A Hybrid Method of Face Detection Based on Feature Optimization and Neural Network

Apurwa Raikwar, Jitendra Agrawal

***Abstract:** The advancement of digital technology needs biometric security systems. Face detection plays an essential role in the security of digital devices. The detection of a face based on the lower content of the facial image for the processing of detection. In this paper modified the BP Neural Network Model for the detection of the human face. The modification of face detection algorithms incorporates feature optimization. The feature optimization process reduces the distorted features of the facial image. The optimized features of facial image enhance the performance of face detection for the optimization of features used glowworm optimization algorithms. The glowworm optimization algorithm is a dynamic population-based search technique. The concept of glowworm is a neighbor's selection of worms based on the process of lubrification. For feature extraction we use discrete wavelet transform. The discrete wavelet transform function drives the features component in terms of low frequency and high frequency of facial image. The proposed algorithm simulated in MATLAB software and used a reputed facial image dataset from CSV300. Our experimental results show a better detection rate instead of the BP neural network model.*

***Keywords:** ANN, BP neural Network, DWT, Face detection, Feature Extraction, GSO optimization, MATLAB*

I. INTRODUCTION

A human biological component such as the face, finger, iris plays a significant role in the security system. The proposed face detection algorithm is very efficient instead of an existing algorithm. The face detection algorithms work in two phases pre-processing and post-processing. In pre-processing used the feature extraction algorithms and in post-processing used neural network-based classification algorithm for the detection of face [1,2]. For the extraction of a feature used feature extractor, discrete wavelet transform function. The discrete wavelet transform function is a well-known feature extractor used in digital image processing. For the optimization of features used, a glowworm optimization algorithm [3,4,5]. The glowworm optimization algorithm based on the concept of neighbor's selection process. For the detection of a face used BP neural network models. In the feature extraction process, extract the lower content of face images such as color, texture and shape, and size. The texture feature is a major dominated feature of the face image for the extraction of texture features used discrete wavelet transform function. The discrete wavelet transform function is a collection of small waves represents the band of frequency for the processing of image data. In feature optimization reduces the distorted feature component of image data. For the optimization of features various optimization algorithms are used. In this section used glowworm optimization algorithms [9,10]. The glowworm optimization algorithm is dynamic population-based optimization algorithm. The optimization of algorithms used the concept of lubrification. Back-propagation (BP) algorithm is derived for the process of parallel neuron input process. "The neuronal state of $all-layer$ is in a direct relationship and does not interact with each another, each neuron will influence only the sub-layer's neuronal state. If the $real$ output and the $expected$ output have differences, the error is propagated back to input surface". The proposed algorithm is combination of GSO and BP neural network model. The GSO method is used for the process of feature optimization and feature selection. The feature selection process must consider the group of similar texture feature for the process of BP neural network system [9]. The rest of paper organized as in section II. Describe process of feature extraction and optimization. In section III. Describe proposed algorithms. In section IV describe experimental results and finally conclude in section V.

II. FEATURE EXTRACTION AND OPTIMIZATION

Feature extraction is the pre-processing phase of face detection. In the feature extraction process, extract the lower content of face images such as color, texture and shape, and size. "The texture feature is a major dominated feature of the face image for the extraction of texture features used discrete wavelet transform function" [13]. The discrete wavelet transform function is a collection of small waves represents the band of frequency for the processing of image data. Here describes the process of wavelet transform function for the feature extraction. "The 2D-DWT represents an image in terms of a set of shifted and dilated wavelet functions jf LH, jf HL, jf HH and scaling functions L L that form an orthonormal basis for L^2 (R^2)". Given a J-scale DWT, an image x (s,t) of NxN is decomposed as

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L Nr 1
x(s,t) = uJ,k,i LLJ,k,i(s,t) +
k,i=0
LLI N-1 wEJ,k,i\jf EJ,k,;(s,t) ....(1)
EEB j=l k,i=O

with

LLj,k,i (s,t) = r J12 (rj s – k, rJ t – i),
jf E J,k,i (s, t), jf E J,k,i (s,t)
= r i 12 jf E (rJ s – k, r i t – i),B E B,B ....(2)

{LH, HL, HH}, and NJ = N I 2J. "In this paper LH, HL and HH are called wavelet or DWT sub-bands. uJ,k,i = JJx(s,t) J.k,; dsdt is a scaling coefficient and wEJ,k,i = JJx(s,{wEJ,k,; dsdt denotes the (k,i)th wavelet coefficient in scale j and sub-band B. Fig. 1 shows the scaling concept in wavelet transform"[14].

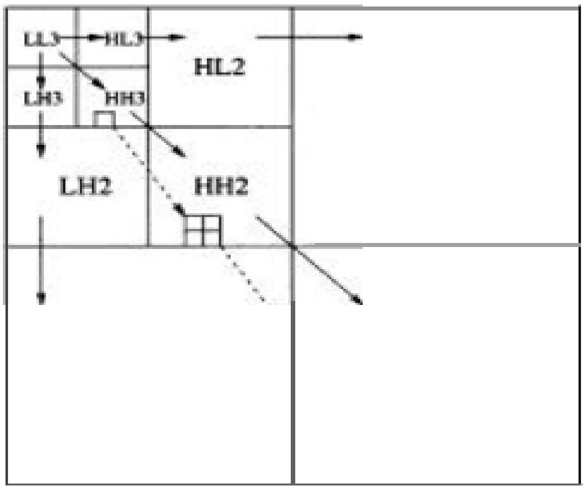


Fig. 1. Frequency domain analysis of during processing of raw image.

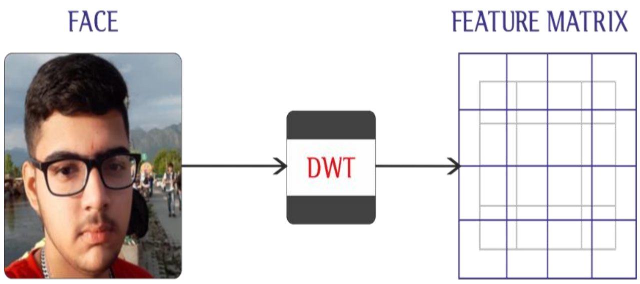


Fig. 2. Process block diagram of feature extraction.

Feature optimization is important phase of face detection. In feature optimization reduces the distorted feature component of image data. For the optimization of features various optimization algorithms are used. In this section used glowworm optimization algorithms. The glowworm optimization algorithm is dynamic population-based optimization algorithm. The optimization of algorithms used the concept of lubrification. The glowworm optimization system maps all features data in terms of glowworm and identifies the population set for further searching of the appropriate features point of the objective function [6]. The mapping method is represented as

The glowworm map K with objective function J(xk(t))

The location of glowworm is described as xk(t)

The factor of acceleration α

The similar group of glowworm produces array of Nk(t)

The updated local function is given in equation (1)

$$r_d^k(t+1) = min\left\{rs, max\left\{0, r_d^k(t) + \beta(nt - |Nk(t)|)\right\}\right\} \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

The local decision value is $r_d^i(t+1)$ and the range of value of t+1 is the range of similar characteristics in the range of similarity. The overall number of optimized functions for local updates is stated in equation (2)

$$N_{k(t)}=\left\{j : \|xk(t)-xk(t)\| < r_d^k ; lk(t) < lk(t)\right\} \ldots\ldots\ldots(2)$$

The derivation of glowworm in equation (3)

$$p_{ij(t)} = \frac{l_{k(t)} - l_{k(t)}}{\sum_{f \in Nk(t)} lf(t) - lk(t)} \ldots\ldots\ldots(3)$$

The position update in equation (4)

$$x_{k(t+1)} = xk(t) + s\left(\frac{sj(t) - xk(t)}{\|xj(t) - xk(t)\|}\right) \ldots\ldots\ldots(4)$$

The value of ρ belongs between 0 and 1. The end of iteration of DWT features matrix with glowworm optimization process gives the optimal features matrix for the process of features point categorization as input of BP neural network model. [7,8].

III. PROPOSED ALGORITM

The proposed algorithm is combination of GSO and BP neural network model. The selection process considers the group of similar texture characteristics for BP neural network [1]. The use of individual coefficient to calculate the pattern difference value to estimate pattern difference is done. The value of pattern discrepancy continues with the face detection location and position. The algorithm process is listed here.

1. Input: a DWT feature point in GSO and BP
2. Output: $Detected\ face\ DF_{Pf)}$
3. Compute $D_{(P_t,k)}$ and $k - disimarilty(p_t)$
4. for all $DP \in BP_{(f_t,k)}$ do
5. estimate local pattern$-Lp(f_t, DP)$
6. end for
7. $W_{\text{update}} \leftarrow GSO\ \{the\ set\ of\ glows\}$
8. for all $Df \in W_{\text{update}}$ and $FP \in M_{(DG,K)}$ do
9. Update $k - disimarilty(DP)$ and $cluester - ds(GSO, DF)$
10. if $DF_{(FP,k)}$ then

11. $W_{\text{update}} \leftarrow W_{\text{update}} \cup \{DP\}$
12. end if
13. end for
14. for all $DF \in W_{\text{update}}$ do
15. Update $FD(DF)$ and $FD(\{GSO_{o,k}\})$
16. end for
17. return $DF(detected\ face)$
18. measure person coefficient for both pattern p1…………pn, s1……………..sn
19. if value of difference is near about zero.
20. The process of face detection is done
21. Measure value of parameters

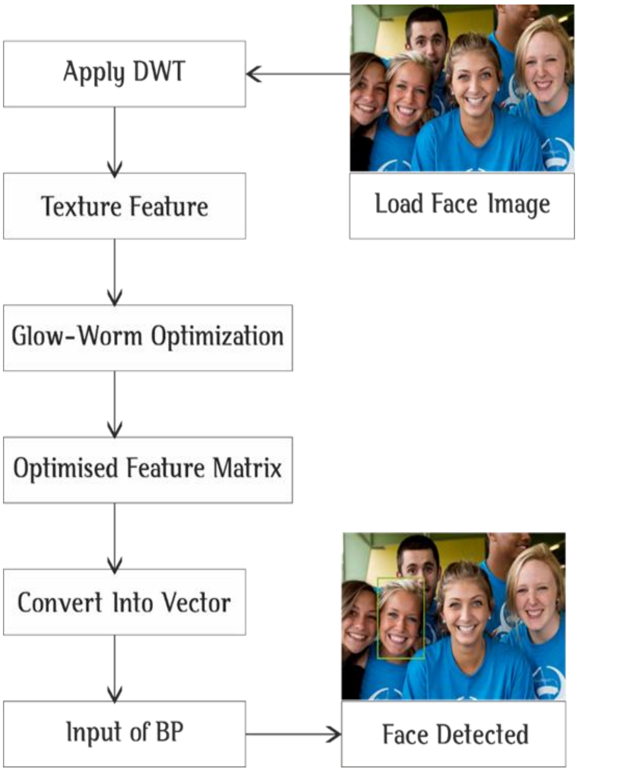


Fig. 3. Processed block diagram of proposed algorithm.

IV. EXPERIMENTAL RESULT ANALYSIS

The performance of proposed method of Face detection can be evaluated using MATLAB software 7.8.0 with a variety of group image dataset used for experimental task. In this chapter we will describe the MATLAB simulation of the proposed face detection method. We will give the details of the simulation tool, input methods & formats, simulation steps, group image collecting and processing steps, feature extraction method and finally get result group images.

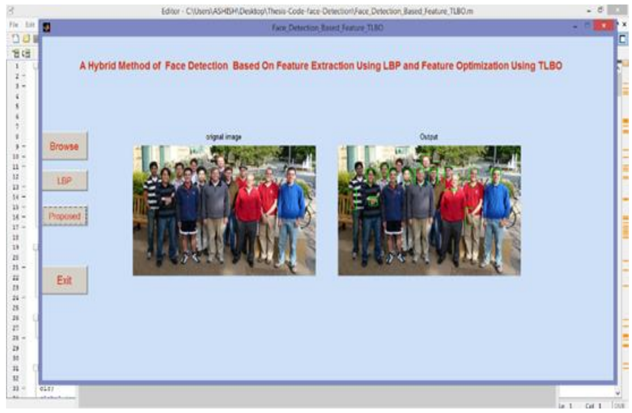


Fig. 4. Shows the result image for face detection using proposed method in hybrid method of face detection based on feature extraction using LBP and feature optimization using GSO.

Table I. Group image 1 statistical study using LBP and proposed model.

Group Image	Method	Total no of face	hit	miss	Detection ratio %
GP1	LBP	19	18	2	90
	PROPOSED	20	19	1	95

Table II. Group image 2 statistical study using LBP and proposed model.

Group image	Method	Total no of face	hit	miss	Detection ratio %
GP 2	LBP	6	4	2	75
	PROPOSED	6	5	1	89

Table III. Group image 3 statistical study using LBP and proposed model.

Group image name	Method	Total no of face	hit	miss	Detection ratio %
GP 3	BP	14	13	2	85
	PROPOSED	15	14	1	93

Table IV. Group image 4 statistical study using LBP and proposed model.

Group image name	Method	Total no of face	hit	miss	Detection ratio %
GP 4	BP	28	28	2	94
	PROPOSED	30	29	1	97

Table V. Group image 5 statistical study using LBP and proposed model.

Group image name	Method	Total no of face	hit	miss	Detection ratio %
GP 5	BP	20	18	2	90

	PROPOSED	20	19	1	95

Table VI. Group image 6 statistical study using LBP and proposed model.

Group image	Method	Total no of face	hit	miss	Detection ratio %
GP 6	BP	30	30	2	92
	PROPOSED	32	31	1	96

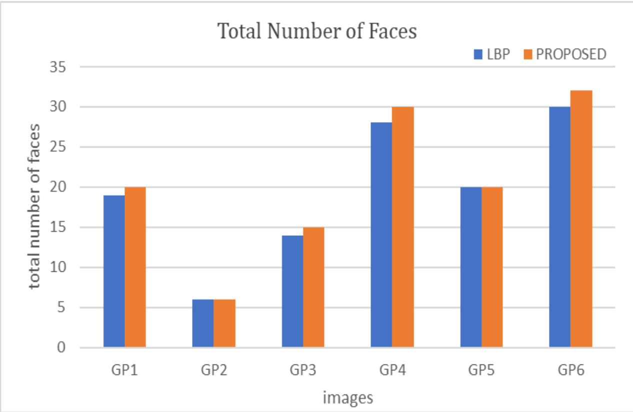
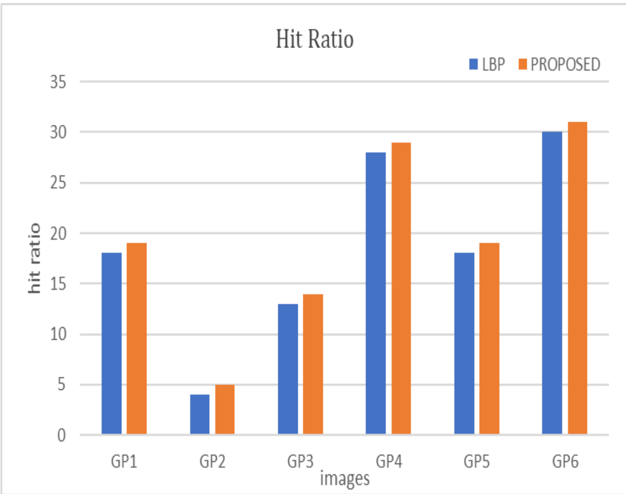


Fig. 5. The comparative performance of LBP and Proposed method for total number of faces with all different images GP1, GP2, GP3, GP4, GP5 and GP6. The performance of proposed represent the better compare to the BP method.

Fig. 6. The comparative performance of BP and Proposed method for hit ratio with all different images GP1, GP2, GP3, GP4, GP5 and GP6. The performance of proposed represent the better compare to the BP method.



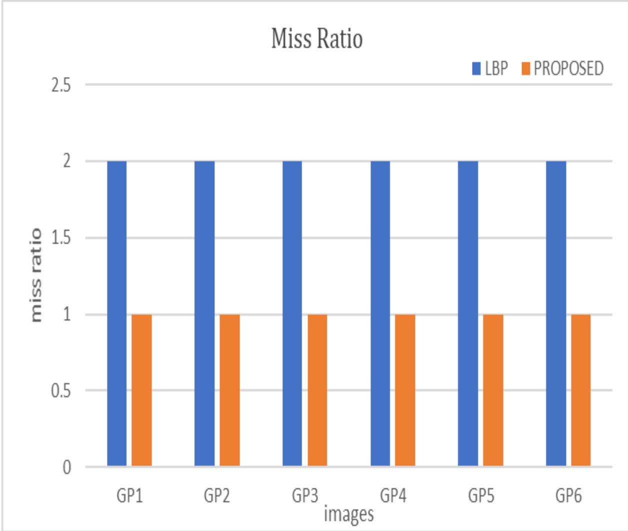


Fig. 7. The comparative performance of BP and Proposed method for miss ratio with all different images GP1, GP2, GP3, GP4, GP5 and GP6. The performance of proposed represent the better compare to the BP method.

Fig. 8. The comparative performance of BP and Proposed method for detection ratio in percentage with all different images GP1, GP2, GP3, GP4, GP5 and GP6. The performance of proposed represent the better compare to the BP method.

V. CONCLUSION AND FUTURE SCOPE

In this paper proposed face detection algorithm, the proposed algorithm is modification of existing algorithm of face detection BP neural network. The proposed algorithms used the concept of feature optimization and feature selection. The features optimization process improved the detection ratio of face image. For the optimization of features used glowworm algorithm. The glowworm algorithm is dynamic population-based algorithms and reduces the distorted coefficient of feature matrix. For the extraction of features used discrete wavelet transform function. Feature extractor is efficiently recognized by the discrete wavelet transform. Lower frequency of raw images is used by the process of feature extraction. The major dominated features of raw image are texture features. So discrete wavelet transform extracts the texture features for the face detection. The extracted feature is passes through glowworm optimization algorithms and estimated the optimized feature matrix. The optimized feature matrix converted into feature vector and passes through BP neural network model.

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The BP neural network models create the features point in dynamic nature and face is detected.

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