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Robust Face Recognition Using Largest Matching Area for Illumination and Occlusion

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Abstract: *Face detection has been one of the most active research topics in computer vision over the past decade. Viola-Jones face locator has accepted an extraordinary consideration, and has turned into the defacto standard of face identification approaches. In this project, we have used the Haar-like features to detect faces. Only the frontal faces can be detected. The face detection is done in three phases with the algorithm specified by Paul Viola and Michael J. Jones . We get some of non- faces which are classified as faces along with the faces. We tried to reduce those non-faces from the image and keep only faces using two algorithms. The first algorithm is based on observation method of the errors and removing the non faces based on a certain threshold . The second method detect the upper body and then keep the faces which are present in the upper body and discard the non faces which are not present inside the upper body region. By using the two algorithms, we tried to minimize the non-faces in the algorithm. We have taken real life examples and simulated the algorithms in MATLAB successfully.*

Keyword: *Biometrics, Face recognition, Identification of person*

I. Introduction

Computer vision, when all is said in done, means to double (or in a few cases compensate)human vision, and customarily, have been utilized as a part of performing routine monotonous undertakings, for example, classification in monstrous mechanical production systems. Today, scrutinize on machine vision is spreading gigantically so it is very nearly difficult to organize every last bit of its subtopics. Notwithstanding of this, one can rundown important a few provisions, for example, face processing (i.e. gesture recognition and face expresssion), machine human cooperation, swarm reconnaissance, and substance-based picture recovery. All of the applications stated above require detection of face, which can be simply viewed as a preprocessing step for obtaining the “object”. The face is our primary center of consideration in social life assuming an imperative part in passing on feelings and character. We can perceive various appearances adapted all around our lifespan and distinguish faces considerably after numerous years of division. This aptitude is very hearty in spite of numerous varieties in visual jolt because of maturing, changing condition and preoccupations, for example, glasses, facial hair, or changes in hairstyle.

Face detection is a technology that determines the sizes and locations of human faces in digital images. It recognize faces and ignores anything else, such as trees, bodies and buildings. Face detection might be recognized as a more general instance of face confinement. It is the center of all facial analysis, e.g., face localization, face recognition, face authentication, facial feature detection, face tracking, and facial expression recognition. Additionally, it is an essential strategy for all different requisitions, for example, features conferencing, substance-based picture recovery and adroit human machine cooperation (HCI). The objective of face detection is to figure out if or not there exist any appearances in the picture and, if present, give back where its due and the degree of each one face. While face detection is an inconsequential assignment for human vision, it is a test for machine vision because of the varieties in scale, area, introduction, posture, facial articulation, light condition, and different appearance characteristics. Face discovery is utilized within numerous places now a day particularly the sites facilitating pictures like photobucket, picassa and facebook. The consequently labeling characteristic adds another measurement to imparting pictures around the individuals who are in the picture and likewise gives the thought to other individuals about who the individual is in the picture.

II. Related Work

2.1 Introduction

Looking at the history, pattern recognition system has come a long way. Earlier it was confined to theoretical research in the field of statistics for deriving various models out of the large amount of data. With the advent in computer technology, number of practical applications is increased in manifold which lead to further theoretical developments. At present, pattern recognition has become integral part of any machine intelligence system that exhibit decision making capabilities. Many different mathematical techniques are used for this purpose. Pattern recognition is concerned with the design and development of systems that recognize patterns in data. The purpose of a pattern recognition program is to analyze a scene in the real world and to arrive at a description of the scene which is useful for the accomplishment of some task. The real world observations are gathered through sensors and pattern recognition system classifies or describes these observations. A feature extraction mechanism computes numeric or symbolic information from these observations. These extracted features are then classified or described using a classifier. The process used for pattern recognition consists of many procedures that ensure efficient description of the patterns.

Pattern recognition can be defined as the categorization of input data into identifiable classes via the extraction of significant features or attributes of the data from a background of irrelevant detail. Duda and Hart defined it as a field concerned with machine recognition of meaningful regularities in noisy or complex environments. A more simple definition is search for structure in data. According to Jain et al. pattern recognition is a general term to describe a wide range of problems like recognition, description, classification, and grouping of patterns. Pattern recognition is about guessing or predicting the unknown nature of an observation, a discrete quantity such as black or white, one or zero, sick or healthy, real or fake. Watanabe defined a pattern as "opposite of a chaos; it is an entity, vaguely defined, that could be given a name." For example, a pattern could be a fingerprint image, a handwritten word, a human face, or a speech signal. The pattern recognition problems are important in a variety of engineering and scientific disciplines such as biology, psychology, medicine, marketing, artificial intelligence, computer vision and remote sensing. The field of pattern recognition is concerned mainly with the description and analysis of measurements taken from physical or mental processes. It consists of acquiring raw data and taking actions based on the "class" of the patterns recognized in the data. Earlier it was studied as a specialized subject due to higher cost of the hardware for acquiring the data and to compute the answers. The fast developments in computer technology and resources enhanced possible various practical applications of pattern recognition, which in turn contributed to the demands for further theoretical developments. The design of a pattern recognition system essentially involves the following three aspects: data representation, Classification and finally, Prototyping. The problem domain dictates the choice of sensors, pre-processing techniques, representation scheme, and decision making model.

i. Representation - It describes the patterns to be recognized;

ii. Classification - It recognizes the "category" to which the patterns provided belong to;

iii. Prototyping - It is the mechanism used for developing the prototypes or models. Prototypes are used for representing the different classes to be recognized.

A general pattern recognition system is shown in the Figure 2.1. In the first step data is acquired and preprocessed, this step is followed by feature extraction, feature reduction and grouping of features, and finally the features are classified. In the classification step, the trained classifier assigns the input pattern to one of the pattern classes based on the measured features. The training set used during construction of the classifier is different from the test set which is used for evaluation. This ensures different performance environment.

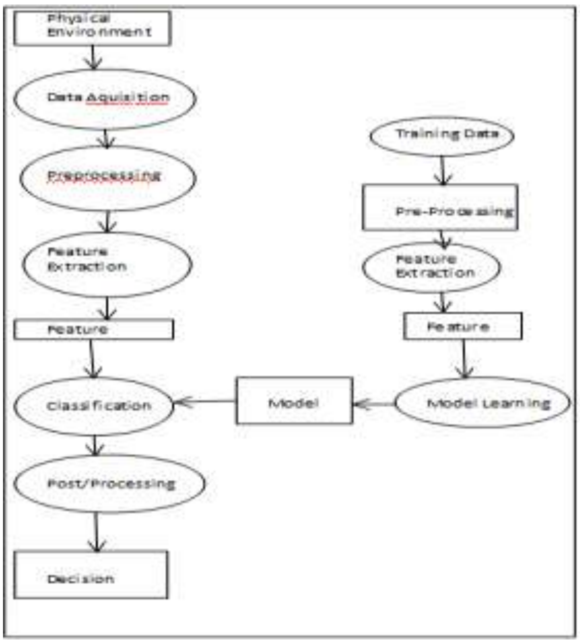


Fig. 2.1: A general pattern recognition system

2.2 Pattern Recognition Approaches

Patterns generated from the raw data depend on the nature of the data. Patterns may be generated based on the statistical feature of the data. In some situations, underlying structure of the data decides the type of the pattern generated. In some other instances, neither of the two situation exits. In such scenarios a system is developed and trained for desired responses. Thus, for a given problem one or more of these different approaches may be used to obtain the solution. Hence, to obtain the desired attributes for a pattern recognition system, there are many different mathematical techniques.

The Two best-known approaches for the pattern recognition are:

2.2.1 Template Matching

One of the simplest and earliest approaches to pattern recognition is based on template matching. Matching is carried out to determine the similarity between two entities such as points, curves, or shapes of the same type. In template matching, a template or a prototype of the pattern to be recognized is available. The pattern to be recognized is matched against the stored template while taking into account all allowable operations such as translation, rotation and scale changes. The similarity measure, often a correlation, may be optimized based on the available training set. Often, the template itself is learned from the training set. Template matching is computationally demanding. Present day computers with higher computation power, due to their faster processors, has made this approach more feasible. The rigid template matching even though effective in some application domains has a number of disadvantages. For example, it would fail if the patterns are distorted due to the imaging process, viewpoint change, or large intra-class variations among the patterns. When the deformation cannot be easily explained or modeled directly, deformable template models or rubber sheet deformations can be used to the match patterns.

2.2.2 Statistical Pattern Recognition

The statistical pattern recognition approach assumes statistical basis for classification of data. It generates random parameters that represent the properties of the pattern to be recognized. The main goal of statistical pattern classification is to find to which category or class a given sample belongs. Statistical methodologies such as statistical hypothesis testing, correlation and Bayes classification are used for implementing this method. The effectiveness of the representation is determined by how well pattern from different classes are well separated. To measure the nearness of the given sample with one of the classes, statistical pattern recognition uses probability of error. Bayesian classifier is a natural choice in applying statistical methods to pattern recognition. However, its implementation is often difficult due to the complexity of the problems and especially when the dimensionality of the system is high. One can also consider simpler solution such as a parametric classifier based on assumed mathematical forms such as linear, quadratic or piecewise. Initially a parametric form of the decision boundary is specified; then the best decision boundary of the specified form is found based on the classification of training samples. Another important issue concerned with statistical pattern recognition is the estimation of the values of the parameters since they are not given in practice. In these systems it is always important to understand how the number of samples affects the classifier design and performance.

2.3 Feature Extraction and Reduction

The Feature selection is the process of choosing input to the pattern recognition system.Many methods can be used to extract the features. The feature selected is such that it is relevant to the task at hand. These features can be obtained from the mathematical tools or by applying feature extraction algorithm or operator to the input data. The level at which these features are extracted determines the amount of necessary preprocessing and may influence the amount of error introduced into the feature extracted. Features many be represented as continuous, discrete, or discrete binary variables. During the features extraction phase of the recognition process objects are measured. A measurement is the value of some quantifiable property of an object. A feature is a function of one or more measurements, computed so that it quantifies some significant characteristic of the object. This process produces a set of features that, taken together, forms the feature vector. A number of transformations can be used to generate features. The basic idea is to transform a given set of measurements to a new set of features. Transformation of features can lead to a strong reduction of information as compared with the original input data. In most of the situations relatively small number of features is sufficient for correct recognition.

Obviously feature reduction is a sensitive procedure since if the reduction is done incorrectly the whole recognition system may fail or may not produce the expected results. Examples of such transformations are the Fourier transform, Empirical mode decomposition, and the Haar transform. Feature generation via linear transformation techniques is just one of the many possibilities. Feature extraction also depends on application in hand and may use different techniques such as moment-based features, chain codes, and parametric models to obtain required features.

III. Working Of System

A comprehensive overview of the proposed system is given in Figure 2. Given a target (i.e., probe) face image (which can be occluded or not) to be recognized, the possible presence of occlusion is first analysed. The probe image is divided into a number of facial components for occlusion detection. Each component is individually analysed by an occlusion detection module. As a result, potential occluded facial components are identified. Then, an occlusion mask is generated by a more precise segmentation approach to supervise the feature extraction and matching process. Based on the resulting occlusion mask, its LGBPHS representation is computed using the features extracted from the nonoccluded region only, namely, selective LGBPHS. The recognition is performed by comparing the selective LGBPHS from the probe image against selective LGBPHS from the template images using the same occlusion mask.

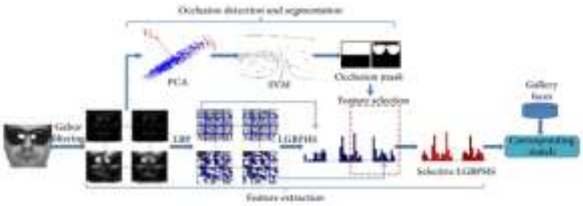


Figure2: Feature Extraction Process

3.1. Occlusion Detection In Local Patches

As depicted in Figure 3, our occlusion detection starts by dividing the face image into different facial components. The number and the shape of the components are determined by the nature of the occlusion. Since our focus in this work is scarf and sunglasses, we accordingly divide the face images into two equal components as shown in Figure 3. The upper part is used for analyzing the presence of sunglasses while the lower part is used for detecting scarf.

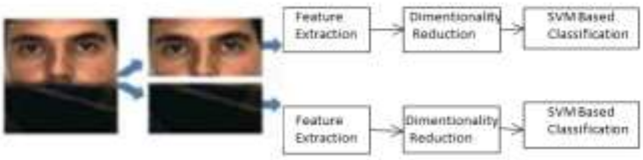


Figure3: Occlusion Detection Process

3.1.1. Gabor Wavelet Based Feature Extraction

Gabor wavelets are used for extracting features from the potentially occluded regions. The choice of using Gabor wavelets is motivated by their biological relevance, discriminative power, and computational properties.

3.1.2. Dimensionality Reduction Using PCA

Because the size of extracted Gabor feature is rather big, in order to reduce the dimension of the feature vectors while preserving its discriminative power, we apply principal component analysis (PCA) to maximize the variance in the projected subspace for the Gabor features. To compute the PCA subspace, we consider a training dataset consisting of feature vectors from both occluded and nonoccluded image patches.

3.1.3. SVM Based Occlusion Detection

Occlusion detection can be cast as a two-class classification problem. Since nonlinear support vector machines (SVM) are proven to be a powerful tool for discriminating 2 classes of high dimensional data, we adopted then a nonlinear SVM classifier for occlusion detection.

3.2. Occlusion Segmentation

In order to efficiently exploit the information of facial occlusion for face recognition, we generate a binary mask (1 for occluded pixels and 0 for nonoccluded pixels) indicating the location of occluded pixels to facilitate later feature extraction and matching in the recognition phase. This mask generation process is called occlusion segmentation. To generate an accurate occlusion mask (which can remove the occluded part meanwhile preserving as much as information from the nonoccluded part), we adopt a generalized Potts model Markov random field (GPM-MRF) [22] to enforce structural information (shape) of occlusion, so as to identify if a given pixel is occluded or not.

Figure 4: Illustration of our occlusion segmentation: examples of faces occluded by scarf and sunglasses.

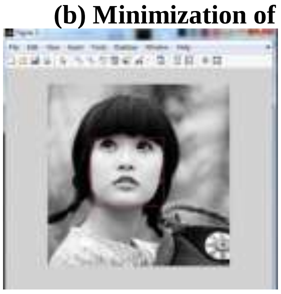
3.3. Selective Lgbphs Based Face Representation And Recognition

To perform the recognition step, we propose a variant of LGBPHS [11] based face representation (namely, selective LGBPHS) which selects features from nonoccluded pixels only. The choice of using LGBPHS based representation is based on the following facts: it takes the advantage of both Gabor decomposition (multiresolution and multiorientation for enhanced discriminative power) [6] and LBP description (robustness to monotonic gray scale changes caused by, e.g., illumination variations) [4]; block-based histogram representation makes it robust to face misalignment and pose variations to some extent; it provides state-of-the-art results in representing and recognizing face patterns under occluded conditions [11, 20]; Gabor features in LGBPHS share the same computation as in our occlusion detection module.

IV. Results

The figure 4.1.1 shows the input image in case of illumination and occlusion (a), To detect face minimization of background portion are done (b), and after minimization the backgound portion we get output at (c).

(a) Input Image **(b) Minimization of Background Portion**



(c) Detection of face

Fig. 6.1.1 Output Images of Face Detection in Case of Illumination and Occlusion

V. Conclusion

We addressed the problem of face recognition under occlusions caused by scarves and sunglasses. Our proposed approach consisted of first conducting explicit occlusion analysis and then performing face recognition from the nonoccluded regions. The salient contributions of our present work are as follows: (i) a novel framework for improving the recognition of occluded faces is proposed; (ii) state-of-the-art in face recognition under occlusion is reviewed; (iii) a new approach to detect and segment occlusion is thoroughly described; (iv) extensive experimental analysis is conducted, demonstrating significant performance enhancement using the proposed approach compared to the state-of-the-art methods under various configurations including robustness against sunglasses, scarves, nonoccluded faces, screaming, and illumination changes. Although we focused on occlusions caused by sunglasses and scarves, our methodology can be directly extended to other sources of occlusion such as hats, beards, and long hairs. As a future work, it is of interest to extend our approach to address face recognition under general occlusions, including not only the most common ones like sunglasses and scarves but also beards, long hairs, caps, and extreme facial make-ups. Automatic face detection under severe occlusion, such as in video surveillance applications, is also far from being a solved problem and thus deserves thorough investigations.

References

[1]. Wuming Zhang, Xi Zhao, Jean-Marie Morvan and Liming Chen, Senior Member, IEEE [1], “Improving Shadow Suppression for Illumination Robust Face Recognition” V1 IEEE,13 october 2017

[2]. H.Roy and D. Bhattacharjee [2], “Local-Gravity-Face (LG-face) for Illumination-Invariant and Heterogeneous Face Recognition” IEEE Transactions on Information Forensics and Security (Volume: 11, Issue: 7, July 2016)

[3]. Yandong Wena, Weiyang Liub, Meng Yangc, Yuli Fua, Youjun Xianga, Rui Hua [3],“Structured Occlusion Coding for Robust Face Recognition” IEEE 2015

[4]. Ronghua Liang, Xiao-Xin Li [4], “Mixed Error Coding for Face Recognition with Mixed Occlusions” IJCAI 2015

[5]. Rui Min, Abdenour Hadid, and Jean-Luc Dugelay[5], “Efficient Detection of Occlusion prior to Robust Face Recognition.The Scientific World Journal Volume 2014.

[6]. Hassen Drira, Ben Amor Boulbaba, Srivastava Anuj, Mohamed Daoudi, Rim Slama [6], “3D Face Recognition Under Expressions,Occlusions and Pose Variations”31 Jan 2013.

[7]. Niall McLaughlin, Ji Ming, and Danny Crookes, Largest Matching Areas for Illumination and Occlusion Robust Face Recognition, 2168-2267, 2016 IEEE

[8]. Turk, M. A., Pentland, A. P., Eigenfaces for recognition, 1991, Cognitive Neurosci., V. 3, no.1, pp.7186.

[9]. M. Turk, "A Random Walk Through Eigenface", IEICE Trans. INF. & SYST.,Vol. E84D, No. 12, Dec. 2001.

[10]. Handbook of Face Recognition by Stan Z. Li Anil K. Jain

[11]. Zhao,W., Chellappa, R., Phillips, P. J., Rosenfeld,A.,2003,Facerecognition: A literature survey, ACM Computing Surverys (CSUR), V. 35, Issue 4, pp. 399458. 66

[12]. M. Yang, D. J. Kriegman, and N. Ahuja, "Detecting Face in Images: A Survey", IEEE Trans. on PAMI, Vol. 24, No. 1, pp. 3458, Jan. 2002.

[13]. Survey paper: Face Detection and Face Recognition By Hyun Hoi James Kim