(2)

SYNOPSIS

Feature Optimization using Swarm Intelligence in Image Analysis

Submitted to:

CSE Dept. (2nd shift)

Submitted By:

Uditi Chaudhary (35496302715)

Pooja Sahore (02996302715)

31/8/18

MAHARAJA SURAJMAL INSTITUTE OF TECHNOLOGY

AUG-DEC 2018

1. INTRODUCTION

Image analysis is the extraction of meaningful information from images; mainly from digital images by means of digital image processing techniques. Image analysis tasks can be reading bar coded tags, identifying a person from their face, detecting a face in a picture, recognising a given pattern, identifying objects in a scene and many more. However, the common basis on which all these tasks are dependent is a complete analysis of the image which provides with the required information. With the advent of machine learning in image analysis finding this information from images has been made feasible by the concept of feature extraction from the image, which basically aims at reducing the amount of resources required to describe a large set of data. Feature selection, which is the process of selecting a subset of relevant features, is done after extraction for use in model construction. A common phenomena which has been observed is the redundant nature of selected features and presence of noise. Various computational intelligence techniques such as swarm intelligence help optimise these features. In this project we propose to employ Swarm Intelligence for optimising selected features to be used in various tasks requiring analysis of images.

2. SUMMARY OF THE RESEARCH PAPERS

[1] Om Prakash Verma, Anil Singh Parihar This paper presents a fuzzy system for edge detection, using SUSAN principal and BFA. A parametric fuzzy intensifier operator (FINT) is proposed to enhance the weak edge information, which results in another fuzzy set. BFA is used to optimize the parameters involved in fuzzy membership function and FINT. The quantitative measures: Pratt's FOM, Cohen' Kappa, Shannon's Entropy and edge strength similarity based edge quality metric, are used. The quantitative results are statistically analyzed using t-test.

[2] Ayan Seal, Suranjan Ganguly, Debotosh Bhattacharjee, Mita Nasipuri and Consuelo Gonzalo-Martin This paper presents an algorithm for feature selection based on particle swarm optimization (PSO) for thermal face recognition. Thermal human face image is preprocessed and cropping of the facial region from the entire image is done. Then SIFT is used to extract the features from the cropped face region. PSO is an optimization method, which optimizes the extracted features. Finally, minimum distance classifier is used to find the class label of each testing images.

[3] Navpreet Rupal , Poonam Kataria In this paper clusters of the dataset of a bank with the help of h-means clustering are formed. This work is also based on comparative study of GA, PSO & BFO based Data clustering methods. To compare the results we use different performance parameters for classification such as precision, cohesion, recall and variance.

[4] Gaurav Kumar, Pradeep Kumar Bhatia In this paper, detailed Review of Feature Extraction in Image Processing Systems is done. Before getting features, various image preprocessing techniques like binarization, thresholding, resizing, normalization etc. are applied. After that, feature extraction techniques are applied to get features that will be useful in classifying and recognition of images. In this paper, features and feature extraction methods in case of character recognition application.

[5] Rasleen Jakhar, Navdeep Kaur, Ramandeep Singh This paper presents a feature selection algorithm based on Bacteria Foraging Optimization (BFO). The algorithm is applied to coefficients extracted by discrete cosine transforms (DCT). Evolution is driven by a fitness function defined in terms of maximizing the class separation (scatter index). Performance is evaluated using the ORL face database.

[6] Renuka Rattan, Er.Kumud Sachdeva In the proposed work, the biometrics recognition system based on the iris and thumbprint using the artificial neural network as a classifier is presented. The work is being designed and developed on the basis of ANN as a classifier and as a feature extraction technique we use SIFT and minutia for iris and thumbprint respectively with BFO (Bacterial foraging optimization) and GA (Genetic Algorithm) as optimization techniques.

3. FINDINGS OF THE RESEARCH PAPERS

[1] Om Prakash Verma, Anil Singh Parihar A fuzzy system for edge detection, using Smallest Univalue Segment Assimilating Nucleus (SUSAN) principal and Bacterial Foraging Algorithm (BFA) is proposed. The optimized parameters obtained from BFA are used to construct a fuzzy edge map. The fuzzy edge map is de-fuzzified using adaptive thresholding to result in binary edge map.

[2] Ayan Seal, Suranjan Ganguly, Debotosh Bhattacharjee, Mita Nasipuri and Consuelo Gonzalo-Martin A scale, translation, and rotation invariant thermal face recognition system using SIFT for face recognition systems is proposed. In this system, a PSO based feature selection algorithm is efficiently utilized to search the optimum features which are not noisy and also not irrelevant.

[3] Navpreet Rupal , Poonam Kataria The paper presents enhancement of classification scheme using various bio-inspired approaches. Three algorithms GA, PSO and BFO are implemented. Using each algorithm, some performance parameters such as Cohesion, Variance, Precision, Recall are calculated. BFO has been implemented successfully over GA and PSO.

[4] Gaurav Kumar, Pradeep Kumar Bhatia The paper provides detailed study about the features that are useful in pattern recognition system. For extracting features, many feature extraction techniques have been developed and are discussed.

[5] Rasleen Jakhar, Navdeep Kaur, Ramandeep Singh A BFO-based feature selection algorithm for face recognition is proposed. The algorithm is utilized to search the feature space for the optimal feature subset. Experimental results show the superiority of the BFO-based feature selection algorithm in generating excellent recognition accuracy with the minimal set of selected features.

[6] Renuka Rattan, Er.Kumud Sachdeva Biometric Fusion System based on SIFT and Minutia feature with optimization technique using Artificial neural network as a classifier is proposed. SIFT descriptor is used to extract the feature from the uploaded Iris image and minutia feature are extracted from the thumbprint. The extracted feature sets are optimizing using the BFO and GA for iris and thumbprint respectively.

4. PROBLEM STATEMENT

Feature extraction algorithms produce actual features from an image that are used for its analysis. However they also contain irrelevant, redundant and noisy features. These unwanted features have to be removed and optimum features have to be selected for enhancing the accuracy of the results of the image analysis. We aim to optimise the features extracted from images using the Swarm Intelligence technique - Bacteria Foraging Algorithm

5. OBJECTIVE

- Study different research papers on implementation of swarm techniques for feature optimization.
- To construct the method for implementation based on the findings from research paper.
- To perform feature extraction using any one of the following techniques SIFT, PCA, etc.
- To perform feature optimization using Bacterial Foraging Optimization (swarm technique) to eliminate redundant features and noise.
- Provide a program that will successfully provide optimized features for image analysis.

6.1 HARDWARE REQUIREMENTS

- High Computational Power CPU: An i5/i7 Intel processor or equivalent.
- High Memory Requirement: Both primary and secondary memory are required in large amount, around 50 GB HDD and 4-8GB of RAM.

6.2 SOFTWARE REQUIREMENTS

- Operating System: Any Linux based distribution like Ubuntu, Linux Mint, Windows 10, Mac OS Sierra, etc.
- Language: Python along with many dependencies like scikit-learn, etc.
- Package/ Libraries: pandas, numpy, matplotlib, cv2, skimage, etc.

7. SOLUTION

SIFT:

The scale-invariant feature transform (SIFT) is an algorithm in computer vision to detect and describe local features in images. SIFT keypoints of objects are first extracted from a set of reference images and stored in a database. An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors. From the full set of matches, subsets of keypoints that agree on the object and its location, scale, and orientation in the new image are identified to filter out good matches. The determination of consistent clusters is performed rapidly by using an efficient hash table implementation of the generalised Hough transform. Each cluster of 3 or more features that agree on an object and its pose is then subject to further detailed model verification and subsequently outliers are discarded. Finally the probability that a particular set of features indicates the presence of an object is computed, given the accuracy of fit and number of probable false matches. Object matches that pass all these tests can be identified as correct with high confidence.

PCA:

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. If there are n observations with p variables, then the number of distinct principal components is $min(n-1,p)$. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it is

orthogonal to the preceding components. The resulting vectors are an uncorrelated orthogonal basis set. PCA is sensitive to the relative scaling of the original variables.

BFO:

The Bacterial Foraging Optimization Algorithm is inspired by the group foraging behavior of bacteria such as E.coli and M.xanthus. Specifically, the BFOA is inspired by the chemotaxis behavior of bacteria that will perceive chemical gradients in the environment (such as nutrients) and move toward or away from specific signals. The information processing strategy of the algorithm is to allow cells to stochastically and collectively swarm toward optima. This is achieved through a series of three processes on a population of simulated cells: 1) 'Chemotaxis' where the cost of cells is derated by the proximity to other cells and cells move along the manipulated cost surface one at a time (the majority of the work of the algorithm), 2) 'Reproduction' where only those cells that performed well over their lifetime may contribute to the next generation, and 3) 'Elimination-dispersal' where cells are discarded and new random samples are inserted with a low probability.

8. REFERENCES

[1] Verma, O., Parihar, A.: An optimal fuzzy system for edge detection in color images using bacterial foraging algorithm. IEEE Trans. Fuzzy Syst. 25(1), 114–127 (2017)

[2] Seal A., Ganguly S., Bhattacharjee D., Nasipuri M., Gonzalo-Martin C. (2015) Feature Selection using Particle Swarm Optimization for Thermal Face Recognition. In: Chaki R., Saeed K., Choudhury S., Chaki N. (eds) Applied Computation and Security Systems. Advances in Intelligent Systems and Computing, vol 304. Springer, New Delhi

[3] Rupal, Navpreet and Poonam Kataria. Comparative Analysis of Clustering & Enhancing Classification Using Bio-Inspired Approaches.IJCSIT, Vol. 5 (5) , 2014, 6453-6457

[4] Gaurav Kumar, Pradeep Kumar Bhatia, A Detailed Review Of Feature Extraction In Image Processing Systems. IEEE, pp. 978–1-4799-4910-6, 2014.

[5] Rasleen Jakhar, Navdeep Kaur and Ramandeep Singh, Face Recognition Using Bacteria Foraging Optimization-Based Selected Features. International Journal of Advanced Computer Science and Applications(IJACSA), Special Issue on Artificial Intelligence, 2011.

[6] Rattan, R., & Sachdeva, K., Er. (2017). Biometric Fusion Based On Iris & Thumbprint Using Artificial Neural Network With Optimization. International Journal Of Engineering Sciences & Research Technology, 6(6), 591-599. doi:10.5281/zenodo.817970