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Object Detection and Tracking for Computer-Vision Applications

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Abstract: **- Object tracking is to estimate locations of target in an image sequence, it is the most challenging aspect in the computer vision applications with difficulties that arise due to intrinsic, extrinsic factors like deformation, camera motion, motion blur. Object tracking plays vital role in human-computer interaction, surveillance, robotics and overcomes practical problems of disturbance and effective noise. Object detection is the task of identifying the physical movement of an object in a given region. It is challenging role to detect the shape of the object as dynamic scene changes accordingly.**

Keywords**: Object detection, tracking, surveillance.**

I. INTRODUCTION

In computer vision applications tracking is an important aspect which involves activity analysis classification and recognition of an object and human computer interference. Object detection is the task of identifying the physical movement of an object in a given region or area [1].it has the wide applications like human motion analysis, event detection, traffic analysis and security. Object tracking is an important task within the field of computer –vision [2]. The availability of high quality and inexpensive video cameras, and the interesting need for automated video analysis has generated a great deal of interest in object tracking. In its simplest form, tracking can be defined as a method of following an object through successive image frames to determine its relative movement with respect to other objects. Prior knowledge about the number and the size of objects, or the object appearance and shape can also be used to simplify the challenges in the field of object tracking. Numerous approaches for object tracking have been proposed. In addition, moving object detection is efficient topic of research in the field of computer vision applications which involves identifying the actual shape of the object in the motion becomes tricky [4] due to various challenges like dynamic scene changes, illumination variations, and presence of shadow, camouflage and bootstrapping problems.

II. ORGANIZATION OF THE PAPER:

The remainder of this paper as follows. In section III includes the detailed literature survey on object detection and tracking. In the section IV includes wide-range of applications .section V describes how the object representation which plays a crucial role in tracking an object. Section V describes the various approaches on object detection section VI includes an comparative analysis of those discussed methods. Section VII describes the framework of how the object is being tracked. Section VIII describes the classification of object tracking section IX the challenges of object detection and tracking. Section X describes the conclusion of the paper.

III. LITERATURE SURVEY

sino	Year of publication	Title	Author	Overview
1	2016\IEEE	Moving object detection: Review of recent research trends.	Sumati manhanda [1]	Provides various approaches for moving object detection.
2	2015\IEEE	Analysis of computer vision based techniques for motion detection.	Jaya s kulchandani [2]	Analyzed and estimated in terms of computational time and usability.
3	2015\IEEE	Object detection and tracking-A survey	k.Rasool reddy[3]	Approach in order to reduce distortion in image sequence.
4	2015\IJCS	Video segmentation for moving object detection using local change & entropy based adaptive window thresholding.	Anuradha. S.G. Dr. k. kambasappa[4]	the contemporary video segmentation & tracking methods, organize them into different Categories.
5	2010\IEEE	Moving object tracking using object segmentation.	Sanjay singh, Srinivas Murali Dangra[5]	A new approach to track object in an image sequence.
6	2015\IJRITCC	Real time object detection and tracking (locally and globally)with rotating camera.	Ravi D.nanaria, Prof.D pipalia[6]	To track the object using static camera according to the path of the moving object within a specified region.

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7	2013/IJARCCE	Human object detection and tracking using background subtraction for sports applications	R. Manikandan ,R.Ramakrishnan [7]	Proposed an algorithm to detect player motion and track using background subtraction.
8	2014/IEEE	Adaptive color attributes for real-time visual tracking.	Danelljan, Martin [8]	Classifications of various video tracking methods are proposed using real-time tracking methods.
9	2011/IEEE	Moving Object Tracking from Moving Platform	Shibarchi Majumder, Rahul Shankar[9]	A modified template matching Technique was proposed with the increased processing speed & reduced mismatch probabilities.
10	2014/IJCSE	Morphological Image Processing Approach of Vehicle Detection for Real-Time Traffic Analysis	Prutha Y M , Annradha S G[10]	Analysis and implementation of vehicle detection in the traffic flow using background subtraction and Morphological operations

IV. REAL-WORLD APPLICATIONS:

There are widespread of real world computer-vision applications few of them are follows:

- Visual surveillance: A human action recognition system process image sequences captured by video cameras monitoring[4] sensitive areas such as bank, departmental stores, parking lots and country border to determine whether one or more humans engaged are suspicious or under criminal activity.

- Artificial intelligence: Defined as intelligence exhibited by machines, has many applications in today's society. Programs are developed to perform specific tasks ,that is being utilized for a wide range of activities including medical diagnosis, electronic trading, robot control, and remote sensing.

- Biomedical image analysis: It is an interdisciplinary field at the intersection of computer science, and medicine. This field develops computational and mathematical methods [6]for solving problems pertaining to medical images and their use for biomedical research and clinical care.

- Human–computer interaction: The design and use of computer technology, focused on the interfaces between people and computers [1]. Researchers in this field observe the ways in which humans interact with computers and design technologies that let humans interact with computers in novel ways.

- Vehicle tracking: Due to the increasing urban population and hence the number of cars, need of controlling the traffic in streets, highways and roads is vital . A system that detects the vehicle in real time in highway is done by using image processing.

Figure1: Applications of object detection and tracking

V. OBJECT REPRESENTATION

In a tracking scenario, an object can be defined as anything that is of interest for further analysis. Objects can be represented by their shapes [4].In this section, we will describe the object shape representations commonly employed for tracking.

1. Points:

The object is represented by a point, that is, centroid (fig 2(a)) or by a set of points (fig 2(b)). The point representation is suitable for tracking objects that occupy small regions in an image.

2. Primitive geometric shapes:

Object shape is represented by a rectangle, ellipse (fig 2©, (d)) etc. primitive geometric shapes are more suitable for representing simple rigid objects , they are also used for tracking non rigid objects.

3. Object silhouette and contour:

Contour representation defines the boundary of an object (fig 2(g), (h)). The region inside the contour is called the silhouette of the object (fig 2(i)). These representations are suitable for tracking complex non rigid shapes.

4. Articulated shape models:

Articulated objects are composed of body parts that are held together with joints. For example, parts of the human body such as legs, hands, head, connected by joints. In order to represent an articulated object, one can model the constituent parts using cylinders or ellipses as shown in fig 2(e).

5. Skeletal models:

Object skeleton can be extracted by applying medial axis transform to the object silhouette. This method is commonly used as a shape representation for recognizing objects. Skeleton representation can be used to model both articulated and rigid objects (fig 2(f)).

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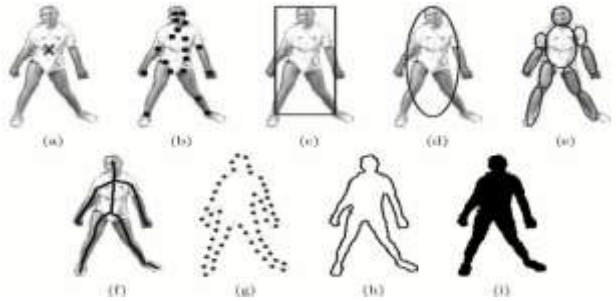

Figure2:object representations(a)centroid,(b)multiple points,(c) rectangular patch,(d)elliptical patch,(e) part-based multiple patches,(f)object skeleton,(g)complete object contour,(h) control points on object contour,(i) object silhouette.

VI. APPROACHES OF OBJECT DETECTION:

Object detection is the task of identifying the object in image sequence .Moving object detection can be defined as the process of detecting physical change in the position of an object with respect to the background area in an image sequence.

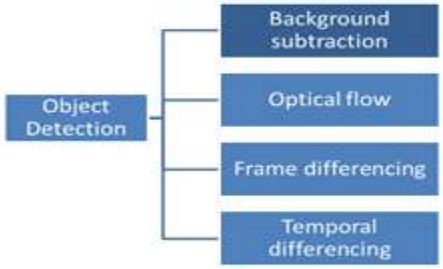

Figure 3: various approaches of object detection

A. Background subtraction:

It is the most basic and the reliable method that is used for the detecting the motion of an object in a video. The implementation and the calculation involved in this method are also simple in which background model or a background frame is considered for reference, and then the difference between the background frame and the current frame is calculated to obtain the resultant image.

B. Optical Flow:

Optical flow approach of moving target detection is based on calculation of optical flow field of image (or video frame).Clustering is performed on the basis of the obtained optical flow distribution information obtained from the image (video frame).This method allows obtaining complete knowledge about the movement of the object and is useful to
Determine moving target from the background.

C. Frame Differencing

This traditional approach for motion detection uses the basic subtraction operator to evaluate the difference between the two consecutive frames. Any camera captured video can be divided into frames. This approach is computationally easier as compared to other models. It makes use of image subtraction operator that obtains output image by subtracting second image frame from first image frame in corresponding consecutive frames

D. Temporal Differencing:

Temporal differencing method detects the moving target by employing pixel-wise difference method among two successive frames. Traditional temporal difference method is flexible to dynamic changes in the scenes. This approach does not provide the good results when the when the object to be detected is either moving too slow or too fast, because in this case there is a very small difference between the video frames and as a result the object description is lost.

VII. COMPARATIVE STUDY ON OBJECT DETECTION METHOD

Methods	Reliability and Accuracy	Computational Time	Description
Background Subtraction	Moderate	Moderate	• In computation requires a buffer with recent pixel value. • It requires less memory space. • Not capable of handling dynamic background. • Cannot handle multi object frames.
Optical flow	Moderate	High	• Requires more memory. • Best results. • Suitable for real time scenarios. • Complex calculations are involved. • Sensitive towards noise.
Frame Differencing	High	Moderate	• Easiest approach. • It requires background frame as initial. • Can handle videos of low resolution. • Suffers noise issues.
Temporal Differencing	Low	Low	• Pixel wise difference in successive frames is calculated. • Result degrades when object moves too slowly or either too fast. • Can handle sudden change in illumination.

Methods Reliability and Accuracy Computational Time

VIII.FRAMEWORK FOR OBJECT TRACKING:

We aim to identify new trends and ideas in the tracking community and hope to provide insight for the development of new tracking methods, the basic framework of moving object detection for video surveillance is shown in figure below.

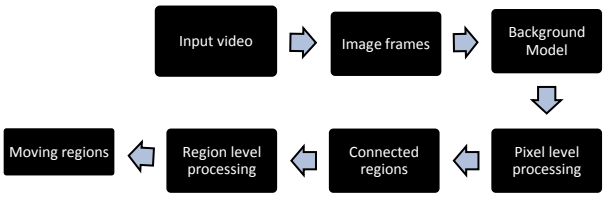

Figure4: framework of object tracking

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Prior knowledge about the number and the size of objects, or the object appearance and shape, can also be used to simplify the problem. The process of moving object detection in video consists of two steps - Background extraction and moving object detection. The preliminary idea is to capture a series of video pictures at regular intervals; the video is divided into n number of frames to describe the vector information of the region.

- Which object representation is suitable for tracking?
- Which image features should be used?
- How should the motion, appearance, and shape of the object be modeled?

The answers to these questions depend on the context/environment in which the tracking is performed and the end use for which the tracking information is being sought.

IX.CLASSIFICATION OF OBJECT TRACKING:

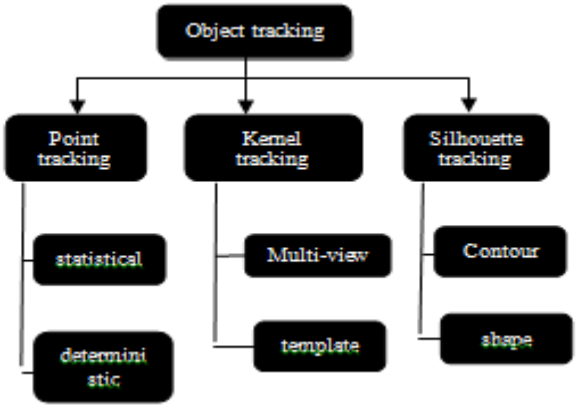

Figure5: classification of object tracking

A.Point Tracking: Tracking can be formulated as the correspondence of detected objects represented by points across frames. Point tracking mainly correspondence with two main categories statistical and deterministic approach.

- Statistical Approach: In fact, motion segmentation can be seen as a classification problem where each pixel has to be classified as background or foreground. Statistical approaches can be further divided depending on the framework used. At First, the motion vectors are accumulated over a few frames to enhance the motion information, which are further spatially interpolated to get dense motion vectors. The final segmentation, using the dense motion vectors, is obtained by applying the expectation maximization (EM) algorithm.
- Deterministic Approach: In deterministic approach, whose main purpose is to recover the geometry of the image, that it contains useful information of the shape, especially structural information. To have skeleton of a shape, first boundary or edge of the shape is extracted using edge detection algorithms and then its skeleton is generated by skeleton extraction methods.

B. Kernel tracking:Kernel tracking is based on object motion. It is typically performed by computing the motion of the object, from one frame to the next. There are few algorithms which may differ in terms of the representation of the object , the number of objects that are being tracked, and the methods used to estimate the motion of the objects.

- Multi-view Based:Multi view appearance is the new approach used to track objects that may have different views in different frames. Firstly, the appearance models are generated and these models represent the information collected through the most recent observations of the object. If the object view changes dramatically during tracking, the appearancemay change, and the object being tracked might be lost. Different views of the object can be generated and used for tracking to overcome this difficulty.
- Template Based: Template based is the method of searching the image, for the object template that is defined in the previous frame. Due to its relative simplicity and low computational cost Templates and density-based appearance models have been commonly used.

C.Silhouette Tracking:

The main objective of silhouette tracking is to find the object region in each frame by means of an object model generated using the previous frames. This technique is used when complete region of an object is to be tracked. This model can be in the form of an object edges or the object contour and color histogram. There are mainly two categories of silhouette tracking namely shape matching and contour tracking.

Object Detection	Object Tracking
• To detect the actual shape of the object in the presence of shadow.	• Loss of information might be caused in projection of 3D world object into a 2D image.
• To detect object when the scene changes dynamically.	• To track objects of complex shape and motion.
• Hard to detect the object in case of camera motion.	• To track multiple objects in a same video frame.
• Complex object shapes.	• Presence of noise in images.
• Camouflage and bootstrapping problem.	• Motion blur and occurrence of **occlusion.**

- Shape Based :In this approach, the search is performed by means of computing the similarity of the object with the model generated from the presume object silhouette based on previous frame. Shape matching can be performed to track an object of silhouette and its associated model which is in search of the current frame.
- Contour Evolution:This contour evolution requires that some part of the object in the current frame overlap with the object area in the previous frame. This type of tracking by evolving a contour can be performed using space models and contour by minimizing the contour energy.

X.CHALLENGES OF OBJECT DETECTION AND TRACKING:

XI. CONCLUSION

Object tracking means tracing the progress of objects as they move about in visual scene. In this paper comparative analysis is done on various object detection methods. Object tracking, thus, involves processing spatial as well as temporal change Certain features of those objects have to be selected for tracking. These features need to be matched over different frames. Significant progress has been made in object tracking. .Performance of various object detection is also compared. Moving Object Detection is very efficient research field that is powerfully motivated by number of applications. New techniques can be developed using strength of recent trends for better performance results. Further work can be done in future for the development of the optimized algorithms that will be able to handle the problems like global illumination, detection of object in the presence of shadow.

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