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Emotion Recognition Based on Facial Expressions and Hand Gesture Using Image Processing-A Survey

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ABSTRACT: In Human species, expression of emotions is a method of communication to the outside world. Emotion is an individual feeling which can be expressed and every other individual have the ability to recognise these emotions very effectively. Various methods of expressing emotions are recognised since civilization of humans. Facial expression, hand gesture, body language are various means to express human emotions. Significant researches have been carried out to recognise human emotions as a part of interpersonal communications. In this work, an extensive study is done for recognition of human emotion, involving both facial expressions and hand gestures. Interesting results were observed in these research works, which is motivational to carry out further investigations.

KEYWORDS: Emotion Recognition, Facial expression, Hand gesture, feature extraction, classification.

I. INTRODUCTION

Facial expression is one method to express emotions and more emotions can be expressed by making use of facial expressions. Hand sign is another way for expressing emotions. Emotion Recognition is very widely used in several applications of Human Computer Interaction (HCI), video surveillance and robotic assistance. By nature, every individual has inner feelings and expresses it in different ways, based on his facial expressions, gestures by limbs and body language. Emotions are based on individual mindset and his reactions to any situations. Human emotion expressions are complex to analyse and robots express emotions using artificial intelligence and machine learning algorithms. The awareness for Human Emotion Recognition is being given importance widely. They play an essential role in decision-making, problem solving and intelligence [1]. Emotions not only regulate and organize behaviour cognitive processes, but they also play an important role in social development. The way in which humans convey their emotions are generally based on factors such as age, gender, personality, cultural, emotional, mental, physical body characteristics, culture etc. Each and every individual has his/her own ways of expressing their emotions. Children's are more indicative especially in the case of emotional states such as fear or guilt than adults [2].

Hand gesture recognition is receiving a wide interest due to its applications in the area of human–computer interface (HCI), which is a natural way of communication with machines. Even though hand posture recognition has been reported to be very successful in HCI, dynamic gestures continue to have many barriers for an accurate recognition [3]. This hand gesture recognition system has many applications in computer games, sign-to-text translation systems, robotics and video based surveillance. Gesture recognition is still a challenging task due to the variety, similarity, shapes and the complexity of gestures [4]. These gestures are essential so that the configurations of the hand are accurately defined to the machine. It is difficult to recognize the gestures gesticulated in different pattern. Researchers can overcome this problem by separating presence of left sector trajectory and right sector trajectory features [5].

Facial expression is another way of expressing the emotional and mental state of human. Using facial expression, various particulars can be collected to detect a human's perception. Facial expression recognition (FER) aims to evolve an accurate system to differentiate facial expression of human beings so that human emotions can be viewed through facial expression such as happiness, sadness, anger, fear, surprise, disgust and many more [6].

II. LITERATURE SURVEY

[6] This paper author develops a new intelligent real time facial emotion detection to control equipment such as Electric wheel chair or robotic assistance vehicles. The authors give clear view about Human Machine Interface (HMI) which

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eliminates the need any sensors attached to the user body. It mainly works on the combination of Neural network and specific image pre-processing steps to detect emotions of disabled persons and each wheel chair will move based on users facial expression only. The work incorporates the Viola and Jones technique for robust face detection. It has three steps Haar -like feature integral image and adaboost learning rule – it is one kind of large margin classifier efficient for online learning.

[7] This paper gives information about hand gesture recognition which tells us about various addresses about variations of gesture patterns during gesticulation. There are different gestures which can be gesticulated in various patterns but it is very difficult to recognise the gesture. Authors proposes two new features they are left side trajectory feature and right side trajectory feature which uses to recognise gesture even they have more variations in gesticulation pattern. Authors have done a comparative study on the proposed features and three states of art feature such as (i) orientation (ii) combination of location, orientation, velocity and (iii) a combination of ellipse and position feature. It has an accuracy of 91.07% using classifier fusion technique - it is a combination of multiple classifiers. In this work authors have used five classifiers namely Artificial Neural Networks(ANN), Support Vector Machine(SVM), K-nearest neighbours (KNN), Naïve Bayes(NB) and Extreme Learning Machine(ELM) and evaluated on the basis of accuracy.

[8] Affective computing is an important field is the emotion recognition based on the facial expressions. It has two main defects for current emotion systems they are classifier is not robust and translation in the facial image may deteriorate the performance of image. To overcome this problem authors propose a novel intelligent emotion recognition system. Authors use stationary wavelet entropy to extract features and work is implemented with single hidden layer feed forward neural network for classification. They introduced java sorting algorithm to prevent the training of classifier fall into local optimum points. This algorithm gives an overall accuracy of 96.80%.

[9] This paper presents a novel data gloves for capturing gestures and their recognition based on inertial and magnetic measurement units(IMMUs) and it is made of three axis gyroscope, three axis accelerometer and three axis magnetometers. The data glove used to capture the three dimensional gestures of palm, fingers and arm. In this work, authors used the extreme learning machine for gesture recognition. It can used as an application for ELM (Extreme Learning Machine) is used as classifier for gesture recognition with an application for robotic tele operation – it is a remote operation where we can access robot by human for recognition for future.

[10] In the human robot interaction applications, facial expressions recognition plays a very important role and it requires facial expression analysis. The author proposes a novel feature fusion network for facial expressions in order to get facial expressions. This network consists of intra category common feature channel (IC) and inter category distinction channel (ID) for facial expressions. The cross database is used for expressions which is a combination of both IC and ID. Authors used CK+, MMI, SFEW, RAF databases and Fusion network is used for recognition.

[11] In this paper authors propose a separate 3D convolution network for the dynamic gesture recognition as it is very important for human computer interaction (HCI) and it is used for Augmented Reality. This work consists of a simplified 3D model decomposed into 3D depth wise and 3D point wise processes without compromising the high accuracy. Authors have generated a new data set called AMI hand gesture dataset. The dataset is acquired from RGB camera of hololen (smart glasses developed by Microsoft) from 10 people and it has 110k training samples and 10k test samples. It uses t-SNE (t-Distributed Stochastic Neighbour embedding), it is a machine learning algorithm to visualise the samples of 1.2k selected from set.

[12] In this author proposes Fuzzy based Behaviour Prognostic System for Disparate Straits (FBPSDS) for face recognition and it deals with quandary situation (it is a situation where a person do not know what to do). It mainly has three stages- face detection, face recognition and behaviour analysis. In this work only face detection has been implemented based on HOG (Histogram of Oriented Gradients) method with an accuracy of 91%. For testing they used the facial dataset-LFW (Labelled Faces in the Wild) (Face 94, Face 95 and Face 96), it has 13000 images of faces collected from the web. They made a comparative study on Haar cascade (an image feature used for object recognition), skin colour based on HOG method.

[13] The proposes a new model for face detection based on the visual attention model for the saliency map and visual cortex HMAX model for the C_2 texture features. In this work, face region is founded by saliency map of visual attention model on the input colour image. To reduce region they used cluster background to reduce the searching regions and increase the face detection process. Authors used the SVM classifier with C_2 texture features for non-face region. The work is carried out using the Caltech face database for feasibility and effectiveness.

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[14] In this paper, authors propose new developed software for emotion recognition from the facial expressions. This work incorporates the detection of emotions from the video files and image files and it uses webcam data for the real time, continuous expressions. Authors use the Fuzzy Unordered Rule Induction (FURIA) algorithm. The work is carried out n two stages-in first stage, the webcam data for real time for accurate analysis of the facial expressions. The second transforms the facial expressions to detect emotions. The authors used the RAGE software (it is a software used for gaming) architecture which creates an emotion recognition component and achieved an accuracy of 83.2%.

[15] This paper provides a holistic approach for 3D face recognition, with 'one to all' comparison method. In 3D face image, four different types of curvatures are captured from local feature and surface feature. From these features a new feature space, EC (Edge _Curvature) image is generated and recognition is done with fuzzy rule. In this work, authors investigated the two data bases: Frav3D (synthesized dataset) and GavabDB (original range face images) with two sets of investigations. The success rates of acceptance of the probe images from the two datasets are 98.87% for Frav3D and 87.20% for GavabDB. The classification rate from the original dataset is 76.78% for GavabDB and 91.69% for Frav3D. This paper gives solution for real time face recognition problems like pose, illumination and expressions.

[16] This paper gives a new expression based on the cognition and binary mapped patterns. It has two approaches: first approach based on LBP operator to extract facial expressions and second approach is to establish a pseudo 3D model. It is used to find the correlation between the local facial expressions and features. In this work, RWTH-BOSTON data set is used to obtain an accuracy rate of 80.06%. They used Active Appearance Model (AAM) algorithm which is based Principal Component Analysis (PCA) statistical approach.

[17] In this paper, the authors stated that the facial expression to display emotions is a way for communication. Human can express their emotion in different expressions and no human can express similar emotions due to different cultural background and it is applicable for robot face also. In this work, authors have developed a generation system to produce facial expressions with 24 degree of freedom for humanoid social robot KOBIAN-R to produce expressions of different cultures. The authors have considered 12 facial expressions for humanoid with a recognition rate of 7.7% to 84.3% with different cultural background across the world.

[18] In this work, the authors used the facial expressions to estimate the affective state of person using a 2D valence arousal model. SVR (Support Vector Regression) model is used for the valence and arousal values based on FEPs identification of each person. The work incorporates the Principal Component Analysis (PCA) and SVM algorithm to achieve an accuracy of 70% for valence and 72% for arousal. This system can be applied for to develop an accurate multi-modal affect estimation system for HRI applications.

[19] This work focuses on recognising the facial emotions of the student community towards the affective computing based learning. It uses SVM and Immune Memory Clone Feature Selection (IMCFS) algorithms for feature selection and classification for the formation of emotion recognition model. In this work, authors used JAFEI (Japanese Female Facial Expression) data set to obtain an average accuracy of 85.3%. It indicates the application of this work to identify students comprehension based on spontaneous facial expression in distance learning also.

[20] This paper gives a clear study about multimodal automatic emotion recognition when speech based interaction is present. The authors use the facial expressions, body language, and acoustic analysis for emotion recognition with Bayesian classifier (Naïve Bayes). This result is find emotions of different persons belonging to different countries like France, German Greek. The overall performance is 67.1% for body gesture data, 48.3% for facial expression and 57.1% for speech data.

III. PROPOSED CURRENT WORK

Implementation of emotion recognition with high accuracy, always poses challenge to researchers. In our work, we propose to demonstrate human emotion recognition in real time considering the facial expression and hand gestures. Figure 1 shows the block diagram of the proposed system. Input images are captured from the video camera and pre-processed. A database is generated which serves as input to feature extraction stage. Various facial features, hand gestures are labelled and a feature table is prepared. The features are fed to a classifier to recognise the human emotions.

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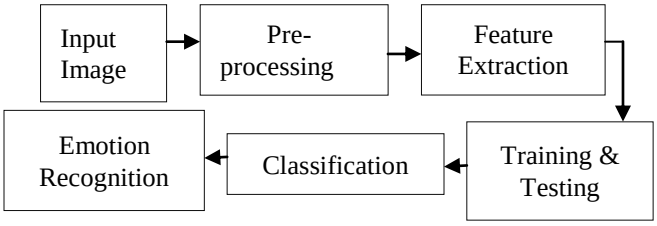

Fig. 1 Block diagram for proposed emotion recognition system

MATERIALS AND METHODS

The proposed method has following steps.

1. Various hand gestures and various facial expressions are captured.
2. A data base is created for combining the facial expression and hand gestures to indicate the emotions.
3. The feature extraction stage involves identification/extraction of features from facial expression and hand gestures.
4. A classification system is proposed to recognise the human emotions.

As the work is carried out in real time a Video Camera with high resolution is a primary requirement. Image acquisition and pre processing is implemented in MATLAB software. Hardware implementation uses Raspberry pi for real time emotion recognition.

IV. CONCLUSION

There are several research papers which work on the emotion detection. The emotion detection is based on facial expression, hand gestures and body language. The overall procedure is the facial feature extraction and classification to identify the emotions with significant accuracy of recognition. In this paper, we made an extensive study of different algorithms and databases used for emotion recognition with facial expressions and hand gestures. The researchers used both synthetic database and original database as input to the classifiers. The proposed work is aimed at increasing the accuracy of classification for human emotion recognition.

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