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Intelligent Recognition Method of Multitype Human Posture Based on Deep Learning

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Abstract: *Human posture recognition is widely used in intelligent monitoring, human-computer interaction, video retrieval, virtual reality and so on. So it has been an active research direction in the field of computer vision. Firstly, the edge of human posture is detected, and the key feature points of the target image are calibrated. Then the human posture image is mapped by convolution neural network. Experimental results show that the proposed method has some advantages in both recognition rate and recognition time.*

Keywords: *deep learning; human posture; multiple types; intelligent recognition*

1. Introduction

With the rapid development of artificial intelligence in recent years, more and more people are engaged in the research and exploration of artificial intelligence. Human motion recognition, as the key research direction of computer vision, has been constantly updated and breakthrough. The aim of human body action recognition is to let the computer automatically determine the human body's various behavioral characteristics, so as to carry out further application operations. But the action recognition modes of human body action recognition are unpredictable and diverse. The different wears of the recognition object, the different weather environment, the difference of the recognition background or the clarity of the video in the video recording are all important factors to be considered [1], so it is necessary to combine various comprehensive technologies in the recognition research. With the increase of concurrent data in practical applications, it is difficult to identify them. With the introduction of deep learning technology, these problems can be effectively solved.

Deep learning is a new direction in machine learning research. It uses learning mechanisms similar to human brain neural networks to process data. Deep learning combines the target features of the lower level to form more abstract high-level features or attribute elements to represent the distributed features of the data. In order to improve the recognition rate, shorten the recognition time and improve the recognition efficiency, a multi-type human posture intelligent recognition method based on deep learning is proposed.

2. Human posture image preprocessing

2.1. Human body edge detection

The Kinect captures human body contours in real time and captures video at a resolution of 240 × 320. In order to reduce the computational complexity, the human body in the image is extracted and scaled to 28 × 28 [3]. The method comprises the following steps: edge contour detection, contour segmentation and feature identification for the acquired human body attitude image, wherein, the threshold of contour segmentation of the image is:

$$y = Ah^2 \in R \tag{1}$$

Where， A is the template matching value of the subregion feature matching region, h is a sparse coefficient vector. Through the method of edge blurring degree identification and the combination of edge and region information processing, the template feature distribution of the image is:

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$$I(x,y)=\sum_{x'\le x}\sum_{x'\le x} I(x',y') \tag{2}$$

Where, $I(x',y')$ is the pixel value of image I at point (x',y') .Using the edge gradient information of the image for visual tracking, the output image tracking results are:

$$I=\exp\left\{-\frac{\left|x_i-x_j\right|^2}{2\sigma^2}\right\}\sum_{x'\le x} I(x',y') \tag{3}$$

2.2. Key feature point calibration

The two-dimensional position of human body can be effectively output by tracker, but the three-dimensional position information can not be effectively provided at this time. The relevant staff through a variety of methods for research and analysis, the use of continuous and multi-frame image data with the relationship, dynamic planning camera for 3D information acquisition. Through the application of dynamic planning camera, the moving position of the camera can be planned, the human body images with different angles can be obtained, and the 3D posture can be recovered effectively. This method also has some disadvantages, that is, if it can not capture the motion effectively, it can not match the ideal image. Therefore, the infrared sensor with high precision is used to capture the image and detect the edge of the human posture image to recognize the human posture image. The gray histogram distribution structural model of human posture image is constructed, and the regional block matching method is adopted to effectively extract the human posture and motion features. The template matching function of the human posture image is:

$$\begin{cases} I_1=ySum(A)+2\sigma^2 \\ I_2=y^2Sum(A)+2\sigma^2 \\ I_3=y^3Sum(A)+2\sigma^2 \\ I_4=y^4Sum(A)+2\sigma^2 \end{cases} \tag{4}$$

The reconstruction model of 3D feature distribution region is established, the dynamic fusion of human motion is carried out [5], and the gray pixel fusion model of human posture information is established, and the fusion result is satisfied:

$$II=I_1+I_4-(I_2+I_3) \tag{5}$$

The gray level edge features of human posture images are as follows:

$$\min_y\left(\frac{y}{A}\right)=\min\left(\min_y\left(I\cdot\frac{y}{A}\right)\right)+(1+t) \tag{6}$$

Thereinto, t is the spatial region pixel of the human posture image. Adopting the method of region block matching [6], the adaptive fusion output of the obtained image is:

$$L=s(\chi_1-\chi_i)\times 2 \tag{7}$$

Where, s is the gray information component of the image, and χ is the transmission intensity of the human posture scanned by the infrared sensor. An image adaptive fusion model of unlabeled human motion video is constructed, and a multi-dimensional phase space reconstruction method is used to simulate the human posture. The result of image calibration is as follows:

$$J(x,y,\sigma)=\begin{pmatrix}\frac{\partial P}{\partial x}\\ \frac{\partial P}{\partial y}\end{pmatrix}=\begin{pmatrix}1 & 0 & L_x(x,y,\sigma)\\ 0 & 1 & L_y(x,y,\sigma)\end{pmatrix} \tag{8}$$

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3. Intelligent recognition method for multi-type human posture

3.1. Human posture image mapping

If the size of the convolution kernel w for deep learning is $a*b$ and the output image feature is g, then:

$$Z=\sum_{i=a}^{b} w_i g \tag{9}$$

Deep learning can back-propagate convolution kernels, which can extract the basic visual features of the target image in the process of propagation, and input convolution kernels in deep learning will automatically generate two-dimensional images.The convolution kernel can output the eigenvalue of the target region image and detect the target position.

3.2. Human body posture intelligent recognition

When a moving object is detected at k time, the coordinates of the moving object on the x and y axes are xs_k, ys_k, the velocity is xv_k, yv_k, and the interval period for detecting the moving object is T, so that the time interval for the infrared sensor to obtain the image of the moving object is Δt, and the acceleration of the moving object on the x and y axes is xa_k, ya_k, then the motion equation of the moving target is:

$$\begin{cases} xs_{k+1}=xs_k+xv_k\bullet\Delta t \\ ys_{k+1}=ys_k+yv_k\bullet\Delta t \\ xv_{k+1}=xv_k+xa_k\bullet\Delta t \\ yv_{k+1}=yv_k+ya_k\bullet\Delta t \end{cases} \tag{10}$$

This realizes the intelligent recognition of multiple types of human posture.

4. Experimental verification

In this paper, KTH dataset is used as experimental data. The dataset is made up of 25 experimenters of different sex and clothes, 500 videos are made up of 500 continuous actions collected by infrared sensors.

The experimental process includes training phase and testing phase. During the training phase, the body, part and joint levels of the training samples are used (Based on the data of bone points, the space domain is decomposed into three levels: body, part and joint. The body level is the whole body containing 20 bone points. The area of each component in part level is determined by the maximum distance between the three bone points, which is divided into 9 parts and can cover the whole body. Each component in the joint level contains 1 bone point.). During the testing phase, the network model is trained separately by using three levels of test samples to input the network model respectively, and the output results of the classification level of the network model are fused, and the label corresponding to the maximum score is taken as the recognition result.

4.1. Identification rate test results

Table 1 shows the recognition rate of multi-type single action classification in the KTH dataset. It can see from the table that the recognition rate of multi-type human posture image recognition is stable and has high recognition efficiency. But the literature method recognition rate is unstable, and the recognition efficiency is lower than the present method.

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Table 1: Comparison results of the action recognition rate of the different methods

Action type	Methods of literature [2]	Methods of literature [3]	Methods of this paper
Boxing	93.12	94.25	95.68
Skipping rope	91.36	92.34	96.17
Jogging	90.59	93.17	96.38
Eurhythmics	95.41	96.26	100
Play basketball	86.12	93.10	98.98

3.2 Identify the time test results

In order to further verify the effectiveness of the proposed algorithm, the following experimental tests compare the identification time consumption of different algorithms, and the specific experimental comparison results are shown in Figure 1:

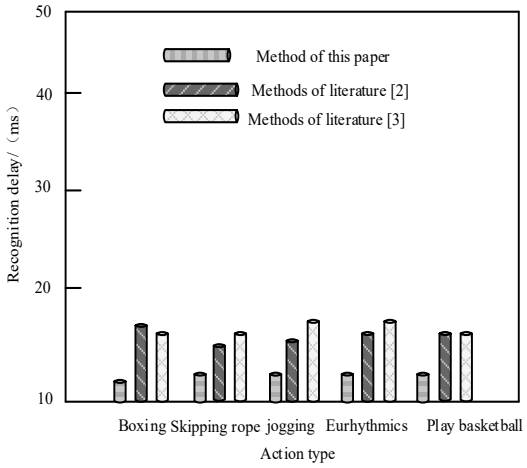

Figure 1: Identification and time-consuming comparison of different algorithms

According to the experimental data in Fig. 1, the proposed algorithm takes the shortest time consuming and is significantly better than the methods in the literature.

5. Conclusion

In order to improve the performance of multi-type human posture intelligent recognition, a multi-type human posture intelligent recognition method based on deep learning is proposed. Based on the preprocessing of multi-type human posture images, the key feature points are calibrated and the image features are extracted to realize the intelligent recognition of multi-type human posture images. Experimental results show that the proposed method has high recognition rate and high recognition stability.

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