Research on Moving Object Detection and Tracking Algorithm Based on Optical Flow Method in Complex Background

Hongbin Luo
GanSu Institute of Political Science and Law, Lanzhou 730070, China

Abstract

With the continuous improvement of science and technology, humans have entered into the information age. The information technology based on computer and Internet has been fully used in all traditional fields, and there has been a deep integration between human beings and information technology, which are mainly reflected in two points. The first point is that human beings rely more and more on computers. People, whether they major in computer science or not, must master a certain computer technology; the second point is that the functions of computer are more and more powerful, and a variety of complex algorithms also lead to that the interaction function of compute becomes more stringent and rigid. In actual production and life, the moving object detection technology has broad application prospects in fields such as industrial robot control, car navigation, detection events, organizational information, medical graph analysis, human-computer interaction and application detection. However, how to improve the detection and tracking ability of moving objects and optimize the algorithm constantly becomes one of the most important issues that experts and scholars attach great importance to. In this paper, the moving object detection in the complex background based on the optical flow method and the moving object detection and tracking algorithm is constructed, which plays an important role in promoting the development of the object detection technology.

Keywords: Optical Flow Method, Moving Object Detection, Tracking Algorithm.

1. RESEARCH REVIEW

1.1 Research background

Under the information age, the moving object detection and tracking technology has broad application prospects in many important fields such as transportation, military affairs, medical treatment and sports. Many experts and professors from universities and institutes all attach great importance to the detection and tracking technology of moving objects. For example, MIT and Oxford University set up a research team specializing in the detection and tracking technology of moving objects, and invested a large amount of manpower, material resources and financial costs. A large number of research results have flowed into the market, which plays an important role in promoting the development of detection and tracking technology of moving objects. In China, Chinese Academy of Sciences also started to research the moving object detection and tracking technology. The traffic monitoring prototype system is independently developed based on other research data, which is an important breakthrough of application of the moving object detection and tracking technology in the transportation field. Even so, there are still some shortcomings in the research on moving object detection and tracking technology at home and abroad. First of all, the practicality of such products is far from satisfactory, and its performance and reliability are far behind the actual needs of various fields. Secondly, the dependence on foreign theories and foundations is still high, and the degree of independent research is still insufficient. Finally, it is difficult to carry out the detection and tracking of moving objects in the complex background, in particular, it will be affected by self-occlusion issues. Therefore, the moving object detection and tracking technology still has a broad research prospect and needs further research and improvement.

1.2 Literature review

At present, there are mainly the following problems in the research on moving object detection and tracking technology. The first one is the background. Only when there is moving object in the background, the background information can be obtained. At the same time, the disturbed objects in the background cannot be too many to
support the moving object detection and tracking technology in the complex background. The second one is the external interference. A variety of external interference factors will have an impact on the accuracy of the detection and tracking of moving objects, such as sunlight, etc. At different time periods, different results will be produced as the light changes. The third one is the fixed object of background. If the fixed object in the background has undergone a major change, it is required to change the background in time to be able to ensure its normal operation. It is of higher restrictions (Xu and Huang, 2014). Human beings obtain information mainly through visual, auditory, olfactory and tactile channels. Among them, vision is the most important way to obtain information. More than 70% of the information in the brain comes from the eyes, while only 30% relies on other channels. The optical flow method is a kind of easy-to-understand one that can represent the state of movement of the objects with images. The state of movement of the objects is mainly represented through the brightness of the light. Compared with the traditional moving object detection and tracking technology, this method is more intuitive and simple, and it can be applied in many aspects of moving object detection and tracking technology, with high adaptability (Hou et al., 2014). In the moving object detection and tracking technology, the computer must have the following functions. The first one is the image acquisition capability. The image obtained by optical flow method is a whole sequence constituted by two-dimensional and three-dimensional images. In order to capture these images, the computer must have the function of camera, remote sensing, ultrasonic wave, radar, etc. The second one is the pretreatment technology, that is, the image should be preprocessed before analyzed, such as noise reduction, secondary sampling and so on, so as to enhance the accuracy of analysis and research. The third one is the feature extraction. When an image is examined by the moving object detection and tracking technology, the features are extracted through multiple parts such as corners, edges and spots to obtain better results (Yu et al., 2014).

2. OVERVIEW OF OPTICAL FLOW METHOD

The optical flow method is essentially a way to represent the state of motion of an image. Compared with the moving object detection and tracking technology of other images, the optical flow method is simple and practical (Li et al., 2014). Optical flow method is mainly to feed back the operation form of objects in the image sequence through the intensity of light for different parts of the light intensity, that is, to detect and track the operation conditions of objects by means of video sensors. The optical flow method is essentially the geometric change of the objects in the planar image (Xin, 2014). In 1998, scientists further redefined the optical flow by studying it in a deeper level. They think that the optical flow refers to the geometric change of the image on the one hand, and the change of radiosity of the image on the other hand. Through the above two kinds of contents, the movement of each pixel position is determined to get the overall movement of the object (Li et al., 2014). Overall, the optical flow is mainly generated by the camera movement, object movement or both ways, and the calculation method is mainly divided into three types as follows:

The first one is based on the matching method. This method mainly includes two calculation modes of feature and region. The feature-based method continuously locates and tracks the main features of the object and has a strong robustness on the movement and brightness of large objects. However, the main problem of this method is that the optical flow is not dense enough and can not support the system for feature extraction and accurate matching (Hu et al., 2014). The region-based method first locates similar regions and then calculates the light flow through the contents in the obtained region by displacements. This method is widely used in many fields, such as video coding. However, there is still a problem of non-compact optical flow, which restricts its further development (Yan et al., 2014).

The second one is based on the method of frequency domain. This method mainly depends on the use of energy, so it can be called energy-based method. The results obtained by this method are generally of high accuracy and relatively less affected by impurities or noise. However, in the meantime, the use of the method based on frequency domain can result in extremely complex calculation processes, and it is difficult to develop reliability evaluation. Therefore, in case of omissions in the assessment during the calculation, there are still some errors (Chen et al., 2014).

The third method is based on gradient. This method is used to calculate the 2D velocity field by the space-time differential, and the brightness of the image sequence of the moving object detection and tracking system based on the optical flow method is calculated. This method is relatively simple, and the results can also guarantee the accuracy and usability. Therefore, it is more commonly used; at the same time, it has also been studied by experts and scholars (Zhang et al., 2015). However, in practice, the gradient-based method still has some shortcomings which are mainly reflected in the manual selection of adjustable parameters and the selection of reliability evaluation factors. There will be some difficulties due to the effect of many subjective or objective factors. In
addition, the pretreatment process will affect the optical flow to a certain extent in the moving object detection and tracking system. Although the influence is small, it will have a certain impact with respect to the gradient-based method (Li and Zhang, 2015).

The basic principle of moving object detection and tracking based on the optical flow method is that in a background, each pixel point of the observed object will produce a certain velocity vector. By analysis of this velocity vector, an object motion model can be constructed. When the object moves to a corresponding point, according to its corresponding relationship, the characteristics of projection and other vector parameters can be obtained, and thus the pixel motion state of the detected object is analyzed. If there are no moving objects in the image, the optical flow vector changes continuously throughout the image area. When there are moving objects in the image, there is a relative motion between the object and the image background. The velocity vector formed by moving objects must be different from that of the background, so that the moving objects and positions can be detected. The main problem of moving object detection by optical flow method is that most of the optical flow methods are time-consuming, but the actual time and practicality are poor. However, the advantage of optical flow method is that the optical flow not only carries the movement information of the moving objects, but also contains rich three-dimensional structure information of the scene. It can detect moving objects without knowing any scene information (Yuan et al., 2013).

For the moving object detection and tracking system based on optical flow method, its camera is usually used for shooting in a static environment. Therefore, there will be a certain deviation with the basic needs of optical flow method, and pure use of optical flow method to conduct moving object detection and tracking will have some difficulties. Therefore, the moving object detection and tracking system needs to be adjusted accordingly in practical applications based on the optical flow method, supplemented by other available algorithms, so as to effectively improve the detection and tracking level of moving objects in a complex background (Zhou et al., 2013).

3. MOVING OBJECT DETECTION AND TRACKING SYSTEM BASED ON OPTICAL FLOW METHOD

The moving object detection and tracking system built by the optical flow method combined with a variety of hardware, platform and software can be finally available. Through practical research, it can be seen that the moving object detection and tracking system is workable, feasible and accurate under the framework of clock frequency below 80M. However, if the moving object detection and tracking system produces a matching error, which is generally due to the parallel processing architecture, the level of error can be effectively reduced after the problem of parallel processing is solved. At the same time, it can be seen through practice that if the operation clock frequency of the system is around 50MHz, the number of frames processed by its image can still meet the basic requirements of the moving object detection and tracking system, which proves that it is feasible. In general, the moving object detection and tracking system based on optical flow method has the following characteristics:

Firstly, the algorithm is relatively simple. Most of the operational symbols in the algorithm are addition and subtraction, and the part needs to use the absolute value is also replaced by way of addition and subtraction, which makes the professionalism of this algorithm greatly reduced and feasibility greatly improved (Gao et al., 2011).

Secondly, the operation speed of the moving object detection and tracking system is greatly enhanced through the construction of a pipelined structure, which can achieve real-time object detection and tracking.

Thirdly, the moving object detection and tracking system based on the optical flow method can be used in many situations and effectively solves the defects of the traditional system for the detection and tracking of the object under the complex background. At the same time, its application scope greatly increases, which enable the moving object detection and tracking system to be applied in more fields and play an important role in promoting the development of military, transportation, industrial and sports industries (Zhang et al., 2012).

ACKNOWLEDGMENTS

The project is funded by the high school research project in Gansu province (No: 2014A-084) and the key funding project of GanSu institute of Political Science and Law (No: GZFXZDLW004).
REFERENCES

Xu C., Huang D.Q. (2014). Detection of moving targets in dynamic background based on robust M estimation and Mean Shift clustering, Photons, 43(01), 142-147.