Facial Emotion Recognition System – A Machine Learning Approach

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Abstract. Frown is a medium for people correlation and it could be exercised in multiple realsystems. Single crucial stage for frown realizing is to exactly select hysterical aspects. This journal proposed a frown realization scheme applying transformative Particle Swarm Optimization (PSO) based aspectaccumulation. This entity initially employs changed LVP, handles crisscross adjacent picture element contrast, for achieving the selective first frown portrayal. Then the PSO entity inserted with a conceptofmicro Genetic Algorithm (mGA) called mGA-embedded PSO designed for achieving aspect accumulation. This study, the technique subsumes no disposable memory, a little-populace insignificantflock, a latest acceleration that amends with the approach and a sub dimension-based in-depth localfrown aspect examines. Assistance of provincial utilization and comprehensive inspection examine structure of alleviating of an immature concurrence complication of conventional PSO. Numerousidentifiers are used to diagnose different frown expositions. Stationed on extensive study within andothe- sphere pictures from the continued Cohn Kanade and MMI benchmark directory appropriately. Determination of the application exceeds most advanced level PSO variants, conventional PSO, classical GA and alternate relevantfrow realizatons structures is described with powerful limit. Extending our accession to a motion based FER application for connecting patch-based Gabor aspects with continuous data in multi-frames.

1. Introduction
Frown realization has not closed the latest generation for people–system interaction and afforded assistance to a vast scope of system perceiving applications such as healthcare, surveillance, event exposure, Demonstrated learning, and robotics. Robust empathy categorization confide massively on impressive frown representation. Nonetheless, it is still a required work for finding powerful selective frown aspect that could produce the characteristics of each emotion because of the distinction and discrepancy of frown expositions. Frown progression aspects which include specific aspect position and shape modification are naturally created by the progressive of frown entities and muscles at the same time of course of frown interpretation. The frown entities specifically key factor will frequently modify their positions with different frown realization.

- We aim to accord with such objection for effective yield and optimized selective frown portrayal to benefit real-time frown realization.
In comparison with other feature selection methods, Evolutionary Computational (EC) algorithms show powerful global search capabilities and have been widely accepted as efficient techniques for feature selection.

Among the relevant EC algorithms, converging behaviours of birds have been continuously applied for aspect accumulation with the assistance of little computing cost and rapid concurrence speed is excited by the Particle Swarm Optimization (PSO) algorithm.

Exercised dataset is a baseline used to identify possible guessed relationships. A test set is a baseline used to estimate the strength and utility of a guessed relationship. Dataset present in the system is to find the emotion interpretation in face and the facial expositions are:

- Happiness
- Sadness
- Surprise
- Animal frown exposition

Figure 1. (a) Application Structure Expression elicitation. (b) Expression maximization using the determined PSO (c) Categorization

Database MS Access is used to store the calculated values of grains that is velocity, Position at x,y,z axis. Compared these values with the trained dataset ie. If the set of particle value (position and velocity) are 2.5. The trained database contains the information, that if the value is in the range of 2.5 of a person is smiling, and then the output will be shown as Smiling. The preprocessing technique is used to modify the images more suitable for the applications of algorithm. These techniques are the situation specific and they increase the success rate. Ancillary Data is the process of retrieving the information from origin another than remote sensing, recycled to assistance in inquiry and categorization or to colonize Metadata. The proposed mGA-Embedded PSO Algorithm is used to diagnose the powerful features for individualize unique frown interpretations.

PSO algorithm clarifies a complication by obtaining a populace of candidate solving dubbed grains and transferring these grains around in search-space in relation to uncomplicated analytical rules over the grains position and velocity. Each grains transfer is determined by its local well known position but it is also educated against the well-known positions in the search-space which are restoring the best positions are identified by another particle. This is familiar to transfer the swarm toward the good solutions. For any feature to showcase a selective expression and to modify one form of picture to other form of picture in picture databases, also in videos is done by the geometric-based position and appearance-based shape. This form of transferred aspects which impersonate a prosperous pool of twain static and dynamic peculiarity of exposition represents the crucial role of FER. Some of the well-known algorithms used to identify the exposition are discussed below.
Using Multi task sparse machine Learning approach we have analysed the frown exposition by scrutinizing some regular and distinct data among various expositions. Specific facial patches are discovered to discriminate all the expositions along with a specific interpretation using the algorithm learning common patches [1]. Viterbialgorithmimproved the realization pursuance of continuous naturalistic affective interpretation. Information theory approach shows that the transitions occur very slowly and it suggest modelling them as first-order Markov models [2]. Iterative Closest Point Algorithm (ICA) proposed individual automatic frown point exposure combined with retrogression-planted intensity evaluation for frown action units (AUs) and expression gathering to accord with such confrontation. Identifying 54 facial points in pictures of frowns with blockages, pose changes and scaling changes using Gabor filtering, BRISK (Binary Robust Invariant Scalable Key points), an Iterative Closest Point (ICP) algorithm and fuzzy c-means (FCM) clustering can be done by Frown Point Identifier [3].

Naive Bayes Classifier have experimented a context-based altered identifier component encapsulated in an innovative imaginary platform. Naive Bayes classifier is used to classify these twain types of communication like acknowledging the secret biased suggestions or feelings about situations, while others are occurred by social cooperation and show suggestions and emotional feedback to other associate characters [4]. PSO Aspect selection in a multi-Objective structuredefeat the complication of maximizing the categorization of pursuance and minimizing the number of aspect is illustrated by multi-objective particle swarm optimization (PSO). Two types of PSO-based multi-objective aspect collection of algorithms are investigated where the first algorithm implements the idea of non-dominated sorting into PSO to locate aspect selection complication and the second algorithm employs the opinion of crowding, mutation, and dominance to PSO to search for the Pareto front solutions [5].

Bare Bones particle swarm optimization has found the optimal feature subset is illustrated by the latest method of bare bones particle swarm Optimization (BPSO). Using this technique, fortified memory approach is planned to amend the common heads of grains to avert the declination of superior genes in the grains, and a unique connection is suggested to equalize the provincial utilization and the comprehensive inspection of the technique [6]. PSO in Non-linear function accumulated the nonlinear functions using particle swarm technique and baseline examining of the model is explained and systems accommodating nonlinear function accumulation and neural network training [7].

PSO algorithm for SJSSP aimedfor reducing the predicted total weighted detention is due to the twain-level particle swarm Optimization (PSO) method for SJSSP. In the initial-level PSO, a pursuance evaluation is done for fastest estimation of results, and a common finding structure is embedded to expertise the concurrence of assured locations in the results area. The next-level PSO extends the inspection mechanism, but exercise a much authentic result assessed guideline, i.e. the Monte Carlo simulation [8]. Face Action Coding System: Web based database analysis discussed about the various problems that make the issue of creating a benchmark frown expositions database challenging. MMI Frown Interpretation Database is suggested to accompany more than 1500 samples of both static picture and picture progression of frowns in frontal and in profile view exhibiting multiple expositions of expression, single and various frown muscle simulation [9]. Deep Convolutional neural network analysis found the face emotion accompanied with speech is very challenging one. So, there are two methods to implementation one is a kind of people-crafted visual feature and another one is handles visible aspects cultivated by deep convolutional neural network [10]. Micro Genetic Algorithm (mGA): Multi-objective Accumulation proposed a multi-objective maximizing structure based on a micro genetic algorithm (micro-GA) with a very little populace and a re-loading process [11]. Sizing populaces for serial and parallel genetic algorithmsare capable finding methods that are used superior to solve issue in various contrast practices. This method gives massive benefit over the Sum-Product decoder, which confirms its capability. The robust behavior must be upgraded by Multi-objective Accumulation and for this we adapted the Weighted Sum method to upgrade PGAD, this latest variant is called (MOGAD) gives higher pursuance correlated to one [12]. A micro-genetic method for stagnant and non-stagnant function accumulation is used to find for an excellent elucidation to an original systematic economic dispatch (ED)
issue. GA is a comprehensive finding method based on regulations encouraged from the ancestral and enlargement process recognized in common life system. Correlation of Nigerian 31-bus system fed by four thermal and three hydro generating units is exercised [13]. Multi-objective structural Accumulation approach dealt with embedding of genetic algorithm with robust framework design through a smaller culture of individual’s outcome in a solution that leads to better culture values for design inflation problems. This advent can be used as first level in other multi-objective genetic algorithms to increase the pursuance of genetic algorithms. At last, the shape accumulation of a vehicle is conferred to decorate how the present framework can be applied for solving multi-objective shape design accumulation problems by shape accumulation of the vehicle [14].

2. System Model
The System Architecture of the explored system is depicted below:

*Figure 2. System Architecture*

**Steps to be followed:**
- User should login/launch the application
- Input the image as per the user needs
- Digital Image has been converted to Binary image based on the pixels derived
- System will identify the facial expression based on the input image
- Output will be displayed with the identified expression name (e.g. Smile, Happy, Surprise, Animal frown exposition, Normal)

The Flow Diagram for deriving the facial expression is depicted below:

*Figure 3: Flow structure of Facial Emotion Recognition (FER) system*
Steps for achieving the output:
The Digital data (digital image) is given for pre-processing and it is a method followed before the processing of given input image for the correction from different errors and this has to be done before enhancement of image. The specific feature has been selected and extract as a new feature with PSO algorithm, then the selected feature will be present as the binary image as a particles which has the image enhancement for the correction of the errors. The Selection of training data has been picked up from Extended Cohn Kanade (CK+) and MMI databases to compare and to achieve the expected result.

Decision and Classification has two methods
a. Supervised data means observe and direct the execution of a task.
   b. Unsupervised data means the data are not watched over in the interest of their or others’ security. The Ancillary data is a process of retrieving the information from origin another than remote sensing, recycled to assistance in inquiry and categorization or to colonize metadata.

Then the output will be retrieved by the classification or comparison with the available databases and after the post processing operations which is done for quality improvement image processing and the accuracy will be assessed then Images, Data and Reports will be retrieved.

3. Machine Learning
A PSO entity and micro Genetic Algorithm (mGA) together called as mGA embedded PSO and suggested for achieving aspect accumulation, also for identifying different frown interpretation using multiple classifiers. Protracted Cohn Kanade and MMI baseline databases appropriately, the observational outcome reveal that the suggested application results other state-of- the-art PSO variants, conventional PSO, classical GA and another relevant frown interpretation realization structure recorded in the literature by an important margin. The suggested method consolidate a no replaceable memory and a limited-culture insignificant flock, a latest directional updating approach, a sub dimension-planted provincial frown aspect finding approach, also the collaboration of provincial utilization and comprehensive inspection finding approach for defeating both immature concurrence and local optimum issue identified by conventional PSO.

The suggested frown expression realization system consists of 3 stages:
- Feature Extraction
- Feature Optimization
- Emotion Recognition
3.1 Feature Extraction
For any initial level in frown realization application is the finding of aspect pattern. A common aspect abstraction technique extends to frame calculative structure through some linear or nonlinear transformation of the information so that the abstracted aspect is as ideal as possible. PSO entity called as High Exploration PSO (HEPSO) for feature selection and Crisscross adjacent picture Contrast LBP (hvnLBP) for aspect abstraction as described in the following subsections.

3.1.1 High Exploration PSO (HEPSO) for Feature Selection
Integration of PSO and GA multicrossover technique also the food source discovery functions of bee colony accumulation to amend the entity velocity and position appropriately. Estimated to an acclaimed baseline operation, HEPSO has visible perfection over other PSO Entities.

3.1.2 Horizontal and Vertical neighbourhood pixel contrast LBP (hvnLBP)
hvnLBP is an unified with the Gabor filter for generation selective frown portrayal. There are 4 levels in the aspect abstraction methods:
- Pre-processing of brightness changes and noise invariance
- Frown Detection
- Gabor Magnitude Picture development
- Experimented hvnLBP based textural description

Figure 4. Sample outcome of the suggested hvnLBP function in resemblance with contrast of original LBP.

3.2 Feature Optimization
In this section, any specific frown realization system is the accumulation of the feature matrix. The suggested PSO algorithm recovers the immature concurrence issue of conventional PSO to represents the perfect abilities of particular aspect selection. The suggested mGA-embedded PSO method engages secret average practice and Gaussian mutation for direction restoration.

3.2.1 In-depth local optimal feature search
Higher or lower interactions with the commander are enlisted in the insignificant flock. We partition every entity in the insignificant flock into five aspect branches and every branch comprising of limited magnitude that represents particular frown area. Specific area implements the altered PSO function with the modified velocity updating method.

3.3 Emotion Recognition
Frown Expression realization is the process of finding people emotion using Nonlinear Neural network (NN) with backpropagation, a multiclass Support Vector Machine (SVM) and ensemble classifiers. The optimal NN structure is retrieved and also grid-search processes are practised for identifying the excellent specification of multiclass SVM classifiers with the RBF Kernel. Later on multiple trials, the NN are provided with single layer 25-40 nodes demonstrating the maximized aspects acquired for suggested PSO Algorithm.
4. Results and Discussion
As per the description in section 3, the features are selected and extracted then the emotion will be recognized. The Sequence of steps is applied to achieve the actual output and the steps are:

- Skin Color Segmentation
- Face Detection
- Eyes Detection
- Lip Detection
- Apply Beizer Curve on Lip
- Apply Beizer Curve on Eye
- Comparison with database
- Emotion Recognition

4.1 Skin Color Segmentation
Image will be contrasted first and then we perform Skin color Segmentation. Find the largest connected region by checking the probability and the output will be face region.

4.2 Face Detection
To convert binary image from RGB image by calculating the moderate rate of RGB for every pixel and if the moderate rate is less than 110, we restore it by black pixel and differently we restore it by white pixel. By this approach, we retrieve a binary picture from RGB picture. To identify the forehead in the face, kickoff the scour from the middle of the picture, then will identify extended white pixels after an extended black pixel. When it reaches the eye brow region scan will be breaked and cut the identified face region.

4.3 Eye Detection
In the binary image, scan the image to identify the mid position of two eyes. The maximal white continuous pixel onward with the height between the bounds in the mid position of two eyes. Eyebrow’s uppermost position will be starting position of scan. The left eye scan will start from right corner then mid and to left corner of the eye. The right eye scan will start from left corner then mid and to right corner of the eye.

4.4 Lips Detection
Determine the lip box and then consider the lip which is present in the box. After performing the calculation, the determined box will contain only lip and might be some area of nose. The RGB picture will be cutted conferring to the box area. For the identification of eyes and lip, we have to modify binary picture from RGB picture and search amidst of binary picture.

4.5 Apply Beizer Curve on Lip
Beizer curve applied on the lip box to cut the lip region alone after the removal of nose region and convert this into binary picture.

4.6 Apply Beizer Curve on Eye
Beizer curve applied to extract eyebrow from eye. For extracting eyebrow, we have to inspect first continuous black pixel then extended white pixel and then extended black pixel from the binary picture of the eye box. Then we extract the 1st extended black pixel from the box and then retrieve the box which has the eye that contains skin region too. Then applying big connected region and to identify the probability of eye area is extracted.
4.7 Emotion Recognition

Then image will satisfy which emotion’s height is adjacent the present height and the source code will provide the adjacent emotion as product message. If the person’s emotion data not present in the database, then the source code determines the moderate height for every emotion in the database for every person and after gets an opinion conferring to the moderate height. If user inputs the animal image instead of human image then the application will throw an error message to input a human image.

The actual output is depicted below.

Figure 5. Smile - Emotion Recognition

The image is converted to the binary image and then the face shape is found. Then the eye and lip region is identified on the major parts with other region embedded. The Beizer curve region is applied on the eye and lip part to found the appropriate curve shape of eye and lip. Once the curve shape of eye and lip region is found the training dataset is compared with the trained dataset in the available database and the appropriate emotion is recognized.

5. Conclusion

This system exhibits the problem of frown interpretation realization using frown transfer aspects. The excellence of experimented concept is analyzed by the realized pursuance, computational time, and contrast with the state-of-the-art pursuance. Empirical result explains important pursuance advancements on owing to inclination of frown changing aspects, and rising pursuance under frown enrolled flaws. The outcome represents the patch-based Gabor features represents good pursuance over point-based Gabor features according to retrieval of provisional aspects, storing the position data, acquiring well-known realization pursuance and needed less number. Nonetheless, complexity of those regions is scattered across mouth and eyes. Represented structure is commonly applied into multiple systems, such as patient state detection, driver fatigue monitoring, and intelligent tutoring system. In forthcoming research, structure of motion based FER application by connecting patch-based Gabor features with continuous data of multi-frames will be continued. Latest progression of action perception and frown perception has laid groundwork for applying twain appearance and motion aspects.

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