Recognition of Facial Structures Using Extreme Learning Machine Algorithm

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Abstract: *Recognition of natural emotions from human faces is an interesting topic with a wide range of potential applications like human-system interaction, automated systems, image and video retrieval, smart environments, and driver warning systems. Traditionally, facial emotion recognition systems have been initiated on laboratory controlled data, which is not representative of the environment faced in real-world applications. To robustly recognize facial emotions in real-world natural situations, this paper proposes an approach called Extreme Sparse Learning (ESL), which has the ability to combine and learn both dictionary (set of basis) and a non-linear classification model. The proposed approach combines the discriminative power of Extreme Learning Machine (ELM) with the reconstruction property of sparse representation to enable the accuracy of classification when presented with noisy signals and imperfect data recorded in natural settings. Additionally, this work presents a new local spatiotemporal descriptor that is distinctive and pose-invariant. The proposed framework is able to achieve the modern recognition accuracy on both acted and actual facial emotion databases.*

I. INTRODUCTION

Facial emotion recognition in uncontrolled environments is a very challenging task due to large intra-class variations caused by factors such as illumination and pose changes, occlusion, and head movement. The accuracy of a facial emotion recognition system generally depends on two major factors: (i) extraction of facial features which are robust under intra-class variations (e.g. pose changes)different facial emotions based on noisy and imperfect data (e.g., illumination changes and occlusion). Face detection is an essential application of visual object detection and it is one of the main components of face analysis and understanding with face localization and face recognition. It becomes a more and more complete domain used in a large number of applications, amid which we find security, new communication boundary, biometrics and many others. The purpose of face detection is to detect human faces in still images or videos, in different situations. Many algorithms implement the face-detection task as a binary pattern classification task. That is, the contented of a given image is changed into trained classifier or extracts the facial feature, after which a trained the classifier faces decides whether that particular part of the region of the image is face or non face. Frequently, a window-sliding method is in work. That is, the ELM classifier is used to categorize usually square or rectangular the portions of an image, at but are distinctive for various emotions.(ii) design of a classifier that is capable of distinguishing all locations and scales, as moreover faces or non-faces.

2. EXISTING SYSTEM

Facial emotion recognition in uncontrolled environments is a very challenging task due to large intra-class variations caused by factors such as illumination and pose changes, occlusion, and head movement. The accuracy of a facial emotion recognition system generally depends on two critical factors: (i) extraction of facial features that are robust under intra-class variations (e.g. pose changes), but are distinctive for various emotions, and (ii) design of a classifier that is capable of distinguishing different facial emotions based on noisy and imperfect data (e.g., illumination changes and occlusion).The objective of the existing work is to develop a facial emotion recognition system that is capable of handling variations in facial pose, illumination, and partial occlusion. Robustness to pose variations is achieved by extracting features that depend only on relative movements of different facial regions. However, the feature encoding may fail in the case of extreme poses, where some parts of the face are not visible in the recorded images.

Disadvantages of Existing System

- Most of the existing techniques are applicable only for laboratory-controlled data and are not able to deal with natural settings.
- Sparse representation is not sufficient because our end goal is to correctly recognize the facial emotion.

3.Proposed System

To recognize the emotions in the presence of self-occlusion and illumination variations, we combine the idea of sparse representation with Extreme Learning Machine (ELM) to learn a powerful classifier that can handle noisy and imperfect data. Sparse representation is a powerful tool for reconstruction, representation, and compression of high dimensional noisy data (such as images/videos and features derived from them) due to its ability to uncover important information about signals from the base elements or dictionary atoms. While the sparse representation approach has the ability to enhance noisy data using a dictionary learned from clean data, it is not sufficient because our end goal is to correctly recognize the facial emotion. In a sparse-representation-based classification task, the desired dictionary should have both representational ability and discriminative power.

Since separating the classifier training from dictionary learning may cause the learned dictionary to be sub-optimal for the classification task, we propose to jointly learn a dictionary (which may not be necessarily over-complete) and a classification model. To the best of our knowledge, this is the first attempt in the literature to simultaneously learn the sparse representation of the signal and train a non-linear classifier based on sparse codes.

The key contributions of this paper are as follows:

- A pose-invariant OF-based spatio-temporal descriptor, which is able to robustly represent facial emotions even when there are head movements while expressing an emotion. The proposed descriptor is capable of characterizing both the intensity and dynamics of facial emotions.
- A new classifier called Extreme Sparse Learning (ESL) is obtained by adding the ELM error term to the objective function of the conventional sparse representation to learn a dictionary that is both discriminative and reconstructive. This combined objective function (containing both linear and non-linear terms) is solved using a novel approach called Class Specific Matching Pursuit (CSMP). A kernel extension of the above framework called Kernel ESL (KESL) has also been developed.

Advantages of Proposed System

- A pose-invariant OF-based spatio-temporal descriptor, which is able to robustly represent facial emotions.
- Sparse Representation based Classification can improve the discriminative ability of the method and lead to better classification results.

IMPLEMENTATION

A. Face Detection

It is an essential application of visual object detection and it is one of the main components of face analysis and understanding with face localization and face recognition. It becomes a more and more complete domain used in a large number of applications, amid which we find security, new communication boundary, biometrics and many others. The purpose of face detection is to detect human faces in still images or videos, in different situations. Here we have made a global overview of face detection and then focussed on a detector which processes images very quickly while achieving high detection rates. This detection is pedestal on a boosting algorithm called AdaBoost and the response of simple Haar- Based features. The motivation for using such a face detection framework is to explore issues and obstacles concerning the application of machine learning to object detection. Face Detection Technique Face detection is a computer tools that determines the position and amount of size of human faces in subjective digital images. It detects facial characteristics and ignores everything else, such as house, foliage and human bodies. Face detection performance is known to be highly influenced by variations and illuminations.

B. Process in Face Detection

In many algorithms implement the face-detection task as a binary pattern classification task. That is, the contented of a given image is changed into trained classifier or extracts the facial feature, after which a trained the classifier faces decides whether that particular part of the region of the image is face or non face. Frequently, a window-sliding method is in work. That is, the ELM classifier is used to categorize usually square or rectangular the portions of an image, at all locations and scales, as moreover faces or non-faces. A face characters can contain the appearance, shape, and action of faces. There is some figure of faces is recognizable ones are oval, diamond, in a circle, rectangle, feeling, and triangle. Movement include, but not partial to, blinking, raised eyebrows, flared nostrils, wrinkled brow, and open lips. The face shapes will not be proficient to distinguish any person making any expression, it is very difficult to find other algorithms but the ELM method does result in a high accuracy.

C. Overview of Face Recognition

It is an important field within biometrics and computer vision. With biometrics, we can more reliably identifying or verify a person. In this context, facial recognition can provide a user friendly way of recognizing a person by capturing the persons face using a camera attached to computer systems. Facial recognition is achieved by means of comparing the rigid features of face, which do not change over a period of time. It can also achieved by comparing other parameters such as skin tone against the information that are stored in facial database. Many different algorithms are already available to perform this comparison. However, the basic steps remain the same. Facial Recognition Align is the face may not be perpendicular to the camera and hence the alignment needs to be determined and compensated to before recognition. Extract involves a process of measuring various facial features and creating a facial template, face print for the purpose of matching and identification. Match involves the process of matching the facial template with the records in the facial database. Similar often involves a scoring method are obtained by running the corresponding algorithms on the facial data. The high scores indicate a higher probability of match being accurate. Report may involve returning one or more facial matches depending on the usage scenario. Matches can be returned based on the score and user preferences.

D. Feature Extraction and Recognition

Once the face image has been normalized, the features can be extracted and detection of the face and then recognize the face images by using proposed algorithm. In feature extraction, a mathematical representation called a biometric template or biometric reference is engender, which is accumulate in the database manage initial recognition step. Proposed algorithms of face recognition can be varied in different way to transfer a face image into simple mathematical equation and then perform the task in recognition. Then process of recognition and the maximum recognition features can be extracted and can template matched can be matched individually and can be processed. Then it cannot be processed in other algorithm but able to proper recognition rate in proposed method Issues in the different face templates cannot be individually performed and then it should be proper biometric templates should be generated. The process of feature extraction and recognition proposed algorithm can be detected and provides exact recognition rate. The recognition of simple face regions can be extracted due to different approaches and the proposed method can be proper rate and it can be achieved proper detection rate. In the process of face detection more difficulties are occurred to overcome the problem of proposed method.

E. EXTREME LEARNING MACHINE

The time is an important factor while designing any computational intelligent algorithms used for classifications, medication, manage etc. Recently, Extreme Learning Machine has been proposed, which significantly decrease the quantity of time needed to train a Neural Network. It has been extensively used for many applications. This paper proposed ELM and its applications is described. When the input weights and the hidden layer biases are randomly assigned, SLFNs (single-hidden layer feed-forward neural networks) can be simply considered as a linear system and the output weights (linking the hidden layer to the output layer) can be computed through simple generalized inverse operation. Based on this idea, this paper proposes a simple learning algorithm for SLFNs called extreme learning machine. Different from traditional learning algorithms the extreme learning algorithm not only provides the smaller training error but also the better performance. The input weights and hidden layer biases of SLFNs can be randomly assigned if the activation functions in the hidden layer are infinitely differentiable. Subsequent to the input weights and the hidden layer biases are chosen arbitrarily, SLFNs can be simply measured as a linear system and the output weights of SLFNs can be analytically determined through simple generalized inverse operation of the hidden layer output matrices. Based on this concept, this paper proposes a simple learning algorithm for SLFNs called extreme learning machine (ELM) whose learning speed can be thousands of times faster than traditional other learning algorithms like local binary pattern, local ternary pattern, main element analysis, k nearest algorithm, linear discriminant algorithm while obtaining better generalization performance. Different from established learning algorithms the proposed learning algorithm not only tends to reach the smallest training error but also the smallest norm of weights. ELM was initially proposed for pattern single hidden layer feed forward neural networks and has recently been extended to kernel learning as well:

- ELM provides a united learning platform with widespread type of feature mappings and can be applied in regression and multi-class classification applications directly. • From the optimization technique point of view ELM has milder optimization constraints compared to SVM, LSSVM and so on.
- In theory ELM can approximate any objective permanent function and classify any disjoint regions

•In theory evaluate to ELM, SVM, LBP, LTP, LDA, KNN can be achieved different explanation and achieve the more computation difficulties. The fundamental nature of ELM is that

1. Hidden layer of ELM should not be iteratively tuned.
2. According to feed forward neural network theory both the training error and the norm of weights need to be minimized.
3. The hidden layer feature mapping need to satisfy the universal approximation condition. ELM is efficient for batch mode learning, sequential learning, incremental learning.ELM provides a unified learning model for regression, binary/multi-class classification.ELM works with different hidden nodes including kernels.ELM always provides better generalization performance than other techniques using equation

1. Two-Step learning model 1.Initialization phase: where batch ELM is used to initialize the learning system.
2. Sequential learning phase: where recursive least square (RLS) method is adopted to update the learning system sequentially. A. Implementation in Extreme Learning Machine Algorithm (ELM): Given a training set of patterns of input are , activation function g(x), and hidden node features N.

Step 1: Randomly assign input weight i and bias i ,i= 1,...,N.

Step 2: calculate the hidden layer output matrix H.

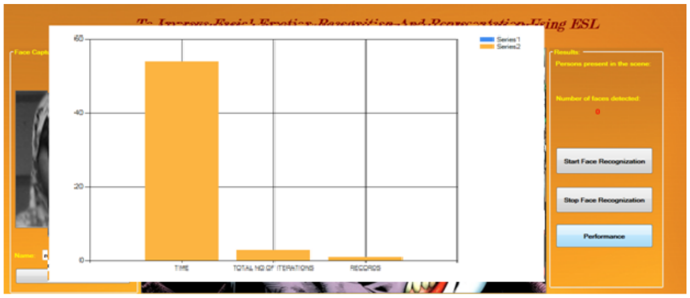
Step 3: compute the output weight||β|| ||β|| (1) Where T= [T1,....,TN] The advantages of extreme learning machine algorithm are needs less training time compared to popular Local Binary Pattern (LBP) and other algorithm. The prediction performance of ELM is usually a little better than LBP and close to SVM in many applications. Nonlinear activation function still can work in ELM.

RESULTS

EXAMPLE: 1

FIG(a): starting face recognition

Fig(b): detection of face recognition

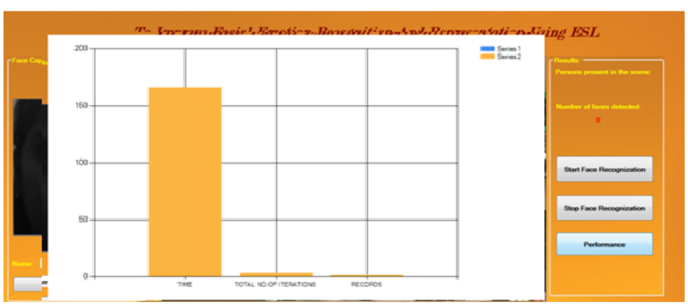


Fig(c): performance evaluation

EXAMPLE: 2

FIG(a): starting face recognition

Fig(b): detection of face recognition



Fig(c): performance evaluation

CONCLUSION

In this paper, we proposed a novel classification scheme called ESL, which is motivated by the recent advancements in the field of sparse representation and supervised dictionary learning. ESL incorporates reconstruction properties of sparse representation and discriminative power of a nonlinear ELM for robust classification. In addition, we proposed a novel OF-based spatio-temporal descriptor for pose invariant facial emotion detection. We have performed extensive experiments on both acted and spontaneous emotion databases to evaluate the effectiveness of the proposed feature extraction and classification schemes under different scenarios. Our results clearly demonstrate the robustness of the proposed emotion recognition system, especially in challenging scenarios that involve illumination changes, occlusion, and pose variations. The limitations include the higher computational cost for both feature extraction and classification as well as the need to optimize many parameters. Furthermore, there is still a large room for improvement in the recognition accuracy when dealing with natural or spontaneous emotions. Possible ways to improve the proposed emotion recognition framework include: (i) combining the proposed spatio-temporal descriptor with static (appearance) based features to deal with failure in motion feature (e.g., optical flow) extraction, (ii) use of motion exaggeration techniques to improve the recognition accuracy for subtle facial emotions, and (iii) enhancing the OF correction model to remove the effect of facial muscle movement caused due to the person speaking.

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