

Personnel Management using Image Processing in MATLAB

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Abstract— This paper aims to implement a novel idea for personnel management in large corporations and colleges. This work takes its theoretical basis from the Digital Image Processing (DIP) techniques. The scenario of a college is proposed as an example. The technique involves the image acquisition of a student who stands in front of a camera. This image is then divided into numerous regions, where the top part consist of face, second part consists of a striped shirt with an orange tag for identification, third part consists of black belt, fourth part consists of navy blue pants and black shoes in the bottom part. Here we are going to apply different algorithms to each of the parts and finally when all the standards are met, attendance is taken through facial recognition by Viola Jones Algorithm. Texture filtering is applied to the second part for checking the uniformity of stripes followed by color segmentation to detect the presence of tag worn by the student. The same segmentation algorithm is applied to the third and fourth part for the detection of belt and shoes. The proposed system is trained and tested in MATLAB, based on a set of collected samples using a camera and the experimental results are accordant with the actual values in the scope of permissible error rate. The simulation results show the effectiveness of the proposed method for developing a system to recognize different attires worn by professionals, employees or students for the respective management and recording of their presence.

Keywords—Image Processing, Personnel Management, Segmentation.

I. INTRODUCTION

With extensive advancements in the field of image processing, it has found abundant applications in image compression, target recognition, intelligent monitoring, human computer interaction etc. This paper presents a study in MATLAB for the implementation of a system to detect if the attire worn by a professional in a corporate, a student in a college

or an attendant at a hotel is as per the standard required by the authorities and accordingly manage their attendance through facial recognition.

Our system uses a single close-circuit camera usually situated at the entrance of an organization looking straight so as to get a full scan of a person standing in front of it at a specified distance. The system requires only the camera calibration parameters and direction of people flow for initialization. This is done by identifying a still background. For the operation, an image is acquired from the video at an interval of 5 seconds. When a person stands in front of the camera for a time longer than 5 seconds, then the image acquired is analyzed to check whether the person's dress is proper and only then the attendance is recorded, otherwise not.

II. PROPOSED SYSTEM

A. Source Image Extraction

There are a number of methods for the extraction of the source image. Background difference method is such a technique for detecting the motion area by making the difference between the current frame and the background frame. An image is divided into foreground and background in this method. The background is modeled, [1] and the current frame and the background model are compared pixel by pixel. Those pixels accordance with the background model are labeled as the background, while others are labeled as the foreground. Background subtraction is a common method for identifying a new object in an area, which is used more often in situations with still background.

This method has low complexity. However, acquired background frames become sensitive to scene changes caused

by illumination and external conditions as time goes on. The method of refreshing background reference frames needs to be added in, under uncontrolled environment. For such cases we can use the adjacent frame difference method. In this method, moving objects are extracted according to the differences among two or three continuous frames. The method is the most simple and direct. With which the changing part in video can be quickly detected. Since the time interval between two images is quite short, illumination changes have little influence on different images, so the detection is effective and stable. The method using frame differences can better adapt to environment in intensive fluctuation, and can easily detect pixels causing the image.

It is extremely mandatory that the person stands exactly within a specified area, preferably a small marked rectangle so that a complete body scan can be taken.

B. Foreground Image Segmentation

- This foreground image is thereby divided into five regions. These regions are pre specified with the help of rectangular blocks consisting of the face, upper body, waist, lower body and the feet respectively. In MATLAB, this is achieved through the Region of Interest (ROI) command to use rectangular blocks.
- The analysis begins with the second block or ROI which consists of a black and white striped shirt and a bright orange colored tag (ID card) as an example. There are a number of ways to detect stripes as it can be considered as a texture. A texture can be characterized by little change in grey values. Gabor Filter based algorithm of space–time interest point (STIP) detection can be used to detect the instability of image intensity by taking into account the gradient of an image spatially and temporally by using a Laplace operator. The salience of a specific region in the image sequences in space and time domain is measured by applying a Gabor filter. The Gabor filter is widely used for fingerprint recognition, iris recognition, or any other applications of texture analysis as it fairly captures texture information of images.

In their method, the response function is defined as follows:

$$R(x,y,t) = (I(x,y,t) * g(x,y;u,\sigma) * h_{ev}(t;\omega,\tau))^2 + (I(x,y,t) * g(x,y;u,\sigma) * h_{od}(t;\omega,\tau)) \quad (1)$$

Where, the image sequences are denoted as $I(x,y,t)$. In addition, ‘g’ represents 2-D Gaussian kernel: h_{ev} and h_{od} and are a pair of temporal Gabor filters, corresponding to that of the channels.

$$h_{ev}(t;\omega,\tau) = -\cos(2\pi t\omega) e^{-t^2/\tau} \quad (2)$$

$$h_{od}(t;\omega,\tau) = -\sin(2\pi t\omega) e^{-t^2/\tau} \quad (3)$$

On detecting the texture and verifying it as a black and white striped shirt, we move on to detect the orange tag of identification. Using the color thresholder application in MATLAB, we can create a binary mask by moving the slider handle of one of the histograms across the spectrum. By proper adjustment we can detect the orange color present in the tag. Then a threshold is kept on the number of pixels. We can experiment with the controls until we achieve the cleanest segmentation. Small imperfections are cleaned up after creating the mask image using other toolbox functions, such as morphological operators. Thus after the verification of the presence of a black and white striped shirt and an orange tag, the next block is analyzed.

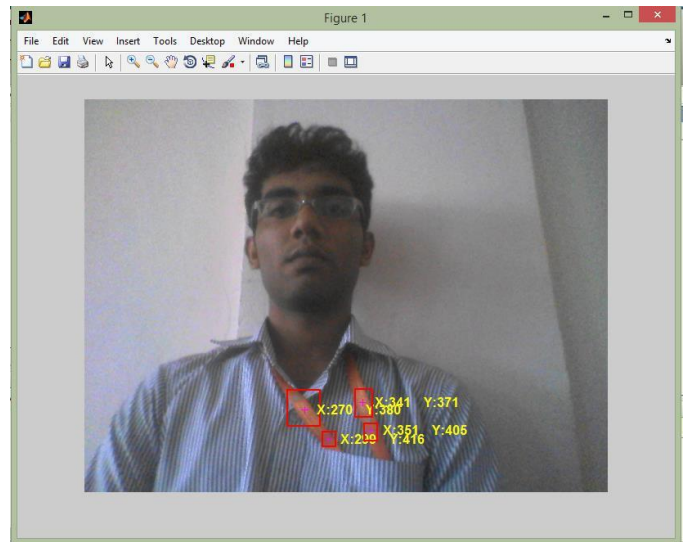


Fig. 1 Detection of Orange tag

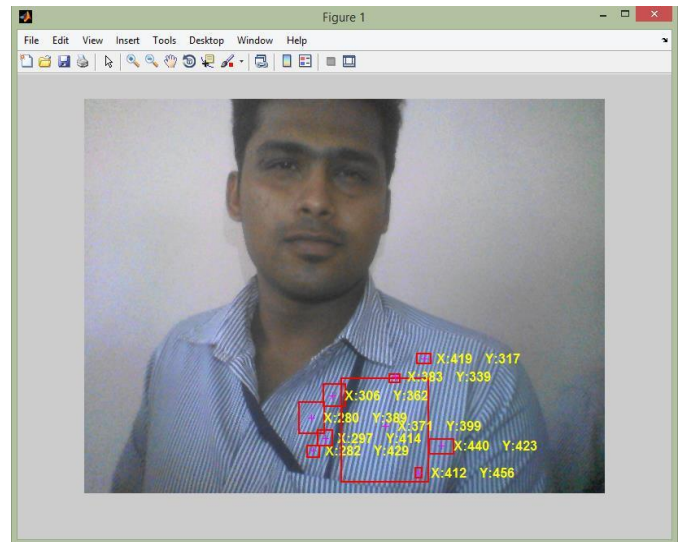


Fig. 2 Detection of Stripes in Uniform

- The third region is where the belt is located. Here we use the color image segmentation techniques of MATLAB. One method would be to create a region of interest within this block based on color values.

Another method would be to use the color thresholder application in MATLAB as previously discussed. Thus the number of black pixels greater than a preset value shows the presence of a black belt on the waist. Different hues of black is used for the analysis. The same algorithm is used for checking the navy blue pants in the fourth block and also for checking the black shoes in the fifth block.

- It is equally important to check for exceptions. Therefore coding in MATLAB also involves exception handling. Thus we need to check for the presence of white or any other colored belts in the third block. Also we need to check if the person is wearing pants of a different color. Presence of pixels having a skin or peachy color may suggest the presence of sandals or slippers.

C. Face Recognition

1) Traditional Viola Jones Algorithm Overview

A proper and efficient face detection algorithm always enhances the performance of face recognition systems. Various algorithms are proposed for face detection such as Face geometry based methods, Feature Invariant methods, Machine learning based methods. Out of all these methods Viola and Jones proposed a framework which gives a high detection rate and is also fast using Adaboost Algorithm based on Haar classifiers. Adaboost for face detection has marked an important breakthrough in image processing with considerable speed improvement and reduced computing needs. Its continuously increasing popularity recommends it as a simple but impressively versatile algorithm. On the other hand, the Haar wavelet remains the main tool to use along with Adaboost, due to its simplicity and ability to capture local textural information.

Viola & Jones in [2] proposed each weak feature to classify using a parity bit and a threshold value.

$$h_j = \begin{cases} 1 & \text{if } p_j f_j(x) < p_j \theta_j \\ 0 & \text{otherwise} \end{cases}$$

This method applies integral image to work out mass Haar-like features, then use Adaboost algorithm to pick out several features with the strongest classification ability as weak classifiers, after that make these weak classifiers become a strong classifier by the way of weighted voting, finally get a better face detector through making use of cascade framework to combine these strong classifiers. The combination of Adaboost algorithm and cascade framework gets a face detection system with practical value and high-performance.

2) Haar-like and integral image

Haar-like feature is a simple rectangular feature. Haar-like feature describes the gray level deference between the two adjacent rectangular regions, and reflect the partial gray change of image. Haar-like feature could divide into edge features, line features and the center surround feature. The value of Haar-like feature is equal to the difference between the sum pixel of the

white rectangular regions and the sum pixel of the black rectangular area. Haar-like features is relatively sensitive to the image structure of the edge, line type, but it can only describe the level, vertical and diagonal structure with specific trend. As can be seen, some facial features can be expressed simply by the Haar-like features. The integral image regard the sum pixel of a rectangular from the upper left to the lower right point as an array stored it in the memory, when the sum of the pixels within an area is need, you can directly call the elements of an array, instead of re-calculating the pixel values in this area, which makes the calculation speed has been greatly improved. For a point as $P(x, y)$ in an image, the integral [3] value is:

$$ii(x, y) = \sum i(x', y') \quad (5)$$

The integral value of image is the sum of pixel gray, where

$i(x', y')$ is the original value of $i(x', y')$. The step of calculation is:

$$s(x, y) = s(x, y-1) + i(x, y) \quad (6)$$

$$ii(x, y) = ii(x-1, y) + s(x, y) \quad (7)$$

Where $s(x, y)$ is the accumulated value of each row, so the integral image of each image can be acquired by a scan of the original image.

So Face Recognition involves two stages, feature extraction and classification. The above mentioned feature extractors combined with classifiers are compared in various real world scenarios such as lighting conditions, unintentional facial feature changes (occluded faces) and expressions.

3) Algorithm for proposed detection [4]

- Capture the Student's Image
- Apply Viola-Jones algorithm (Face Detection)
- Extract the ROI in Rectangular Bounding Box
- Convert to gray scale, apply histogram equalization and Resize to 100x100
- if Updating Database then Store in Database
 - else Apply PCA/LDA/LBPH (For feature Extraction)
 - Apply Distance Classifier/SVM/Bayesian (for Classification)
- end if
- f) Post-processing

4) Post Processing

In the proposed system, after recognizing the faces of the students, the names are updated into an excel sheet. Using MATLAB, the system can also be equipped with the facility of sending notification mail to the absentees. In organizations, this method can be used to record the number of working hours of an employee.

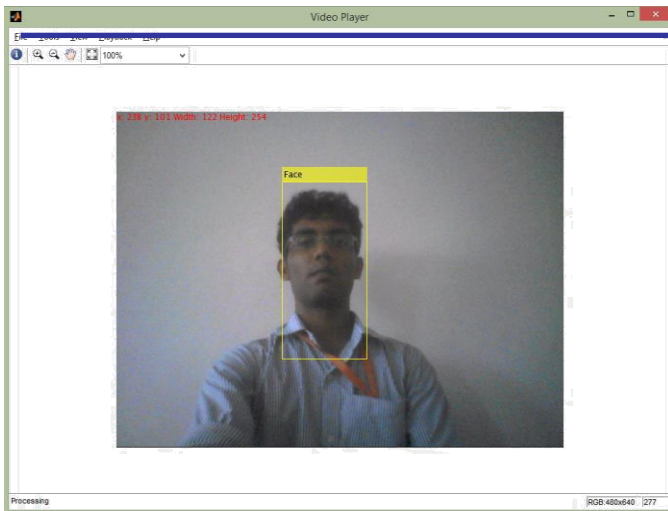


Fig. 3 Face Recognition

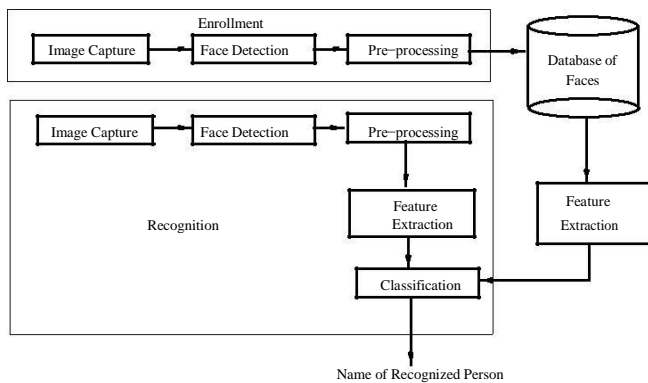


Fig. 4 System Architecture [4]

III. CONCLUSION

This paper presents a brief overview of an effective method to improve the management of employees in companies, hotels, schools and colleges. The algorithm performance, both w.r.t. accuracy, by adopting the Haar classifier construction, and computational time, by adding cascade network to it, leads to almost real-time capability in MATLAB environment.

The algorithm presented above is highly accurate, and it can as well meet the system's real-time demand. This paper presents the cumulative approach of many previous papers [5] [6] [7] with all features combined and color histogram analysis, which definitely gives an edge towards human surveillance system for many practical applications [8] [9]. Many commercial as well as military services can make the ultimate usage of the system at moderate cost.

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