Feature Selection and Recognition of Face by using Hybrid Chaotic PSO-BFO and Appearance-Based Recognition Algorithms

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ABSTRACT

Swarm intelligence based approaches are a recent optimization algorithm that simulates the groups (collective) behavior of decentralized and self-organized systems and have gained more proliferation due to a variety of applications and uses in the feature selection to solve the complex problems and classify the objects based on chosen optimal set of features. Feature selection is a process that selects a subset from the extracted features sets according to some criterions for optimization. In computer vision based face recognition systems, feature selection, and representation algorithms play an important role for the selection of optimal, and discriminatory sets of facial feature vectors from the face database. This paper presents a novel approach for facial feature selection by using Hybrid Particle Swarm Optimization (PSO), and Bacterial Foraging Optimization (BFO) optimization algorithms. The hybrid approach consists of two parts: (1) two types of chaotic mappings are introduced in different phase of proposed hybrid algorithms which preserve the huge diversity of population and improve the global searching and exploration capability; (2) In proposed hybrid approach, appearance based (holistic) face representation and recognition approaches such as Principal Component Analysis (PCA), Local Discriminant Analysis (LDA), Independent Component Analysis (ICA) and Discrete Cosine Transform (DCT) extract feature vectors from the Yale face database. Then features are selected by applying hybrid Chaotic PSO and BFO algorithms for the selection of optimal set of features; it quickly searches the feature subspace of facial features that is the most beneficial for classification and recognition of individuals. From the experimental results, the authors have compared the performance of proposed hybrid approach with existing approaches and conclude that hybrid approach can be efficiently used for feature selection for classification and recognition of face of individuals.

Keywords: BFO, Biometrics, Computer Vision, Face Recognition, Feature Selection, Pattern Recognition, PSO, Swarm Intelligence

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1. INTRODUCTION

Face recognition have gained more recent advances to identify individuals based on their facial images in computer vision since few years. It is getting more proliferation due to variety of applications and uses for individual’s recognition and verification due to increasing the security requirements of different organizations in public, private sectors and societies (Zhao et al., 2003). Therefore, Face recognition has gained more significance attention for the security applications using biometrics. Biometrics is one of the most popular and widely used technologies for recognizing individual using their physiological and behavioral modalities such as face, iris, fingerprint, signature, voice, and gait. Several algorithms have been proposed to authenticate an individual’s identity using these traits (Jain et al., 2007).

The Face image as physical characteristic has advantages over other biometric modalities (e.g., Ear, Iris, Palm, Fingerprints) for recognition purpose. Face recognition of individual is a non-intrusive because it can be performed without the subject knows and identifies the individual based on their discriminatory facial feature vectors (Jain et al., 2007). To verify or identify an individual based on face image (Zhao et al., 2003); the discriminatory sets of features are extracted from the face image databases and compared with stored face template in the facial database. Therefore, it has become important in modern times due to the demand for the enhancement of individual security (Jain et al. 2007).

The various applications of face recognition based biometric systems are used in legacy systems, access control, individuals authentication, passports verification, voter registration, crowd management by surveillances, interaction of human-computer and deployment of smart cards. Moreover, face recognition has been a well-studied problem for various covariates such as illumination, pose variation; occlusion and these covariates based problems are still challenging in the recognition process of individual based on their facial features. The facial features are extracted from the different face images of individuals. The extracted huge data of facial features may contain many features that are either useless or irrelevant sets of features. The irrelevant feature sets may provide miss classification of data and not provides the better recognition performance measurements. Therefore, feature selection approaches play a significant role to choose set of optimal features from the huge database.

The feature selection is that the method of choosing a set of important feature from the extracted features. It’s a vital preprocessing step for the foremost machine learning algorithms particularly pattern classification and object recognition (Guyon, & Elisseeff, 2003). In feature selection, a given set of candidate features of involved dataset, choose a subset feature vectors that accomplishes the best under some classification algorithms for defined systems or models. The selection of a subset features can mitigate not only the cost of recognition, classification of any objects by reducing the number of sets of features which are needed to be collected, however, in some cases feature selection can also cater better classification accuracy because of effect of finite sample size (Jain, & Chandrasekaran, 1982). The word “feature selection” is taken to refer to algorithms that provide output subset features of the input feature sets. In the more general approaches that build new features based on transformations approaches or combinations of the original feature sets are known as feature extraction techniques.

There has been a renaissance of major interests in applying feature selection algorithms due to the huge numbers of feature sets have been encountered in the following types of defined problems:

1. **Data Acquisition from Different Multiple Sensors**: As per requirements of various applications where data are captured by applying multiple sensor for various types of modalities
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