VIDEO SURVEILLANCE SYSTEM OF TARGET CONTOUR

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Computer vision is the science and technology of making machines that see. It is concerned with the theory, design and implementation of algorithms that can automatically process visual data to recognize objects, track and recover their shape and spatial layout.

When recognizing objects, the most informative part of the image is the contour. An object contour is a part of an object that contains a lot of information about the shape of the object and almost does not depend on the color and texture of the image. You can analyze the shape of the object along the contour. In many cases, information about the shape of the object is sufficient to organize automated or automatic systems. In addition, the transition to object recognition by their contours allows to reduce the amount of processed information by several times, as a plus, the contours are invariant to the brightness transformations.

The first element of an intelligent video surveillance system is a video sensor. Examples of video sensors are digital or IP cameras. For ease of use, installation and taking into account the cost of the module, I will use a WEB camera without an ultraviolet filter, with a resolution of 1280 × 720 pixels and a video recording rate of 25 frames per second.

From the video sensor, the image is fed to the image forming device. After that, the image is pre-processed to improve the image quality and reduce the amount of video information and enters the frame drive. Next, the target area is localized and contour segmentation is performed. Contour segmentation consists of: contour selection, tracing and selection of feature points on it.

Contour tracing is the entry of the coordinates of the contour points in a two-dimensional array. In fact, the algorithm of tracing the contour resembles the behavior of the "beetle". The obtained coordinates of the points of transition from black to white or from white to black will be the coordinates of the contour points.

You need to get an outer contour in the form of a closed curve, when selecting a contour, so approximation methods are often used. The method of curves approximation can be used for contour segmentation by selecting an analytically set curve to a set of points of the contour preparation. If there is information about the expected shape of the object, for example, as in the case of identifying the car it is a rectangle, then as an approximating curve you need to use a rectangle.

After that, the characteristic contour points (points in areas of significant curvature) are selected using a Harris angle detector. Based on the information about the characteristic points of the contour, an identification vector (identification procedure) is built on the basis of which further classification is carried out - the procedure of assigning (assigning) the studied object (image) to a certain class.

Once the data about the objects which are represented by points or identification vectors in the image space to be recognized is collected, the system needs to find out to which class of images this data belongs. Let the system be designed to recognize M classes denoted by w_1, w_2, ... w_m. In this case, the image space can be considered to consist of M areas, each of which contains points corresponding to the image from one class. In this case, the recognition problem can be considered as the construction of the boundaries of the solution domains, which are divided into M classes, based on the registered measurement vectors. Let these limits be defined, for example, by the functions $d_1(x)$, $d_2(x)$, … $d_M(x)$. These functions, also called discriminant functions, are scalar and unambiguous functions of the image x. If $d_i(x) > d_j(x)$ for all i, j = 1, 2, ... M, $i \neq j$, then the image x belongs to the class w_i . In other words, if the i-th decisive function $d_i(x)$ has the largest value, then $x \in w_i$.

After identifying the class of characteristic points of the contour of the object, it is illuminated by a frame of a certain color and the image is displayed on the screen.

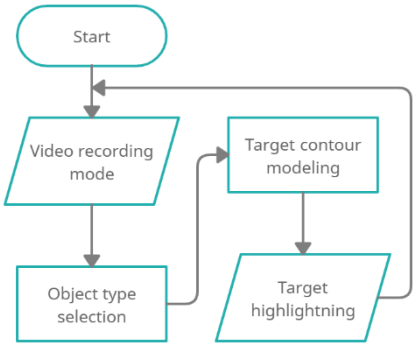

Fig.1. Algorithm of the video surveillance system of target contour action

Therefore, the algorithm of the video surveillance system of target contour action (Fig.1) has the following sequence:

1) video surveillance and data recording operation mode (as a normal camera);

2) selection of the type of object to be monitored by the system operator (selection of the class of images and interclass features);

3) modeling of target contour;

4) Detection of characteristic points (Harris angle detector operation);

5) Target highlighting by the frame on the video stream and data recording of its position.

Elements such as a microcontroller and the camera itself are required to develop a hardware-software layout. Therefore, modern software was used, namely Arduino IDE, Matlab Simulink, which allowed to program and debug the layout based on Arduino Nano and RaspberryPI microcontrollers. The validity of the choice of Arduino IDE and Matlab environment is a greater programming flexibility than in similar programming environments.

Thus, the intelligent video surveillance system of target contour is a system with its own real-time OS, which provides high reliability and the most efficient use of computer resources. It allows to achieve the maximum speed, the minimum time of reaction to events and has long-term stability in comparison with usual systems of video surveillance.

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