the different methods that are available to perform these steps. Then different algorithms are studied and compared.

![Figure 1 Common block diagram of video surveillance system](image-url)

Object detection is divided into different stages which are shown in figure 1. There are different approaches to get more accurate result in video surveillance. Each stage has diverse algorithms for different environment conditions. As it is associated to the security, there are quite a lot of approaches to get precise result in...
minimum time period. Due to environmental conditions like illumination changes, shadow object detection becomes difficult and significant problem. A familiar approach for object detection is to use information in a single frame. Now, each stage is described as follows:

**Environment Modeling:**

Environment modelling is also divided into 2D and 3D models. But here we have considered only 2D models. In environment modelling, there are different approaches for the frame subtraction. Here each frame of video is subtracted and the background value is updated. In [20], a tracking algorithm based on adaptive background subtraction for detecting and tracking moving objects in the video is used. Due to the changes of the moving of objects and other environment disturbance, the background image always changes.

**Pre-Processing:**

Pre-processing in video is necessary for real time detection. As in real time detection system, much chances of noise are there, it is necessary to do pre-processing. Real time system requires much precise algorithms for detection because environment effects, lighting condition affect the systems.

**Moving object segmentation:**

Background or motion segmentation is also an important task in object detection. In video surveillance system, the difficult task is to extract the moving object accurately. After the extraction, the object is detected by applying different algorithms. Motion segmentation is difficult task here because cameras are mounted on the crossroads. Occlusion is major problem, as there are different moving object going across the road. Therefore we cannot differentiate the objects.

**Object detection:**

In video surveillance system, to track and detect the object is a tricky task. It has also applications to recognize an object in video surveillance. There are so many environment factors such as sunlight, traffic lights, and weather effects. Kalman filter is better option for object detection but accuracy is low compared to other algorithms. Object detection comprises of motion detection or segmentation and object classification. Once the object or the motion is extracted, the classifiers are used to detect a particular object.

### II. LITERATURE SURVEY

A number of algorithms have been developed over time and the different methods that are used in each of these algorithms. Dong Kwon Park and the rest (2000) present a semi-automatic object tracking algorithms in [1]. The two steps involved are intra-frame object extraction and inter-frame object tracking. The human intervention is decreased by using homogeneous region segmentation in intra-frame object extraction. Yining Deng and B.S. Manjunath (2001) propose a method for unsupervised segmentation in both images and video in [2]. The algorithms, called JSEG, works based on colour-texture regions in image as well as video. Yaakov Tsaig and Amir Averbuch (2002) present an algorithms for automatic segmentation of moving objects in MPEG-4 videos in [3]. MPEG-4 relies on decomposition of each frame of an image sequence into video object planes (VOPs). Each VOP relates to a single moving object in the scene. Moving object detection is a first step for object classification and object recognition. Chih-Hsien Hsia et al [4] proposed efficient modified directional lifting-based discrete wavelet transform (MDLDWT) for moving object detection.

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Year of publication</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image-based Face detection and recognition</td>
<td>Faizan Ahmad, Aaima Najam and Zeeshan Ahmed</td>
<td>Nov. 2012</td>
<td>Local Binary Pattern (LBP), Support Vector Machine.</td>
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<tr>
<td>Learning AND-OR Templates for object recognition and detection</td>
<td>Zhangzhang Si and Song-chun Zhu</td>
<td>Sept. 2013</td>
<td>AND-OR templates matching technique.</td>
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<td>Grab Cut-Based Abandoned object detection</td>
<td>Kahhil Muchtar, Chih-Yang Lin, Chia-Hung Yeh</td>
<td>Sep. 22-24, 2014</td>
<td>Detection based method, Markow random field model, Gaussian mixture model.</td>
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</table>
The proposed methods detects multiple moving objects very perfectly even though the object shape issues. The contribution of Pranab Kumar Dhar et al [5] proposed an efficient moving object detection is used for video surveillance system using enhanced edge localization mechanism and gradient directional masking.

This method detects moving object with better accuracy than exist method relating to edge based method. Nijad Al-Najdawi et al [6] proposed an automated real-time people tracking system based on KLT features detection. They used Kanade-Lucas-Tomasi (KLT) technique to detect feature of both continuous and discontinuous nature of an object. They suggested Kalman filter for object tracking. In the survey from several papers on recognition and detection various attributes are grouped in a table i.e. title of paper, year of publication, author name, and techniques used those papers.

III. OBJECT DETECTION METHOD
Object detection is the first step in tracking in an object in the video. The basic idea is to identify this pixel cluster as object which are not only moving in X and Y direction but also in time. Let us examine following methods of object detection in details in the following section;

A. Optical flow:-
Optical flow or optic flow is the pattern of apparent motion of objects, surfaces, and edge in a visual scene [7]. Optical flow is a method to calculate a velocity for points within the images, and provide an estimation of where points could be next image sequence [8]. Optical flow is vast area of study [9] and provides a summary of the different methods available.

B. Frame differencing:-
Frame differencing is a technique where computer checks the difference between two video frames. If the pixel have change there apparently was something changing in the image. Most technique work with some blur and threshold, to distinct real movement from noise. Because frame could differ too when light condition in a room change.

C. Background Subtraction:-
Background subtraction, also known as fore ground detection, is technique in the fields of image processing and computer vision where in an image’s fore ground is extracted for further process. There are two types of algorithms for background subtraction. They are recursive algorithms and non-recursive algorithms.

IV. OBJECT DETECTION TECHNIQUE
1) Template matching:-
Template matching is a technique for finding small parts of an image which match a template image. It is a straightforward process. In this technique template images for different objects are stored. Templates are frequently used for recognition of characters, numbers, objects, etc. It can be performed on either color or gray level images

2) color based:-
Color provides potent information for object recognition. A simple and efficient object detection scheme is to represent and match images on the basis of color histograms. The paper investigates the
incorporation of color for object detection based on
the above mentioned criteria and demonstrate the
advantages of combining color with shape on the two
most popularly used detection frameworks,namely
part-based detection with deformable part models and
Efficient Subwindow Search (ESS) for object
localization. The resulting image representations are
compact and computationally efficient and provide
excellent detection performance on challenging
datasets. Fig.5 provide how the extension correctly
detects all Simpsons in the image; Simpsons is an
American animated sitcom. The technique correctly
detects challenging object classes where state-of-the-
art techniques using shape information alone

(1) Scanning for likely object locations on a coarse scale
(ii) Refining the scanning position on a fine scale
3) Active and Passive:-
Object detection in passive manner does not involve
local image samples extracted during scanning. Two
main object-detection approaches that employ passive
scanning. Some methods try to bound the region of
the image in which passive scanning is applied. It is a
computationally expensive and inefficient scanning
method. In this method at each sampling point costly
feature extraction is done active scanning local samples
are used to guide the scanning process. At the current
scanning position a local image sample is extracted
and mapped to a shifting vector indicating the next
scanning position.

4) Shape based:-
Recently, shape features have been extensively
explored to detect objects in real-world images. The
basic subroutine in deformable shape matching takes
as input an image with an unknown object (shape) and
compares it to a model by solving the correspondence
problem between the model and the object. Then it
performs aligning transformation and computes a
similarity based on both the aligning transform and
the residual after applying the aligning transformation.
The Authors have considered various reasons like
Intra-category variation, Occlusion and clutter, 3D
pose changes that makes correspondence problems
more difficult.

1) Local and global feautures:—
The most common approach to generic object
detection is to slide a window across the image and to
classify each such local window as containing the
target or background. Merging algorithm is used to
recognize and detect the object with full boundary in
the other images based on ASIFT keypoints and a
similarity measure for merging regions in the image.
Fig. 6 shows the trained image for an object (left) and
detected image of the object in a image (right).

V DIFFICULTIES IN OBJECT RECOGNITION UNDER
VARIED CIRCUMSTANCES
1) Lightning: The lightning conditions may differ
during the course of the day. Also the weather
conditions may affect the lighting in an image. In-
door and outdoor images for same object can have
varying lightning condition. Shadows in the image
can affect the image light. Whatever the lightning may
be the system must be able to recognize the object in
any of the image. Fig.1 shows same object with
varying lightning.

2) Positioning: Position in the image of the object
can be changed. If template matching is used, the
system must handle such images uniformly.

3) Rotation: The image can be in rotated form. The
system must be capable to handle such difficulty. As
shown in fig 2, the character “A” can appear in any of
the form. But the orientation of the letter or image
must not affect the recognition of character “A” or
any image of object.

4) Mirroring: The mirrored image of any object
must be recognized by the object recognition system.

5) Occlusion: The condition when object in an image
is not completely visible is referred as occlusion. The
image of car shown in a box in fig 3 is not completely
visible. The system of object recognition must handle
such type of condition and in the output result it must
be recognized as a car. In [1], a segmentation aware
object detection model is presented with occlusion
handling.

6) Scale: Change in the size of the object must not
affect the correctness of the object recognition system.
Above stated are some of the difficulties that may
arise during object recognition. An efficient and
robust object detection system can be developed by
conquering the above stated difficulties.

VI APPLICATIONS OF OBJECT DETECTION AND
RECOGNITION
1. Biometric recognition:-
Biometric technology uses human physical or
behavioral traits to recognize any individual for
security and authentication [10]. Biometrics is the identification of an individual based on distinguished biological features such as finger prints, hand geometry, retina and iris patterns, DNA, etc. For biometric analysis, object recognition techniques such as template matching can be used.

2. Surveillance:-
Objects can be recognized and tracked for various video surveillance systems. Object recognition is required so that the suspected person or vehicle for example be tracked.

3. Industrial inspection:-
Parts of machinery can be recognized using object recognition and can be monitored for malfunctioning or damage.

4. Content-based image retrieval (CBIR):-
When the retrieval is based on the image content it is referred as CBIR. A supervised learning system, called on topic, which provides an automated keyword annotation for images and content–based image retrieval [11].

5. Robotic:-
The research of autonomous robots is one of the most important issues in recent years. The humanoid robot soccer competition is very popular. The robot soccer players rely on their vision systems very heavily when they are in the unpredictable and dynamic environments. The vision system can help the robot to collect various environment information as the terminal data to finish the functions of robot localization, robot tactic, barrier avoiding, etc. It can decrease the computing efforts, to recognize the critical objects in the contest field by object features which can be obtained easily by object recognition techniques [12].

6. Medical analysis:-
Tumor detection in MRI images, skin cancer detection can be some examples of medical imaging for object recognition.

7. Optical character/digit/document recognition: -
Characters in scanned documents can be recognized by recognition techniques.

8. Human computer interaction:-
Human gestures can be stored in the system, which can be used for recognition in the real-time environment by computer to do interaction with humans. The system can be any application on mobile phone, interactive games, etc.

9. Intelligent vehicle systems:-
Intelligent vehicle systems are needed for traffic sign detection and recognition, especially for vehicle detection and tracking [13]. Such a system is developed. In detection phase, a color-based segmentation method is used to scan the scene in order to quickly establish regions of interest (ROI). Sign candidates within ROIs are detected by a set of Haar wavelet features obtained from AdaBoost training. Then, the Speeded up Robust Features (SURF) is applied for the sign recognition. SURF finds local invariant features in a candidate sign and matches these features to the features of template images that exist in data set. The recognition is performed by finding out the template image that gives the maximum number of matches.

CONCLUSION
Review of object detection, tracking and recognition is briefly overviewed in this paper. The motive of this paper is who are interested in this field for doing research work it will definitely help to choosing the related algorithm for their work accordingly. In the future, we plan to propose an algorithm that overcomes the disadvantages of the existing object detection methods and track objects in a video with capability to handle multiple objects and occlusions.

References
Processing, Image Processing and Pattern Recognition


