Application of Video Recognition Technology in Landslide Monitoring System

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Abstract. The video recognition technology is applied to the landslide emergency remote monitoring system. The trajectories of the landslide are identified by this system in this paper. The system of geological disaster monitoring is applied synthetically to realize the analysis of landslide monitoring data and the combination of video recognition technology. Landslide video monitoring system will video image information, time point, network signal strength, power supply through the 4G network transmission to the server. The data is comprehensively analysed though the remote man-machine interface to conduct to achieve the threshold or manual control to determine the front-end video surveillance system. The system is used to identify the target landslide video for intelligent identification. The algorithm is embedded in the intelligent analysis module, and the video frame is identified, detected, analysed, filtered, and morphological treatment. The algorithm based on artificial intelligence and pattern recognition is used to mark the target landslide in the video screen and confirm whether the landslide is normal. The landslide video monitoring system realizes the remote monitoring and control of the mobile side, and provides a quick and easy monitoring technology.

1 Introduction

Landslide Geological Hazards is a geological hazard caused by geological disasters in China. Now more advanced monitoring technologies are 3D laser, BOTDR, GNSS, osmotic pressure, inclinometer and so on. A variety of monitoring methods are proposed for different landslide types: displacement monitoring, physical field monitoring, and groundwater monitoring and external induced factor monitoring to monitor, prevent, treat and evaluate the landslide bodies. With the development of video surveillance technology, the artificial intelligence is promoted. The video for automatic analysis, identification and retrieval of intelligent video surveillance system are achieved.

Intelligent video recognition technology is applied to landslide monitoring in this paper. The target trajectory tracking is carried out by using the difference chart method to realize the image and data, and the dynamic trajectory recognition system is established. The system is established in order to facilitate the timely transmission of image information to the receiving terminal, and retain valuable image and data information which method can achieve low cost, low power consumption, intelligent, network and remote. In the field of geological disaster monitoring, the system starts remotely and has sleep function. The system can be controlled through the 4G network by the terminal man-machine interface for intelligent identification processing to send and receive orders. The application of landslide video monitoring technology provides intuitive data and image information for post-level expert analysis and decision-making, and it basically realizes disaster information uniformity, integrity and real-time efficient reporting. For the geological disaster group, the system provides more reliable technical support.

2 Intelligent Video Recognition Technologies

Intelligent video recognition system refers to the use of intelligent video analysis algorithm. The system detects and identifies automatically to set the scope of the target which is an integrated system. The computer is used instead of the monitor to achieve the monitoring of the target body. The computer can do a series of calculation, interpretation, and classification etc., it can also maintain the image sequence database, detect abnormal actions, storage image sequence and send the data image information to the monitoring center.

Landslide video recognition process is affected by the surrounding natural environment, for example trees, light shadows, seasonal weather changes, etc... In the extraction of the background trajectory, the edge of the landslide reference frame is needed to constantly select repeatedly. Using three frame image difference methods, the pseudo-motion information caused by the background

movement and green plant shaking is removes. The target body is separated from the complex background.

3 Foreground and background discrimination

The segmentation between the foreground and the background needs to compare the current frame with the background colour and brightness difference. If a pixel colour distortion value is close to the pixel coding of a coded word and its brightness is in the encoding of the word brightness range. The pixel may be classified as a foreground, and vice versa as a background. After the self-improvement of the colour class library, the edge feature of the target body and the background is extracted, and the target is tracked and the target model is established.

3.1 Colour clustering and weight index

In the separation process of foreground and background, the video block color clustering and color weight index data structure is established. The visual field RGB color space is converted to YUV space by using the average method that the color and brightness is separated. This will directly record each pixel changes; each pixel block is managed in units. The weight of each piece of color clustering is calculated, that is, the color weight. The color weight is the reduction of the pixel class. Thus the extraction of the target body can be avoided the impact of light.

Color weight:

$$w = (1 - \alpha) \times w + \alpha \times M$$

α is adaptive learning parameter(0.5~0.3), adjust weight is w ;

M is the foreground mask, getting pixel values that match color clustering M is 1, Otherwise it is 0.

3.2 Geometric feature recognition

First, the target body geometric feature is recognized, the distance between the various parts of the target body are accurately measured, These distances are identified as features to identify.

3.3 Pseudo-motion removal and selection of key frames

A new method of moving target detection in complex scene is used to extract the motion information of the monitoring target. Using motion compensation technology, the key frame of the three frames as eliminate the camera, leaves and other pseudo-motion are selected. The coordinates of the pixels in three frames are set respectively as $f_1(x_1, y_1)$ 、 $f_2(x_2, y_2)$ 、 $f_3(x_3, y_3)$. The motion parameter from the first frame to the second frame is (dx_1, dy_1). The motion parameter from the second frame to the third frame is (dx_1, dy_1):

$$\begin{cases} f_1(x_1, y_1) = f_1(x_1 - (dx_1 + dx_2), y_1 - (dy_1 + dy_2)) \\ f_2(x_2, y_2) = f_2(x_2 - dx_2, y_2 - dy_2) \\ d(x, y) = \left|f_1(x, y) - f_2(x, y)\right| \times \left|f_2(x, y) - f_{3(x,y)}\right| \end{cases}$$

When $d(x, y)$ is not zero, the key frame of the target is the pixel. But this information may still have a small amount of pseudo-motion information. Then the clustering analysis techniques are used to reduce the error in the follow-up work, and extract the target key frame. This way is to avoid overlapping two adjacent objects and remove the pseudo target point.

4 Identification and locking of the target

After the foreground target is determined, the target is detected in the environment which the foreground target is located in, and the target body is selected in the static background. For the monitoring of landslides, it is targeted, fixed and non-random changes. Camera position, focal length and other parameters are fixed. The relative area of the target body is relatively stable. The color, texture and shape of the reference material need to be extracted which is mainly to avoid the influence of factors such as light and shadow, seasonal variation of trees and so on, and to reduce the variation of landslide displacement.

After the image recognition target is locked, the point cloud data will be concatenated through the CAD image processing software to construct the surface of the target body, so that the dynamic variation surface model of the landslide body is obtained. During the process of landslide, the shape of the landslide is changing constantly. In the process of video recognition, it is necessary to record all the shapes in the course of the movement of the target. Once the relative motion is generated, the basic characteristics of the landslide movement can be clearly documented and provides a basic data base for geological research. (Figure 1)

Figure 1. Image processing system.

4.1 Image acquisition equipment

Through the laser scanning system, Space point information can quickly access high density and high precision in real-time.

Through the DS-2DF8823IV-A800 camera, the high-definition images are obtained. This kind of camera can control light, through the fog, 3D noise reduction, and intelligent movement tracking.

4.2 Target characteristics and signal processing

CAD software will be used to pretreat the digital signal acquisition, extract points, lines, and surface features. the point cloud data is used to build surface model.

4.3 Image recognition processing

The selected image frame is set color clustering, recognition and other operations to select the key frame. The part of the dummy data will be removed.

4.4 Artificial intelligence

Target selection: The shape of the target body will change during the course of the movement, and the background will vary with the movement of the target. The real-time image and the original reference image of the record will change slowly. This process maybe bending, or tilting, or stretching, etc., the edge of the target body is slowly changing, on the basis of image recognition, the surface changes are increased, the background of the background continue to filter out.

Morphological processing: Before the target body moves, there is a comparison of the initial template. Through the expansion or corrosion of the image manipulation method, the target part is really complemented to avoid the monitoring of the object of the incomplete.

5 Target body tracking processing

For the dynamic study of the landslide disaster in this paper, it is difficult to track the video target recognition. Once the relative movement of the landslide occurs, its shape, movement speed and surrounding background are likely to change. Therefore, it is necessary to carry out motion simulation during the tracking process of the target body, and records a variety of possible changes, that is, the possible trajectory Variety. To a certain extent, this process can reduce the amount of calculation and expand the scope of application.

The Gabor filter is used to extract the feature, and the tracking problem of the target is transformed into the classification problem of target and background. A variety of morphological parameters may occur in landslide bodies. Gabor filters can be high frequency and maintain progressive stability under the specific structure and size of perturbation Calculation.

After the target body is determined, the target body is marked with a special mark in the system, and the possible movement pattern in the system is estimated in advance and the edge of the target body is set. The relative displacement of the target body can automatically record the trajectory of the target violation.

6 Landslide video surveillance

6.1 Landslide foreground and background separation

Three frame image difference map method is used to separate the landslide body from the surrounding natural environment, and remove the background and green plant shaking and other pseudo-motion information.

6.2 Landslide recognition

The edge of the landslide is treated by morphological corrosion and expansion to eliminate the shadow. The form of the entire landslide is completeness.

6.3 Landslide tracking

Gabor filter is used to extract the features of the landslide, and the landslide body is marked with special markings. The possible motion patterns are preliminarily estimated in the system. The landslide Edge boundaries, in the event of landslide displacement, can automatically record the landslide violation of the boundaries of the trajectory.

6.4 Track analysis

After the target tracking of landslide foreground and background is completed, the position information of the recorded position is analysed and calculated, and the change of the relative position is calculated, and the meshing is simulated in the simulated 3D graphics. (Figure 2)

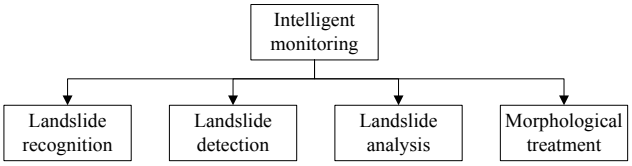

Figure 2. Intelligent analysis

7 Design of video surveillance software for landslide

Landslide video monitoring center is the terminal server to achieve data image reception, quality inspection, query display, statistical analysis and other fixed functions. With the development of science and technology, only limited to use the terminal server to control the operation of monitoring equipment has been unable to meet the needs of the public.

Mobile phone is widely used for monitoring and provides a more convenient and economical platform. Fixed control terminals have been unable to meet today's needs. In the network under the cover, anytime, anywhere a variety of information can be accessed. Through the Internet, the system links to the cloud and receives monitoring image information.

Landslide video surveillance software is designed to be able to access anytime, anywhere monitoring information. In the smart phone, the system will be able to access the terminal server through the network to require information, and to achieve remote monitoring of the monitoring equipment. (Figure 3)

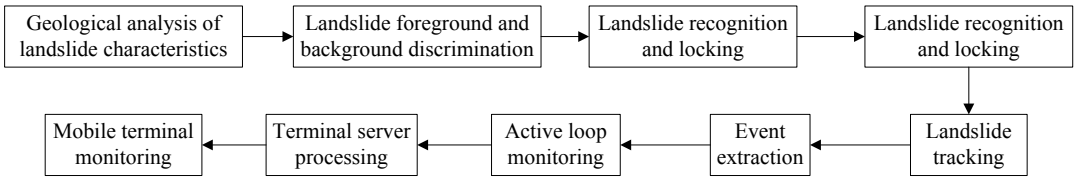

Figure 3. Monitoring process.

8 Summaries

Intelligent video recognition system has developed a mature self-contained system. The computer vision is applied to the landslide monitoring to achieve landslide monitoring image data visualization monitoring.

1) Image pre-processing: The colour clustering and weight index and pseudo-motion processing algorithms are used to outline the foreground and background interval.

2) Target detection: The colour, texture and shape of the landslide and surrounding environment are relatively stable, which mainly avoid the influence of light and shadow, seasonal variation of trees and so on. This way can reduce the error of landslide displacement.

3) Target tracking: a variety of dynamic characteristics of the landslide is estimated to reduce the amount of calculation. The system records the dotted line feature beyond the boundary, and draws the three-dimensional map.

4) Post-processing: the information will be returned to amend the use of open operation to remove the tiny noise in the image which corrects the overall image contour and ensures the integrity of the image.

In the application of landslide disaster monitoring is still relatively simple, the overall design is only from the dynamic simulation point. It does not carry out practical application testing. In the field application, there are still many immeasurable factors; the system is still constantly improving.

References

1. Tang Yaming, Zhang Maosheng, Xue Qiang, Bi Junbo, Landslide Monitoring and Early-warning: an Overview. GEOLOGICAL REVIEW, 58 (2012)
2. Zhang Xiaoyu, Research on Foreground Extraction and Action Recognition for Intelligent Video Surveillance, Zhejiang University, (2012)
3. Huang Dong, Abnormal behavior detection in intelligent video recognition system. Beijing University of Posts and Telecommunications. (2014)
4. Tu Tianyi, Fast Detection and Recognition of Human Face in Video Surveillance System, Xiangtan University, (2005)
5. Yang Wei, Zhang Tianwen, A new method for the detection of moving targets in complex scenes. COMPUTER RESEARCH & DEVELOPMENT, 35 (1998)
6. Chen Xiao, The research for feature-based algorithm of video tracking, XIDIAN UNIVERSITY, (2008)
7. Zhang Guilin, Zhang Tianxu, Wei Luogang, Xie Xianming, An edge-feature-based approach to the extraction and tracking of a moving object, J.Huazhong Univ. of Sci & Tech. 22 (1994)
8. Zhu Hui, LI Zaiming, Moving Objects Detection Algorithm in Video Sequences, SIGNAL PRCESSING, 18 (2002)
9. Hu Xianming, Yan Echuan, Zhou Yu, Zhang Ting-ting, Fractal Characteristics of Landslide Monitoring Point Movement Trace and Its Application, Chinese Journal of Rock Mechanics and Engineering, 31 (2012)
10. Li Xiaojun, Feng Xiating, Yang Chengxiang, HUANG He, Landslide Monitoring and Intelligent Analysis On Deformation Prediction Based On Three Dimensional Geographic, Chinese Journal of Rock Mechanics and Engineering, 23 (2004)
11. Xu Jinjun, Wang Haicheng, Luo Yuzhen, Wang Shangqing, Yan Xueqing, Deformation monitoring and data processing of landslide based on 3D laser scanning, Rock and Soil Mechanics. 31 (2010)
12. Chen Xianhua, Study on Image Processing and Recognition Techniques for Intelligent Video Monitoring System, Ocean University of China, (2004)