Study Of Image Processing, Recognition And Computer Vision Algorithms

Zulfia Afreen. M. A, Ramachandran. A

Abstract: This paper is a collaboration of appearance-based linear face recognition algorithms and image processing algorithms and few methods to recognize the face features in computer vision. It deals with human facial features, biometrics, identifying leaf species, fingerprint liveness, Indian sign language. By implementing these algorithms on various fields, we can provide increased security to the real time applications.

Index terms: LDA (Linear Discriminant Analysis), PCA (Principle Component Analysis), SIFT (Scale-Invariant Feature Transform), SURF (Speeded-Up Robust Features), SWLDA (Stepwise Linear Discriminant Analysis), HCRF (Hidden Conditional Random Fields), FER (Face Expression Recognition), K-NN (K- Nearest Neighbors), LPQ (Local Phase Quality), SVM (Support Vector Machine, ISL (Indian Sign Language).

1. INTRODUCTION

This paper describes about the collective analysis of various image recognition algorithms and models for better outcome of features and to reach higher accuracy. This mainly focuses on image recognition and computer vision using four major algorithms which are Linear Discriminant Analysis (LDA), Principle Component Analysis (PCA), Scale Invariant Feature Transform (SIFT), and Speeded-Up Robust Features (SURF). We discussed time complexity, efficiency and accuracy about each algorithm for better image recognition and discussed about various models which are used in the above-mentioned algorithms. A basic computer vision requires camera, a camera interface and a computer to process an image, but this has boundaries, which uses 2D image for recognition which may give wrong data. to overcome this lidar sensor is used which is explained later.

2 LITERATURE SURVEY

In this paper [1], Facial Expression Recognition system (FER) is used in order to recognize the different facial expressions given by the people. Facial expressions are classified into two, posed facial expressions and spontaneous facial expression. This paper deals with the former one. FER system uses an algorithm called Stepwise Linear Discriminant Analysis (SWLDA), which extracts the most significant features from the expression frames, and reduces the class variance between each frame thereby increasing the low within class variance. It is achieved using partial F-Test values. The Hidden Conditional Random Fields (HCRF) is used to classify the human facial expression accurately and categorizes the recognitions. A Sequence based FER system called SH-FER is used to produce the high recognition rate, which only deals with the posed facial expressions. To reduce complexity, K-Nearest Neighbors (k-NN) method is one solution. In this paper, four datasets are used, each having six facial expressions, and it gave 96.8% of accurate results. Thus, Further research is required to maintain the same recognition rate with different angles.

- Zulfia Afreen. M. A is currently pursuing master's degree in computer science and engineering in B.S. Abdur Rahman Crescent Institute of Science and Technology, Chennai, India. E-mail: zulfia.missy1996@gmail.com
- Ramachandran. A, B.S. Abdur Rahman Crescent Institute of Science and Technology, Chennai, India. E-mail: msg2chandran@gmail.com

Opinion--The proposed HCRF model improved with its accuracy over the existing HCRF model. They proved 96% of accuracy in recognizing the different facial features. There is no need to make any improvement in this paper. Thus, the proposed system is already good enough to make recognition on different human facial expressions. This algorithm is not suitable for fast-paced image recognition.

In this paper [2], the identification of leaf species is done using two algorithms called Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA). Generally, there is a considerable amount of information in the plant leaves to identify its species. At earlier stage, an artificial identification method called plant morphology was used to identify the plant species. Now, the species identification can be achieved by simple image processing methods. The leaves captured in a camera may affect the recognition rate. To minimize this, it is necessary to pre-process the image before performing feature extraction. The three types of images binary image, gray-scale image, texture image, are the output for the feature extraction. Shape features and texture features are extracted from feature extraction to describe the details of the leaf. Back-Propagation Neural Network is used to classify the feature data. In this paper, they used two datasets Flavia and ICL for which the results are 94.22% and 87.82% respectively. Since plants are two dimensioned, Image processing techniques are used to identification of species. Each plant has a specific shape and texture in which it acquires some specific characteristics. Hence, they proposed a method using Principle Component Analysis (PDA) and Linear Discriminant Analysis (LDA) to extract the shape and features of leaves. They made a discussion about the comparison of original image, gray-scale image, binary image, and texture image. After pre-processing the input color image, binary image, gray-scale image, texture image is obtained. They have shown that there are 2183 dimensions of leaves. A classifier called BP classifier is used to classify those two datasets. Opinion--They proposed a method using LDA and PCA to identify the leaves species effectively. The main purpose of these two algorithms was to reduce the feature dimension. LDA is better than PCA to extract low dimensional featuresIn this paper [3], they proposed a new detection technique based on jones and viola and Principle Component Analysis (PCA) that matches the images according to the face expressions. It follows certain conditions such as the picture should be resized to N*N format and it should be converted to gray-scale format for 2D image. The pre-processing steps includes the transformation of color

of an image, lighting compensation (the brightness is reduced and the contrast in increased) and detecting the edges of an image. Therefore, it is easy to extract the features from the image dataset. All these are done and implemented in MATLAB. Opinion—Some betterment is done on the basis of accuracy and computational time. These two algorithms give the most optimum detection rate. In this proposed system, the pre- processing stages on images is the main component for the success of implementation. Also, a high-quality compression algorithm may be needed to efficiently use the bandwidth during implementation. In this paper [4], the proposed system is a new software- based liveness detection approach using multi-scale local phase quantity (LPQ) and Principle component Analysis (PCA) is proposed. Support Vector Machine (SVM) is to classify whether the fingerprint is live or artificial. The author Sheng proposed a method by making fingers to rotate in all directions and thereby creating movement and skin deformation which also produces fingerprint distortion during capturing. The author Jia X got various still fingerprints from testers and the dataset is used for feature extraction. The author Nikam and Agarwal checked the liveness of the fingerprints based on ridgelet transform. The author Abhyankar et al proposed fingerprint vitality detection by lowering the energy of the phase and orientation maps. Two techniques are used. One is multi-resolution texture feature analysis and other is cross-rich frequency analysis. Opinion—It is best if this method is implemented in the mobile phone fingerprint sensor and in the confidential systems to improve the security in all the means. And also, this method does not require any special hardware and can be implemented to avoid spoof attack. This paper [5] is based on the Scale-Invariant feature transform (SIFT) algorithm to provide some possible solution to the deaf and hard hearing people. SIFT is a feature detection algorithm in computer vision to detect and describe the local features in images. SIFT phases includes input image, scale space extrema, key points localization, assigning orientation, computing descriptors, and SIFT features. Each phase is carried out in a step by step process. This algorithm is used to support the deaf and hard hearing people. Some distinctive features are extracted for the people to make their communication in an easier way. Several approaches are available to recognize the Indian Sign Language (ISL) gestures but it is practically impossible to apply on the real-world applications. In the existing paper, it was about the implementation of SIFT algorithm to extract features for the deaf and hard hearing people to easily communicate with others. In the proposed paper, the main focus is on the time taken in implementing each phases of SIFT algorithm. Opinion—The proposed system has directed a great deal of attention towards the time taken for the implementation of each phase of the SIFT algorithm while none of the previous research were about the computing time to process SIFT algorithm. Thus, the authors have done a good job on discovering the time taken rather than making improvements on the existing survey. In this paper [6] traffic sign recognition system was implemented by the authors using SURF and this system will give assist to drivers for safe driving and thus it is used as a third eye in the vehicle. This system will recognize the traffic signs on the road and make the driver aware of that sign. The authors used three steps for this process, the first one is the image is normalized and done some morphological operation and filtering after that the properties are extracted, then secondly shape verification is carried out using translation, scaling and rotation, finally the recognition is done using ANN classifier under Supervised environment. The authors implemented this in MATLAB and ROC curves are obtained to calculate the performance of the system. Opinion—Vehicles tends to move faster in highways and there may occur camera input lag, plus there are large categories of road signs have to be trained, which is tedious and they also need a special night vision hardware during night times (as cameras have low visibility at night). In this paper [7], they proposed a solution based on describing the facial appearance by applying Fisher Vector encoding on Speeded-Up Robust Features (SURF) extracted from different color spaces. They used three datasets on face anti-spoofing. After applying the SURF descriptor on the dataset, the obtained features are linked together to form a single feature vector which is called CSURF. The extracted CSURF is high dimensional and importance of it is higher than the SURF. PCA algorithm and fisher vector encoding is applied on the features that are linked together. The fisher vector encoding is based on describing the facial appearance. Opinion—The Speeded-Up Robust Features algorithm is applied on the color images and the gray-scale image is obtained. Fisher vector encoding method is applied on the extracted features. SURF is used because it is faster than SIFT and it is better than SIFT in rotation invariant. The computational complexity is reduced by applying SURF.

3 CONCLUSION

As the above survey compares the four main algorithms for image recognition, PCA offers better dimension reduction, LDA offers better pattern classification due to class separation, SIFT is faster than SURF by 3 times, but the SURF is good at handling images but it is worse in viewpoint handling. So, each has its ups and downs, by accurately using the specific algorithm for certain situation we can improve accuracy at times.

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