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A Review on Applications of Real Time Automated Facial Expression Recognition System

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ABSTRACT

Emotions have vital impact in perception, decision making and learning. Human emotions can be identified by facial expression recognition system. We must provide computers the ability to understand and recognize the emotions in real time if we want computers to be genuinely intelligent. Facial expressions play important role in human beings conversations to communicate their emotions, intentions and opinions. Facial expressions provide information about cognitive state, such as anger, sad, boredom, happy, interest and neutral state. In this paper we have studied framework of facial expression recognition system and data sets available. In last we have reviewed various applications of real time automatic facial expression recognition system.

Keywords: *Emotion, Facial expression, Facial expression recognition, AAM .*

1. INTRODUCTION

Facial expressions are the facial changes in response to a person's internal emotional states, intentions, or social communications. Facial expression analysis refers to computer systems that attempt to automatically analyze and recognize facial motions and facial feature changes from visual information [9]. Sometimes the facial expression analysis has been confused with emotion analysis in the computer vision domain.

As computers have become more and more advanced, with even the most basic computer is capable of doing the tasks that is almost unimaginable only a decade ago, researchers and developers are focusing on improving the way that computers can interact with people in their everyday lives [3]. A core goal is, therefore, to develop a computer system which can understand and react appropriately to natural human behavior.

A major requirement for such a system is the ability to recognize human facial expressions automatically and in real time. In addition to this, this goal must successfully achieve regardless of the inherent differences in human faces or variations in lighting and other external conditions.

The problem is how to detect the face of a person, if we have a number of objects surrounding the person then there must be a way to detect the human face in all those objects [1], [2]. After detecting the human face the next challenge is to recognize and extract the emotions on the human face.

2. Framework

The task of designing a Real Time Automated Facial Expression Detection System can be accomplished in various stages:

- The first and key step in this system is to recognize a human face with nearly 100% success rate using most appropriate and fast detection algorithm for face detection. For this a large number of face detection techniques needs to be analyzed and evaluated. An algorithm like Viola John classifier would be very

helpful in fast face detection and reducing the overhead of excessive computational requirements [2],[7].

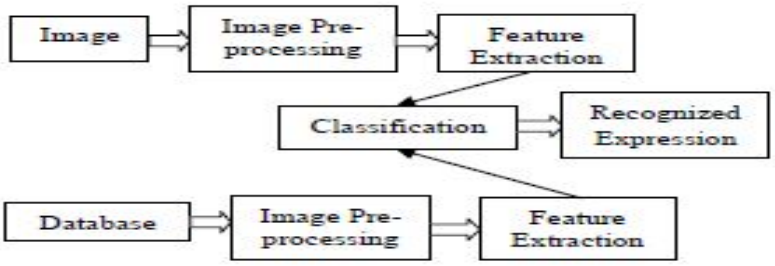


Fig 1: Block Diagram of Facial Expression Recognition Methodology

- The next step for the system will be to enhance and extract the facial features. To achieve this goal successfully, the enhancement and extraction of the facial features must reduce the number of facial dimensions to ensure the system can operate in real time, as well as providing sufficient clear and detailed features to allow the facial expressions to be accurately recognized. This part of the system is to be completed by using AAM (Active appearance Model) and also we may need to modify existing Contrast Limited Adaptive Histogram Equalization technique so that we can quickly and accurately represents facial features while ensuring that it should operate in real time [5], [6], [9].

- The final step for the system is to use the information provided by the first two steps to accurately recognize facial expressions. This is achieved using an SVM trained using a database including both real and computer generated facial images with various facial expressions [1], [4], [10].

Experimental Datasets:

A facial expression database is a collection of images or video clips with facial expressions of a range of emotions [11]. Many publicly available databases are categorized.

Table 1: Facial expression databases.

Database	Facial expression	Number of Subjects	Number of images/videos	Gray/ Color	Resolution, Frame rate	Ground truth	Type
Extended Cohn-Kanade Dataset (CK+)	neutral, sadness, surprise, happiness, fear, anger, contempt and disgust	123	593 image sequences (327 sequences having discrete emotion labels)	Mostly gray	640* 490	Facial expression labels and FACS (AU label for final frame in each image sequence)	Posed; spontaneous smiles
Japanese Female Facial Expressions (JAFFE)	neutral,sadness, surprise, happiness, fear, anger, and disgust	10	213 static images	Gray	256* 256	Facial expression label	Posed

MMI Database		43	1280 videos and over 250 images	Color	720* 576	AU label for the image frame with apex facial expression in each image sequence	Posed and Spontaneous
Belfast Database	Set 1 (disgust, fear, amusement, frustration, surprise)	114	570 video clips	Color	720*576		Natural Emotion
	Set 2 (disgust, fear, amusement, frustration, surprise, anger, sadness)	82	650 video clips	Color			
DISFA	-	27	4,845 video frames	Color	1024*768; 20 fps	AU intensity for each video frame (12 AUs)	Spontaneous
Multimedia Understanding Group (MUG)	neutral, sadness, surprise, happiness, fear, anger, and disgust	86	1462 sequences	Color	896*896, 19fps	Emotion labels	Posed
Indian Spontaneous Expression Database (ISED)	sadness, surprise, happiness, and disgust	50	428 videos	Color	1920* 1080, 50 fps	Emotion labels	Spontaneous
Radboud Faces Database (RaFD)	neutral, sadness, contempt, surprise, happiness, fear, anger, and disgust	67	Three different gaze directions and five camera angles (8*67*3*5=8040 images)	Color	681*1024	Emotion labels	Posed
Oulu-CASIA NIR-VIS	surprise, happiness, sadness, anger, fear and disgust	80	three different illumination conditions: normal, weak and dark (total 2880 video sequences)	Color	320×240		Posed

FERG (Facial Expression Research Group Database)	angry, disgust, fear, joy, neutral, sad, surprise	6	55767	Color	768x768	Emotion labels	Frontal pose
AffectNet	neutral, happy, sad, surprise, fear, disgust, anger, contempt		~450,000 manually annotated	Color	Various	Emotion labels, valence, arousal	Wild setting

Few more datasets of public faces are also available: GEMEP-FERA, BU-3DFE, Bosphorous, LFW, FERET, CMU-PIE, IITK, ATT,CALTECH, GRIMANCE and SHEFFIELD.

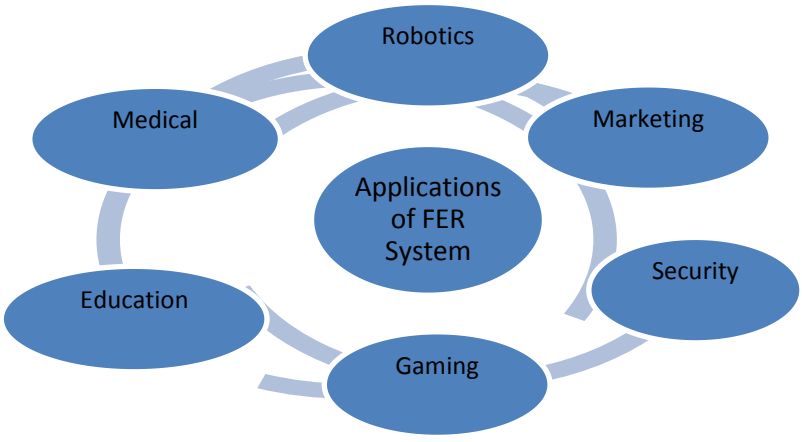
3. Applications

3.1 Robotics:

AIBO is a biologically-inspired robot and is able to show its emotions through an array of LEDs situated in the frontal part of the head. In addition to the LEDs' configuration, the robot response contains some small head and body movements [33]. From its concept design, AIBO's affective states are triggered by the Emotion Generator engine.

3.2 Marketing

In marketing also FER system plays an important role by confirming the first expression in launching and display of a product. It helps in confirmation of attention and engagement and impact on purchasing decision of product. It improves sales of a product.



3.3 Security: FER system improves security from terrorist activities and works on boarder security as well. It helps to find any suspect by real time automatic facial expression recognition system.

3.4 Gaming: Video games belong to the wide area of entertainment applications. Thus, assum-ing the existence of human emotions and in fact basing on them, they attempt to make the player to become emotionally attached with them. As the primary goal of a video game is to entertain the player [Adams 2009], each video game try to allow the

player to fulfill his or her "dream". Standard video games try to do it in different ways depending on their genre and involving such elements as good gameplay, immersing storytelling, novelty, graphics.

3.5 Education: Automatic emotion recognition algorithms can help to explore this phenomena by making assessments of learner emotional states more objective than typical questionnaire-based investigations. Improves online tutoring system by improving the presentation style of tutor while reading the state of the learner. AFER systems makes sessions interactive and effective.

3.6 Medical: In the field of medical, patient emotions recognition must be done during the treatment. Rehabilitation monitoring, counseling and what patient is feeling about and after treatment.

4. Conclusion

Recognition of facial expression is most popular research area as FER system has many applications in different verticals Like: Robotics, Marketing, Education, Gaming, Medical and Security. Many algorithms can be designed to make a competitive FER system so that its implementation must be done and human can get maximum benefit out of it.

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