Application of Stereo Vision Technology In 3D Reconstruction of Traffic Objects

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***Abstract*—The extensive use of modern intelligent transportation system is inseparable from computer technology,especially stereo vision technology,which has become an important technology for 3D reconstruction and detection of mixed traffic scenes.On the basis of the comprehensive description of the technology used in the traffic environment acquisition based on computer stereo vision,this paper analyzes the related object segmentation,shadow detection and 3D reconstruction and model recognition related technology in complex background traffic scene,and the 3D reconstruction technology in stereo vision matching.The development trend and difficulties of 3D reconstruction technology in stereo vision matching are also prospected.**

Keywords-stereo vision;traffic scene;3D reconstruction; camera calibration

I. INTRODUCTION

In the current mainstream traffic scene understanding system,It is the key technology for 3D information reconstruction and modeling of various objects such as pedestrians and vehicles in traffic scenes.In 3D object reconstruction,the steps and processes involved are:bottom processing,motion detection,model matching,shadow detection and so on.[1]The underlying processing means to digitally symbolized the scene image,extract the feature points,and finally realize the segmentation and description of the image.In the motion detection and matching,the related operations can be realized by using the method based on the spatiotemporal gradient,the correlation method and the frequency domain method.For the performance of the related systems,it is more important to realize the real-time performance of the system,which is mainly due to the large calculation of the 3D reconstruction,and the real time of the reconstruction process is very important.Among the key technologies mentioned above,3D reconstruction,motion detection of traffic objects,motion matching of different targets,matching and recognition of different models,which constitute the key technical support of the whole stereo vision traffic scene understanding system,are the core of stereoscopic vision technology.From the perspective of computer vision,the related methods in the model traffic detection technology system can be divided into three different types,namely,the method based on the region tracking,the target tracking method based on the dynamic contour,the feature based tracking method and the traffic object tracking and recognition based on the erect vision.The last method is also the main concern in the text.

II. 3D RECONSTRUCTION METHOD BASED ON STEREOSCOPIC VISION

The 3D reconstruction of the object is realized by using stereo vision technology.By analyzing and processing two-dimensional images,the 3D information of each object in the processed image is extracted by using the mature stereovision theory.[2]In the multitudinous stereo vision technology,binocular vision is a new research method that uses human eyes to deal with the scene directly.The method is proved to be more flexible and can be used to extract the 3D information of objects in a variety of scenes. This section will illustrate the main algorithms involved in stereo vision.

A. Adaptive Threshold Segmentation

The adaptive segmentation method based on the image threshold can quickly capture the moving target in the scene when the selected eigenvalues and parameters are ignored.Using this method,the sequence images of all kinds of objects in the traffic scene can be processed to classify the object features in the traffic scene and improve the discriminant ability of the category of the objects.Considering the wide range of thresholds used in this method,this method can not only have a good recognition rate,but also improve its real time performance.Even if there is only a relatively small movement in the background and the brightness of the scene is abrupt,it can show higher robustness.Researchers have used this method to accurately detect and count objects in traffic images.

A more commonly used threshold selection method is to use the morphological values,With the help of lane and camera parameters,the DTSU algorithm is used to extract the connected domain information of candidate lights.In addition,the researchers selected the image gray value as its threshold target and extracted the moving target in the image based on the image difference technology,realized the extraction of all vehicles in the virtual detection area,and realized the extraction of the background in the sequence image through the already mature digital noise filtering technology,the accurate data of the traffic flow in the scene.In addition,a new method of moving object extraction based on a new adaptive threshold is proposed.In this method,the researchers divide the running properties of all objects into two categories,namely,the moving object and the background.According to the extracted traffic sequence images,classification can be realized according to the pixels of the image.The segmentation threshold is selected through the extremum between the root mean square and the mean distance between different clusters.The two threshold value of the

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extracted moving target is updated and extracted in real time.After subsequent processing,the accurate and complete extraction of the related moving targets in the traffic scene can be obtained.

B. 3D Reconstruction Method Based on Silhouette Profile of Traffic Objects

Using the silhouette of the traffic object to model the 3D information is a new modeling method,which can also be called the method of the visible shell generation.In the silhouette method,the fundamental principle is to make use of the images obtained or photographed by different angles to achieve the stereoscopic reconstruction of the object target.The consistency between the geometry and the topology is often better,and the number of feature points determined and extracted is less,and the calculation process can be completed more quickly.The robustness of the method is also good.Many researchers have used different images obtained by different cameras to reconstruct the 3D data.

In this method,the matching process is realized mainly through the reflection projection cross section of the scene object,and the surface of the object is reconstructed.It is common to use Marching Cubes algorithm to reconstruct the silhouette of objects in sequence images,In order to reconstruct the silhouette of objects in a sequence image,the visible hull of objects in the scene is finally obtained.In addition,researchers used the basic principle of flat mirror reflection.The relatively simple geometric relationship between the contours of the image is analyzed.After obtaining more accurate internal and external parameters of the camera,it is possible to reconstruct the 3D information of the objects in the scene.

C. Method of 3D Reconstruction Based on Sequence Image

Here,the method of 3D reconstruction based on sequence images is actually the use of digital image processing technology to process and operate the multiple images collected in the same scene by two values,which lays the foundation for the subsequent reconstruction process.In the specific operation,we need to match the similarity between the different feature points mentioned,and then the 3D reconstruction process can be realized by using the matrix analysis technique.The application and research experience of this method shows that the key is to obtain the correct 3D data,and the difficulty of the method is to realize the image scanning,preprocessing,the establishment of data model and the noise identification and filtering through the relevant professional software.Although there are some noise pollution in the sequence images obtained in reality,the application of this method to the traffic scene is wide,considering that the requirement of the method is not high.For example,some researchers have used the extracted image sequence as the parameters of the measurement matrix,and designed a least square reconstruction method based on the matching similarity,which can achieve high precision 3D reconstruction of the scene target.In addition,there is a method of reconstructing the scenic spot based on PCA,which mainly uses the least square method to solve the 3D trajectory in the traffic field.Finally,the 3D reconstruction of the moving target and the background model is realized based on the data obtained.In addition,the researchers added the necessary iterative algorithm to the widely used perspective projection reconstruction algorithm,By using the existing matrix perturbation theory,the influence of different types of noise on the reconstruction of feature points in the 3D reconstruction process is analyzed.It is proved that the more the number of images used,the higher the accuracy of the reconstruction.

D. Mixed Gauss Model to Implement Background Modeling

Because of the rapid development and application of modern information technology,sensor technology and network technology,more and more intelligent traffic control systems are used in the traffic management and control,and many intelligent traffic control systems based on video are used to monitor the real traffic scene.The Gauss model is used.The extraction of moving objects is very important in the whole scene. [3]A large number of research results show that the background color of the eigenvalues extracted from the video image and the gray value of the pixels have a good agreement with the Gauss distribution.

At the same time,the distribution of all the pixels in the image shows Gauss distribution from the time dimension.If the pixel is used to construct the background model,it can better solve the related problems caused by the light mutation in the real scene,which makes the 3D reconstruction process more adaptable to the outdoor complex light.The actual application results show that the model obtained by this method is more robust and accurate.Therefore,the background modeling based on Gauss model has been widely applied in the intelligent traffic control system.

With the help of this theory,researchers have proposed a hybrid Gauss background modeling method based on edge features,which can greatly improve the convergence rate in the original Gauss model and have a better adaptation to the photodenaturation.By making full use of the temporal and spatial distribution characteristics of pixels,a spatio-temporal background modeling method based on adaptive hybrid Gauss model is proposed.The data obtained in this method include not only the information of time dimension but also the spatial dimension information,but also the spatial displacement of the object.The effective utilization of the information in the time and space dimension of the pixel is effective to improve the accuracy of the modeling.It also solves the problem that the modeling of the traditional mixed Gauss background is easy to be invalid.

III. 3D RECONSTRUCTION SYSTEM DESIGN OF STEREOSCOPIC VISION

A. Camera Calibration

In the existing system based on binocular stereo vision,the two dimensional images of real scene are usually obtained by two similar CCD cameras,and the 3D coordinates and depth parameters of different objects and targets in the real scene are obtained by using the related algorithm,and then the 3D weight of the whole scene is realized.Construction and depth information extraction.According to the imaging mechanism of

geometric optics,the 3D coordinates of a point in the real scene correspond to the two-dimensional pixels in the image taken,which is determined by the geometric model of the CCD camera.Here,the parameters of the geometric model can be corresponded to the internal and external parameters of the phase machine.Among them,the acquisition of these parameters can be collected through experiments,and the specific experimental calculation and acquisition process is called the camera calibration process.

Similarly,in a binocular stereoscopic imaging system,the relationship between the point in the real scene and the pixels in the two-dimensional image can be determined by the imaging geometry model of the camera.In a large number of imaging geometry models,the most common is the small hole perspective imaging model,which mainly includes the different parts of the optical center,the optical axis and the imaging plane. [4]The specific image coordinate system is shown in Figure 1.

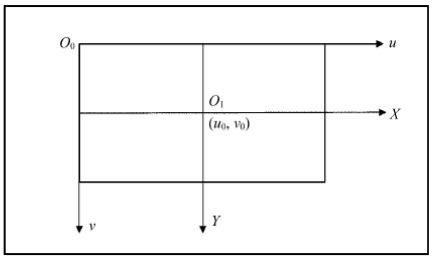

Figure 1. Image coordinate system in a camera

B. 3D Reconstruction of Stereovision

Because the traffic anomaly of the expressway is an event related to the space position,the occurrence of traffic abnormal events is identified by the dynamic changes of the surface 3D model of the surface of the road.High definition cameras can not be photographed in the air very much.By changing the attitude angle and focal length of the camera,different sections are photographed.According to the principle of digital photogrammetry,the attitude of the camera at the moment of shooting is determined.In addition,the camera needs to be corrected.All these require a datum - the 3D coordinate system of space.The 3D model of the pavement is to describe the space state of the pavement in a specific 3D (Reference) coordinate system or to determine the 3D coordinates of any point on the road in the set coordinate system.

The 3D object reconstruction process based on stereoscopic vision can be understood as the process of restoring the 3D coordinates and geometry of the related objects in the real scene from the acquired two-dimensional image.The 3D coordinate information and depth information of objects or objects in the real scene are implied in the two-dimensional images obtained,so the depth information in the two-dimensional image can be extracted by using the depth calculation algorithm.Then,the 3D coordinates can be calculated by the three dimensional reconstruction algorithm of the space point set.Count. [5]As shown in Figure 2,in the binocular stereo vision system,the distance between the optical centers of the two CCD cameras in different locations is called the baseline B,while the coordinates of a point in the real space and the scene are projected,and the coordinates on the image platform are corresponding to (x1,Y1) and (X2,Y2).

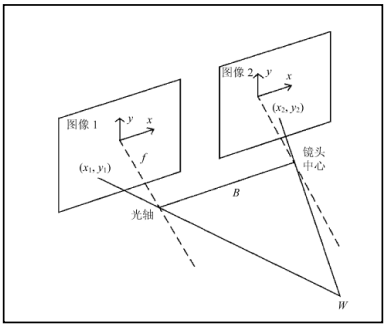

Figure 2. Typical geometric relationship of binocular stereo vision imaging system

Using the basic geometric relation shown in Figure 2 and two different projection points,we can calculate the coordinates of a point in the real 3D space,and this method is called the point to point operation.Finally,with the help of software platform,the coordinates of various targets in real scene can be calculated,and the real parameters of the 3D model can be obtained.

IV. CONCLUDING REMARKS

3D modeling with stereo vision technology and theory has been widely used in the detection and calculation of traffic parameters.In practical applications,the computer image acquisition and processing technology can be used to assist the road resources in the traffic environment to digitize and digitize the collected resources.In stereo vision technology,binocular stereo vision is an effective remedy for single viewpoint monitoring system.With the aid of binocular stereo vision technology,the detection and monitoring of all kinds of objects in real traffic scene can be realized.On the basis of the analysis of the collected image data,the 3D information of various objects and objects in the scene can be reconstructed and extracted,and the popularization and widespread of the intelligent traffic system can be continuously promoted.Application and gradually realize the informatization and automation of object monitoring in traffic scenes.

REFERENCES

[1] YANG GaoBo,CHEN Ning,JIANG Qin,A robust hashing algorithm based on SURF for video copy detection. Computers&Security, 2012,31(1)

[2] Ning Ning Peng,based on 3D laser scanning technology to deal with traffic accident scene,science and technology wind,2012.05

[3] LIAO Ming,ZHOU Liang chen,Lǔ guo-nian,SHENG Ye-hua,PAN Yi,CAO Yan,Theoretical analysis of the geometric relations between human stereo visional space and virtual 3D space,Computer Engineering&Scicncc,2014.06

[4] LI Jing,WANG We,ZHANG Mao-jun,3D reconstruction method combined by binocular stereoscopic vision and coded-structured light,Journal of Computer Applications,2012.12

[5] ZHOU JiaLi,ZHANG ShuYou,YANG GuoPing,A 3D Face Reconstruction and Recognition Method Based on Passive Binocular Stereo Vision,ACTA AUTOMATICA SINICA,2009.02