Image Detection System Using W-CoHOG

B.G. Poornima Hima Ketan, Velamuri Manasa, Sowjanya Pathi
Assistant Professor, Dadi Institute of Engineering & Technology.
himaketanb@gmail.com, velamurimanasa@diet.edu.in,
sowjanyap@diet.edu.in

Abstract
In many fields, face recognition is a crucial duty. In this paper, a weighted co-occurrence histogram of oriented gradient (W-CoHOG) face identification system is given. In recent years, face recognition has seen extensive use of the Co-occurrence Histogram of Oriented Gradient (CoHOG) method. We are using Weighted Co-occurrence Histogram Oriented Gradient (W- CoHOG) in this paper. In contrast to CoHOG, which only considers a pair of orientations, W-CoHOG also takes magnitude into account. As a result, histograms and a weighted co-occurrence matrix are constructed. Compared to CoHOG, W-CoHOG has a better recognition accuracy. In order to increase accuracy, the weighted co-occurrence histogram of oriented gradients (W-CoHOG) idea is introduced in this study. Magnitude value is added to the feature vector to make it perform better than with current techniques. On the YALE and CALTECH face recognition datasets, experiments were performed.

Keywords— Histograms of Oriented Gradients (HOG), Co-occurrence histogram of oriented gradients (CoHOG), Weighted Co-occurrence histogram of oriented gradients (W-CoHOG).

Introduction

The field of computer vision has grown significantly in the recent years. A significant challenge in computer vision is face recognition. Face recognition is used in many different applications, including biometric systems and video surveillance, among others. Face recognition's primary objective is to compare a particular human face to a person in our database. If a human face can be seen in the given image, more analysis can be done on it. One of the difficult problems in computer vision is face recognition because of the continuous fluctuations in facial appearance brought on by lighting, position, emotion, and occlusion. This research identifies a human face in a static image.

Related Work

Finding effective ways for face representation is one of the main challenges in face recognition. These techniques are numerous. In some face representation techniques, the fundamental vectors needed to represent the face are found using statistical techniques and transformations. These techniques include PCA, LDA [5], and ICA. A feature-based strategy is an additional approach. In essence, they are geometric correlations between facial characteristics like the mouth, eyes, and nose that are used in structural based techniques. SIFT, HOG is one of the methods in this group. As a result of its capability to accommodate picture transformations such size alterations (zoom), image rotation, and lighting, SIFT [13] has become one of the most popular detection systems.

Scale-space extreme detection, Orientation assignment, and Key point descriptor are the three main components of the SIFT algorithm. Because of their robustness, histogram-based features are frequently employed in face recognition, human recognition, and item detection.

The well-known and reliable Histogram of Oriented Gradients (HOG) method of Face detection. As a feature descriptor, it uses histograms of directed gradients. HOG characteristics can withstand changes in lighting and facial deformations. HOG descriptors are taken out of regular grids and applied to classification in [7]. The multiscale that is created by computing the HOG of grids of various sizes is also taken into account to improve accuracy.

The vectorization technique is used to integrate classifiers operating on various grid sizes. By taking into account the relationship between pairs of oriented gradients, CoHOG is an expansion of HOG. Co-HOG has been successfully used to solve the challenge of facial recognition [8]. CoHOG is used in that study to represent faces for face recognition.

For Feature Extraction in Human Detection, Weighted Co-occurrence histogram-oriented gradients (W-CoHOG) [2] has recently been employed. In this work, we employ W-CoHOG, where the gradient magnitude also contributes to W-CoHOG computation, for face recognition. Following is the organization of the remaining portions of this essay; section 3 provides a brief review of HOG and CoHOG. Section 4 contains a detailed discussion of the proposed approach W-CoHOG. Results from the experiment are compared with those from earlier sections in Section 5.

Background

A. HOG

A HOG descriptor is a histogram that counts the number of pixels in an image's gradient orientation. In particular, the gradient image I is initially calculated as I = Gmag, Gdir, where Gmag and Gdir represent the gradient's magnitude and direction, respectively. The image is split into n distinct, non-overlapping parts next. Then, oriented gradient histograms are computed for each and every little region. Finally, vectorization is used to concatenate the histograms of each region.

B. CoHOG

A more reliable version of HOG is co-occurrence histograms of oriented gradients (CoHOG). CoHOG is described in this section. It takes into account how pixels in pairs are related. In CoHOG, a bin is a pair of edge gradient directions between the interest pixel and the offset pixel in a two-dimensional histogram. Calculated co-occurrence matrix for the two gradient orientations with various offsets.

$$C_{\Delta x \Delta y}(p, q) = \sum_{i=1}^{n} \sum_{j=1}^{m} \begin{cases} 1, if I(i, j) = p \text{ and } I(i + x, j + y) = q \\ None Otherwise \end{cases} \quad (1)$$

Equation (1) shows the calculation of Co-occurrence matrix.
I will serve as the input image. Where m, n is the number of rows and columns in a matrix, and p, q are any two orientations from among the eight provided orientations that are offset for co-occurrence. is a matrix of co-occurrences for an offset and orientation p, q.

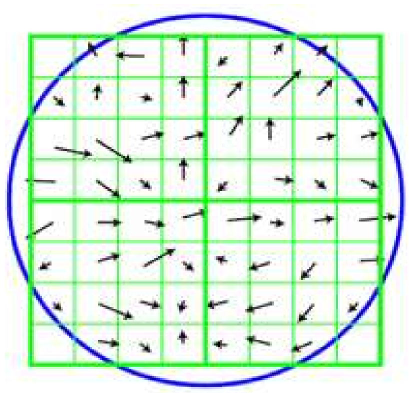
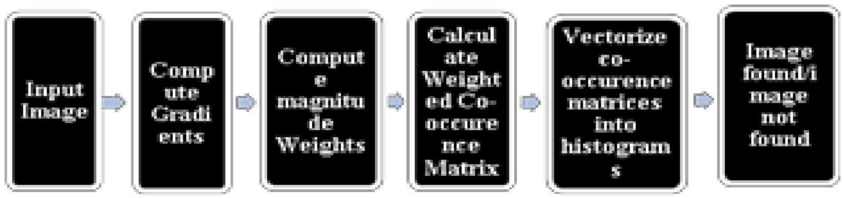


Fig.1. Image Gradients

Proposed Method (W-COHOG)

A. Overview

The magnitude is also taken into account in the suggested method to extract more robust features. A improved feature description is proposed using the W-CoHOG approach. W-CoHOG technique is briefly explained in Figure (1).



Initially, oriented gradients are created by converting magnitude and direction gradients from an image. The image is then split into non-overlapping 3x6 or 6x12 cells. Following that, weighted co-occurrence matrices for each region were calculated. The weighted co-occurrence matrices from each region are then added together.

A. FEATURE EXTRACTION

In order to achieve expression and posture invariance, this section introduces a unique feature descriptor with W- CoHOG. Many feature detectors in image pre-processing begin their calculations by ensuring normalized color and computing the gradient values. The gradients for a particular input image are calculated for each pixel. This technique makes use of Sobel and Robert's filters to calculate the gradients in an input image. For a given input image I, as illustrated below, equations (2) and (3) demonstrate gradient calculation using Sobel and Robert's filters, respectively.

Sobel Gradient Operator

$$\textit{(a)}\ G_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} * I$$

$$\textit{(b)}\ G_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * I \qquad (2)$$

Robert's Gradient Operator

$$\textit{(a)}\ G_x = \begin{bmatrix} +1 & 0 \\ 0 & -1 \end{bmatrix} * I$$

$$\textit{(b)}\ G_y = \begin{bmatrix} 0 & +1 \\ -1 & 0 \end{bmatrix} * I \qquad (3)$$

Then, using equation (4), gradients are transformed into magnitude and direction. Eight equal bins with 450 intervals are created from the gradients' directions.

$$(a)\ \theta = \tan^{-1}\frac{g_x}{g_y} \qquad (b)\ m = \sqrt{{g_x}^2 + {g_y}^2} \quad (4)$$

After that, magnitude matrix is convoluted with a mean mask to eliminate noise which may cause an aliasing effect. Eq

(5) shows the 12 X 12 mean mask used in the proposed method.

$$Conv_{12\ x\ 12} = \frac{1}{144}\begin{bmatrix} 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \\ 1 & 1 & 11 & 1 & 11 & 1 & 11 & 1 & 1 \end{bmatrix} \quad (5)$$

The suggested method uses the gradient's magnitude component as the weight function to determine the weighted co-occurrence matrix. The magnitude weights of each pixel are computed to create the magnitude weighted co-occurrence matrix. The gradient magnitude of each pixel is used as input for the Weight function, which modifies the co-occurrence matrix. The following paragraph gives an explanation of the weight functions that were employed in this method.

I will serve as the input image. A weighted co-occurrence matrix for a given offset x, y, and orientation i, j is given together with any two orientations (i, j) from a set of eight orientations. The weighted co-occurrence matrix calculation is explained in Eqs. 6 and 7.

$$C_{\Delta x,\Delta y}(i,j) = \sum_{p=1}^{n}\sum_{q=1}^{m}\{W_{(p,q)\ ,(p+\Delta x,p+\Delta y)} * \alpha$$

$$\alpha = \begin{cases} 1 & if O(p,q) = i and O(p+\Delta x, q+\Delta y) = j \\ 0 & Otherwise \end{cases}$$

Let be a gradient at pixel p, q in the provided input image. The mean and maximum gradient values in I are I. and Mmax. Simple operations like mean and division operations were used to get the weight. Two different weight calculation methods are shown in equations 8 and 9: (p,q) and (p+x, q+y).To calculate weights for creating weighted co-occurrence matrix, one of two functions is preferred. Eq (8) is employed in this proposed method to determine the weights for experimental outcomes.

$$W_{(p,q),(p+\Delta x,p+\Delta y)} = \left(\frac{m_{p,q}}{\bar{m}} * \frac{m_{p+\Delta x,p+\Delta y}}{\bar{m}}\right) + \mu$$

is a constant, and equals 1.The magnitude weighted co-occurrence matrices are computed for each region, and then the matrices are vectorized by concatenating all of the matrix rows into a single row. W-CoHOG feature extraction in our suggestion will enhance face recognition system performance. We are also using magnitude in this system to increase recognition rates. The feature vector will perform better than the current method by include magnitude. An image's gradients are initially calculated in direction form, and then they are converted into oriented gradients. Then, we'll use W-CoHOG to extract image features.

Experimental Results

Two datasets, the YALE and CALTECH datasets, each containing 165 and 450 photos, respectively, are used to assess the suggested technique. YALE has 165 total photographs of 15 different subjects, while CALTECH has 450 total images of 27 different subjects. Different facial emotions, including happy, normal, sad, sleepy, and astonished, as well as various hairstyles, backgrounds, winks, and lighting conditions with and without glasses, were used to capture the images. For each dataset, we built a training database and a testing database during the experiment. All of the photos from the dataset are included in the testing data, which is used to assess how well our system performs under various scenarios. The training data also include all of the images from the dataset. Each image in the YALE dataset is 100 × 120 pixels, while each image in the CALTECH

Fig.2.YALE sample images in dataset

Fig.3.CALTECH sample images in dataset

Conclusion

In this research, a brand-new technique termed W-CoHOG—an improvement on CoHOG—is offered. To increase the precision of image retrieval, magnitude is additionally included to the feature vector. On two benchmark datasets, the suggested technique improved accuracy. Experimental findings demonstrate that the proposed method performs better than existing cutting-edge methods. Even though weight calculation increases computational complexity, the generation time of the feature vector as a whole was improved by lowering the number of offsets to two. Better feature extraction techniques for face recognition will be the focus of future effort.

Required Refernces