An Integrated System for Recognition of Facial Expression and Head-Pose Estimation.

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***Abstract*— Facial Expression Recognition (FER) has been active research topic in recent years in the field of image processing. Several advancements have been made in recent few years in terms of face detection and tracking, feature extraction mechanism and techniques used for expression classification. Here in this paper, we have discussed the three levels for recognizing activities of human face. There are various advantages of detection of expressions of face in today's world. Similarly, the ability to estimate the position of head of any human being is also a common human ability that presents a challenge for computer vision systems. In this paper, we are clubbing these two, the facial expression recognition and head pose estimation techniques, to give result in combination. We are using Viola Jones Algorithm for detecting the human face. And for the head pose estimation we are using Linear Optimization Method to estimate the position of head.**

***Keywords*— FER, Feature Extraction Mechanism, Head-Pose Estimation, Viola Jones Algorithm, Linear Optimization Method, Face Detection, Tracking, Image Processesing.**

I. INTRODUCTION

Recovering facial activities from an image sequence is a challenging and important problem. A number of computer vision techniques have been developed to track and recognize facial activities. Basically there are three levels of recognizing the activity of a human face. Firstly at the bottom level, facial feature tracking, which usually detects and tracks prominent facial feature points (i.e., the facial landmarks) surrounding facial components (i.e., mouth, eyebrow, etc.), captures the detailed face shape information. Secondly, facial action recognition, which means recognizing the actions performed on the face like any kind of movement by the prominent features of the face like mouth, nose, eyes, eye brows, eye lids etc. In the top level, facial expression analysis attempts to recognize facial expressions that represent the human emotional states.

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The facial feature tracking, Action Unit recognition and expression recognition represent the facial activities in three levels from local to global, and they are interdependent problems. For example, facial feature tracking can be used in the feature extraction stage in expression/Action Units recognition, and expression/ Action Units recognition results can provide a prior distribution for facial feature points.

The estimation of head pose angle from face images is a sub-problem of human face analysis with several applications like 3D face modeling, gaze direction detection, driver monitoring safety systems, etc. With the expanding need for robust face recognition systems, realistic solutions to this problem require the ability to handle significant head pose variations. While coarse head pose estimation has been successful to a large extent, accurate person-independent head pose estimation, which is crucial for applications like 3D face modeling, is still in the works.

The existing methods for head pose estimation:

- Shape-based geometric analysis, where head pose is discerned from geometric information like the configuration of facial landmarks.
- Model-based methods, where non-linear parametric models are derived before using a classifier like a neural network (Eg. Active Appearance Models (AAMs)).
- Appearance-based methods, where the pose estimation problem is viewed as a pattern classification problem on image feature spaces.
- Template matching approaches, which are largelybased on nearest neighbor classification agains texture templates/signatures.
- Dimensionality reduction based approaches, where linear/non-linear embedding of the face images is used for pose estimation.

II. PROBLEM STATEMENT

With Recent advances in image analysis and pattern recognition open up the possibility of automatic detection and classification of emotional and conversational facial expressions. Automatic facial expression analysis and recognition could bring facial expressions into man-machine interaction as a new modality and make the interaction tighter and more efficient. Research says that the verbal part or spoken words of a message contributes only for 7 percent to the effect of the message as a whole, the vocal part contributes 38 percent, while facial expression of the speaker contributes

for 55 percent to the effect of the spoken message. This implies that the facial expressions form the major modality in human communication.

Facial expressions have an important role in human communications. Cognition of human emotions is usually performed through recognition of facial expression. Analysis of facial expressions has numerous potential applications in areas such as psychological studies, synthetic face animation, image understanding, robotics, entrance security etc.

III. SOLUTION METHODOLOGY

In this project, we are going to recognize the facial expression as well as the estimation of the head-pose. For this purpose we must have a dataset for matching the input image and retrieve the desired output.

In the dataset we are having classified data, both for facial expression recognition and head-pose estimation.

For Facial Expression Recognition:

- Neutral
- Happy
- Angry
- Sad
- Scared

For Head-Pose Estimation:

- Front
- Left
- Right
- Up
- Down

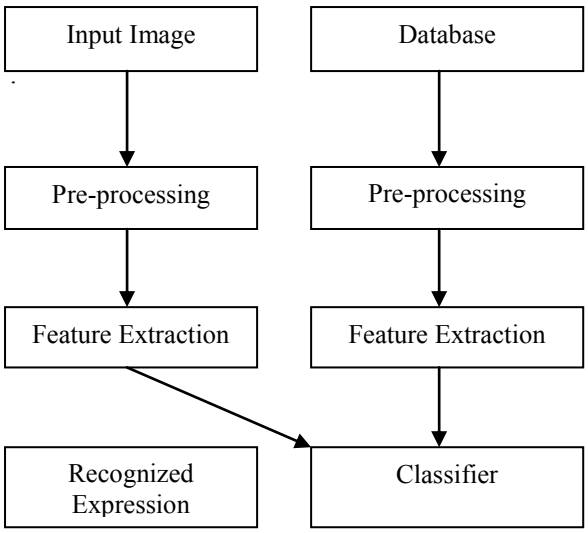

Fig. 1. Block Diagram for Facial Expression Recognition Methodology.

In this project we are using Viola Jones Algorithm for Face Detection and Sparse L0 Norm Method for Estimation of Head-Pose. The sensor cameras will take the picture of any human being at a random manner. These pictures will be identified as we are using the Viola Jones Algorithm for detection of faces. The faces will be detected and will be taken as input. The system will be such designed that it will have a huge database of numerous persons.

For Head-Pose Estimation, the methodology moves in such a manner that it will take any picture of any person to estimate its position

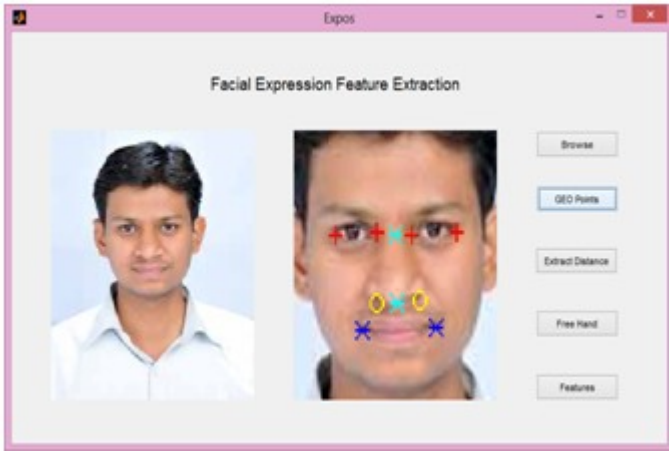

Fig. 1 . Facial Expression Feature Extration and Detecting Fiducial Points.

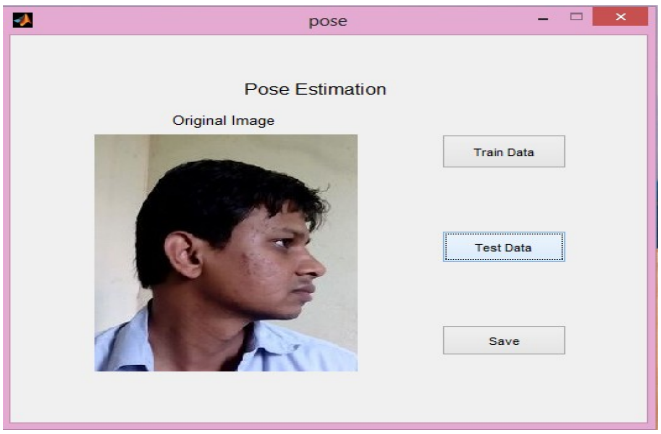

Fig. 3 Estimation of Head-Pose.

As we see in Fig. 2. the input image is being taken and we are extracting the features of the face like eyes, eye-lids, nose, nostrils, lips, the four corners of the lips. The central point between the eyes. The feature is extracted and the points are being known as the fiducial points of the face. Their positions on the face are the benchmarks for recognizing the facial expressions.

After this feature extraction we do the extraction of distance, these distances actually helps in determining the movements of fiducial points which ultimately gives the result for recognition of expression.

The Head-Pose Estimation is done in three steps.

1. Train the Data: Here we train the data as per various

possible positions of head of any person.

2. Test the Data: In this step, we select any picture of any person having any random head-pose.
3. Save the Data: Finally after that testing it is saved

IV. RESULTS AND CONCLUSIONS

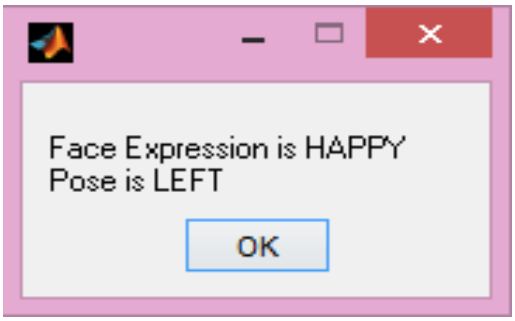

Fig.4 Final Output.

In this paper, we have designed and developed an integrated system to know about the information of the face of the person. The system will recognize the face and will extract the features of it. The fiducial points will be detected and on the basis of their actual and modified positions the system will recognize the actual expression of the human face. Similarly, the features of the face in the input data and their positions will be identified which will give us the estimation head-pose.

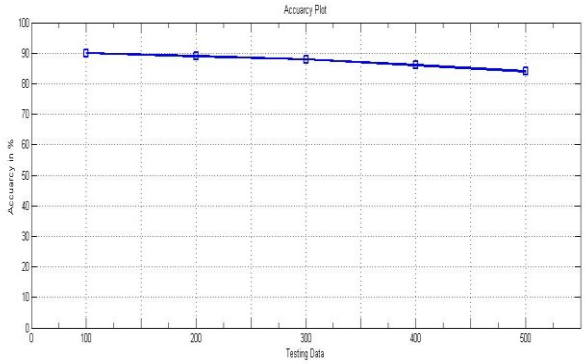

Fig. 5. Graph showing accuracy rate of the output.

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