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Development of novel algorithm by combining Wavelet based Enhanced Canny edge Detection and Adaptive Filtering Method for Human Emotion Recognition

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Abstract:- In this paper we have proposed a new method to recognize human emotions in which a combination of wavelet-based canny edge detection and adaptive filtering is used for detection of human emotions. In the first stage edge detection carried out using wavelet based canny edge detection method. In second stage adaptive filtering is designed for noise cancellation of decomposed noisy signal. Applying combination of wavelet based canny algorithm and adaptive filtering method we arrive at a better result of human emotion recognition.

Keywords:- Adaptive filtering, Canny algorithm, Edge detection, Median Filtering, Wavelet.

I. INTRODUCTION

Emotions play important role not only people in our relations but also in the way we use computers. As an emotional state of a person may affect concentration, task solving, decision making skill, the vision of affective computing is to make system able to recognize human emotions and influence them in order to enhance effectiveness and productivity of working with computers. Affective computing has gained enormous research interest in the development of human computer interaction over the past decades. With the increasing power of emotion recognition, an intelligent computer system can provide a more friendly and effective way to communicate with users in areas such as video surveillance, interactive entertainment, intelligent automobile system and medical diagnosis. The computer vision based pattern recognition techniques largely focuses on facial features due to the importance of human perception of emotion through visual facial expressions. Each emotion corresponds to a unique facial expression, whose characteristics serves as the input to the classification system, and the output gives the machine-perceived emotion state based on various classification algorithms.

Emotion detection is developing in the recent years because of advancement in different field like image processing and machine learning, human-computer interaction. Research on emotion has increased significantly over the past two decades with many fields contributing including psychology, neuroscience, Medicine, sociology and even computer science. Emotions play an essential role in social interactions and facilitate rational decision making and perception. The human computer interaction have started their investigation and tried to understand different causes and effects

There are several edge detection methods for human emotion recognition. But still accuracy and clarity are challenging tasks in order to obtain better emotion recognition. So, keeping in view wavelet based enhanced Canny edge detection method is used in combination with adaptive filtering The method suggested by Bing Wang and Shao Sheng Fan is CANNY arithmetic operator has been proved to have good detective effect in the common usage of edge detection. However, CANNY operator also has certain deficiencies. Based on the analysis of the traditional CANNY algorithm, an improved canny algorithm is proposed [11]. In the algorithm, self-adaptive filter is used to replace the Gaussian filter, morphological thinning is adopted to thin the edge and morphological operator is used to achieve the refining treatment of edge points detection and the single pixel level edge. The results of experiment show the improved CANNY algorithm is reasonable. But, the improved algorithm has the problem of heavy calculation.

The method suggested by GUO Lingyun, NAN Jingchang is the combination of wavelet transformation and adaptive median filter RAMF proposes a new method in place of the traditional Gaussian filter[9]. The method makes use of the wavelet transform in time - frequency analysis features and at the same time RAMF well protected edge of the smooth nature. Experiment results show that the proposed method performs better than the traditional method for impulse noise.

GengXin, Chen Ke, Hu Xiaoguang suggested the method of an improved Canny edge detection algorithm for color image. An improved Canny algorithm is proposed to detect edges in color image. This algorithm is composed of the following steps: quaternion weighted average filter, vector Sobel gradient

computation, non-maxima suppression based on interpolation, edge detection and connection. This algorithm outperforms other color image edge detection methods and can be widely used in color image processing[5].

The method suggested by WeibinRong, Zhanjing Li, Wei Zhang and Lining Sun is An Improved Canny Edge Detection Algorithm .This algorithm introduced the concept of gravitational field intensity to replace image gradient, and obtained the gravitational field intensity operator. Two adaptive threshold selection methods based on the mean of image gradient magnitude and standard deviation were put forward for two kinds of typical images (one has less edge information, and the other has rich edge information) respectively. The improved Canny algorithm is simple and easy to realize. Experimental results show that the algorithm can preserve more useful edge information and more robust to noise [1].

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II. METHODOLOGY

A. Median Filter

Median filtering is considered a suitable method to remove impulse noises from images. This non-linear technique is a good substitute to linear filtering as it can efficiently subdue impulse noise while preserving edge information. The median filter operates for each pixel of the image and ensures that it fits with the pixels around it. It filters out samples that are not representative of their surroundings; in other words the impulses. Therefore, it is very useful in filtering out missing or damaged pixels of the image. Median filter has complexity to implement in hardware, as large amount of data involved in representing image information in digital format.

The Median Filter is performed by taking the magnitude of all of the vectors within a mask and sorted according to the magnitudes. The pixel with the median magnitude is then used to replace the pixel studied. The Simple Median Filter has an advantage over the Mean filter since median of the data is taken instead of the mean of an image. The pixel with the median magnitude is then used to replace the pixel studied. The median of a set is more robust with respect to the presence of noise. The median filter is given by,

Median filter(x1…xN)=Median(||x1||2……||xN||2)

Median filter is a spatial filtering operation, so it uses a 2-D mask that is applied to each pixel in the input image. The median value is determined by placing the brightness in ascending order and selecting the centre value. The obtained median value will be the value for that pixel in the output image.

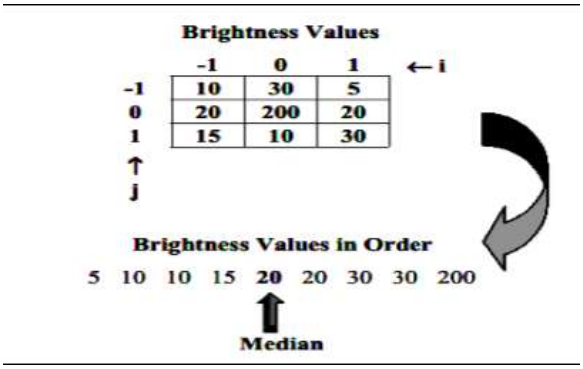


Figure. 1: Application Of Median Filter

B. Use Of Wavelet and canny operator

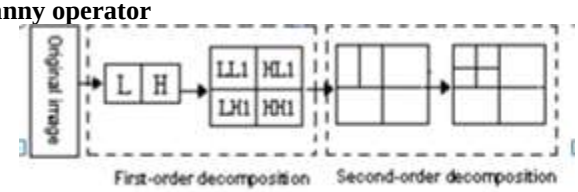


Figure.2: Digital images of second wavelet decomposition process of frequency allocation

After wavelet decomposition, the energy is distributed in the low frequency region. Therefore, noise the proportion is small, high frequency noise energy in the proportion is larger.

Wavelet analysis and canny edge detection combination is used for edge detection. In wavelet transform all approximate coefficients are converted to zeros and vertical, horizontal and diagonal details coefficients are combined to give a resulting edges . Finally, combined result of wavelet and canny method gives edge detection

C. Adaptive Filter

An adaptive filter is a Wiener filter which filters out noise that has corrupted a signal. It is based on a statistical approach. Typical filters are designed for a desired frequency response. The Wiener filter approaches filtering from a different angle. One is assumed to have knowledge of the spectral properties of the original signal and the noise, and one seeks the LTI filter whose output would come as close to the original signal as possible.

Wiener filters are characterized by the following:

a. Assumption: signal and (additive) noise are stationary linear random processes with known spectral characteristics.

b. Requirement: the filter must be physically realizable, i.e. causal (this requirement can be dropped , resulting in a non-causal solution).

c. Performance criteria: minimum mean-square

III. PROPOSED METHOD

We collect images of human emotions from standard database as well as self captured. Total database is of 175 images. Self captured images are 30 which are also used for testing purpose. Features of testing images are compared with features of training images. Closely matching features gives emotion classification

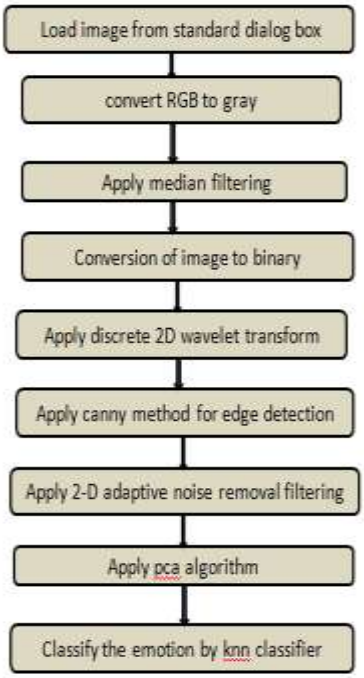


Figure. 3: Flow diagram of Human Emotion recognition

Test image is loaded which is in RGB or Gray form. If Input image in RGB form, convert to Gray Form. Median filtering is applied to replace noisy pixel by noise free pixels. Conversion of image to binary form based on threshold. Discrete 2D wavelet transform is applied for decomposition of image. Canny method is applied for edge detection. 2-D adaptive noise removal filtering is applied to evaluate gray values of each pixel. PCA algorithm is applied to reduce dimensionality of target. The emotion is classified by passing features of both testing image and training image to knn classifier.

IV. RESULTS AND DISCUSSION

We create dataset for total 175 database images. Features are extracted for testing images. Both the features of testing images and trained images are passed to knn classifier with label. Features of testing images are compared with features of training images to give classification of human emotion.

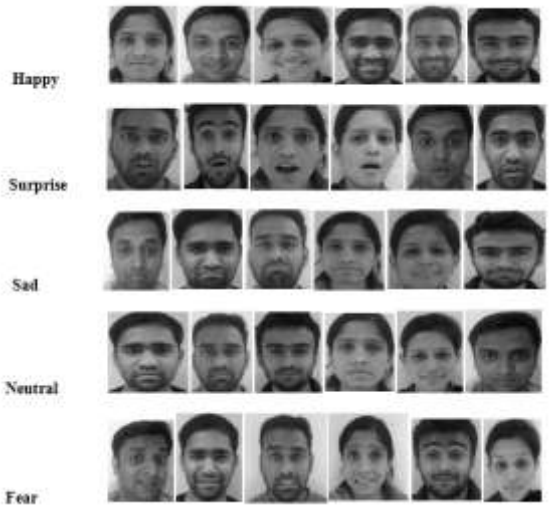
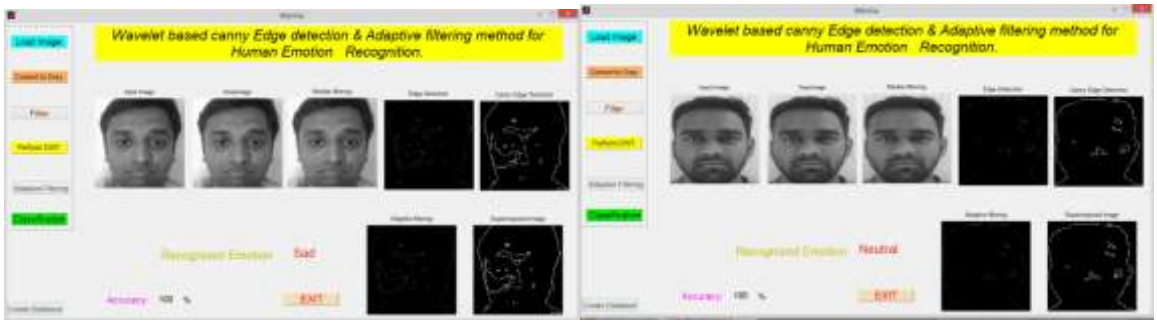


Figure. 4 : Sample Database Images of 5 different emotions

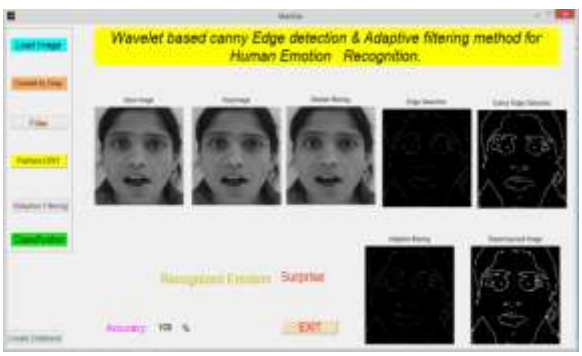
Results of different classification of human emotions are as below:

a b



d e

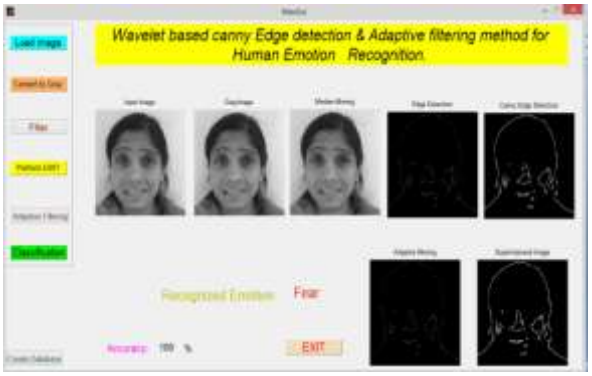
e f



g

h

i



j

Figure.5: (a),(b),(c),(d),(e),(f),(g),(h),(i),(j) different classification of human emotions obtained after edge detection and noise removal.

Figure 5 shows the classification of human emotions for different testing images.

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Confusion Matrix
    15     0     0     0     0
     0    22     0     0     0
     0     0    14     0     0
     0     0     0    18     0
     0     0     0     0    18
```

Figure.6: Confusion matrix of classification of human emotions

Figure 6 shows confusion matrix for trained database which consist 175 facial images. We are getting 15 correctly classified 'Happy' images,22 correctly classified 'Surprise' images,14 correctly classified 'Sad' images,18 correctly classified 'Neutral' images,18 correctly classified 'Fear' images. We are not getting any misclassified image. In main coding testing images are selected from same trained dataset images. So, accuracy is 100%. From the figure we can see our proposed method achieves the better results for the final emotion recognition.

V. CONCLUSION

The problem of human emotion recognition by using canny method has relatively slow computing speed, which need to be further improved. The goal of human emotion recognition is to provide accurate human computer interaction. Human emotion recognition techniques includes detection of emotion, match it with database and give accurate recognition. Now days human emotion is used for various purpose. So because of that only one method of recognition is not useful. So, we use combination of method for detection and recognition. This technique achieves good performance by combining different algorithms for recognition of human emotions. This algorithm is fast and simple to implement and gives higher accuracy.

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