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Coma Patient Expression Analysis Using Computational Intelligence Techniques

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Abstract-This work presents a new architecture for detecting facial changes of coma patient in a hospital Intensive Care Unit. In this research we have considered different facial changes as represented by eyes and mouth movements. The proposed system uses different facial expression images and it consists of three modules. The first module implements database collection which consists of two set images called training and testing images. The next module constructs preprocessing of the images. The third module is about the feature extraction from the training images. From that extracted features the dataset are collected. After the dataset collection it is proposed to use classifier techniques. The conditions of the patient were determined based on classifiers such as Euclidean Distance and Artifical Neural Network. All the codes are written in MATLAB software.
KEYWORDS: Coma patient, Facial Expression, Intensive Care Unit, Classifier techniques

I .INTRODUCTION

A coma is a profound or deep state of unconsciousness. It is a condition in which patient unable to respond to their environment but alive. It may occur as a complication of an underlying illness or as a result of injuries, such as head trauma. The coma-patients who are in ICU to be carefully monitored by nurses for any body movements. Since the nurses have multiple responsibilities in ICU, they may miss such events.

Based upon the recent developments in vision technology offer new ways to present information about coma patients in Intensive Care Unit (ICU). Some research focuses on identifying information that needs to be conveyed and has led to configural graphic displays that show relations between sensed measures and physiological functions. In the existing system, they have used pattern recognition algorithms and PIR sensor based motion detection for analyzing patient expressions. They have used LCD, sensors and microcontroller [1]. The problems found in the existing systems like PIR sensor based are complex steps involved and background noise, improper lightening. The proposed work presents a new architecture for detecting facial changes of coma patient. In our method, it is planned to analyze different facial changes of patient by using detection of face, eye and mouth regions and then feature extraction from eye and mouth regions of patients.

II .PROPOSED METHODOLOGY

The block diagram representation of the proposed system is as shown in Figure 1. After giving a facial image as input, an algorithm is applied to preprocess the image to improve the constrast of the image. Then different features are extracted from the image by using the feature extraction algorithm. The conditions of the patient were determined based on classifiers such as

Euclidean Distance and Artifical Neural Network. All the codes are written in MATLAB software.

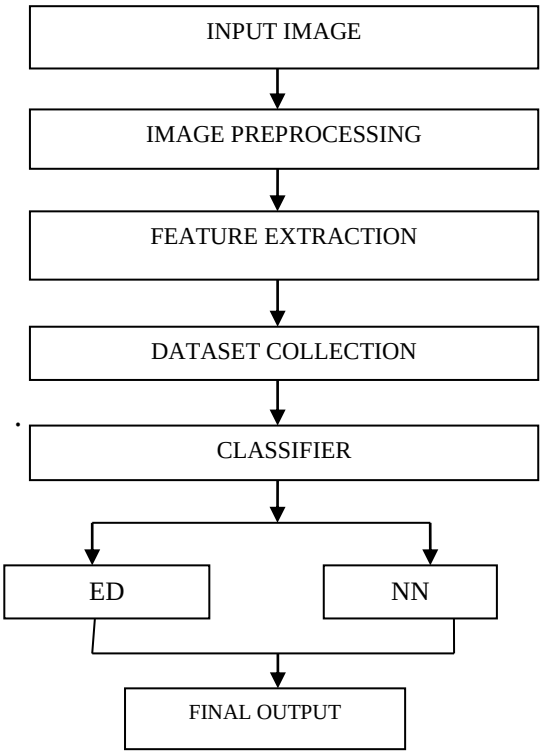

Fig 1 Proposed System

III .DATABASE COLLECTION

This module mainly focuses on the database collection for analyzing the expression of coma patients. This work is mainly categorized into two different parts. First part focuses on training the image. Second part focuses on testing the image. In the first part different expressions of different persons are collected.

Those images are trained by extracting features from that collected images. Different algorithms are used for training purposes. After that work the testing images are given as input for finding the state of patients whereas the testing images are the coma patient different expression images.

IV .IMAGE PREPROCESSING

The aim of preprocessing is an improvement of an image data that suppresses the unwanted distortions or enhances some image features important for further preprocessing. Image preprocessing methods use considerable redundancy in images. The steps include

1.Image resize
2.Filter
3.Contrast Adjustments

Here, Filtering operations are done to improve the contrast of the image and to remove noise in the image. Those preprocessed images are taken for the next step called, feature extraction.The output of the preprocessed image is shown in the figure 2.

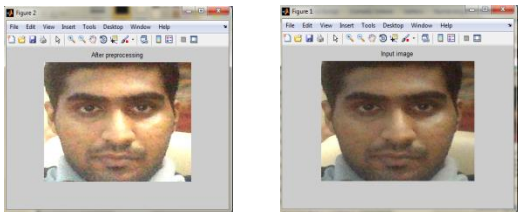

Fig 2 Preprocessed image

V. FEATURE EXTRACTION

Principal component analysis(PCA) [2] is used to extract features from the images. Eigen face is constructed for each image in the database by using the PCA algorithm which extracts features like Mean, Variance, Covariance , Eigen vector, Eigen Value.

There are the 6 general steps for performing a principal component analysis, which are:

1. Take the whole dataset consisting of *d*-dimensional samples ignoring the class labels
2. Compute the *d*-dimensional mean vector (i.e., the means for every dimension of the whole dataset)
3. Compute the scatter matrix (alternatively, the covariance matrix) of the whole data set
4. Compute eigenvectors and corresponding eigen values
5. Sort the eigenvectors by decreasing eigen values and choose *k* eigenvectors with the largest eigen values to form a *d* x *k* dimensional matrix **W** (where every column represents an eigenvector)
6. Use this *d* x *k* eigenvector matrix to transform the samples onto the new subspace. This can be summarized by the mathematical equation:

   $$\boldsymbol{y} = \boldsymbol{W}^T \times \boldsymbol{x}$$

   (where **x** is a *d* x 1 -dimensional vector representing one sample, and *y* is the transformed **k** x 1 -dimensional sample in the new subspace.)

VI .CLASSIFIER

When a classifier classifies the images for distance and area, the condition of patient can then be monitored for high agitation, medium agitation or low agitation [3]. The following table 6.2.1gives the details of Modified Riker (SAS) Table.

TABLE 6.1

Score	Term	Description
3	Dangerous Agitation	Pulling at endotracheal tubes (ET) tube trying to remove catheters, climbing over bedrail, striking at staff, thrashing side to side
2	High Agitated	Requiring restraint and frequent verbal reminding of limits.
1	Medium Agitated	Anxious or physically agitated, calms to verbal instructions
0	Low Agitated / Calm	Calm, easily or follow command

However, this feature extraction method is not optimized towards obtaining most acceptable features. Hence, some classifiers were employed for obtaining optimum set of features.

The classifiers are

- Euclidean Distance
- Artificial Neural Network

6.1 Euclidean Distance classifier

The classifier based on the Euclidean distance has been used which is obtained by calculating the distance between the image which are to be tested and the already available images used as the training images. Then the minimum distance is observed from the set of values.

In testing, the Euclidean distance (ED) has been computed between the new (testing) image Eigenvector and the Eigen subspaces for each expression, and minimum Euclidean distance based classification is done to recognize the expression of the input image. The formula for the Euclidean distance is given by

$$ED=\sqrt{\sum}(x_2-x_1)^2$$

6.2. Artifical Neural Network

Artificial neural network (ANN) is machine learning approaches that models human brain and consists of a number of artificial neurons. Neuron in ANNs tend to have fewer connections than biological

neurons. Each neuron in ANN [4] receives a number of inputs. An activation function is applied to these inputs which results in activation level of neuron (output value of the neuron). The structure for feed forward neural network is shown in the following figure 3.

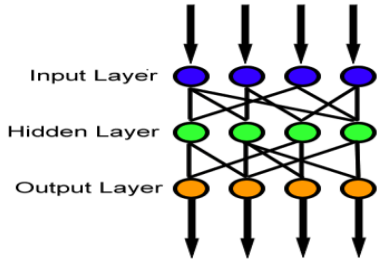

Fig 3 Feed Forward Neural Network

VII. RESULTS AND DISCUSSION

In this study, a system capable of doing preprocessing of an image and feature extraction have been developed. And dataset are collected from the feature extracted. The proposed system consists of two types of classifiers to classify the patient state.

VIII. CONCLUSION

The future work mainly focuses on classifying images of coma patient. Here the two types of classifiers are used. They are Euclidean distance and Artificial Neural Network (ANN).In the Artificial Neural Network technique it is planned to use Feed forward neural network.

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