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Optimized Framework for Face Expression Recognition form Human Emotions by using h-SVM Classifier

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Abstract

A face expression is one or more motions or positions of the muscles underneath the skin of the face. Facial Feature extraction is done by a new feature descriptor technique to recognize proper facial expression from the facial images. Then it computes different directional motion information and directional flow information with enhanced local patterns. As it captures the spatial temporal changes of facial movements through by using Pyramidal Lucas Kanade method and it shows its robustness in recognizing facial information along with that Speeded-Up Robust Features (SURF) is used for feature extraction. Finally, the extracted features can be used to train the expression model through h-Support Vector Machine (h-SVM). The performance of the proposed method has been measured by accuracy. Experimental results may demonstrate that the proposed algorithm is more robust in extracting facial information and provides a higher data rate than other existing promising methods.

Index Terms – *Face expression, Human emotions, Spatial-temporal changes, Pyramidal Lucaus Kanade, SURF, h-SVM.*

1. Introduction

Face expression is used to convey information to humans without using words and it is natural way to convey any information. In past years people use to express their opinion in textual form but nowadays it changes, people are expressing their views in video format through what's app, face book etc[1]. Face detection is an active research in an image sequence for computer vision because it has many applications like monitoring classifying images, smart rooms, biomedical, image analysis, human computer interface in robots, etc. Facial expressions are recognized by three expressions such as anger, happy, and fear [2]. Support vector machine is applied to recognize different face expressions. Support vector machine is a machine learning technique utilized for both classification and training, but most widely used in classification [3].

There are few methods for face associated problems were distinct face feature extraction methods are introduced based upon feature types. Facial feature extraction method divided into two parts: geometric component based method and appearance based method. Feature vectors are formed based on geometric relationships [4]. In geometric approach feature vectors are position, distance, angle between eye, ears, nose etc. Facial action coding system is a geometric feature based method this facial action coding system represents different expressions by using group of action units. Each and every action unit indicates behavior of facial muscle. Geometric based method depends on error free detection of facial part. Appearance based method. Appearance based method takeout facial aspect by putting image filter or filter bank on entire face image [5]. Face attributes are used in many applications they are for face verification, identification and retrieval. Prediction of face attributes from an image is challenging because of poses, lightings and occlusions. Characteristic acknowledgment techniques are for the most part categorized into two groups: global and nearby strategies. In global method it extracts the features from entire object but accurate location and landmark does not required. And this method proposes frame work to integrate CNNs [6]. L-Net is used to recognize entire face and A-Net extract high-level face. Local method it first detect part of the object and it extract the features. Then we formulated the problem statement is, "To develop a computationally challenging design model that can ensure an efficient facial expression recognition rate from facial video using a novel of h-support vector machine and Pyramidal Lucus-Kkanade and Speeded up robust feature". The primary aim of the proposed work is to address the above research problem, to carry out the proposed aim the following research objective were set. To carry out a critical analysis of the existing technique and extract research gap.

1. To develop a framework for motion feature extraction by Lucus Kanade and Speeded up robust feature.
2. To develop a frame work to train the facial expression model through Machine learning Method. i.e h-SVM technique.
3. Evaluation of performance parameters like Accuracy, Precession, Sensitivity, Specificity.

From Facial expression recognition we can easily understand Human behaviour and Synthetic human expressions and also for detection of mental disorders. Hence, the proposed article discusses a novel framework towards optimizing the facial expression recognition by using h-SVM classifier techniques. The prime emphasis is to enhance the computational efficiency associated with it. Section 2 discusses about the existing literatures where different techniques are discussed for face recognition in association with h-

SVM classifier schemes followed by discussion of research problems in Section 3 and 4 solution and implementation techniques and also about algorithm implementation followed by discussion of result analysis in Section 5. Finally, the conclusive remarks are provided in Section 6.

2. Literature Review

The significant of our research work has been already discussed in section 1. In this section we discussed about various research contribution towards facial recognition using SVM classifier techniques. Therefore, we upgrade more about existing literatures in this section. Such system have regularly bring down asset accessibility and also insignificant channel limit, which offer ascent to corruption of received image alongside nature of administration issue. There are many methods to recognition different face expressions. In existing system Local Binary Pattern is applied to extract characteristics of a picture and Hidden Markov Model is applied to classify different facial expressions in facial video. In Proposed system Speeded up Robust Feature (SURF) is used in feature extraction. And Support Vector Machine (SVM) is use to train different type of facial expressions and it classifies the different facial expression and store in database.

Authors in [7] [8] proposed algorithm for face detection, DFD deformable part models and deep pyramidal feature algorithm is used to detect face in a various size of an image. This algorithm is also known has DPZMFD method. In this paper deep pyramid deformable parts model is used to detect face. Proposed system contains two stages: testing stage and training stage. In [9] [10] the authors proposed a face spoofing detection using dynamics. The major aim of this document is to extract dynamic details like moving lips, blinking eyes, dynamic mode decomposition (DMD) is used to detect face spoofing. Local binary pattern and support vector machine with histogram is used to classify pipeline. DMD has special feature that it represents temporary information of entire video has single image. While representing DMD keeps same dimensions contained in original image. These three algorithms are efficient and also more effective.

Same techniques are implemented in [11] [12], to perform detection of human face in an image. Human beings can easily identify expressions but it is difficult task for computer systems. Viola-Jones method is used to find different faces in an image. This algorithm also detects children's faces and old age people's faces. In [13] the researcher used the random forest and SVM algorithm is use to recognize face. Random forest tree algorithm is more popular in both face identification and computer vision.

In [14] researcher proposed a convolution channel features (CNN) and filtered channel features for edge recognition face identification and point proposal creation. Absorb merits from both methods this is known as convolution channel features and it sends low stage description as of CCN. Similar work was implemented in [15] put forward a technique to deal with challenging unimpeded face recognition, they are random pose changes. Original picture characteristic known as NPD features are estimating dissimilarity to total fraction between the two images in the values stimulated by Weber division in investigational psychology.

In [16] the main intension is to recognize character using neural network, SURF techniques. Recognition of character is an active research area in image processing. By using Matlab neural network tool alphabet can be recognized in given text document. Neural network and SURF algorithm is used for feature extraction and input to these algorithms are input image providing promising result in terms of PSNR and MSE. The advance techniques is implemented in [17] it aims to perform detection and tracking of human body skeleton. Paul Viola and Michal jones approach is used to uncovering of body joints. This algorithm is a machine learning algorithm for visual entity recognition.

In [18], the researcher proposed a DWT and SVM algorithms to recognize surface EMG patterns. In this paper surface electromyogram (EMG) pattern classification method is used to recognize contradictory myoelectric signals and these waves are more robust signals. To detect electrical activity and to measure electrical activity EMG signals are used. SVM are used to classify different electrical signals and it is machine learning technique. In continuous with the above work, an author [19] propose a joint generalized local binary pattern (GLPP) and laplacian of Gaussian filters are used to measure quality of blind image. The picture is decayed in to multiple size sub-band pictures then sub-band pictures are encoded with proposed GLBB histogram from encoded map of every sub-band picture.

In [21], proposes the organization hypothesis to develop reach details of HIS technique is projected. The projected frame work employ LBP to extract local picture description. Two level of synthesis are functional to extract LBP characteristics alongside with global Gabor features. Similarly in [22] it describes Face expression identification using Meta-analysis method. It identify and classify different action units of the human face, action units are referred to as emotion or behaviour of human. The new algorithm was developed in [23] in this Data Prior Model is introduced for face action unit identification. This technique is applied to capture active and semantic association between Action Unit.

The performance of the facial expression recognition and classification is evaluated using PSNR and recognition rate. All the above discussed techniques have their associated limitations apart from its advantages. The next section discusses about the research problems.

3. Research Problem

The significant research problems are as follows:

- Majority of the existing approaches uses conventional facial expression recognition techniques without much inclusion of novelty towards optimization.
- Existing studies doesn't focus on applying a novel h-SVM classifier method to achieve better facial recognition rate.
- The performance of h-SVM classifier could be further enhanced using facial recognition process prior to implement it which is not found in existing system.
- There are least number of benchmarked studies towards claiming the robustness of h-SVM classifier scheme for facial recognition.

Therefore, the problem statement of the proposed study can be stated as "*To develop a computationally challenging design model that can ensure an efficient facial expression recognition rate from facial video using a novel of h-support vector machine and Pyramidal Lucus-Kkanade and Speeded up robust feature"*. The performance evaluation is done using Average, Processing time, Accuracy, Mean, and Standard deviation.

4. Proposed Method Implementation

The prime aim of the proposed study is to evolve up with a novel framework that perform Optimized Framework for Face Expression Recognition form Human Emotions by using h-SVM Classifier to achieve better recognition rate of the facial expressed image using h-SVM method. The proposed system uses analytical research methods in order to develop and implement the algorithms. The schematic diagram is shown as Fig.1 and fig.2.

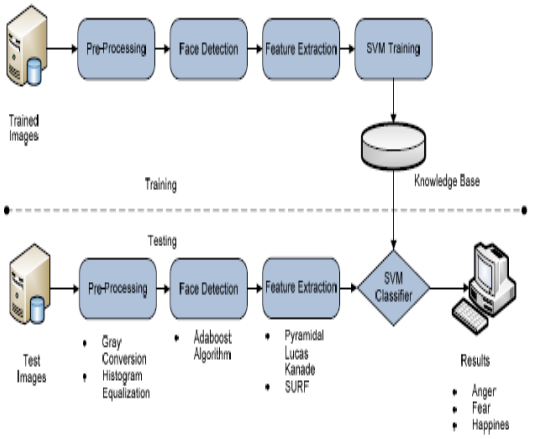


Fig. 1 Basic block diagram of the proposed work.

Fig. 1 and fig.2 depicts the proposed block diagram of FER (Facial Expression Recognition) System. Mainly, this system consists two sections training and testing. In training section, all images are trained by using pre-processing step, face detection step and feature extraction methods with SVM. Pre-processing step performs by applying the gray conversion and histogram equalization. After preprocessing the images apply face detection technique i.e. Adaboost method then extract the features by SURF and Pyramidal Lucas Kanade technique. These characters are trained by SVM and get stored in knowledge base. In testing section, we have to test the image to recognize the face expression. Same here also we should apply pre-processing step, face detection method and features extraction techniques. Then we get the test features; compare these features with knowledge base by SVM Classifier. This classifier gives us that face expression of the test image.

Fig 4.3.1 represents the flowchart of the main toolbox function. In this function we are creating Five buttons (function call) by using menu inbuilt function. First button depicts to create the database; second function will help us to train all features. Third function is used to test the image and fourth will perform SVM Classifier which helps us to find the classes. Final button will exit the program. Fig. 4.3.2 depicts the flowchart of feature collection function. This function is useful to collect all features which we wants to train the images. Initially find the directory path of the database then extract all images by using feature Extraction function. Fig. 4.3.3 depicts the flowchart of feature extraction function. In this function firstly get the input parameters and create the database. Then extract the0features by using file Feature and pre-processing functions. Fig. 4.3.4 depicts the flowchart of feature files. This is employed for extract the features for face recognition via Lukus Kanade and SURF techniques. Then concatenate all features and get stored in feature .data file.

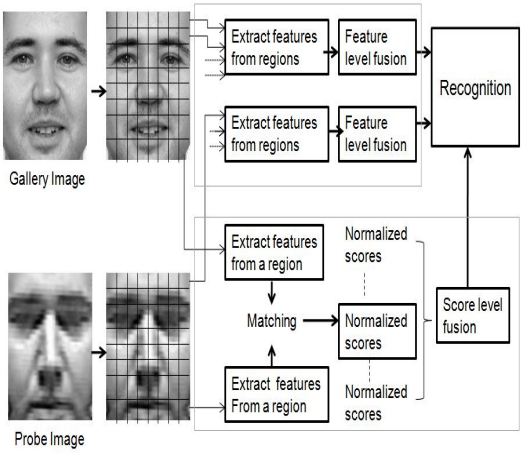


Fig. 2 Schematics diagram of the proposed work.

There are many methods to recognition different face expressions. In existing system Local Binary Pattern is applied to extract characteristics of a picture and Hidden Markov Model is applied to classify different facial expressions in facial video. In Proposed system Speeded up Robust Feature (SURF) is used in feature extraction. And Support Vector Machine (SVM) is use to train different type of facial expressions and it classifies the different facial expression and store in database.

We are applying gray conversion and histogram0equalization to pre-process input image. Histogram equalization is one of the statistical techniques of images0processing. It performs as a arithmetical histogram of color sharing of mean spotted in histogram. After applying pre-processing step need to identify the face region. Thus we are using Adaboost algorithm for face detection. This algorithm is very significant for face detection. Detail explanation of this method is explained below with certain steps. Initially, face detection technique is turn as an input picture into an integer picture. This integral picture is called as summed part table. This used efficiently and quickly calculating sum of the values in rectangle subset of grid pixel.

Algorithm 2: The AdaBoost algorithm

1. Consider Input training set : $S = \{(x_1, y_1), \ldots, (x_N, y_N)\}$

2. Assign Weighted distribution

3. Consider $t = 1, \ldots, T$,

(a) Train each classifier with weighted sample set

(b) Calculate each weighted training error εt of h_t :

$$\varepsilon t = \sum_{n=1}^{N} d_n^{(t)} I(y_n \neq h_t(x)_n)$$

(c) Set:

$$\alpha t = \frac{1}{2} \log \frac{1-\varepsilon_t}{\varepsilon_t}$$

(d) Update weighted distribution on training samples:

$$d_n^{t+1} = d_n^{(t)} \exp\{-\alpha_t y_n h_t(x_n)\}/Z_t$$

Where Z_t is a normalization constant, such that $\sum_{n=1}^{N} d_n^{(t+1)} = 1$.

4. Finally add weight distributions

5. Output: $f_T(x) = \sum_{t=1}^{T} \frac{\alpha_t}{\sum_{r=1}^{T} \alpha_r} h_t(x)$

Fig. 3 depicts the flowchart of Adaboost Algorithm.

In this flow get the preprocessed image and load the haarcascade .xml file also load this haar cascade file to mexhaardetect function. Then initialize counter by zero and increase the count to draw the rectangle, find out the maximum area of face image and detect the face image. Fig. 4 depicts the flow of Lukas kanade. Feature collection is collecting all extracted feature values and Passes this into training section. To train the features we are using SVM Traing function. Then Knowledge base gets stored of features for all images. Select query function will select one input image to test it. This function is performs and get stored in test feature file and SVM Classifier (fig.5) compares these test features by knowledge base. Finally a result shows that which expression is detected.

Here, the author perform a three test cases are occurring such as Anger, Fear and Happiness images (Table.2). In proposed system we are considering only three test cases to identify the face expressions. For example we are selected to fear image to test it. Initially this image is get pre-processed by using gray conversion and histogram equalization. Then apply Adaboost algorithm to notice face and apply feature extraction method to extract the features. Finally in fig. 5 gives the SVM classifier method will perform that fear expression is detected.

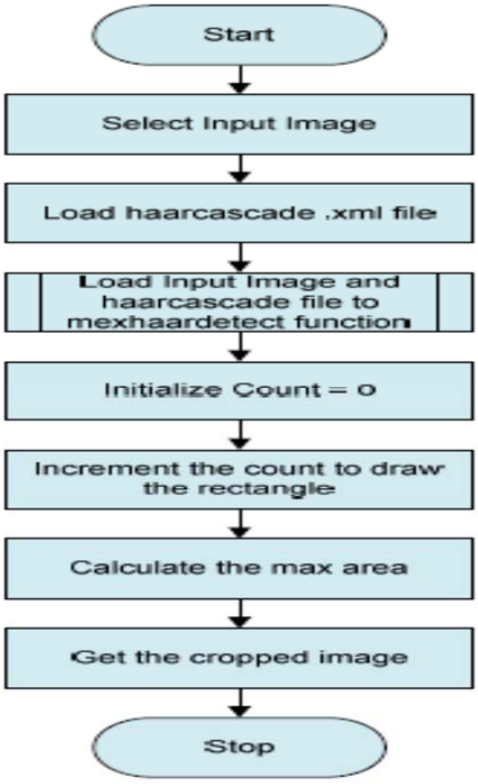


Fig. 3 Flowchart of Adaboost Algorithm.

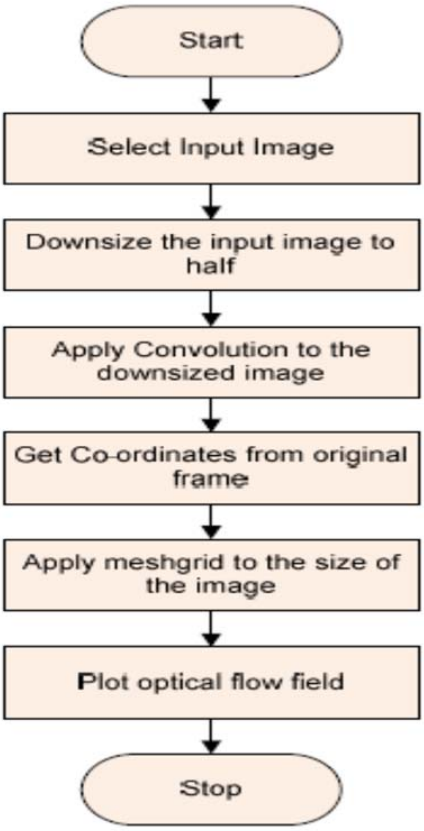


Fig. 4 Flowchart for Lucas Kanade Technique.

Feature extraction step is significant in machine learning scheme so they are using to separate images which belong to different classes from each other. The features are basically set of numbers for image is to explain the attributes and texture of the particular picture or the complete set of images which can belongs to identical class. Extracted features used for particular classification mistake since, there is potentially a more number of attributes are available. The usefulness of particular varies are depending on some mistakes but good traits should be robust to variability within a class and also to be orientation and scale. The feature for each image collected in vector named as feature vector. In this project we are using Lucas Kanade and SURF technique to extract the features.

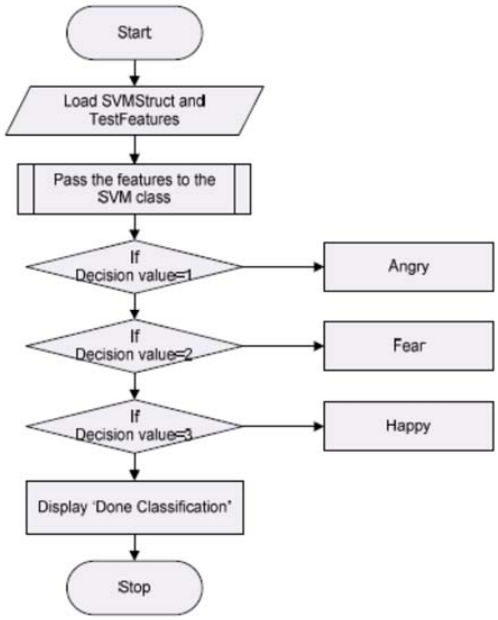


Fig. 5 Flowchart for SVM classifier Technique.

5. Result Analysis

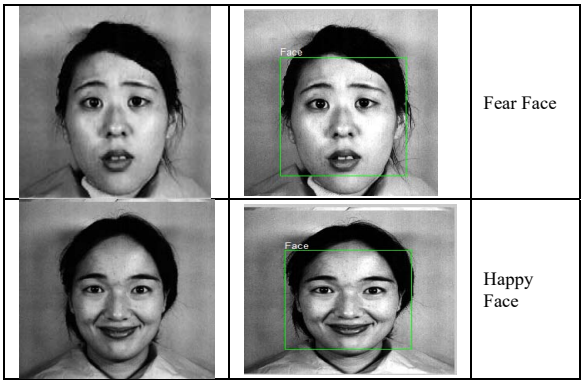
The prime aim of the proposed study is to evolve up with a novel framework that perform Optimized Framework for Face Expression Recognition. The implementations of the four algorithms are carried out on 1000 various faces dataset of Cornell University. The dataset consists of different form of facial images with different expressions. This section discusses both visual and numerical outcomes. Table.1 shows the comparison table for accuracy parameters.

Table 1: Comparison Table for Accuracy Parameter

	Accuracy
Existing System	87.91%
Proposed System	90%

Table 2: Results obtained after h-SVM techniques.

Test Input Image	h-SVM Technique	Face Expression
		Angry Face



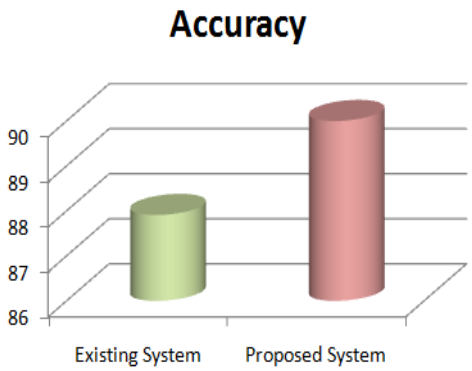


Fig. 6 Comparison Graph for Existing and Proposed System

In fig.6 and Table.3 gives, our proposed work recognizing based on human face expressions such as fear, happiness and anger. We are training 24 images and testing 30 images then we get true positive (Tp) rate is 24, true negative (Tn) rate is 3, false positive (Fp) is 1 and false negative (Fn) is 2. The comparison of different parameters are shown in fig.7.

Table 3: Proposed System parameter analysis

	Proposed System (Performance Analysis)
Accuracy	90%
Sensitivity	92.30%
Precision	96%
Specificity	75%

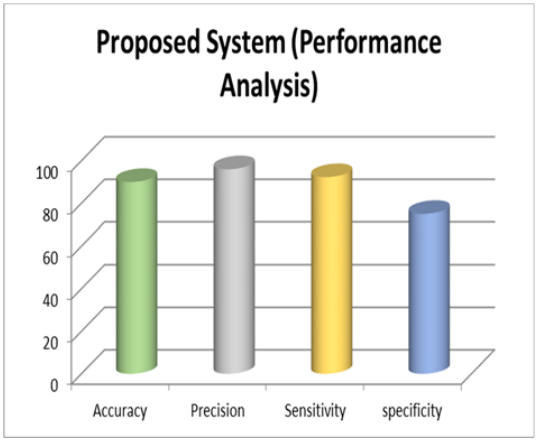


Fig. 7 Performance Analysis Graph

6. Conclusion And Future Scope

The facial expression recognition system (FER) is proposed. The proposed method is Lucas Kanade and SURF for feature extraction. By using these methods generate features to generate the expression characteristic vectors. Facial expressions are recognized with the help of SVM classifier. Facial Expression recognition has been increasing an application area and needs more accurate and reliable system. Results are showing that improved an accuracy rate of predicting the human face expressions. Feature work is to improve the performance of SVM by presenting the solution for nonlinearity since human face with huge posture variety shows significant nonlinearity.

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