International Journal of Informatics and Communication Technology (IJ-ICT)
Vol. 11, No. 1, April 2022, pp. 1~7
ISSN: 2252-8776, DOI: 10.11591/ijict.v11i1.pp1-7

A novel enhanced algorithm for efficient human tracking

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Article Info

Article history:

Received Aug 30, 2021
Revised Jan 20, 2021
Accepted Feb 12, 2022

Keywords:

Background subtraction
Bubble routing
Deep learning
Human tracking
Image filter
Movable objects
Object tracking

ABSTRACT

Tracking moving objects has been an issue in recent years of computer vision and image processing and human tracking makes it a more significant challenge. This category has various aspects and wide applications, such as autonomous deriving, human-robot interactions, and human movement analysis. One of the issues that have always made tracking algorithms difficult is their interaction with goal recognition methods, the mutable appearance of variable aims, and simultaneous tracking of multiple goals. In this paper, a method with high efficiency and higher accuracy was compared to the previous methods for tracking just objects using imaging with the fixed camera is introduced. The proposed algorithm operates in four steps in such a way as to identify a fixed background and remove noise from that. This background is used to subtract from movable objects. After that, while the image is being filtered, the shadows and noises of the filmed image are removed, and finally, using the bubble routing method, the mobile object will be separated and tracked. Experimental results indicated that the proposed model for detecting and tracking mobile objects works well and can improve the motion and trajectory estimation of objects in terms of speed and accuracy to a desirable level up to in terms of accuracy compared with previous methods.

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1. INTRODUCTION

This paper aims to introduce a fast method of human tracking based on background subtraction. Object tracking is a substantial task in the field of computer vision. Tracking can include the path and movement type of object. Besides, tracking can provide other information such as the direction, area perimeter or shape, speed, and acceleration of the object. But object tracking can be complicated for some reasons like loss of some part of 3D real-world information when converting to the 2D image, different types of noise in images, complex movements of the object, the non-networked nature of the object, and even more. Therefore, restrictions can be placed on object tracking in dimensions such as movement or body shape. An object's motion is almost assumed to be smooth in all tracking algorithms, without sudden direction changes. Another assumption is constant speed and acceleration for the object.

There are several methods for tracking an object. The purpose of tracking objects is to analyze the video frame by frame. The applications can be named video surveillance systems, human action recognition, and human-robot interactions. Background subtraction is an easy and crucial technique for separating foreground objects from an image. The overall accuracy of an algorithm depends on the accuracy of the object preview. The process of image background subtraction requires maintaining the image model and subtracting the foreground image from the processed frame [1]. One of the main objects in any frame to track is humans. Understanding the human from the background, different types of motion, recognizing the person with some other features like name, are just some of the main applications of human detection from a simple approach to biometric recognition.

Recent papers as [1]–[4] have focused on the teaching-based approach. The support vector tracker in the paper Bradski and Kaehler [5] uses an out-of-line learning support vector machine that is classified and embedded in a current-based optical tracker. In the article Allen *et al.* [6] the current frame is classified using a classifier learned in the previous frame. In order to track, the ratio of variance is used to measure the distinguished feature and to select the best feature from a feature set. In Ning *et al.* [7] poor classifiers are trained online, and pixels are labeled as target or background. Since only local spatial structures have been extracted, the resolution power decreases in crowded scenes.

In Qiu *et al.* [8] the target is shown in a comparatively small subdivision that has been comparatively updated, using image tracking in previous frames. In the paper, Ganoun *et al.* [9] a cascade particle filter with a set of different longevity characteristics is proposed, while the probabilistic model is noisy and has many peaks without Gaussian diffusion in the sampling stage. Diagnostics-based tracking has recently been studied in articles [10], [11]. This is, in fact, a method of detection-based tracking methods. If the learner learns outline, it could be considered as a special style of machine learning-based models.

As discussed above, object detection is a key important section in computer vision. The goal is to find, label and recognize the object properly. This task can be done, easily, by machine and deep learning techniques. And human is one of the crucial objects, that needs to be detected. This task has many applications in video surveillance, action recognition, robotics, and human-computer recognition. Even on the farm, human detection could be useful in farms and Agricultural vehicles. By using the histogram of oriented gradients (HOG) algorithm to detect the person and support vector machines (SVM) to classify the motion. The assembly of parts of the human body is used to some extent to identify and trace. New feedback from the object detector (visual inclination) is used to track humans [12]. Alimardani and Almasi [13] proposed a two-step approach that first creates an apparent model of individuals and then identifies them by the model detection in any frames. These methods are based on the analysis of different parts of the human body tracking. However, the image quality of many video surveillance applications may not be clear enough on these issues because the movement of body parts is difficult to precisely track. Also, using deep learning algorithms, there is a fantastic method. As in Chahyati *et al.* [14], they tried to track the human body, using a convolutional neural network (CNN), they got an accuracy of 70%. In Almasi *et al.* [15] they tried to find the human motions in an egocentric viewpoint, the goal of this method is to find the subject motion without directly tracking the subject on the scene, and by tracking objects or background purely. Another challenging task in human detection is underwater body detection in Yasar and Kusetogullari [16] they tried to track the human body using optical flow, while in Chan [17] they tackled this issue using voxel detection, with an accuracy of 67% and 82% respectively.

It should be clarified that deep learning algorithms always need some large datasets to train, test, and validate the idea. In this regard the three best datasets in terms of human tracking are the Euro City [18] the largest dataset for humans so far, the Massachusetts Institute of Technology (MIT) ped [19] with more than 700,000 images, Institut de recherche en Informatique et en Automatique (INRIA) [20] with using histogram of a gradient. One of the applications in human detection is in robotics, as in Bachuet *et al.* [21] for robotics applications humans could be a good way for any detection with rehabilitation or assistive approaches [22]–[43]. One of the best examples of object detection especially with human detection in their feature-based algorithm has been reached almost 93% accuracy, while it can be used for faces and skin as well [37]. Regarding the new deep learning algorithms for human detection, joint detection or pose detection would be a unique application of human detection, by this approach it would be quite feasible to detect the whole body from detecting the joints. Also, from this point, many applications in health, and sports will be achievable. Their goal has been done by using standard datasets like functional living index-cancer (FLIC) with an accuracy of 97%. This approach can be a real competitor for motion capture systems these marker based systems in different model are could be expensive, but pose estimation deep neural network models can do the same job with the same accuracy [38]. Both machine learning and background subtraction methods are quite useful and powerful, while in our mixed model a new SOTA is practiced [39]. The following sections are firstly the method, which will be discussed in detail. Afterward, the results and discussion will be explained. And at the end, we sum up with a conclusion.

2. RESEARCH METHOD

Object tracking is the most important issue in computer vision. We are tracking objects. Background subtraction is an ordinary and useful approach for separating foreground objects from the whole image. Comprehensively, The procedure of subtracting the background image requires maintaining the image model and subtracting the foreground image from the processed frame [1], [40]. Therefore, when the frame km is compared to the reference one, the inputs of the given pixel from the incremental image indicates how many specific point intensity varies from the corresponding pixel values in the reference one. So, if R (x, y) is the reference image and K represents tk so that f (x, y, k)=f (x, y, tk). Internal changes are in the background itself, such as the tree movement water levels, and flags. t is the threshold value. Video backgrounds cannot be completely fixed. This background is called quasi-fixed background [41], [42]. Video backgrounds cannot be completely static. These types of backgrounds are referred to as background quasi-constants. After removing the shadows, the "particle filter" method has been used to distinguish the moving objects in the image from each other [43], [24] as shown in Figure 1.

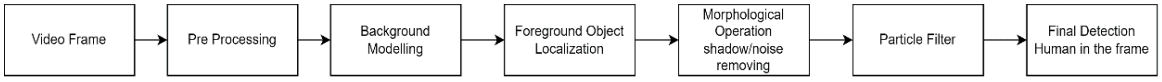

Figure 1. The algorithm architecture of the method

In an attempt to determine a dynamic object in a video is the background subtraction method. Each video frame is subtracted by analyzing with a previously extracted constant image, and a motion preview image of the object will be the final result of the process [25], [26]. This image is then easily converted to binary color space after image processing. In this image, however, there is a lot of noise due to different radiation. The final image may include shadows or small non-fixed objects in addition to a reference object that is necessary to be removed [27], [28]. In order to remove unwanted objects, a set of morphological operations have been performed by deleting the erosion, removing the small noises that have been created unintentionally [29], [30].

3. RESULTS AND DISCUSSION

The proposed algorithm is implemented in detecting and tracking humans, human detection has lots of applications. The first step as shown in Figure 2 is background removal, in this level we tried to separate with high accuracy be foregrounded the person from the background. In a very wide color spectrum, applying different functions, filters and deciding on different image pixels will be e complex and difficult. Thus, turning the image to gray or 1D black and white as shown in Figure 3 is a feasible and desirable step.

Figure 2. The basic black and white detected person

Figure 3. Background removal

Figure 3 is showing a walking human in Figure 4, the aim is to track the image of a person as a moving object, which can be seen in the image at the beginning of its movement. There is also a dot on the person's image, which is displayed as a bubble to represent each object. This point shows the local center

where the object is identified as a moving object in the image. A quadrilateral with a tracking square for it can also be seen around it. Each object is identified and tracked in the object tracking algorithm and in its implementation with a quadrilateral around it. Figure 5 shows that the person is tracked at the beginning of his movement as a moving object with high accuracy in the image. Of course, this tracking shows a little more than the person's range in the image due to the hand movement [31], [32]. In some places of the object, pixels close to the background color are also detected in motion due to the motion type or the speed. In the proposed method, the better this diagnosis, the more accurate and efficient the filters used in image processing.

As shown in Figure 5, the full range of the tracked object is not identified in this image. Also, it is related to the velocity and point of the person. In addition, since the new object is detected at this time, the start of any movement has a significant effect on determining the range of the moving object. Figure 5 reveals the effect of this problem. As can be seen in the Figure, the quadrilateral tracking in the Figure is much more limited than before. The detection of the lower body but using filters other than black and white filters can help in this regard [33], [44].

As mentioned above, after subtracting the background and applying the filter, gaps and small spaces on the image line are connected and smoothed. This is done before the noise is removed, and the result may change the scope of the object slightly. Detection of the scope change and inaccurate general estimation of the object's scope, although is not the main goal in this study, has been tried to be considered in the proposed method to a large extent to introduce a method with better performance and efficiency. The proposed algorithm can be used to detect the motion of several objects as well as faster objects. The test results indicate, the suggested system provides accurate and very reliable results from the tested samples.

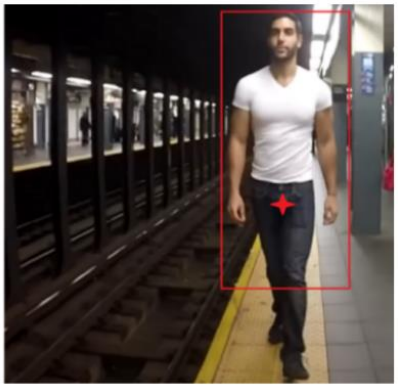

Figure 4. The moving person

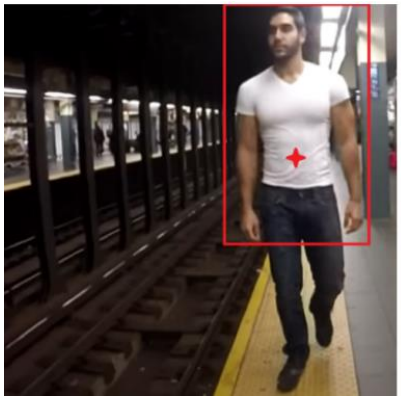

Figure 5. Binary image with detection motion and human

4. CONCLUSION

This research introduced a cost-effective, accurate, and efficient method for detecting a moving object and tracking it using advanced image processing techniques. It has been shown that the proposed system for tracking moving objects with background algorithm, noise cancellation, filtering, and bubble routing, provides full automation by evaluation and dynamic object detection on images. More importantly, system accuracy in determining a moving object in road images is in accordance with the standards set by the decision-making authorities for road control. The most important applications can be named human action recognition and behavior analysis, video surveillance, and autonomous driving.

ACKNOWLEDGEMENTS

This work has been supported by the Shenzhen Basic Research (General Project) (No. JCYJ20190806142601687) and Shenzhen Stable Supporting Program (General Project) (No. GXWD20201230155427003-20200821160539001).

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