A NOVEL APPROACH FOR DECISION TREE OCCLUSION DETECTION (DTOD) CLASSIFIER FOR FACE VERIFICATION AND ESTIMATION OF AGE USING BACK PROPAGATION NEURAL NETWORK (BPNN)

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ABSTRACT

The emerging trend in Face Recognition System is based on Occlusion Conditions. Occlusion Detection is one of the major areas of Face Recognition System. Occlusion in the face image like one feature can be hidden by some objects like (Wearing scarf, sunglasses, beard etc.) are considered as an occlusion condition for the Proposed work. The DTOD classifier is based on decision tree c5.0 algorithm is used to classify the Occluded and Unoccluded parts in the facial features. The proposed system have high recognition rate compared with the existing work using decision tree C4.5 algorithm.

The features like, left eye, right eye, left nose, right nose and mouth are extracted using Local Binary Pattern techniques and the features are classified using Decision Tree Occlusion Detection classifier (DTOD classifier). The back propagation Neural Network is used to estimate the human age estimation with wrinkles as a feature. The proposed work was implemented using Decision Tree C5.0 induction algorithm to detect the occluded part efficiently and also the Unoccluded part was taken as an input for the next processing for face verification and age estimation.

KEYWORDS: DTOD Classifier, Occlusion Detection, Age Estimation, Face Recognition

INTRODUCTION

The aim of this research work is focused on Occlusion Condition in a face image. The Occluded Part of the image can be identified in the first stage of the proposed work. Then the unoccluded part was entering into the processing area. Analyze the Unoccluded part with features like (eyes, nose, and mouth etc.). The Face Verification was performed using the above features. To Estimate the age of a human using wrinkle as a feature and the Back Propagation Neural Network algorithm was applied in the proposed work.

The features was extracted using K means clustering Technique. The Decision Tree C5.0 classifier have been used to classify the occluded and unoccluded part of the face image. The Decision Tree is a technique in data mining and it was used to classify the images at different levels and at the least level the result was obtained. The occluded part can be identified at the last level of classification in the decision tree C5.0 classifier.

RELATED WORK

In the reference [1], the classification of occluded face from the non occluded faces can be identified using the decision tree 4.5 with Adaboost and LDA techniques. The LDA is used to integrate all features and finally conclude that eye and mouth occlusion has been detected. The left eye, right eye, left and right nose, mouth are the features. From reference [2], proposed a discriminative approach to capture the face features and SVM (Support Vector Machine) and
GOP (Gradient Orientation Pyramid) be applied for face recognition. The quality of photos, glasses appeared, Facial hair changes are taken into the account of age related issues. The Euclidean distance was calculated and that value have taken into consideration for face recognition. Next stage is to identify the age related issues.

By reference [3], Feature extraction process the Local Binary Pattern approach for both intensity and gradient values for the texture features can be identified using the Tsallis entropy values. The intensity, gradient and global features are the main characteristics of the face image. From reference [4], the feature extraction, Gender and Age classification was carried out using the global and Grid features, posteriori, priori probability values and wrinkle analysis.

The Gender identification was performed using the classifier and Young aged, middle aged and old aged classification network formed using Back Propagation Neural Network. The FEBGIAC (Feature Extraction based Gender Identification and Age classification) algorithm to identify the face, Gender and Age estimation.

From reference [5], the age estimation was carried out using Easy Neural Network with classification of age of four classes like, childhood, young, youth and old. The proposed work can be again categorized into two more classes which is secondary stage classification using FG-NET and Morph database.

From reference [6] the conventional Local Binary Pattern method applied to extract the feature, and Elastic matching pattern was applied for face recognition. In the reference [7] the skin color as a feature based on the hemoglobin and melanin values to identify the efficient results.

Both [6], [7] the texture features can be found in Local Binary Pattern Method. All the previous methods compared with the proposed system, the occlusion detection using mouth occlude part was not properly encountered. Only eye occluded part only taken into consideration. So the proposed work performed using mouth occluded part as a feature.

**OCCLUSION DETECTION**

Occlusion is defined by, a part hide by some other effects, for example a face is occluded by some mask in eyes, nose or other parts of a face. Occlusion can be identified in face whether it was left occluded part or right occluded part in a face or any other features. Scarf, Mask or some external factors are used to hide the facial features. That is known as Occlusion.

**Proposed Work**

The existing technology in face recognition under occlusion condition has several limitations. The decision tree based occlusion detection technology was used to classify the occluded and unoccluded part in the face. But in that work the more realistic conditions like, pose illumination and expression are not taken into consideration using decision tree 4.3 algorithm.

So the first part of the proposed method arises to overcome all the limitations in the existing system. The proposed work was implemented using Decision Tree C5.0 algorithm with all the directions of features like, eye, mouth, nose and all the pose, expression and illumination factors. Second part of the proposed method is to identify the face in the occluded conditions using the local binary pattern method and SVM classifier.

Third part of the proposed method is to estimate the age of a human using wrinkle as a feature and Back Propagation Neural Network. The FG-NET (Face and Gesture Recognition Research Work) dataset is taken into consideration for this part. The conditions in the database are illumination, pose, expression, Beards, Mustaches, Spectacles and hats.
Workflow Diagram for the Proposed System

Proposed System Methodology

- Feature extraction using Gabor Filter method
- Decision Tree formation:
  1. Integrating among all the features using LDA
  2. Apply DTOD(Decision Tree C5.0) classifier algorithm to find occluded and unoccluded part
- Face Recognition using Elastic Matching Pattern using Unoccluded Part
- Estimate the Age using Back Propagation Neural Network classifier using FG-NET dataset

OCCLUSION DETECTION EXPERIMENTS

First step is to identify the features using Local Binary Pattern Method. Unoccluded part is separated from the original face image and then that result is fed as an input for the next process ie face recognition using Elastic Matching Pattern Method.

System Design

OCCLUSION DETECTION EXPERIMENTS

Image Preprocessing can be done using noise removal techniques the that image was taken into account for feature extraction.
Feature Extraction Using Gabor Filter Method

From Fig 2, Gabor filter based feature extraction was done and the features are extracted. Gabor filter are defined by harmonic function modulated by a Gaussian Distribution. The real and imaginary component are used to form as complex number. Different frequencies and orientation can be used for feature extraction. They can be designed for number of dilations and rotations.

\[
K = K_{\text{max}}/f^{nu} \exp(1i*nu*pi/8);
\]

\[
K_{\text{real}} = \text{real}(K);
\]

\[
K_{\text{imag}} = \text{imag}(K);
\]

\[
N_{K} = K_{\text{real}}^2 + K_{\text{imag}}^2;
\]

**DTOD Classifier Algorithm**

1. Acquisition of input image
2. whole face classifier scan the input image and find the confidence measure
3. individual face part classifier is also scanned and find the confidence measure
4. integrate step 2 and 3 to find a face or non face
   A) step 4: the adaboost and lda is used for integration

\[
\sum_{i=1}^{N} (\mathbf{h}_i (\mathbf{x})) \geq T
\]

lda stage \( h(x) = \left\{ \begin{array}{ll} 1 & \text{otherwise} \\ -1 & \end{array} \right. \)

\( h_i (\mathbf{x}) \) is the output value for the \( i \) th classifier. \( T \) is threshold and \( e_i \) is the projection weight.

5. Decision Tree Stage

   output from the classifier
lda stage:
if output is $\geq$ threshold or output is $< threshold$
take right eye, right eye will be the root
if output is $\geq 0$ or output is $< 0$
right eye: left eye-left
if left eye output is $\geq 0$ then take lip
else occlusion on left
if lip output is $\geq 0$ then take non face
else output is $< 0$ then occlusion on mouth
right eye: left eye-right
if left eye output is $\geq 0$ then occluded on right side
else output is $< 0$ then take nose
if nose output is $\geq 0$ occlusion on eyes
else non face

FACE RECOGNITION USING ELASTIC MATCHING PATTERN

**System Design**

The text block is compared with the neighborhood in the training set and to estimate the best match. The block with the minimum distance was considered. Considering the computational speed and performance measure the size is reduced to 64*64 image and 21*21 grid level. The distance between the block levels is 3 and the size of the block is 5*5. For recognition the model likelihood value can be calculated using the maximum likelihood function. The highest log likelihood is identified as a face. To check whether the face is in the training set or database the Euclidean distance was used.
AGE ESTIMATION USING BACK PROPAGATION NEURAL NETWORK

System Design

The Classification Framework for Age

From Fig 5, The age can be estimated using Winkles as a feature. In the existing work of age estimation the layers can be divided into only 10 years of gap. So the estimation of error rate is very high compared with the existing technologies. To overcome those limitations the age can be categorized into young, middle and adult and old.
The Young age having the categories of 0-2, 3-6, 7-9, 10-11, 12-14, 15-16 etc... The back propagation neural network have been used to estimate the age. The Gender classification was performed using the mustache as a feature and the posteriori and priori probability has been used.

**FEBGIAC Algorithm: (Feature Based Gender Identification and Age Classification)**

1. Input: Face Image
2. Output: Gender classification and age estimation
3. Features like, Total number of white pixels, left and right eye end positions for gender classification.
4. Features like wrinkle (forehead, cheek and eye corner) for age identification.
5. Posteriori and Priori probability are calculated to differentiate the male and female.
6. Back Propagation Neural Network classifier is used to estimate the age

**CONCLUSIONS AND FUTURE ENHANCEMENT**

Occlusion Detection was performed using Decision Tree C5.0 algorithm using DTOD classifier. The performance rate for the proposed system has 99.5%. The proposed work have been overcome the existing system limitations using Decision Tree C5.0 algorithm. The occluded part has identified and the unoccluded part has been entered into the next process of face recognition. The recognition rate is 80% misclassification rate is 0.02%. The age can be estimated using BPNN with 89% of acceptance rate using ORL dataset. The future work will be focused occlusion verification using CBCL dataset and FG-NET dataset with large set of images.

**RESULTS AND DISCUSSIONS**
Figure 7: Feature Extraction Level 1

Figure 8: Feature Extraction Level 2

Figure 9: Face Recognition

Figure 10: Gender Identification
A Novel Approach for Decision Tree Occlusion Detection (DTOD) Classifier for Face Verification and Estimation of Age Using Back Propagation Neural Network (BPNN)

Figure 11: Neural Network Classifier

Figure 12: Age Estimation

Figure 13: Neural Network Training

Figure 14: Performance Comparison with BPNN
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