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Research on Intelligent Embedded Video Surveillance and Analysis System

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Abstract: Based on image processing technology, background subtraction method is used to extract the foreground region, and the mixture Gaussian model is used to set up background model; Combined with histogram auto-threshold segmentation and mathematical morphology algorithm, an algorithm for precise segmentation of moving objects is proposed; a grey model is introduced as the prediction of moving objects. The model establishes a rule library of motion events; the machine learning method of motion events establishes the distribution pattern of events to achieve the purpose of event recognition, which greatly improves the intelligence of the system.
Keywords: Intelligent; Embedded; Background Modeling; Moving Target.

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1. INTRODUCTION

Intelligent Video originates from Computer Vision technology. Computer Vision technology is one of the branches of Artificial Intelligence. It can establish a mapping relationship between images and image descriptions, so that computers can understand the video images through digital image processing and analysis. Most of the traditional video surveillance systems focus on the compression, transmission and storage of video data. The alarm functions are generally implemented using external sensors such as infrared and smoke. After the video data arrives at the terminal, it needs to be observed and analyzed by people in real time, or stored for later review.

Intelligent video surveillance technology is based on common network video surveillance. In addition to the functions of an ordinary surveillance system, the biggest advantage is that it can automatically analyze alarms in real time around the clock, completely changing the mode of monitoring and analysis of surveillance images by observers. At the same time, the intelligent technology turns the post-mortem analysis of the general monitoring system into an analysis and early warning system. It not only identifies suspicious activities, but also prompts security personnel to pay attention to relevant monitoring screens before security threats occur, and prepares them in advance, thereby greatly improving the reaction speed.

In this paper, researching the intelligent embedded video surveillance analysis system is an intelligent system that can replace people in analyzing monitoring scenarios and completing corresponding control tasks. Under the real-time background modeling monitoring scene, the computer is used to automatically detect static objects and active people, capture and identify target objects, focus on the various abnormal behaviors that occur in the scene, generate reliable alarm information in real time. Greatly improve the efficiency of the monitoring system.

2. SYSTEM PRINCIPLE AND BASIC STRUCTURE

On the basis of image color compression, noise reduction, and enhanced contrast, intelligent embedded monitoring system modeling with background model technology.

2.1 System principle

In the target detection process, first determine the preprocessed image frame, if it is set as reference image, update background initial information to the image; Otherwise, perform pixel-by-pixel difference calculation between the current frame image and the stored background information, threshold-based binaryzation of difference images, extract the foreground information of the motion area, and analyze the connectivity of the foreground information to obtain the number, position, size, and other relevant information of the moving target, at the same time, the non-motion area in the connectivity analysis result is regarded as the latest background information to be updated. Extracting objects in the scene through a connected area labeling algorithm mark it and use invariant moments to get related feature parameters, classify and match with the campaign rule base, locate the abnormal target, track the target using the method of minimum external moment and determine whether to leave the monitoring area.

2.2 Basic structure

The basic structure of the intelligent embedded monitoring system consists of five modules:

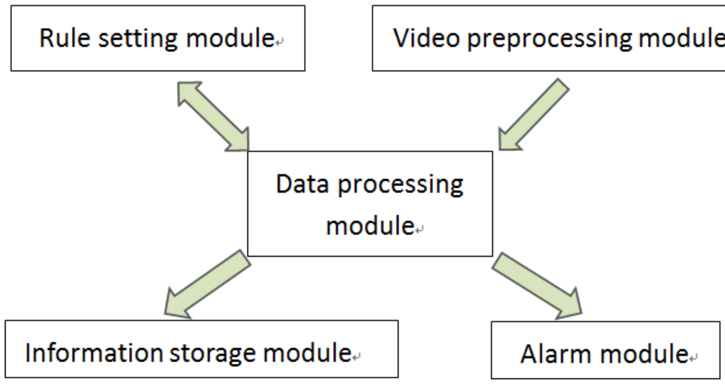

Figure 1. module composition

(1)Video pretreatment module: The main source of information, this part completes the video processing, grayscale processing, noise filtering, binary images. The module mainly uses image processing technology, mainly based on frame image processing technology and background difference method to obtain foreground image;

(2)Rule setting module: Set the observation rule, accept the specific information from the data processing module, and regularize it. Based on the original rules, add it to the current related video source data processing by default;

(3)Data processing module: The core module of the system, compare the information transmitted from the video processing module and rules, obtain the monitoring results;

(4)Information storage module: Stores relevant valuable information from the data processing module;
(5)Alarm module: Receives the signal from the data processing module and sends a prompt signal to the manager or "party".

3. SYSTEM IMAGE PROCESSING TECHNOLOGY

Background modeling, shadow filtering and noise filtering are the basic technologies of image processing systems, the results of these several processes directly affect the work of subsequent systems. On the contrary, if the system can accurately separate the foreground objects in the early image processing, it is very important to provide accurate image data for the later intelligent rule judgment.

3.1 Background modeling

The background modeling is to accurately find the background part from a series of video images and store it as a background image. The background modeling should adapt to changes in lighting, camera shake, high-frequency motion of certain objects in the background, and changes in the background itself. Detection is to compare the current video image with the background model and find the foreground image. The background update is the update of the background model in real time when some changes cause the original background model to no longer fit into the current video image. The difficulty of background updating is accuracy and real-time. The video sequence captured by the fixed camera is the basic element of the background image. Based on this, the RGB values of the pixels are statistically categorized by referring to the gray-scale statistical classification method.
The algorithm steps:

① Samples of N frames from a video sample at mid-interval as background modeling samples, denoted as {A1, A2, ..., An};

② In the (x, y) position, the R value of each sample image is statistically analyzed from 1 to N. The R value is temporarily taken as the gray value to obtain the grayscale histogram, the peak of the histogram is found, and the peak is taken as the center. The average gray value in the interval of length e, which is taken as the R value of the (x, y) pixel in the background model;

③ Change (x, y) go to step ②, loop through all pixels to complete R background modeling;

④ the G, B values of the sample image are respectively processed in step ② to ③, to complete the background modeling of G, B. Combine RGB values to get background model;

⑤ Add the background RGB vector to smooth the background update, adjust the background RGB value with the parameter r, adjust the r value to adapt to the global illumination changes with different intensities. The r value is relatively large when the light changes greatly, and the r value is relatively small when the light changes little.

When the algorithm establishes a background model, the sampled video image may contain moving objects, and the adjustable parameters of the algorithm have only one classification threshold e.

3.2 Shadow out

In video images, shadows fall into two categories: self-shadows and cast shadows. The self-shadow is a dark area where the target surface is not directly projected by the light source; the cast shadow is a dark area in the background formed due to the obstruction of the object in the light irradiation direction. The overall idea of shadow filtering is that for a fixed scene video surveillance system, the background image of the monitoring scene can be used as a reference map in advance, and the foreground is segmented by the difference between the scene image and the background image. Before performing shadow detection and removal, the foreground atlas E= {E1, E2 ...} including shadows is firstly extracted through background modeling and background subtraction, and then the lighting evaluation method is used to determine whether there is a shadow in the foreground image E. If there is a shadow, the shadow ei is detected by multi-gradient analysis and binary fast clustering, at last the target set is subtracted from the shadow, removing the shadow and segmenting the real motion target.

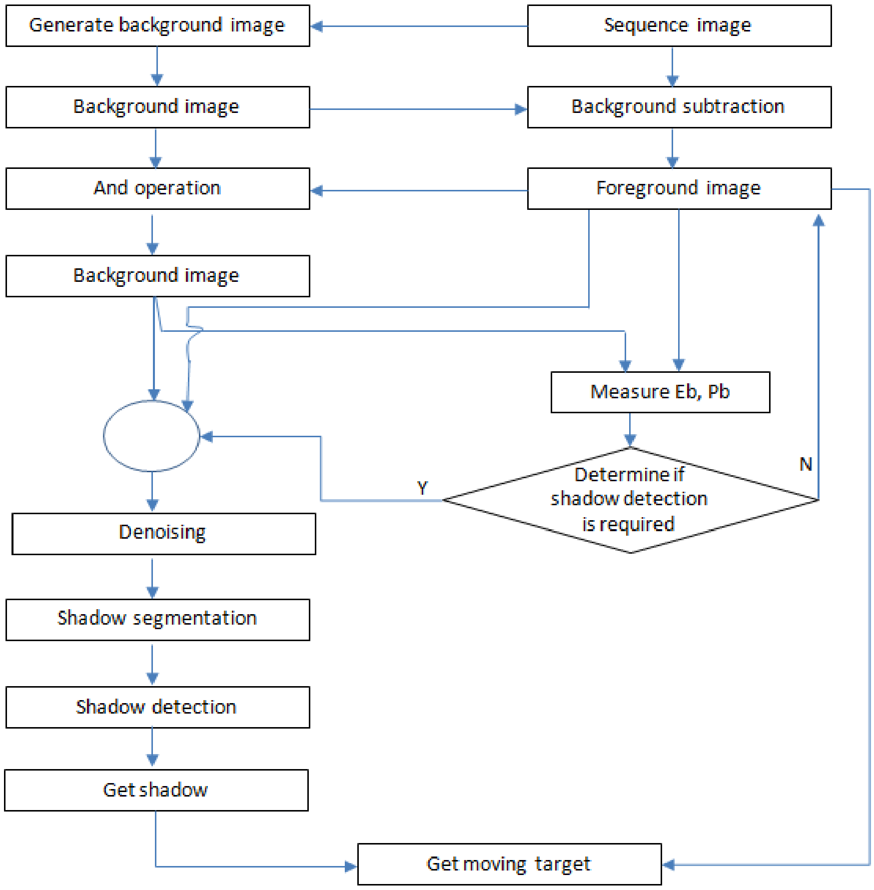

Figure 2. Shadow removal process

Judgment of shadow existence: By calculating the brightness and energy value of each pixel in the image to distinguish the target, a shadow detection method for evaluating light distribution is proposed. Definitions (nb,nd) are the number of bright and dark pixels of the image . If the R, G, B values of the foreground image are smaller than the values of the corresponding background pixels, the foreground pixels are considered as dark pixels; otherwise, they are considered bright pixels. Use (sd,sb) to represent the dark and bright pixels of the image. Calculate the energy values(Ed,Eb) of the set (sd,sb) according to the formula (Ej=).The brightness energy value Eb can be used to indicate the degree of visibility of the target and also reflect the brightness level of the scene. The brightness energy value Eb is used to determine whether the shadow exists, and the parameter P=nd/nb is introduced to represent the relative scale of dark and light in the image. If Eb is smaller or Eb is larger but P is smaller, than the brightness level is lower or the shadow size is smaller, that is, no shadow detection is required.

Shadow preliminary detection: In the RGB color space, if all the coefficients of a certain color are uniformly and proportionally reduced, than only the brightness changes, and the hue is constant, that is, as long as the ratio of RGB is constant, the hue does not change. Objects in the shaded area, because the color does not change, are only equivalent to the RGB component multiplied by a coefficient k at the same time. The color image is also converted into a grayscale image, and the shaded portion is multiplied by the coefficient k. Dividing the current image with the background image to get the shadow image D(i,j).By analyzing the target, shadow, and histogram, the approximate distribution range of the shaded gray values is obtained, and then a wide threshold is determined, and a potential shadow region R(i, j) is segmented. If D(i,j) is in a range, R(i,j)=D(i,j), else is 0.

For a non-zero region in R(i,j), using the gradient to analyze the flatness of the image, the shadow is finally detected.

3.3 Filtering method

When using the background difference method to obtain the foreground region, we must have a good background model, and usually there will be some movement in the foreground image. Therefore, when we obtain the foreground image, we usually cannot avoid the existence of noise. The noise processing method has Mean method and median method.

The median filter is similar to the mean filter, the difference is that the gray value is not a local average, but is the median of the relevant neighboring elements. For the following 3*3 regions, the gray value of the region calculated by the Mean method 6 is (2+5+9+3+6+1+7+2+4)/6=4.33; the gray value obtained by the Median method is the median value 4 of the sequence of (1,2,2,3,4,5,6,7,9).

2	5	9
3	6	1
7	2	4

Based on the above algorithm, the dynamic expansion of the Mean method or Median method, the number of pixels is extended to 3, 5, 7, and so on. Such as the input image:

Input image								
64	68	62	66	63	53	57	60	61
58	58	59	62	61	53	55	58	65
61	59	59	64	66	64	63	59	76
81	69	65	67	71	73	73	61	84
83	78	200	62	74	78	78	74	89
82	82	78	63	76	78	78	80	81
79	82	86	77	80	80	82	85	85
82	87	101	90	87	25	102	93	91
87	90	108	116	96	76	97	93	91

Using a square area with a value of 2 and calculating the mean to get a mean image:

Average			
62	62	57	57
67	63	68	61
81	100	78	77
82	88	68	90

In the current image, each pixel value represents the original four-pixel values in the form of a mean. Using Local value method calculate whether the central value in the 3*3 region is between the maximum and the minimum value, If not in, replace the original 4 pixel values with the maximum or minimum value; If between the maximum value and the minimum value, the original 4 pixel values are not changed, so as to achieve the effect of filtering.

4. CONCLUSION

Rely on image processing technology, intelligent video surveillance system analyzes and processes the data returned by the camera, automatically determine whether there is a violation of the rules in the image according to the rules set by the system, find abnormalities in the monitoring screen, and can send alerts in the fastest and best way. It also minimizes false positives and false negatives, so that it can assist security personnel to deal with the crisis more effectively. This system undoubtedly succeeded in replacing people and liberated people from tedious observation work.

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