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EMOTION RECOGNITION IN MENTALLY RETARDED CHILDREN USING FACIAL EXPRESSIONS

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ABSTRACT----Emotions are an incredibly important aspect of human life and basic research on emotions of the past few decades has produced several discoveries that have led to important real world applications. Facial expression analysis deals with the recognition of emotions from the face expressions in the image. Children with mental retardation find difficulty in emotion recognition. In this method, the emotion of the mentally retarded children is recognized using MATLAB. The expressions includes happy, sad and neutral. It is employed in seven subjects with mild mental retardation. The test and train set of images are obtained from the subjects. The facial features are obtained from the low dimensional test and train images using principal component analysis (PCA). The emotions are recognized from the Euclidean distance of the extracted features calculated between the test and train images.

I. INTRODUCTION

Emotions are the feeling that describes the behavior of a person. Facial expressions are the primary factor that helps the observer by conveying the emotions of the individual. There are 21 different types of emotions; among these seven are considered as the universal emotions. They are happy, sad, neutral, fear, surprise, anger, and disgust. Mental retardation which is also known as Intellectual disability is a neuro developmental disorder which leads to below average IQ level in children under the age of 18. Based on the IQ level, mental retardation is classified into several degrees such as mild, moderate, severe and profound. Children with mild mental retardation have IQ level ranges from 50-70 and the children can be trained to improve the social and communicative skills. In case of moderate mental retardation the IQ score ranges from 35-49 and the individual can do simple work under supervision. The individual with severe mental retardation have an IQ score from 20-34 and exhibits poor communicative skills. Children with profound mental retardation have IQ level below 20. A caretaker is needed for those suffering from such type of mental retardation. These categories are based on the person's level of functioning. People with mental retardation finds difficult in expressing, recognizing and controlling the emotions. The emotional development in children with mental retardation can be encouraged with the help of tools such as emotional pictures and transporters DVD. Hence in the proposed method, the emotional responsivity is a task which is defined as the ability to obtain the emotion using some external stimuli has been employed to recognize the emotion in children with mental retardation

II. RELATED WORK

Many research works have been carried out in the field of emotion recognition in mental retardation till date. A test to identify the ability of understanding the facial expression and Wechsler intelligence scale to test the intelligence were conducted by Carla C V P de Santana et al. (2014) to recognize the emotions in children with Down syndrome (DS) and typical developing (TD). It consists of 30 participants with DS and 30 with TD. It includes three stages, stage1 involves emotion comprehension and in stage 2, the data was collected individually in the presence of the caretaker. In third stage, the feedback is obtained from the guardian.

Guadalupe Elizabeth Morales (2014) aimed to explore the ability of people with DS in emotion recognition with the help of automatic cognitive processing. A two study was conducted in recognizing emotions. The stimuli used was stimulus onset asynchronous (SOA) and inter stimulus interval which helps the participants to categorize an emotional or neutral face. The first study was conducted to explore the emotion classification. The second study explored the effect that gender of a face in categorizing the facial emotion.

Lini joseph and Mariam Ittyerah suggested that individuals with intellectual disability have difficulty in identifying the emotions. The study includes 60 participants who were divided into two groups as experimental and control group. It consists of 6 tasks such as emotion understanding, emotion recognition task, picture task, comic strips, and audio-visual task, audio and video task.

III. MATERIALS AND METHODS

Seven subjects with mild mental retardation were considered as the participants. The block diagram for emotion recognition is shown in figure 1. It includes several modules such as preprocessing, feature extraction, distance calculation and emotion recognition.

BLOCK DIAGRAM

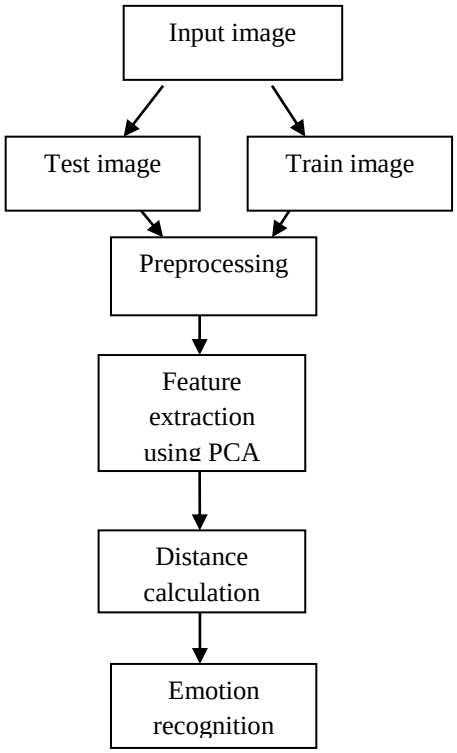

Fig.1 Block diagram of emotion recognition.

IV. IMAGE ACQUISITION

An external stimulus is given to the participants to stimulate the emotion. The stimuli used was Geneva affective picture database (GAPED) which consists of 730 pictures to stimulate positive, negative and neutral emotions. The facial expression of the participants were obtained using SONY DSC-W830 camera with 20.1 megapixels. The face expression is captured in the presence of the caretaker in each participant individually.

V. PREPROCESSING

The purpose of preprocessing is to intensify the degree of excellence of the image by eliminating the unwanted noise. In this method to obtain the relevant features such as edges from the image, the image has to be

converted to gray scale. The removal of noise in the image is done using the median filter.

VI. FEATURE EXTRACTION

Feature defines the nature of an image. Feature extraction has an essential role in the various areas of image processing. Several feature extraction techniques were adapted to extract the features in image processing. In the proposed method, the required features can be extracted using the technique called principal component analysis (PCA). Principal component analysis is a process by which the required information is extracted from the input using orthogonal transformation. The required information which is said to be the principal components must be lesser than the original information. The feature vector is formed using the principal components. The following are the steps in PCA; the mean of the input image is calculated. The covariance matrix is obtained and from the matrix the Eigen values and Eigen vector are computed. The principal component with largest Eigen value which is known as feature vector is formulated.

The distance between the facial features extracted is calculated. The Euclidean distance is the distance between the horizontal and vertical coordinates of the extracted features such as eyebrow rise, inter eyebrow, top lip thickness, bottom lip thickness and mouth width were calculated. Based on the Euclidean distance obtained, the emotion such as happy, sad and neutral are recognized.

VII. FLOW CHART

The following are the steps in the recognition of emotions

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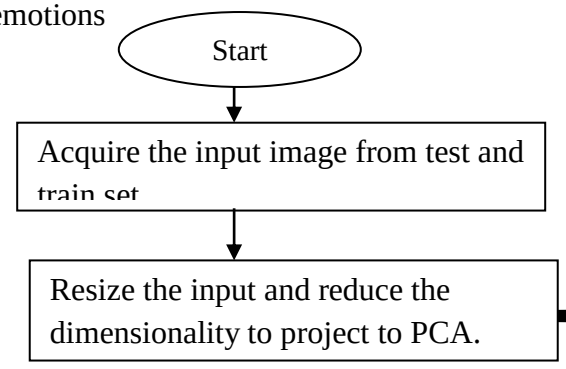

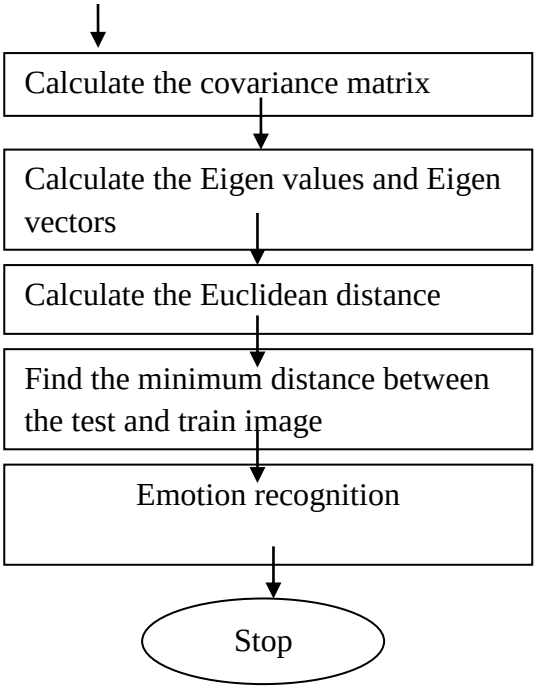

Fig.2 Steps in emotion recognition

VIII. ALGORITHM

1. Input is taken from the test and train set of images.
2. The image is resized and filtered to remove the noise using median filter.
3. The dimensionality of the test and train image is reduced in order to project it into principal component analysis (PCA) and the feature vector is created using the extracted principal components from the Eigen values and Eigen vectors of the covariance matrix.
4. The Euclidean distance of the projected test and train images are calculated. The minimum distance is chosen to determine the train image similar to the test image.
5. From the Euclidean distance obtained, the emotions such as happy, sad and neutral can be recognized. The intensity of each

expression is identified using the neutral expression.

IX. EXPERIMENTAL RESULT

From the Euclidean distance between the extracted features, the emotions can be recognized from the image. The Euclidean distance between the extracted features are calculated for the seven subjects and the performance can be analyzed using the graphs. The performance of seven participants with happy, sad and neutral emotions for parameter of eyebrow rise distance is analyzed from the mean and standard deviation using the following graph

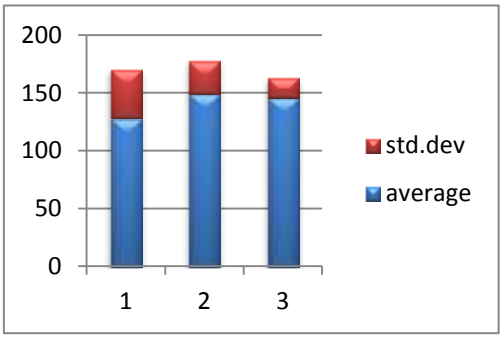

Fig.3 plot of eyebrow rise distance

The performance of inter eyebrow distance for the three emotions of the seven subjects in the graphs shows that the sad expression has the maximum and happy expression has the minimum.

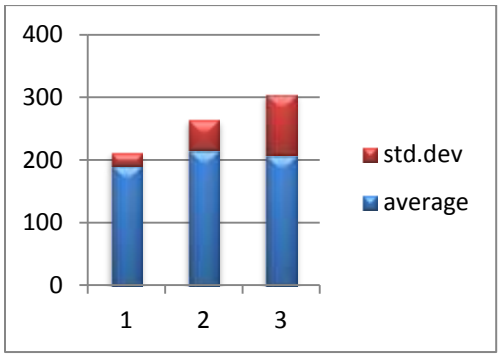

Fig.4 plot of inter eyebrow distance

The performance of top lip thickness for the three emotions of the seven subjects in the graphs shows that the happy expression has the maximum and sad expression has the minimum mean and standard deviation.

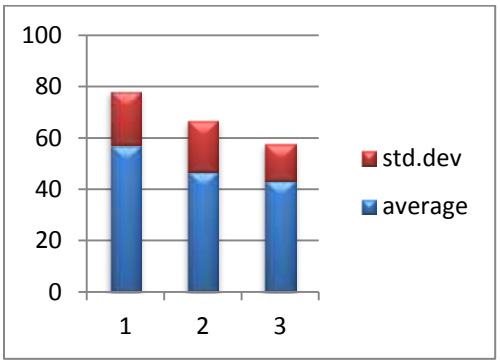

Fig.5 plot of top lip thickness

The performance of lower lip thickness for the three emotions of the seven subjects in the graphs shows that the happy expression has the maximum mean and standard deviation.

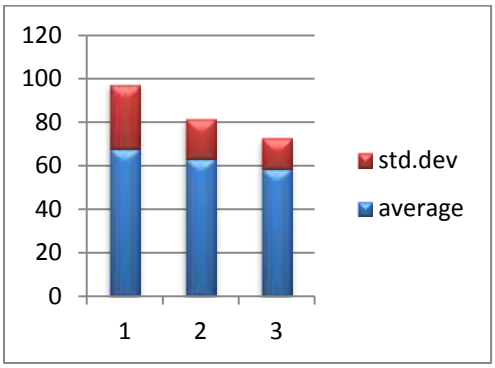

Fig.6 plot of bottom lip thickness

The performance of seven participants with happy, sad and neutral emotions for parameter of mouth width is analyzed from the mean and standard deviation using the following graph. It shows that the happy expression has the maximum value.

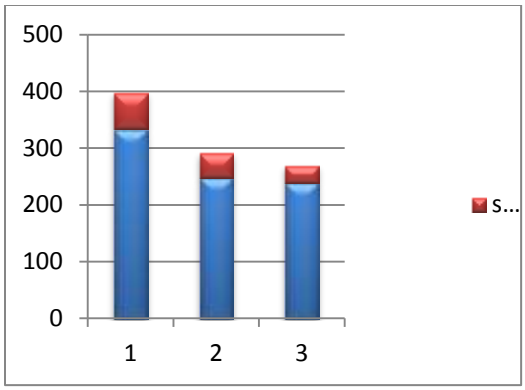

Fig.7 plot of mouth width

X. CONCLUSION

Emotion recognition has been used in various applications in image processing. Emotion recognition in mental retardation is essential for the caretaker to identify the emotions of the children. The emotions includes happy, sad and neutral have been recognized in seven subjects using MATLAB by extracting six feature parameters such as eyebrow rise distance, inter eyebrow distance, top lip thickness, lower lip thickness and mouth width with the help of principal component analysis (PCA) method. Euclidean distance between the extracted features were calculated and compared between the test and train images. From the distance of the extracted features obtained the emotions have been recognized. The work can be extended in future by recognizing more expressions by extracting more features from the facial expression of the subjects.

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