A Comprehensive Study of Object Tracking Methods

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ABSTRACT Object tracking is a key problem in many computer vision applications, including surveillance, automobile navigation, autonomous robot navigation, and so on. It detects fascinating moving items and tracks them from frame to frame. Its primary function is to detect and track a moving object or numerous objects in image sequences. Normally, there are three stages to video analysis: object detection, object tracking, and object reorganization. This paper provides a brief overview of several video object tracking approaches, including point tracking, kernel tracking, and Silhouette tracking algorithms.

АННОТАЦИЯ Отслеживание объектов является ключевой проблемой во многих приложениях компьютерного зрения, включая наблюдение, автомобильную навигацию, навигацию автономных роботов и т. д. Он обнаруживает захватывающие движущиеся объекты и отслеживает их от кадра к кадру. Его основная функция — обнаружение и отслеживание движущегося объекта или множества объектов в последовательности изображений. Обычно видеоанализ состоит из трех этапов: обнаружение объекта, отслеживание объекта и реорганизация объекта. В этом тезисе представлен краткий обзор нескольких подходов к отслеживанию видеообъектов, включая отслеживание точек, отслеживание ядра и алгоритмы отслеживания Silhouette.

ANNOTATSIYA Obyektlarni kuzatish ko‘plab kompyuter ko‘rish dasturlarida, jumladan, kuzatuv,avtomobil navigatsiyasi, avtonom robot navigatsiyasi va boshqalarda asosiy muammo hisoblanadi. U qiziqarli harakatlanuvchi narsalarni aniqlaydi va ularni muntazam kuzatib boradi. Uning asosiy vazifasi harakatlanuvchi obyektni yoki tasvir ketma-ketligidagi ko‘plab obyektlarni aniqlash va kuzatishdir. Odatda, video tahlilining uch bosqichi mavjud: obyektni aniqlash, obyektni kuzatish va obyektni qayta tashkil etish. Ushbu tezis video obyektni kuzatishning bir nechta yondashuvlari, jumladan nuqta kuzatuvi, yadro kuzauvi va siluetni kuzatish algoritmlari haqida qisqacha ma’lumot beradi.

INTRODUCTION Object tracking is an important and difficult task in computer vision. The rise of high-powered computers, the availability of high-quality and low-cost video cameras, and the growing demand for automated video analysis have sparked a significant deal of interest in object tracking algorithms.

Object tracking in video is described as the challenge of estimating an object's trajectory in the image plane as it moves across a scene [1]. It is the process of segmenting an object of interest from a video scene and tracking its velocity, orientation, and occlusion. Furthermore, depending on the tracking domain, a tracker can provide object-centric information such as the direction, region, or silhouette of an object. Video object detection and tracking have a wide range of applications in video processing, including video compression, surveillance, vision-based control, human-computer interfaces, medical imaging, augmented reality, and robotics.

The tracking algorithm can be chosen based on the object's representation, feature, object recognition technique, and tracking algorithm. The most common methods of representation are points, primitive geometric shapes, object silhouettes and contours, articulated shape models, and skeletal models. Color, texture, optical flow, and edge are all common visual aspects. Object identification methods include point detectors, background subtraction, segmentation, and supervised learning.

OBJECT TRACKING TECHNIQUES

The goal of object tracking is to establish a path for an object over time by determining its position in video sequences. Detecting the object and building correspondence between its occurrences in frames might be done independently or simultaneously. In the first stage, an object detection technique is used to determine the region of interest in each frame, and then objects are tracked between frames. In the last stage, the object region is projected by repeatedly updating the object

position gained from previous frames. Object tracking is characterized into three types: point tracking, kernel tracking, and silhouette tracking [1].

Single-Point Tracking. This simple motion tracking technique is ideal for getting started in the field of motion tracking. A single-point tracker tracks an object using only one point of reference within a composition. In single-point tracking, the motion tracking software is assigned a single point in a clip to focus on and tracks the camera's movement around that point (Figure 1). This type of tracking is best suited for things that move in a single direction, such as an image of a flower vase on a table that the camera slowly passes by. This is a simple technique that requires only a basic familiarity of the After Effects motion tracking platform to complete. Using this strategy will help you become acquainted with the Tracker Panel and understand how the Position tracker works.

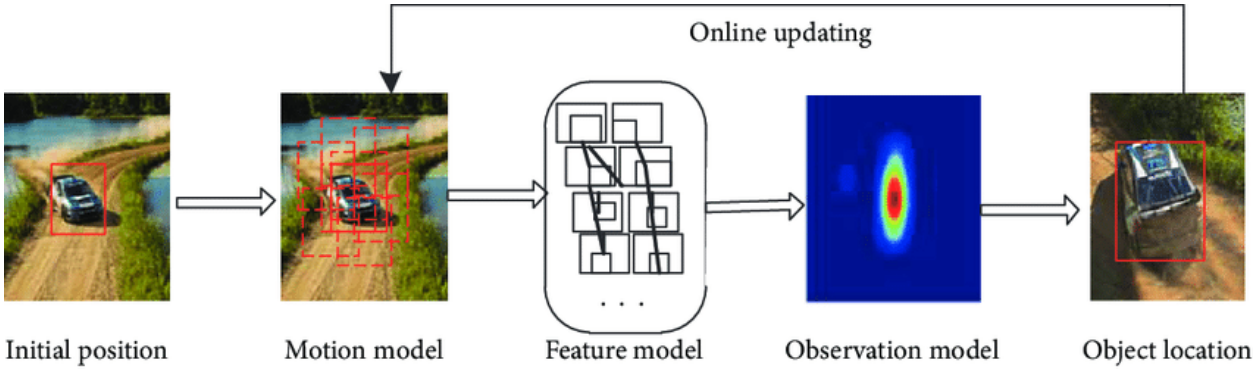

Figure 1. Basic framework of the single-object tracking algorithm

Kernel Tracking. To represent the tracked object, a kernel function is utilized. This might be a Gaussian kernel, an Epanechnikov kernel, or any other form that complements the object's appearance [2]. The kernel aids in the creation of an object model based on its color, texture, and other characteristics. A histogram of pixel values within the kernel is frequently used to illustrate the look of an object. This histogram is used to distinguish the object from its surroundings. Bhattacharyya Coefficient is a metric that compares the histogram of the item in the current frame to the histogram from the previous frame [3]. It aids the tracking process by analyzing how comparable the two histograms are.

Silhouette tracking. Silhouette Tracking is utilized when a specific portion of an object is desired. Complex shape items, such as hands, heads, and human bodies, can be accurately described using the silhouette-based method. The goal of these type tracking methods is to identify the object region in each frame using an object model created from previous frames. This model can take the shape of an object edge or an object contour with a color histogram. There are two primary types of silhouette tracking: shape matching and contour tracking [4]. Silhouette extraction

is the technique of recognizing and extracting an object's silhouette from its surroundings. Common techniques include background subtraction, edge detection, and segmentation. After extracting the silhouette, it is represented as a contour, which is a continuous curve that defines the shape of the item. The contours taken from consecutive frames are compared and matched to discover how the silhouette moves and transforms over time [5]. Occasionally, a predetermined model of the object (such as a human body model) is used to fit the silhouette, resulting in more reliable tracking.

CONCLUSION This paper presents a wide literature survey on several video object tracking algorithms. Video analysis is primarily based on object detection, tracking, and recognition. Comparative analysis is being performed on the basis of three basic object tracking algorithms: point tracking, kernel tracking, and silhouette tracking. Point tracking involves detection in every frame, whereas kernel-based or contour-based tracking requires detection when the item first appears in the scene. Point trackers are useful for tracking very small objects that can be represented by a single point. Different estimation approaches are employed in the kernel tracking strategy to determine the resultant region of the target object. Silhouette tracking determines the sort of representation, which can be motion or appearance models.

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