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Research on motion tracking and detection of computer vision

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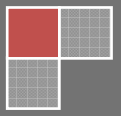
ABSTRACT

With the enhancement of modern signal processing capability and the advent of intelligent computer, researchers are trying to acquire images and other information from the external environment by camera and convert the acquired information into digital signals for processing. The use of Digital Image Processing technique to analyze and process visual information forms a new discipline called Computer Vision. The initial Computer Vision handles mainly two-dimensional images, and with the further development of target segmentation and edge detection, the research on motion tracking and detection of Computer Vision speeds up. This paper introduced a method based on moving target detection and tracking of visual movement. Target Motion Analysis is an act to track and detect the moving targets in the acquired motion video. With the development of science and technology, moving target detection and tracking gradually become a hot issue of modern technology for the practical application not only in military but also in economic activities. In the relative complex context, once the target is changed or the target is blocked, it will make it even harder to detect and track moving targets of Computer Vision, which puts forward higher requirements for moving target detection and practicability.

KEYWORDS

Computer vision; Motion tracking; Motion detection; Image processing; Digital information.



INTRODUCTION

The external world is primarily perceived through the senses, and 80% of the information is obtained mainly through the vision. So the Computer Vision mainly studies the dynamic information which is perceived from the external environment. In modern life, the moving targets contain a large amount of visual information. Although people can see moving objects and judge stationary ones, in most cases, they are more interested in the moving ones like traffic in rush hour and automatic driving.

A developing country is in definite need of technical support, because the advanced high-tech wizardry is the backbone of its development and security. Nowadays, the target detection includes basic computer graphics and video processing, which are widely used in areas of modern industry, education, military business and so on. The researchers divide target detection into static target detection and dynamic target detection according to the state of the target object. The static targets include image scanning, digital photos and so on; and the dynamic targets include human posture, gesture, and the moving plate number and so on. Different from the target detection of static images, the dynamic motion target detection mainly refers to determining whether there is a moving target passing through the video sequences. This can be achieved through analysis of on-site targets according to the videoed moving objects like positioning and tracking a person or vehicle, then figure out why they behave like this, and finally achieve the management of these targets and handling of the emergences. Furthermore, motion target tracking and detection of Computer Vision reduces video information storage capacity and achieves intelligent alarm, which helps solve some potential problems and reduce the occupied bandwidth during data transmission. Technically, motion target tracking and detection of Computer Vision is a main research topic of modern Vision and Image Processing and plays an important role in the current actual production.

MOTION TARGET DETECTION OF COMPUTER VISION

Motion target detection is the top priority of motion target tracking and detection of Computer Vision. The purpose is to automatically separate pixels from the moving objects and the still ones and extract the moving objects from the background image. Precise moving target tracking and detection is very important in the post-processing data analysis.

Time difference measurement

Video image is a two-dimensional image formed by the projection of a three-dimensional image. The two-dimensional image cannot reflect the real movement of the object, but the two-dimensional image projected by the three-dimensional image will change when the moving object changes. For continuously changing video, if the state of motion does not change, little variation will happen between corresponding frames; if the state of motion changes very fast, obvious change will happen between adjacent frames. We process the two adjacent frames mainly through the adjacent frame difference[1], that is, to detect and track the moving objects by means of differences and changes of the two successive frame images. See Figure 1, which explains the process of frame difference.

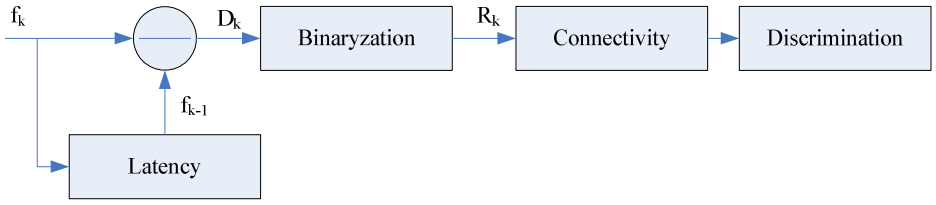


Figure 1 : The process of difference algorithm between two adjacent frames

Generally, calculate the D-value between the K frame image and the K-1 frame image which is $D_k(x, y)$, as shown in Formula (1). T is threshold, which decides the sensitivity of motion detection. This method works fast and is easily realized. But if T is fixed, the method will be inevitably flawed when it rains or snows. In an image of binary difference, the foreground point is a pixel which is 1 and it maybe a point in the motion image. The point of static background image is a pixel which is 0.

$$D_k(x,y) = \begin{cases} 1 & |f_k(x,y) - f_{k-1}(x,y)| > T \\ 0 & else \end{cases} \quad (1)$$

Through the moving objects can be detected through calculation of a large number of adjacent frames, the real-time variation light in the scene of the moving objects cannot be perceived sensitively. Flaws happen when we analyze the acquired data. The motion target tracking and detection by Time Difference is inaccurate[2]. For the objects moving faster, a bigger error often happens between two adjacent frames. So the blocked and projecting area in the scene affect the accuracy of motion target detection to a large extent. Although the adjacent frame difference cannot accurately extract the full property

of a moving object, it is a good method to judge whether an object enters in a scene or not. And most algorithms of motion target tracking and detection of Computer Vision have been improved based on this.

Background Subtraction

Background Subtraction[3] is a main algorithm of modern motion detection, and it is a method which uses the difference between the current image and the background image and is mainly applied in a fixed cameral to detect the moving objects. Background Subtraction stores the current frame image, and if the difference image pixel is greater than a fixed threshold, the target object is considered moving at this point. Otherwise the pixel is considered background image. The target position, shape and other basic information can be obtained according to the analysis of the fixed threshold based on the acquired data.

Background Subtraction includes the following algorithms: (1) Use stored and real-time sequences as the pixels to establish a background model and get $B(x, y)$ (2) Subtract $f_k(x, y)$ to $B(x, y)$ and get the maximum deviation of pixels between the motion image frame and frame of background model at a certain threshold. See Formula (2). We can judge the position, shape, size and other information of the moving targets, and thus know the complete information of the moving objects. (3) The background of the model needs to be updated periodically, so that it can adapt to the dynamic changes of the scene.

$$D_k(x, y) = \begin{cases} 1 & |f_k(x, y) - B(x, y)| > T \\ 0 & else \end{cases} \quad \textbf{(2)}$$

Motion target tracking and detection by Background Subtraction will extract the complete information of the moving objects, but problems still need to be addressed that how to get the background of the model and how to update the background in practical applications.

Statistical background model

Background Statistical Model is the most effective way of motion target detection in applications[4]. Besides the use of difference between the current image and the background image, this algorithm incorporates the concept of statistics to describe the background model, which is much different from pure study by Background Subtraction in 2.2. Background Model includes multi-modal background model and single mode background model. Background Statistical Model is also known as a model describing the background image, which uses a probability distribution model to describe or a dispersed distribution model to describes. Many objects and scenes in nature like rippled water, swaying branches and the monitor screen are multi-modal background models.

The technical key of statistical background model is the updating. Two principles should be followed in the process of updating: (1) the corresponding updating speed should be fast enough, because changes may happen due to changes caused by light or changes of the background area caused by the interchanges of the current area. Assume that the updating speed of the background model is lower than the changing speed in actual motion of the background model, there will be interference noise during motion tracking and detection or there will appear a long time of stillness. (2) The statistical background model should have relatively strong anti-jamming capability. Because every frame of the background model is memorized in the process of updating and researchers hope to obtain the objects both moving and static. But to the motion object itself, this "memorizing" process is invisible, and especially when its speed changes very fast, error will happen, thus causing inaccurate detection.

MOTION TARGET TRACKING OF COMPUTER VISION

Motion Target Tracking[5] is a research focus in areas of Computer Vision and Pattern Recognition. Its purpose is to calculate the coordinate of motion target on a two-dimensional plane through the analysis of the videoed dynamic image sequences. And calculate the track of the same motion target based on different eigenvalues of every frame. See Figure 2.

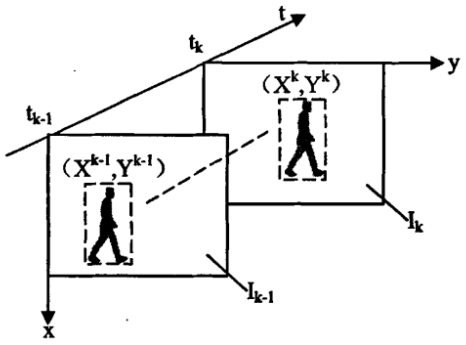


Figure 2 : Motion target tracking

Researchers have proposed many algorithms of Motion Target Tracking, some of which are for Zoning Matching, some are put forward to narrow targets or ranges and some are raised for matching the speed of moving objects. These algorithms have respective advantages and can be used in tracking different motion targets.

Motion tracking of zoning matching

Zoning Matching[6] is a method that makes the former motion track based on data analysis as a target template for Zoning Matching, sets a fixed matching parameter and uses it in the full search for the target object of the next image. Normally, the best matching point is regarded as the position of target object when taking the extreme value of the parameter.

See Figure 3. The matching parameter and algorithm for search are both important factors of Zoning Matching. If the matching parameter and algorithm for search are different, the Zoning Matching method is different, too.

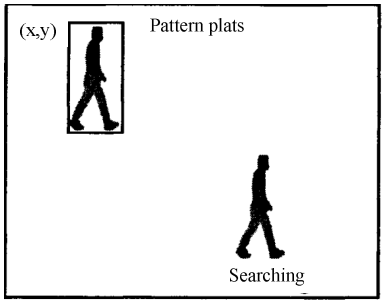


Figure 3 : Zoning matching

The Zoning Matching is a relatively complete algorithm of target matching. So a lot of information is obtained by tracking the objects. The information has been applied to track smaller objects or objects with small contrast. And it is mainly used in the military field. The Zoning Matching tracking algorithm can obtain more satisfactory track results, but it will waste time when it comes to large amount of calculation and especially when it is applied in grayscales image or conducting full search for motion objects. In this case, specialized hardware support is needed. So the zoning matching tracking algorithm cannot meet the requirements of real-time tracking in the practical application[7]. In addition, a large area of the background will be blocked because the motion objects often rotate or due to changes caused by the movement of the light; a corresponding matching point cannot be found when analyzing the data, etc. All these problems need to be solved.

Motion tracking of contour matching

Tracking algorithm based on contour matching is to get the main outline of the boundaries of moving objects[8], and then track the target contour in the frame image behind. It is basically the same with region matching algorithm. They both have template matching and template updating process. The difference lies in that the template matching is based on a certain purpose under binaryzation; the contour matching can only achieve better results when the calculation is small.

Tracking algorithm based on contour matching has no relation with the beginning detection effect. But the detection updating is a bit difficult, and the method is not very suitable for tracking the blocked area.

System framework design

The design is suitable for laptops with relatively better performance, whose tracking and detecting systems can be combined with the corresponding algorithm. And of course, the laptops should have better cost performance[9]. The system is designed based on laptops to track and detect the moving objects and by means of a sophisticated camera capturing the situation of targets. It only processes the images within the scope of the camera. See Figure 4.

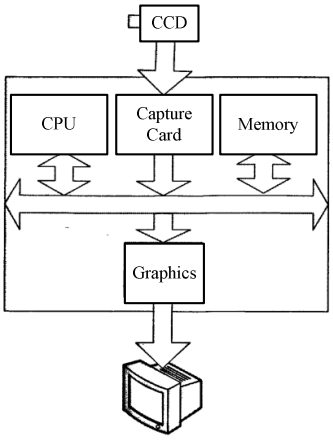


Figure 4 : System framework

The system function includes the following several modules: time adjustment, image acquisition, target detection, classification, tracking and image display. See Figure 5.

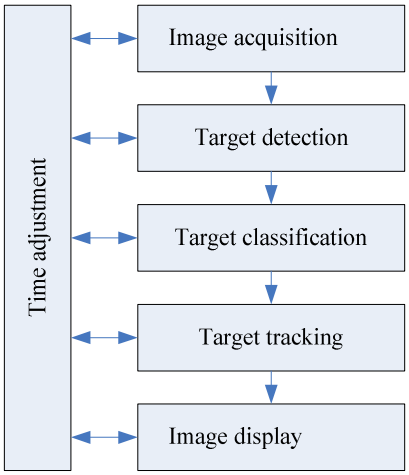


Figure 5 : Structure of system module

CONCLUSION

Motion target tracking and detection is an important research direction of modern computers. It is also widely used in various fields, especially in areas of gesture recognition and weapons manufacturing. The tracking system is intelligent, which can be widely applied in conventional external environment, but it requires higher stability and suitability. The environmental impacts on the detection and tracking of the targets, interference of noise and obstacles from the ground should be fully considered. Only by taking the possible factors that affect the prediction results into account, can the system have strong practical performance, and thus providing better help for applications in various fields.

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