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# ELSA- A Novel Technique to Predict Parkinson's Disease in Bio-Facial Recognition System

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## ABSTRACT

In the recent times, medical system needs the intelligent system for the recognition of the diseases. Since, nearly 50% of the people are unaware about the body change which reflects in terms of the symptoms, or even it leads to the fatal end. Several techniques were invented for the pre-diagnosis of the diseases, but still it remains in the darker side of the research. Hence we propose the new technique called ELSA (Efficient Linear Selection of Adaptive Features) which works on the principle of the different adaptive features extracted based on the principle of ELB (Effective Local Binary Patterns), SIFT(Scale Invariant feature Transforms), GLCM(Gray Scale Covariance Matrix) on the different facial recognition system based on the SNR measured at Inputs, which are then tested with the different classifiers such as the Naïve Bayes Classifier, Neural Networks, Extreme Learning Machines (ELM) out which the ELSA along with the Extreme learning machine proves to be more accurate when compared to the other classifiers.

**Keywords:** ELSA, Naïve Bayes, Extreme Learning Machines, Adaptive Features, Facial recognition System.

## 1. INTRODUCTION

In this generation, non-communicable diseases known to be very important cause for 68% of all deaths globally in the year of 2012, up from 60% in the year of 2000. Out of which 50% of the diseases have occurred due to the inadequate knowledge of the disease that has occurred in the body. The prevention is possible but the inadequate knowledge of relating the pain with symptoms still remains in darker side. Many systems have been used for detection but the results need crystal clear mechanisms.
Hence, we have taken the symptom recognition from the Facial recognition Systems. Since any symptoms of pain can be easily recognized through the faces, hence an intelligent system is required for the identification of the symptoms. But developing the Intelligent Systems for the pre –diagnosis of the diseases is the real challenge among the researchers.

We propose a new methodology ELSA (Effective Linear Selective Adaptive Features) which works on the principle of the effective local binary patterns along with different feature selectors such as SIFT (Scale Invariant Feature Transforms) and Gray scale Co-variant matrix (GLCM) which are selected based on the preprocessed Noise level measurement. The proposed adaptive features selection is then tested with the different machine learning algorithms such as the Neural Networks, Extreme Learning Machine, and Naive Bayes Classifiers to give better accuracy detection.
The organization of the paper is as follows as
Section –I gives the introduction, Section II deals with the related works, the proposed methodology has been discussed in the Section-III, the results were discussed in the Section-IV, and finally conclusion is presented in the Section-V.

## 2. RELATED WORKS

[1] described facial recognition technology that was applied to different analysis tasks which includes face recognition and detection, detection of iris, recognition of fingerprint, and problems related to expressions in face. This method will extract the most important feature from the given image to match the similarities between the different faces. Therefore, this local binary pattern method will work best when compared to the other methods and also provides the efficient result.
[2] introduced a novel system for recognition of face for the classification of distinctive face databases. The new strategy encodes the pictures database generally based on the operation XOR between the focal pixel and its neighbors of quantized orientation, gradients tasks.
The novel system has contrasted with existing methodologies on gray scale pictures. Because of the efficiency of the proposed technique it has the capability for the other pattern applications, for example and other Bio security applications.
[3] using haar like features to reduce the false-positives drastically and increase the efficiency. The technique called Local Binary Pattern Histogram (LBPH) is utilized for the recognition of face. For the detection of face the cascade classifier is used and it includes three phases known as extraction of features, matching of images, and classification of images. At the final stage (classification) of face detection,

unique and useful pictures are segregated and they are contrasted with database images. In this LBP method, the texture information and shape of the images are most important features for the evaluation. The picture that is given is isolate into little parts from which Local Binary Pattern (LBP) are generally used to take and clubbed for single vector features. This vector utilized for the similarity measurements between pictures by framing a proficient portrayal of face.

[4] discussed detection and recognition method is discussed and implemented in this paper. To identify the faces, Haar classifier has been utilized which gives extreme error rate of 0.8%,2.1%, 1.6%, and if there should be an occurrence of picture and video file, Real-Time video individually which might be viewed as precise. LBPH algorithm is utilized for recognition of face and it has extreme recognition rate and error (0.4%), from this statement the algorithm clearly proves that it is highly efficient.

[5] proposed algorithms for recognition of face that are intended to deal with misalignment and variations of poses. To improve the robustness in various lighting conditions the normalization techniques is additionally used with the proposed algorithm. the LBP Histogram based descriptors are utilized with the proposed algorithm to perform the descriptor matching function with Naive Bayes Nearest Neighbor (NBNN) and spatial pyramid matching accordingly. the proposed system accuracy is contrasted with Ahonen's unique Local Binary Patterns based face recognition framework and another classifier known as baseline holistic generally based on four standard datasets. Results outperforms that the proposed algorithm is well suited during pose variations.

[6] discussed various operation in Image Processing, virtual machine or channels, different classifier.

Different methodologies are accessible and well suited for the detection of Facial Expression. the detection of facial expression field generally has different significant applications and it generally act as an interface between individual and PC. Numerous couples of choices are accessible to recognize a face in a picture with extremely efficiency accuracy. finally, this study concludes that Local Binary Pattern (LBP) based facial expression detection and recognition is a best approach in terms of accuracy.

[7] Vishwakarma presents an LBP approaches on classification stage for the extraction of feature and to get the robust decision, SVM (Support Vector Machine) is tested with various facial expressions. The strategy to be produced, tried and contrasted with LPB variants, also examination required with various functions based on kernel and learning strategies

[8] optimized PSO algorithm features for optimization results in improved 96.54% classification accuracy rate using Faces94 database. The proposed method is based on SVM classification. The LBP operator essential property is it has tolerance for illumination changes in real time applications. As shown in the comparison with other techniques, the experimental results show that the optimized face recognition using PSO gives better accuracy than existing technique. We also plan to conduct further experiments on different databases with more subjects.

[9] presents an effective recognition of facial images based on text features of LBP. It's a quick and basic for execution, has demonstrated its predominance in recognition of face. This study proposed a multiscale Local Binary Patterns histogram for a picture. The face picture is separated into a few areas from which distributions of the LBP are extricated and connected into an enhanced feature vector to be utilized as a descriptor for face. Advantage of the proposed scheme is LPB information has utilized completely when there is no need of training steps for the extraction of image features, which are really sensitive samples in training.

[10] proposed algorithm for face recognition technique based on Local Binary Pattern (LBP) classifier. In general, this classification approach has properties of histogram for the extraction of features. Another classifier namely "Combined Learning Vector Quantization" (LVQ) Classifier which is Neural Network approach to recognize the database images. The main advantage of this method is the primary input image is splitted as small ares for example nose, eyes, mouth and from these LBP histograms features can be extracted and it is connected as a single feature vector.

[11]Image from jaffe database is enhanced and implemented with Xilinx to achive 93.33% of classification rate. Priyanka Thakur [12] made a study report on text based emotion recognition system where analysis done at recognition accuracy , Precision rate.

## 3. PROPOSED METHODOLOGY

The proposed methodology ELSA is shown in figure 1. The proposed algorithm for an intelligent detection of the symptom consists of the following mechanisms which are listed below:

### 3.1. Noise Measurement and Selector

The input stage of the ELSA is the noise measurement in the facial images taken as Inputs are taken from the camera. Since the capturing from the device may lead to the addition of the noises in the images. After measuring the SNR of the image, ELSA works on the intelligent selector of the feature extractors which consists of group of Effective Local Binary patterns, Scale Invariant Feature Extractor, and Gray Scale Co variance Matrix. ELSA has been fed with intelligent selectors which are fed with an intelligent rule sets for the selection of the feature extractor. The different types of the feature extractor are described as follows

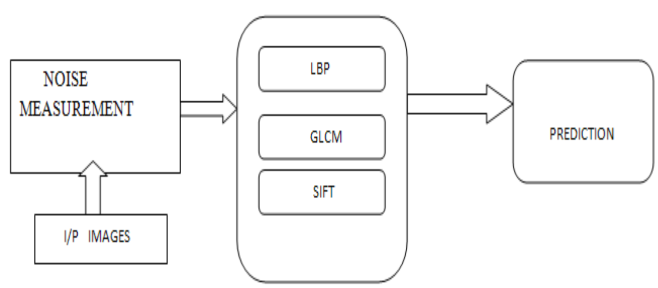


**Figure 1:** Proposed ELSA Algorithm with different Features Extractors

The SNR in the Image is measured by the PSNR mechanism, and selects by the thumb rule sets which is given as follows

If (SNR(I) < SNR_t then LBP is chosen

If SNR(I) > SNR_t then GLCM is chosen

If SNR(I) =SNR_t then SIFT is chosen

These are chosen based on the thumb rule used for the detection /Selection of the Feature Extractor

### 3.2 Effective Local Binary Patterns

Effective Local Binary Pattern (ELBP): The term LBP deals with the unique feature extractions based on the textures. Divide and conquer approach in which the examined the window into cells such as 16x16 pixels for each cell.

As the next stage, correlation of the pixel has been done to every one of its 8 neighbors (to its left side best, left-center, left-base, right-top, and so on.). pixels are generally followed along with thevcircle might be clockwise or counter-clockwise. If the pixel's value in the middle stage is extreme than the neighbor's value, express "0". else, write "1". This gives a 8-digit parallel number as appeared in Fig 2

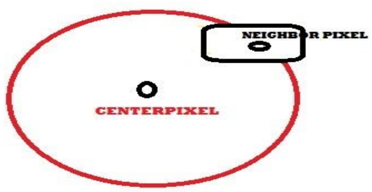


**Figure 2:** Local Binary Patterns -a General pattern: working principle

The histogram is figured over the phone, of the frequency of each "number" happening (example: every combination of which pixels are very littler and they are completely prominent than the inside). This histogram can be generally viewed as a 32-dimensional element vectors for the picture measure 256x256. Normalized histograms all things considered. This generally gives a component vector for the complete window as a Single Value of Feature which has been removed.

### 3.3 Scale Invariant Fourier Transforms

In this method, four stage method is adopted for the extraction of the feature from the image size of 256X256 which are given as follows

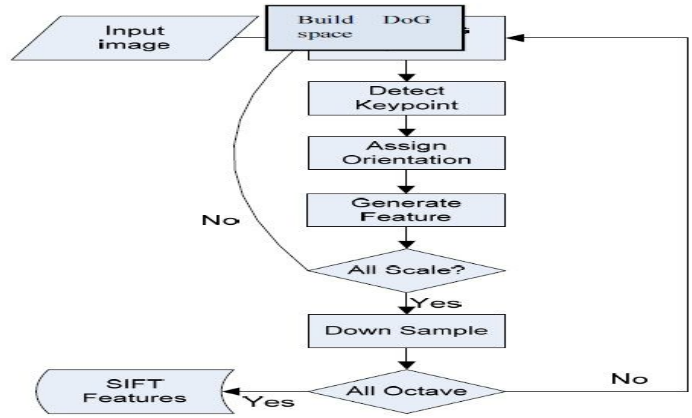


**Figure 3:** Scale Invariant Fourier Transforms-its Working Mechanisms

### 3.4 scale-space extreme detection

This phase of the filtering endeavors to distinguish those areas and scales that are recognizable from various perspectives of same object. This can be proficiently accomplished by utilizing a function known as "scale space" work. Further it has been appeared sensible assumptions it must be founded on the Gaussian capacity. The scale space is characterized by the capacity:

$L(a, b, \sigma) = G(a, b, \sigma) * I(a, b)$

Where * is known as operator used for convolution, $G(a, b, \sigma)$ is known as Gaussian scale variable, I(xa,b) known as input image.

In the scale space to detect the key point locations different techniques can utilized. Gaussians Difference is a general method, locating scale-space extrema, $D(a, b, \sigma)$ by finding two image difference, one with scale k times the other. $D(a,b, \sigma)$ is then given as follows:

$D(a, b, \sigma) = L(a, b, k\sigma) - L(a, b, \sigma)$

For the detection of the local minima and maxima of $D(a, b, \sigma)$ each point is generally contrasted with its 8 neighbors on same scale, 9 neighbors on up and down scale. If this value is known to be the maximum or minimum of all these points, then it is an extrema.

**Key point Localization**

The key point localization stage endeavors to remove focus points from the key points by finding which one is having low difference or are inadequately localized on an edge. By using the z- value, this focus point can be excluded when value of z is below the value of threshold. This generally eliminates the issues of low complexity. To remove the extrema based on poor localization it is noticed that in these cases there is an expansive standard curvature over the edge however a little curvature in the opposite direction in the distinction of Gaussian capacity. The key point is rejected when the difference below the proportion of biggest to smallest eigenvector, from the 2x2 Hessian framework at the location and size of the key point.

**Orientation Assignment**

This main aim of this step to consistent a steady to the key points based on local picture properties. The key point descriptor relative to this orientation, achieving invariance to revolution.

**Key point Descriptor**

gradient data is pivoted to agree with the orientation of the key point and after that weighed by a Gaussian with fluctuation of 1.5 * key point scale. Then this is used to create a lot of histograms.

Key point descriptors ordinarily utilize a lot of 16 histograms, adjusted in a 4x4 grid, each with 8 bin orientations, one for the primary compass headings and later for mid-points of these bearings.

At long last all the element vectors separated and connected to frame the Single dimensional highlights.

### 3.4.1. GLCM (Gray Level Co Variance Matrix)

GLCM has characterized by Haralick and it is 2 – dimensional histogram pictures of gray levels for the match of pixels which are isolated with spatial fixed relationship. GLCM of the Image is figured by the relocation vector "d" which relies upon the radius "R" and orientation.

Orientations edges normally taken from 0 .45, 90 and 135 and texture calculation radius R is considered as 1 in the proposed system. After choosing the factor for orientation and Radius, count of G (gray levels) registered without using time for calculation.

GLCM computes Gray levels of the range R and direction from 0, 45, 90 and 135. In order to decide the texture highlights, chosen statistics are connected with each GLCM by emphasizing using matrix. The highlights of textural directly depend on statistics and it abridged in table 1 describes to the frequency distribution and it portrays how regularly one gray tone will show up in a predetermined spatial relationship to another gray tone on the picture.

**Table 1:** Different Glcm Statistical Textures Representation.

| S.NO | PARAMETERS USED | EXPRESSION |
|---|---|---|
| 01 | Entropy | -∑∑gst log2 gst |
| 02 | Contrast | ∑∑(s − t)2 gst |
| 03 | Energy | ∑∑gs t 2 |
| 03 | Correlations | ∑∑(st)gst − μx μy// σ xσ y |
| 05 | Homogenity | ∑∑1/(s-t) gs |
| 06 | Sum Average | ∑(s − sa)2 g x+y (s) |
| 07 | Sum Entropy | - 2∑Ng g x+y (s) log{g x+y (s)}=2 |

Where,

gst=(s, t)th entries available in GLCM

gx(s) = sth entry at probability of marginal matrix which is normally obtained using sum of rows

s-Image fisrt pixel t- Pixel for neighbor image.

The geya dimensions determined above takes more complexity while computation and for eliminating this kind of disadvantage we have taken just four surface investigation parameters, for example, Energy, Variance, Contrast and Correlations which are utilized for examination, classification.

Above feature selectors are selected for the different input mechanisms for the detection of the different symptoms on the faces.

## 4 EXPERIMENTAL SETUP:

### 4.1. Dataset descriptions

The datasets for the facial recognition framework utilize Kairos_AR Facial Datasets which was made by Aleix Martinez and Robert Benavente in the Computer Vision Center (CVC) at the U.A.B. It completely contains more than 4,000 shading pictures comparing with 126 faces of individuals includes 70 men and 56 ladies. This dataset has many positions of frontal view faces with various outward appearances, enlightenment conditions, and impediments (scarf and sun glasses). The photos were taken at the CVC under entirely controlled conditions. There No limitations on makeup, wear (garments, glasses, and so on.), hairdo, and so on were forced to members. Every individual took an interest in two sessions, isolated by about fourteen days’ time. Similar pictures were segregated in to two sessions. MATLAB R2017 used for the simulation of the proposed ELSA algorithm.

### 4.2 Formation of symptoms

We have taken the Parkinson disease symptoms are identified as the Fear and Anxiety, in which the Fear level is considered to be normal and Anxiety level is considered as the abnormal. Hence the Facial recognition systems in above data bases are used for the mechanisms. Out of 126 people’s faces, 100 people faces with the anxiety and fear are taken into an account for the testing and prediction.

### 4.3 performance evaluation

The proposed algorithm has been tested with the different classifiers and predictors such as the artificial neural networks, Extreme Learning machines, SVM (Support vector machines) and Naïve Bayes Classifier/Predictor. For the different cases, we have taken as 70% of the training data and 30% of testing data

### 4.4 Accuracy measurement

The accuracy detection is measured by the following expression

Accuracy detection = (TP-FP)/TT x100

Where

TP- True Prediction,

FP- False Prediction

TT- Total Trails

The accuracy detection of different feature selectors for normal images along with the different predictors are illustrated in Table 2

**Table 2:** Accuracy detection of the ELBP Feature Selectors with Different Classifiers

| SL.No | Feature Selector | Different Predictors | Accuracy (%) |
|---|---|---|---|
| 01 | LBP | NN | 90.0% |
| | | SVM | 94.0% |
| | | Naïve Bayes | 91.0% |
| | | ELM | 95.0% |

**Table 3:** Accuracy detection of the SIFT Feature Selectors with Different Classifiers

| SL.No | Feature Selector | Different Predictors | Accuracy (%) |
|---|---|---|---|
| 01 | SIFT | NN | 89.0% |
| | | SVM | 90.0% |
| | | Naïve Bayes | 89.0% |
| | | ELM | 94.0% |

**Table 4:** Accuracy detection of the SIFT Feature Selectors with Different Classifiers

| SL.No | Feature Selector | Different Predictors | Accuracy (%) |
|---|---|---|---|
| 01 | GLCM | NN | 89.4% |
| | | SVM | 94.6% |
| | | Naïve Bayes | 89.7% |
| | | ELM | 96.7% |

The accuracy detection of different feature selectors for abnormal(symptoms) images along with the different predictors are illustrated in Table 5

**Table 5:** Accuracy detection of the ELBP Feature Selectors with Different Classifiers

| SL.No | Feature Selector | Different Predictors | Accuracy (%) |
|---|---|---|---|
| 01 | LBP | NN | 91.0% |
| | | SVM | 94.5% |
| | | Naïve Bayes | 90.0% |
| | | ELM | 95.6% |

**Table 6:** Accuracy detection of the SIFT Feature Selectors with Different Classifiers

| SL.No | Feature Selector | Different Predictors | Accuracy (%) |
|---|---|---|---|
| 01 | SIFT | NN | 89.6% |
| | | SVM | 90.1% |
| | | Naïve Bayes | 89.6% |
| | | ELM | 95.8% |

**Table 7:** Accuracy detection of the SIFT Feature Selectors with Different Classifiers

| SL.No | Feature Selector | Different Predictors | Accuracy (%) |
|---|---|---|---|
| 01 | GLCM | NN | 88.9% |
| | | SVM | 96.6% |
| | | Naïve Bayes | 89.0% |
| | | ELM | 96.9% |

From the above tables, it clearly illustrates that ELM with ELBP combination has more advantage in terms of accuracy with 96% in average in compared with the other feature extractors. Even though we have different feature extractor offers the equivalent detection.

**4.5 Overall analysis:**

The analysis of the overall feature extractor has been done at different SNR ratios such as High, Low and medium. The performance in terms of prediction accuracy of the feature extractor are analyzed and given as follows as

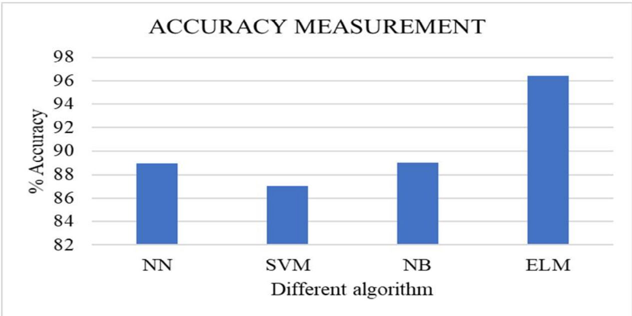


**Figure 4:** Performance of ELSA at the Low SNR with performance measured in percentage

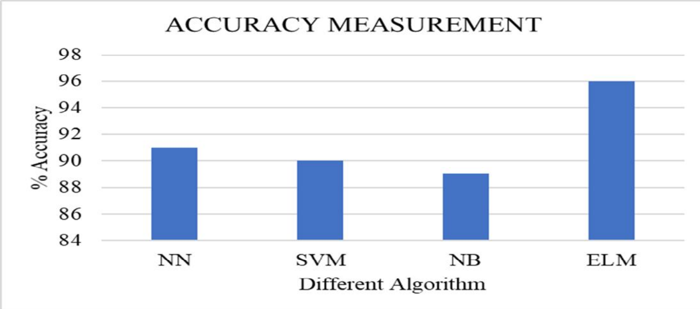


**Figure 5:** ELSA performance at the Medium SNR with performance measured in percentage

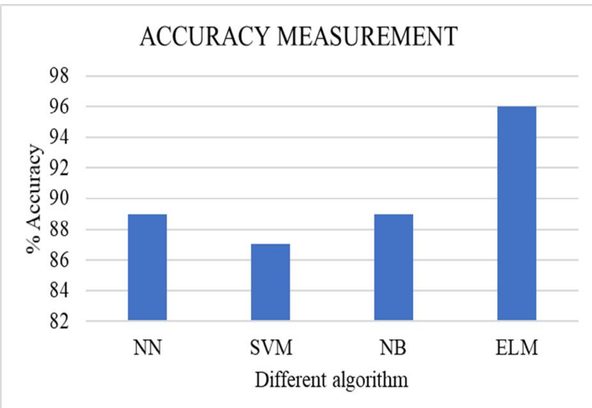


**Figure 6:** ELSA performance at the High SNR with performance measured in percentage.

From the above Fig 4, Fig 5, Fig 6 represents the different prediction performance at the different noise levels in which the feature extractor with ELM provides the 96% accuracy at the different SNR Conditions. Hence ELSA with the ELM will be suitable for the pre-diagnosis of the symptoms using the facial expressions.

## 5. CONCLUSION

The proposed ELSA Algorithm with the different feature extractor selects the proper extractor and it is tested with the different prediction algorithm to prove its accuracy of detection. Moreover, ELSA Algorithm performance can be increased by using the optimization algorithms such as PSO (particle swarm optimization), BAT, ACO (Ant colony Optimization) along with the feature extractors. With this optimization, we can increase accuracy and it can be integrated along with the IoT medical applications.

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