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Improved Emotion Detection by Regression Algorithm with SURF Feature and SVM

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ABSTRACT

One of the major concerns in the field of computer vision and pattern recognition is emotion detection. One difficulty in face recognition is how to handle the variations in the expression, pose and illumination when only a limited number of training samples are available. In this paper KNN Regression algorithm with SURF feature is proposed for facial expression detection. Initially the eigenspace was created with eigenvalues and eigenvectors. . From this space, the eigenfaces are constructed, and the most relevant eigenfaces have been selected using Principal Component Analysis (PCA). The proposed method was carried out by taking the picture database. The database was obtained with 50 photographs of a person at different expressions. Another database was also prepared for testing phase by taking 10 photographs of that person in different expressions but in similar conditions (such as lighting, background, distance from camera etc.) and these database images were stored in test folder.

Keywords

Eigensace, Eigenvalues,Eigenvector,MSE,PSNR

1. Introduction

Emotions are part and parcel of human life and among other things, highly influence decision making. Computers have been used for decision making for quite some time now but have traditionally relied on factual information. Recently, interest has been growing among researchers to find ways of detecting subjective information used in images and videos. These six basic emotions are namely, happiness, sadness, surprise, fear, disgust and anger. The human face is central to our identity. Human beings interact with one another not only through words of mouth but also through other methods such as gestures and facial emotions. If computers can also be intelligent enough to perceive human emotions, then human-computer interaction will change for the better, leading to new ways of interacting with computers and perhaps new set of computer applications could emerge. For example, social welfare robots could be developed to monitor and assist highly disabled patients where there are limited human nurses. Intelligent cars could be developed that monitor the state of the driver and seize over the control when the driver becomes drowsy. The possibilities are only limited by our imaginations. It is no wonder therefore that researchers are putting a lot of efforts in this area nowadays. It plays an essential role in everyday interaction, communication and other routine activities.

Detection and tracking the face and its features thus potentially opens a very wide range of applications. Using the face as a means of human-computer interaction is helping disabled people improve their daily lives, and may become a hands-free alternative in other applications or an entertaining element in innovative games. Model-based coding of facial video relies on facial tracking to enable very low bit rate video communication. As specified in the MPEG-4 International Standard it enables full facial communication at less than 10kbit/s. Similarly, tracking facial actions is a basis for driving computer animated faces in games and entertainment applications.

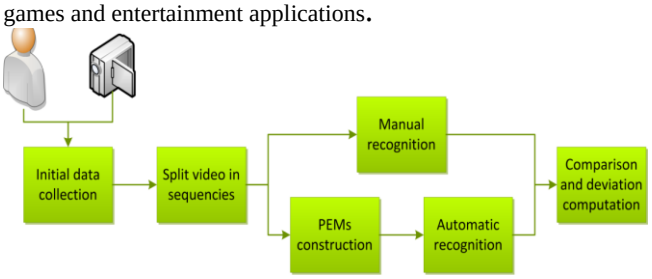

Figure1:Basic procedure of emotion detection

Detection and tracking the face and its features thus potentially opens a very wide range of applications. Using the face as a means of human-computer interaction is helping disabled people improve their daily lives, and may become a hands-free alternative in other applications or an entertaining element in innovative games. Model-based coding of facial video relies on facial tracking to enable very low bit rate video communication

1.1 Emotion Detection

Detection and tracking the face and its features thus potentially opens a very wide range of applications. Using the face as a means of human-computer interaction is helping disabled people improve their daily lives, and may become a hands-free alternative in other applications or an entertaining element in innovative games. It is just the kind of pattern recognition of facial expression. So there are various method for pattern recognition.

1.2 Regression algorithm

In pattern recognition, the k-Nearest Neighbors algorithm (or k-NN for short) a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. K-NN is a type of instance-based learning, or lazy learning, where the function is only approximated locally and all computation is deferred until classification. The k-NN algorithm is among the simplest of all machine learning algorithms. Both for classification and regression, it can be useful to weight the contributions of the neighbors, so that the nearer neighbors contribute more to the average than the more distant ones.

1.3 K-NN regression

In k-NN regression, the k-NN algorithm is used for estimating continuous variables. One such algorithm uses a weighted average of the k nearest neighbors, weighted by the inverse of their distance

1.4 SURF (Speeded-Up Robust Features)

SURF is a fast and robust algorithm for local, similarity invariant representation and comparison. Similarly to the SIFT approach, SURF selects interest points of an image from the salient features of its linear box-space, a series of images obtained by the convolution of the initial image with box filters at several scales. Then SURF builds local features based on the histograms of gradient-like local operators. The main interest of the SURF approach lies in its fast computation of operators in the box-space, enabling real-time applications such as tracking and object recognition.

1.4 Support Vector Machine

The Support Vector Machine (SVM) is a state-of-the-art classification method introduced in 1992 by Boser, Guyon, and Vapnik . The SVM classifier is widely used in bioinformatics (and other disciplines) due to its highly accurate, able to calculate and process the high-dimensional data such as gene expression, and exibility in modeling diverse sources of data .SVMs belong to the general category of kernel methods. A kernel method is an algorithm that depends on the data only through dot-products.

2. Traditional Methods for Emotion detection

Various methods, for emotion detection are given below.

- PEMs (Personalized Emotion Maps) store links between bodily expressions and emotion values, and are individually calibrated to capture each person's emotion profile.
- Particle Swarm Optimization (PSO) algorithm for the purpose applying it to emotion detection. This algorithm, which he called Guided Particle Swarm Optimization (GPSO), involves studying the movements of specific points, called action units (AUs), placed on the face of a subject, as the subject expresses different emotions
- An efficient novel approach for human emotion recognition system based on the fusion of features extracted from the Discrete Wavelet Transform (DWT) and Undecimated Wavelet Transform (UWT) is presented. The main drawback of DWT is not translation invariant. Translations of an image lead to different wavelet coefficients.
- Mosaic algorithm based on SURF feature matching. The algorithm uses SURF operator which has strong robustness and superior performance to extract features instead of conventional SIFT operator
- Content-Based Image Retrieval (CBIR) is a challenging task which retrieves the similar images from the large database. Most of the CBIR system uses the low-level features such as color, texture and shape to extract the features from the images.

3. Proposed Emotion detection

In this paper a new Method is proposed for emotion detection using facial expressions. The objective of this work is to time, SNR and PSNR values. This working model is designed following these steps:

3.1. Image Acquisition

In this paper proposed approach, we first considered that the images of a given person are either color, Gray-scale or intensity images herein are displayed with a default size of 220×220.The images from a video stream are obtained and their snapshots are taken in order to view the areas of interest closely. If it is to take the still images as input then scanner or any other hardware device can be used to feed the image into the system.

3.2 Pre-processing

The pre-processing is a series of operations performed on scanned input image. It essentially enhances the image rendering it suitable for segmentation. The role of pre-processing is to segment the interesting pattern from the background. Generally, noise filtering, smoothing and normalization should be done in this step. The pre-processing also defines a compact representation of the pattern.

3.3 Binarization

Binarization process converts a gray scale image into a binary image. A binary image is a digital image that has only two possible values for each pixel.

3.4 Feature Extraction

In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. We are taking into account the facial region but it leads to a formation of large data set so we will extract only those features that are vital. Such as eyes, eyebrows, nose, cheeks etc. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (e.g. the same measurement in both feet and meters) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction.

3.5 Emotion Recognition

Emotion recognition is the final step in the emotion detection system. In this step, matching of the images is done so that it can find out the emotion of the image under test.

3.6 SURF feature

SURF has the characteristics of scale invariance, strong robustness and good distinction between feature points; Compared with the SIFT operator, it have greatly improved in computing speed .

4. Implementation of emotion detection

The entire sequence of training and testing is sequential and can be broadly classified as consisting of following steps:

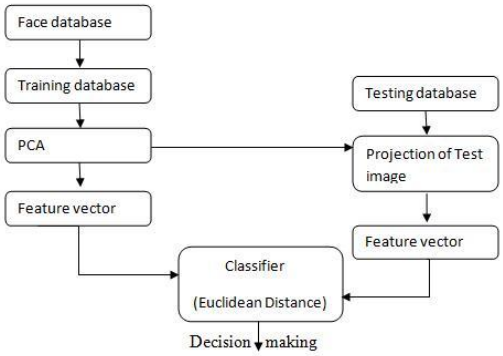

Figure 2: Proposed System of emotion detection

5. Results and Discussion

The simulation is carried out on simulation software MATLAB 7.5 of Math work. In this section we will compute the results for the different faces.

In this thesis, first trained the characteristics of different facial expressions (such as Happy, Disgust, Sad, Neutral, Anger) with the training database. The following table will gives the characteristics of training database.

5.1 Localization time

It is the time taken by the system to locate the feature points onto the image under consideration. In our research it took less time to locate than the previous literature.

5.2 Matching Time

Matching time is the total time taken by the system to match the image under consideration(test image) with that of the images present in the database (train folder).

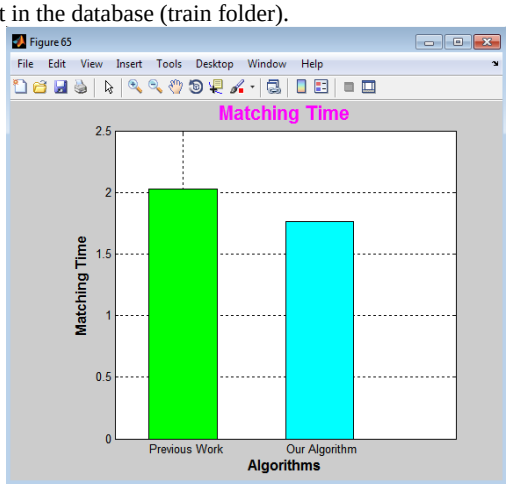

Figure 3: Histogram of matching time

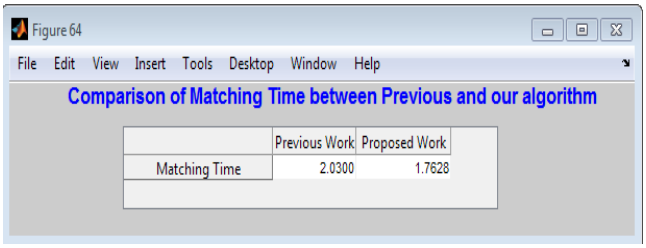

Figure 4: Comparison of matching time with literature

5.4Average Recognition rate

As compared to the previous literature which was studied for better improvements we achieved 67% accuracy which rests earlier at 62%.

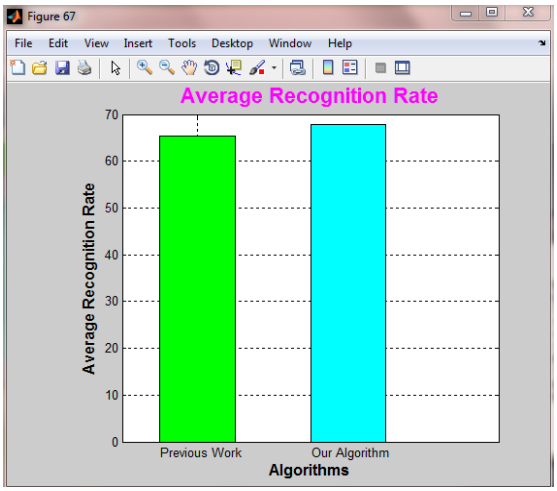

Figure 5: Histogram showing recognition rate

5.5 MSE

Mean Squared Error is essentially a signal fidelity measure. The goal of a signal fidelity measure is to compare two signals by providing a quantitative score that describes the degree of similarity/fidelity or, conversely, the level of error/distortion between them.

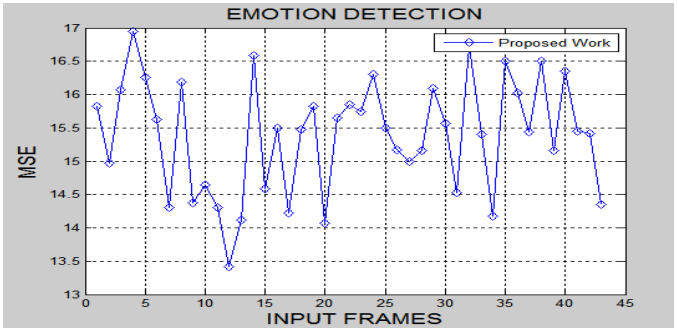

Figure 6: MSE for the proposed work

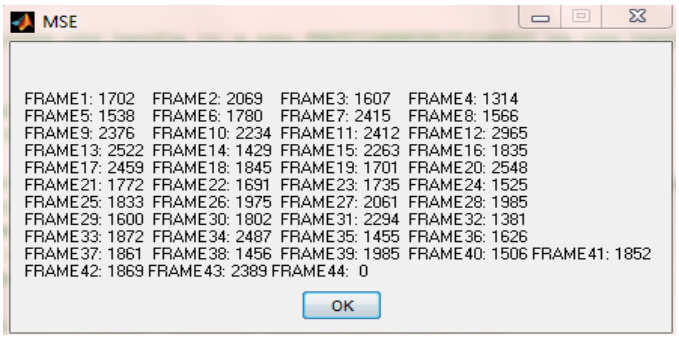

Figure 7: MSE per frame of the train dataset

5.6 PSNR

Embedding this extra data must not degrade human perception about the object. Namely, the watermark should be “invisible” in a watermarked image or “inaudible” in watermarked digital music.

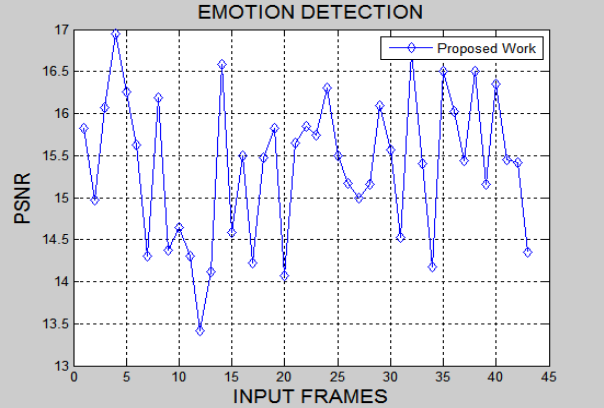

Figure 8: PSNR for the proposed work

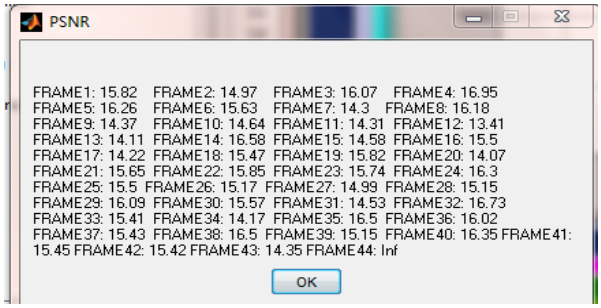

Figure 9: PSNR per frame of test and train dataset

6. Conclusions

In this research, a emotion detection by using human facial features has been implemented. An emotion detection technique for recognition is used to detect the emotion from data and to make the recognition better. Various methods of emotion detection have been studied and reviewed and based on this literature survey, it was found that there is a requirement to recognize the images from the dataset. The feature extraction is used for make the structure of data more clearer and to reduce the dimensions to get more vast information. The KNN and SURF techniques are used for feature detection and recognition. Time and accuracy are the critical parameter on which we worked on. After reducing dimensions how shape of the dataset is maintained. The statistical measures are applied to know which technique producing good results. The recognition or feature matching results show that SURF technique has least access time.

7. Future Scope

Future work will include the combination of emotion detection approach with other approaches. In this paper, KNN Regression algorithm along with SURF are used. In future more techniques can be used to detect the emotions and make the recognition more better and more other statistical measures can be used to measure the accuracy and time complexity in matching images.The whole software is dependent on the database and the database is dependent on resolution of camera. So if good resolution digital camera or good resolution analog camera is used , the results could be considerably improved.

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