

Emotion Recognition System through Facial Expressions Using Machine Learning

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Abstract: Facial expressions plays important role in communication without speaking in social interaction. It is the one of the core application highly used in research area. Emotion recognition through facial expressions is used in self driving cars, entertainment, security systems etc. The ERS is considered as HMI model. Emotion recognition usually uses of speech processing, gesture signal processing, science image processing, and physiological signal processing. Recognizing emotion is a challenging task for machines, therefore we have used specific feature extraction techniques. Different machine learning algorithms are used for this purpose with the help of training algorithms and testing it on appropriate dataset. This system works on four processes face Detection, pre-processing, feature extraction, classification. In this paper we have used some machine learning algoritms and feature extraction techniques that will provide accurate facial emotion [1].

Keywords: ERS - emotion recognition system, HMI - human machine interface

1. INTRODUCTION

Emotion recognition is highly used in advanced security areas, previously face detection was used for security. Therefore, emotion recognition can be considered as secondary step of face detection that helps in advances the security [2]. Facial emotion recognition is widely used in Artificial intelligence to capture real time images or videos of person to check his/her emotion minutely. The twisting of facial muscle is very minimal and due to which the recognition of emotions become a challenging task for machines which further give varied result. In this paper, we have focus only on some face areas which gives maximum emotions like eyes, mouth corner, nose, jawlines [3]. We have used neural network and support vector machine algorithm for this task and it gave good result. The general process of emotion recognition through face expressions is:

- a) Pre Processing
- b) Face Detection
- c) Facial feature Extraction
- d) Classification

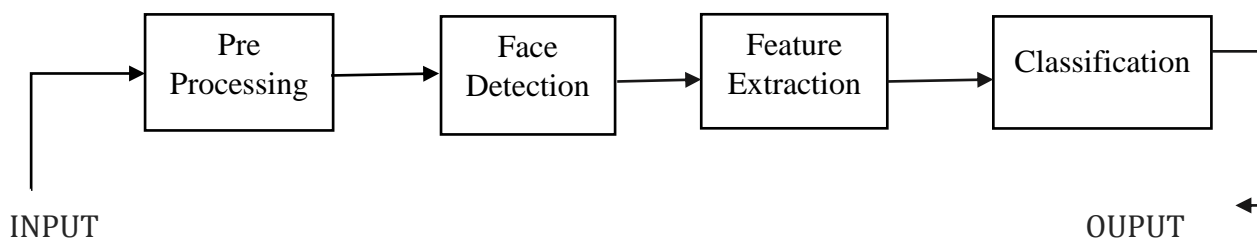


Fig.1 Block Diagram of Emotion Recognition System

2. BACKGROUND

a) Feature Extraction

In this paper, we have used 2D facial features for recognising emotions. The facial feature extraction methods are mainly divided into two types: Appearance based method, Geometric based method [4].

The Appearance based method focuses on face surface which contains wrinkles, bulges, crinkles, etc. The appearance method facial feature extraction can be achieved by Haar feature classifier algorithm and Gabor wavelets method. The Geometric based facial feature extraction usually give areas of points where facial expressions intensity is high like eyebrows, forehead wrinkles, nose, mouth corner, jaw lines. These facial points are known as facial landmarks. According of many researchers, joining together the information of the Appearance based and Geometric based methods would give accurate and best recognised emotion.

b) Machine Learning Approach

Different machines learning algorithms are widely used in research field. Machine learning approach is of two types: context based methods and static predictor method. The context based method makes use of Neural Network and Hidden Markov Model [5] that enhances the edge of dynamic learning. The static predictor method uses the support vector machines algorithm [6]. In this paper we have highly used support vector machine algorithm for emotion detection. The support vector machine has two parts: support vector regression and support vector classification. The support vector regression is used in regression problem whereas support vector classification is used for classification of problems.

Neural network methods is used in research field from ages which gives accurate result and also enhances the performance of the system but it has only drawback of high computational complexity. Random forest technique is currently used by many researchers in machine learning field. Breiman et al. was the first who introduced the term classification and regression tree (CART) in 1984. It is an umbrella term which recursively divides the residual data into classification or regression which further reduces the computational complexity. In 2001 Leo Breiman [7] presented the improved method of CART which was called Random Forest Method. It was the combination algorithm, where if predicted result is a discrete value, it is a Random Forest Classification & if it is continuous value it is called Random Forest Regression. Many empirical studies have conformed that Random forest algorithm give high prediction rate and good tolerance for noise and abnormal value.

Deep Learning has growing attention nowadays. Many systems are implemented using this method, For eg. Image recognition, face recognition as it improves the performance of training task and gives feature learning results. In this paper we have seen that SVM and adaboost has given more accurate results with high performance rate [8].

3. METHODOLOGY

The face expressions play important role in detecting face emotions, they depend upon different physical and mental situations. The emotion recognition system is trained using supervised learning approach which undergoes training and testing of dataset. The general process of facial emotion recognition system includes: Face Detection, Image Pre processing, Feature Extraction, Classification.

i. Face Detection

It is the process of tracking face from raw input image. It is processed by using Haar classifier and implemented through open cv on the training dataset. The haar classifier method finds the difference in average intensities of different parts of image [9].

ii. Image Pre processing

This process removes the complex background, occlusion, noise from the image and separates the normalisation against the varied background. It is of two types:

- a) Color normalisation
- b) Histogram normalisation

iii. Feature Extraction

Feature extraction most important part of classification and emotion recognition. After the pre processing of an image the facial features with high expression intensity are extracted like eyebrows, forehead wrinkles, nose, jawline, mouth corner. The facial feature extraction method is carried out by Local Binary pattern algorithm. The local binary pattern

technique operates by pointing the pixels of an image and comparing it with the neighbourhood pixels by using binary number [10].

iv. Classification

The data which we get from the extraction of facial features has very high dimensionality, therefore classification technique is used to reduce the data dimensionality. This process is done by support vector machine algorithm. SVM is used the recognition of different pattern. SVM is used to train the appropriate data set consist of features and it produce high classification accuracy even with the availability of moderate level of training data[11].

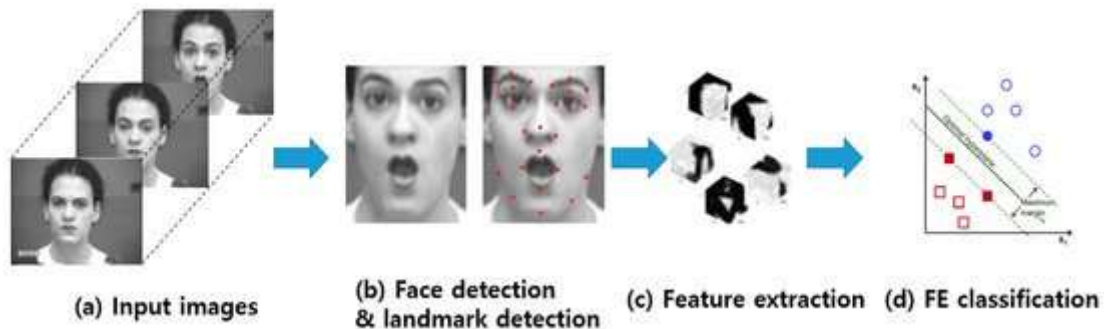


Fig. 2 Process of facial Emotion Recognition

4. RESULT

In this paper we have taken two datasets : MMI dataset and Extended Cohn- Kanade Dataset(CK+). In both the datasets, the data is divided into testing and training parts. Both the datasets have shown different results. The MMI dataset consist of 2000 static images and extended cohn-kanade dataset consist of 550 images. Using the cofusion matrix method, the MMI dataset shows 88.23% of the facial emotions are predicted with average accuracy of around 92.45% and the extended cohn-kanade dataset have predicted 82.62% of facial emotions with the accuracy rate of approximately 93.54%.

5. CONCLUSION

This paper shows the high performance of classifier and feature extraction method that enhances the efficiency of system and improved the accuracy of facial emotion recognition. In this, seven universal emotion from different set of static images is analysed. This paper shows pre processing of face images using Haar classifier followed by facial feature extraction using local binary pattern algorithm and then classification is done by training and testing of dataset using support vector machine classifier.

6. FUTURE SCOPE

The emotion recognition system has evolved from past few decades. Previously the system was worked on static images but now research is taking place on sequence of emotions. Improvements can made by working on high processing time, error during feature extraction, slow recognition rate, system performance. Our system is capable of working with digital camera in which emotions can be captured. It can be used in medical field to recognise the pain of patient. In atm room to check the emotion of person while withdrawing cash.

7. PROPOSED APPLICATIONS

- a) This system can be used in medical field for help monitoring in rehabilitation, in counselling of patient's emotional state and in monitoring while driving a car.
- b) This system can be accessed anytime and from anywhere.
- c) This system can be used by individual, state or country.
- d) This system can be used in E- learning by detecting the state of learner and adjusting the presentation style according online tutor.
- e) Using this system security threats become limited in shops, ATM machines, banks etc.

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