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Representation by histograms in the detection of movements in the image in OpenCV

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ABSTRACT: We want to have direct access to the data contained in each image in order to achieve fast and efficient processing of image data during image processing. Based on the characteristics of the image, we choose OpenCV as a program that provides us with the necessary understanding of the image. The program has well-optimized routines that perform many tasks that we need to perform on the images, and we can choose based on the capabilities of the libraries.

KEY WORDS: Histogram, OpenCV, image processing, histogram model, Images, Python, objects.

I.INTRODUCTION

OpenCV (Open Source Computer Vision Library) is the only digital collection of MATLAB, C++, Python, and other programming languages, which is designed to explain the image to the image on the computer using a certain algorithm, working through free or existing algorithms. The main purpose of this library is to facilitate the analysis and processing of image and video materials. OpenCV has the following features:

- OpenCV includes many image manipulation and analysis algorithms. Among them, it is possible to mention advanced description features, filtering methods, face or object detection, state size balance, preliminary calculation work for experienced state and others.
- The eye recognition feature, or 'Computer Vision', is the main purpose of using OpenCV. In this library, you can recognize given parts on pictures or video materials, distinguish objects, determine point, geometric and technical characteristics of objects, identify flammable bullets, etc. we will be able to perform actions.
- Another feature of OpenCV is that it has good tools for detecting objects and identifying their characteristics. It is used for detecting cars, detecting faces, and detecting object errors.
- It offers algorithms that facilitate the use of various tools on image and video materials and increase their work efficiency. Many of these algorithms are included in their own libraries, for example, creating a system for reading records in the proposed language, motion detection.
- OpenCV allows integration with many other programming languages. It is compatible with Python, C++, Java, MATLAB, and other programming languages, allowing these programs to use OpenCV functions.
- OpenCV runs on Windows, Linux, Mac OS, iOS, Android and other platforms, and is also optimized for mobile applications.

OpenCV is open source, and encryption, authentication, and other security methods can be used to address privacy and security concerns.

II. SIGNIFICANCE OF THE SYSTEM

When analyzing images, objects, and video data, we often want to display what we see as a histogram. Histograms are used to display different symbols representing the object's color distribution, the object's edge gradient template, and the current hypothesis about the object's location. In Figure 1, the use of histograms for fast gesture recognition is popularized, that is, the use of histograms for fast gesture recognition is a qualitative method that does not require time to study changes, and this method is called "Optical Flow". Optical Flow helps to determine the speed and direction changes of each pixel of moving objects, and to analyze the speed and direction changes.

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III. METHODOLOGY

Color regions of interest were detected from the incoming video in each frame; edge gradient orientations were then calculated around these regions of interest, and the orientation information within the histogram of these orientations was collected.

Edge gradients are collected from hand gestures "up", "right", "left", "stop" and "OK". A webcam was then set up to watch the person using these actions to control the web videos.

The histograms were then fitted to the gesture models for gesture recognition.

The vertical lines in Figure 1 show the compatibility level of different gestures. The gray horizontal line represents the acceptance threshold for the "absorbing" vertical line corresponding to the gesture model.

Figure 1. Detection of color regions of interest from incoming video in a frame

Histograms are used in many computer vision programs. Histograms are used to identify scene transitions in video by marking sharp changes in edge and color statistics from frame to frame, and are used to identify points of interest in images by marking "tags". It forms a general feature type that is passed to classifiers to recognize an object based on its edges, colors, corners, etc. A sequence of colors or edge histograms is used to determine whether videos have been copied on the internet. Histograms are one of the classic tools of computer vision.

Histograms are a set of predefined bins, filled with a number of features calculated from the data, such as gradient magnitudes and directions, color, or almost any other characteristic, used to obtain a statistical picture of the underlying distribution of data. A histogram usually has fewer dimensions than the source data. Figure 2 shows a typical case.

The figure shows a two-dimensional distribution of points from top left; we place the grid from top to right and count the data points in each cell, creating a one-dimensional histogram from bottom to right.

OpenCV has a data type for representing histograms. The histogram data structure is capable of displaying histograms in one or more dimensions, and it contains all the information necessary for both uniform and non-uniform measurements.

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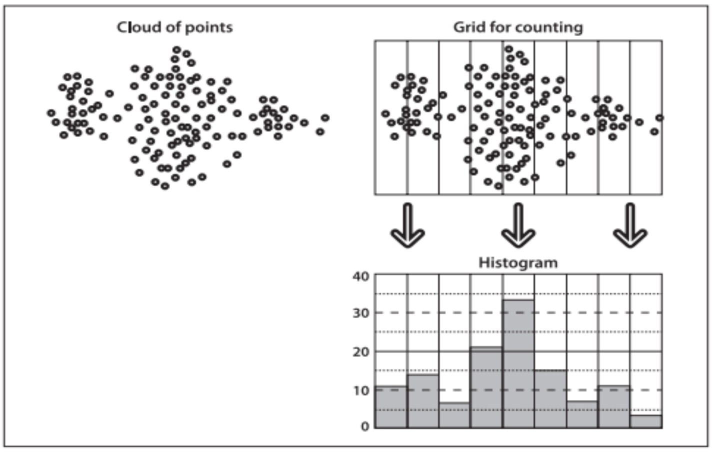

Figure 2. A typical histogram.

The histogram data structure contains all the information needed to represent the histogram. It displays a range of intensity values in a dimension and represents it visually. The important information needed to represent OpenCV histograms is calculated as follows.
The histogram shows the intensity. The x-axis represents the amount of intensity and the y-axis represents the quantity of pixels.
If all the pixels of one image dimension are red, the intensity histogram will be high in intensity and the intensity histogram will have high multiplicity.
An intensity histogram describes the colors in an image (such as red, green, and blue) and their intensity values.
Histogram data describes the level or scale, that is, how many pixels there are for each amount of intensity.
A histogram depicts the amount of strong pixels. This reflects higher intensities compared to other levels of the histogram.
A histogram is the peak, or peak, of the intensity value. This helps in mastering the images and determining the amount of intensity specified in the size.
Another indispensable tool for working with histograms, first introduced by Swain and Ballard and later generalized by Schiele and Crowley, is the ability to compare two histograms in terms of some special criteria of similarity.
The cvCompareHist() function does this.

```
double cvCompareHist(
const CvHistogram* hist1,
const CvHistogram* hist2,
int method
);
```

The first two arguments are histograms to compare and must be the same size. The third argument is where we select the desired distance indicator. The four available options are:
Correlation (method = CV_COMP_CORREL)

$$d_{\text{correl}}(H_1, H_2) = \frac{\sum_i H_1'(i) \cdot H_2'(i)}{\sqrt{\sum_i H_1'^2(i) \cdot H_2'^2(i)}}$$

Here $H_k'(i) = H_k(i) - (1/N)\left(\sum_j H_k(j)\right)$ a histogram equal to the number of bins in N.
For correlation, a higher score means a better fit than a lower score. Perfect fit is 1, and maximum mismatch is –1; A value of 0 indicates no correlation (random association).
Chi-square (method = CV_COMP_CHISQR)

$$d_{\text{chi-square}}(H_1, H_2) = \sum_i \frac{(H_1(i) - H_2(i))^2}{H_1(i) + H_2(i)}$$

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For Chi-Square* a low score means a better game than a high score. Perfect fit equals 0 and total misfit is unbounded (depending on histogram size).
Intersection (method = CV_COMP_INTERSECT)

$$d_{\text{intersection}}(H_1, H_2) = \sum_i \min(H_1(i), H_2(i))$$

For histogram intersection, a high score indicates a good fit and a low score indicates a poor fit. If both histograms are normalized to 1, then perfect fit is 1 and total mismatch is 0.
Bhattacharyya distance (method = CV_COMP_BHATTACHARYYA)

$$d_{\text{Bhattacharyya}}(H_1, H_2) = \sqrt{1 - \sum_i \frac{\sqrt{H_1(i) \cdot H_2(i)}}{\sqrt{\sum_i H_1(i) \cdot \sum_i H_2(i)}}}$$

For Bhattacharyya alignment, lower scores indicate better matches and higher scores indicate worse matches. A perfect fit is 0 and a total mismatch is 1.
A special factor in the code with CV_COMP_BHATTACHARYYA is used to normalize the input histograms. In general, you should normalize histograms before comparing them, because concepts like the histogram intercept make little sense without normalization (even if allowed).

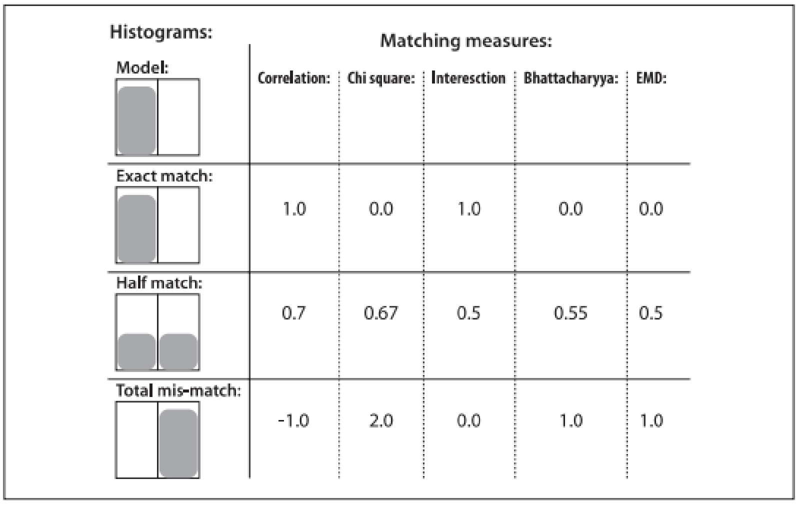

Figure 3. Histogram matching measures

The simple case shown in Figure 3 should clarify matters. In fact, this is about the simplest case imaginable: a one-dimensional histogram with only two bins.
The model histogram has a value of 1.0 in the left bin and a value of 0.0 in the right bin. The last three rows show the comparison histograms and the values generated for them by various indicators (the EMD indicator will be explained shortly).
Figure 4 provides a quick overview of the behavior of the various matching types, but there is also something to worry about.

IV. EXPERIMENTAL RESULTS

If the histogram bins shift by only one notch, as in the first and third comparison histograms of the chart, all of these matching methods will result in a maximum mismatch even though the two histograms have similar "shapes". The rightmost column in Figure 4 represents the values returned by EMD, a type of distance measure. Comparing the third histogram with the model histogram, the EMD measurement clearly defines the situation: the third histogram is shifted to the right by one unit. Intersection works well for quick and dirty fits, and chi-square or Bhattacharyya works best for slower but more accurate fits. EMD measurement gives the most intuitive fits, but is much slower.

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V. CONCLUSION AND FUTURE WORK

In the image processing process, we achieve fast and efficient processing of image data
Based on the characteristics of the image, we choose OpenCV as the program that gives us the necessary image insights
Histograms are used in many computer vision programs.
OpenCV has a data type for representing histograms. The histogram data structure is capable of displaying histograms in one or more dimensions, and it contains all the information necessary for both uniform and non-uniform measurements.
Histograms were compared in OpenCV based on Chi-square, Intersection, Bhattacharyya distance methods.

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