WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Survey on Object Tracking in Video Surveillance

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ABSTRACT –

Security video surveillance of important places such as banks, roads, crowded public places, borders, forests and train stations is monitored by automated video. The system we set up tries to find and follow moving objects. Moving objects and detection algorithms must be fast, reliable and durable to make video surveillance systems "intelligent". This technique uses background subtraction to detect moving objects in the foreground in a series of images. In video analysis, the first step of object detection is background subtraction, and the second step is masksampling. This study suggests using a set of classifiers to capture objects. The article ends with a discussion of different algorithms that can be used for object detection and more, many cutting-edge algorithms were implemented and tested in a real-world driving environment on our own platform. The paper concludes with a discussion of the different algorithms available for object detection.

Keywords: Background subtraction, foreground mask sampling, cascade classifier, etc.

INTRODUCTION

This project includes the use of time tracking software. This section discusses the project specifications. It also provides a high-level overview of the process, leaving design and implementation issues to be discussed in the relevant sections. Video analytics is increasingly in demand for many real-time applications in machine learning.

Object Tracking is the major segment with different areas of analysis:

- Suspicious activity detection
- Constant threat at public places
- Military applications

Intelligent video surveillance, vehicle tracking, human-computer interaction, military medicine, motion recognition and other applications. An important and difficult task in computer vision is trying to recognize, track and capture objects from images called films. Understanding and explaining behavior helps to understand and describe the behavior of objects rather than the computer operator. It tries to find moving objects in video files or security cameras. Search for one or more products using one camera, multiple cameras, or specific video files referred to as object tracking. The creation of new, powerful algorithms and their use in object tracking need the development of high-quality image sensors, enhancements to picture quality and resolution, and the exponential expansion of processing power. tracking and detecting objects.

During object tracking, a deep learning algorithm monitors an object's motion. In other words, the task at hand is to predict or estimate the positions and other crucial information of moving objects in a movie.

The method of object detection typically plays a role in object tracking. Here is a brief rundown of the steps:

- item detection, in which the algorithm identifies and classifies the item by enclosing it in a bounding box.
- Giving each thing a special identifying number (ID).
- Storing the pertinent data while tracking the identified item as it travels across the frames.

All of the aforementioned details enable us to provide a concise overview of object identification and tracking techniques. To distinguish the object that has to be tracked, the backdrop must always be clean of extraneous objects before seeing the tracked output.

Several methods are used in this technique to help find the item and tell it apart from its surroundings.

Here are a few popular techniques for tracking objects:

A. Point Monitoring

Moving objects are represented by their feature points during tracking in an image structure. Point tracking is a challenging issue, especially when there are object occlusions and incorrect object detections. By thresholding at the time of identification of these locations, recognition may be accomplished rather easily.

B. Kernel Based Tracking

In order to accomplish kernel tracking, a moving object that is represented by an embryonic object area is often computed from one frame to the next. Typically, the motion of the object takes the form of a parametric motion, such translation, conformal, affine, etc. These techniques differ in terms of the number of monitored objects, the presence representation that is employed, and the technique for approximating object motion.

C. Approach to Silhouette-Based Tracking

Simple geometric forms are unable to accurately characterize some objects due to their complicated shapes, such as hands, fingers, and shoulders. The items' shapes may be accurately described using silhouette-based approaches. Using an object model created from earlier frames, the goal of a silhouette-based object tracking is to locate the object region in every frame. capable of handling a range of object forms, as well as object splitting and merging due to occlusion.The most popular and extensively applied methods for object identification and tracking are those stated above.

item tracking, which entails locating and tracking an item's movement over time, is frequently used in combination with object detection. Occlusions, changes in illumination, and other circumstances that might make it tough to maintain a steady track of the object can make object tracking challenging. For applications like video monitoring and sports analysis, it may be helpful. To monitor an object's movement over time, object tracking is frequently used in combination with object detection. There are several approaches to object detection, each having advantages and disadvantages.

LITERATURE REVIEW BASED ON OBJECT DETECTION AND TRACKING

This study proposes an automated item recognition and tracking system. To swiftly and precisely extract moving objects, the detector combines a mixed Gaussian background modelling approach with a HOG and SVM detection model. In addition, we use a simple association technique to connect the detector and KCF tracker.During this procedure, the tracking module completes data association and anti-occlusion tasks. The recommended method makes use of the cooperative working mode of the detection and tracking modules. The detection and tracking module may get better results by making the final decision on each frame in this way. Both of its stated objectives—improving detection precision and automatically initializing the location of the item in the first frame—are achieved. Shengzhi Du et al.[1] have used intelligent surveillance films to demonstrate the appropriate operation of the suggested technique.Taekyung Kim et al. [2] describe a block matching-based backdrop generation and non-rigid form tracking technique in this study. By addressing intrinsic issues with current block matching techniques, the suggested adaptive backdrop generation module acts as a crucial building element for reliable tracking. The suggested shape tracking module extracts the moving area of the object based on SCPs after producing the backdrop.The combination of block matching and background generation (BMBG), which permits reliable tracking even with occlusion, is a significant contribution of this study. The computer-generated fish picture and the outside image have been used in several investigations. The suggested technique may offer reliable tracking with many objects, occlusion, and a complex background, according to experimental results.A non-rigid form tracking algorithm and a backdrop generation technique based on block matching by Hetal K. Chavadaet al.[3] are presented in this paper. The proposed adaptive background generation module serves as a fundamental building component for accurate tracking by resolving inherent problems with existing block matching algorithms. After creating the backdrop, the proposed shape tracking module removes the moving portion of the object based on SCPs. This study makes a substantial contribution by combining block matching and background generation (BMBG), which enables accurate tracking even when there is occlusion. Numerous investigations have made use of both the outside picture and the computer-generated fish image. According to experimental findings, the suggested approach can give accurate tracking even when there are multiple objects, occlusion, and a complicated backdrop.The recommended method was used on a video sequence that was compressed and converted to.avi format after being recorded at 115 frames per second. An item was initially identified based on the image input, and it was tracked in subsequent frames. The bounding box placed on top of the observed object's coordinates was also evaluated and tracked. Without missing a frame, the experimental method was able to overlay the bounding box and track objects. The Mean Shift Algorithm could effectively produce an image sequence after being fully implemented. The effectiveness of the method was assessed by Garima Mathur et al. by successfully tracking the user-defined object and executing the overlay function on the discovered item. [4]This article created a high performance tracking algorithm for the surveillance system. Even when people are interacting or when the occlusion is caused by other foreground objects, our solution uses object blobs and velocity to track several moving objects in consecutive frames without the need of color signals or appearance models.The relationship between the subject's proximity to the camera and the camera's distance from the subject causes people to move more. As a consequence, the occlusion problem may be successfully handled by our algorithm's adjustable search range. The failure of foreground detection in situations when the foreground and backdrop are the same can also be fixed using the object grouping approach. More than 94% of these correspondences match accurately, according simulation results by Tsung-Han Tsai et al. [5].Video object segmentation and tracking are used in several applications, such as video surveillance systems, traffic monitoring, and video indexing. This study develops an automated tracking method using particle filters. The recommended method has been used to both the CAVIAR dataset and user-generated datasets. In this instance, the recovered frames have been split, and object tracking using a particle filter has been done. This system can still follow the

objects even when one crosses. The advantage of using this method is that you can keep an eye on the things from different camera angles.Future particle filters will enable the tracking of many objects at once. Abirami S et al. may also attempt to overcome tracking challenges like background and foreground congestion with more potent approaches.[6]

Sr. no	Author/Journal Year	Title	Algorithm	Future scope /conclusion	Application
1	Year : 2016 Author : (Yilmaz, A., Javed, O., and Shah, M. 2006.	Object Detection:A survey	Edge detection, Connected component, Three Tiered, Image segmentation, Adaboost, Hungarian, Twopoint correspondence, Greedy	primitive geometric shapes for object representation is that parts of the objects may be left outside of the defined shape while parts of the background may reside inside it	automated surveillance, humancomputer interaction,
2	Year : 2018 Author : Garima Mathur, Devendra Somwanshi, Mahesh M. Bundele	Intelligent Video Surveillance based on Object Tracking	Mean shift algorithm	Multi view tracking using multiple camera	video retrieval, traffic monitoring, vehicle navigation.
3	Year : 2014 Author : TsungHan Tsai, ChihHao Chang	A High Performance Object Tracking Technique with An Adaptive Search Method In Surveillance System	Adaptive search method	Simulation results show that more than 94% of these correspondence match accuracy is achieved	Surveillance and video security, Traffic monitoring
4	Year : 2014 Author : M. Sivarathinabala, S. Abirami	A Real Time Approach to Track Humans in Surveillance Video	Particle filte	multiple object tracking	security, human computer interaction, scene analysis
5	Year : 2020 Author : Enzeng Dong, Yue Zhang, Shengzhi Du	An Automatic Object Detection and Tracking Method Based on video survillience	kernel correlation filters tracker	The proposed method has high real-time performance and robustness, and is suitable in long time video surveillance.	Activity recognition, event detection
6	Year : 2007 Author : Taekyung Kim, David Tohyun Paik, Joonki Paik	Block matching based background generation and non-rigid shape tracking for video surveillance	Block matching, background generation and non-rigid shape tracking	Provide robust tracking with multiple objects, occlusion, and complicated background.	Security control

7	Year : 2017 Author : Hetal K. Chavda, MaulikDhamecha	Moving Object Tracking using PTZ Camera in Video Surveillance System	PTZ Camera, Kalman filter	Solve the problem of existing block matching-based methods, and at the same time it can track an object with occlusion and/or deformation	Typical event of abnormalities

CHALLENGES WITH OBJECT DETECTION

Working on object tracking algorithms can provide a number of difficulties. On a straight road or in an uncomplicated setting, it is straightforward to track an item.

We've previously spoken about how crucial it is to model the target object appropriately. The target item will face several difficulties in a real-world environment, including deformation, occlusion, background noise, etc.

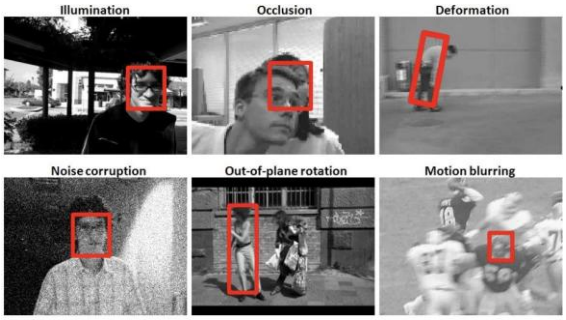

Figure 3.1 Difficulties occurred during tracking

The following are the details from Figure 3.1:

1. Occlusion: When the backdrop or foreground interferes with the object, the tracking algorithm loses sight of it and stops following it. In other words, the algorithm grows perplexed as more items get close. As a result, the first discovered object is mistakenly tracked once more as a brand-new object. It may be prevented by using occlusion sensitivity.
2. Background Clutter: Any machine learning or deep learning activity is significantly hampered by the backgrounds of the input photographs. The more densely crowded the background is, the more difficult it should be to extract features, identify, or even track the item of interest. As a result of the duplicated information or noise introduced by densely packed backgrounds, the network is less receptive to important characteristics, which hinders learning and optimisation.
3. Training and Tracking Speed: Deep learning algorithms used today are far more intricate, which enables them to extract traits and make meaningful connections. But it has also increased the amount of time and energy they need.

In contrast to algorithms used for object identification and picture classification, the tracking technique is not a single-task algorithm. This approach manages object tracking, localization, classification, and detection simultaneously.

different spatial scales The fact that the target objects might come in a broad variety of sizes and forms is one of the challenges with object tracking; this sort of information can confuse the learning process and lead to generalization errors. To deal with the issue of various spatial scales, the following techniques can be used:

1. Awning Boxes

These are the specified measurements of the target item. The boxes are used to gauge the size and aspect ratios of the target items. These boxes are sent into the network during training to help it understand the position and size of the item.

By separately analysing properties and producing accurate results, anchor boxes also help the network distinguish several objects when they overlap.

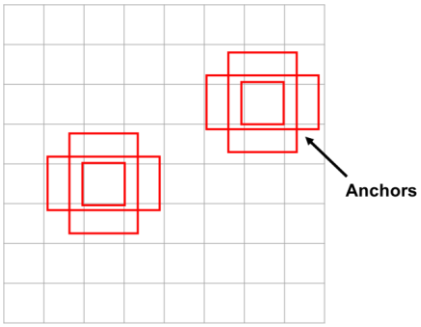

Figure 3.2 Spatial Scale Varying

OBJECT DETECTION USING BACKGROUND SUBTRACTION METHOD

Over the past ten years, the visual analysis of human activity has attracted significant academic attention and is currently a focus of ongoing computer vision research. This technology has a very bright future as well as tremendous theoretical and intellectual value. It may be applied to intelligent monitoring, virtual reality, and human-computer interaction. The goal of object motion detection technology is to extract moving things from surveillance footage with the least amount of background and noise. We use the adaptive background subtraction approach to put it into practice and instantly update the background picture. Adaptive background subtraction is a more efficient approach for moving object detection. It is easy to apply and extracts the desired data's characteristics more precisely. Video tracking is the technique of utilizing a camera to monitor one or more moving objects over time. In order to grasp the moving target tracking problem, which is always used to identify moving objects, we also employ the background subtraction approach.

Target Detection:

Background pictures are removed from each frame to perform moving object detection, which identifies which areas of each video frame are stationary or moving. The pixel value of the background picture is Bt(x,y), whereas the value of the current frame is Xt(x,y). T decides if a pixel is a component of a moving target. When |Xt(x,y)-Bt(x,y)|>T, pixels are deemed to be foreground objects and have their values set to 1. Similar to this, when |Xt(x,y)-Bt(x,y) |>T, pixels are marked as background and their values are set to 0. The result is a binary image. The result is shown in Figure 3 down below.

In this research, we used adaptive background updating. As a result of objects moving and other environmental disturbances, the backdrop image is continually changing. Therefore, it is necessary to regularly replace the background image. In the formula (2), Bn(x,y) denotes the current background image and Fn(x,y) denotes the current frame image. When the difference between Fn(x,y) and B(n-1)(x,y), the background image from the previous frame, is less than the threshold, T, we update the background image and treat the current pixel as the backdrop. If not, the moving pixel is the foreground. The T should be modified for varied situations in order to guarantee the correctness of the backdrop image. The adaptive background updating parameter A controls how rapidly updates are made. Using the mass-by-mass data from the studies, we arrived at a reasonable and precise estimate.

CONCLUSION

In this study, we have reviewed the many methods that may be applied to object detection. To distinguish between foreground and background items in object detection, background removal is a frequent approach. A list of elements can be sorted in ascending or descending order using the straightforward sorting technique known as bubble sort. Although both methods have been widely employed in object identification, further study and development is still needed.

The automatic identification and localization of items of interest inside video feeds are made possible by object detection, which has grown to be a crucial method in video surveillance systems. By identifying possible threats or suspicious activity in real-time, object detection can assist increase public safety and security by utilizing cutting-edge computer vision techniques including background removal, deep learning-based algorithms, and object tracking. Intrusion detection, population monitoring, traffic monitoring, object tracking, and abandoned object identification are just a few of the many video surveillance uses for object detection. The potential for future study and development in object detection to boost its precision, speed, and resilience and make it an even more formidable instrument for boosting public safety and security is enormous as technology develops.

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