Emotion Recognition Model Based on Facial Expressions, Ethnicity and Gender Using Backpropagation Neural Network

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ABSTRACT

Many emotion recognition approaches are built using facial expressions, but few of them use both the ethnicity and gender as attributes. The authors have developed an approach based on Artificial Neural Networks (ANN) using backpropagation algorithm to recognize the human emotion through facial expressions, ethnicity and gender. Their approach has been tested by using MSDEF dataset, and found that there is a positive effect on the accuracy of the recognition of emotion if they use both the ethnic group and gender as inputs to the system. Although this effect is not significant, but considerable (Improvement rate reached 8%). The authors also found that females have more accurate emotion expression recognition than males and found that the gender increases the accuracy of emotion recognition. Regardless of the used dataset, the authors’ approach obtained better results than some research on emotion recognition. This could be due to various reasons such as the type of the selected features and consideration of race and gender.

Keywords: Artificial Neural Networks, Emotion Recognition, Features Extraction, Human Computer Interaction, Human Expression

INTRODUCTION

No aspect of our mental life is more important to the quality and meaning of our existence than emotions. They are what make life worth living, or sometimes ending. So it is not surprising that most of the great classical philosophers had recognizable theories of emotion (William & Klaus, 2009).

While facial expression is the key to the knowledge of feelings and emotions, we need to detect these emotions from facial expressions to reach the main objective and goal of developing and improving the interaction between computer and human, and make it naturally specially it is the latest challenges in human-robot interaction (Terrence, Illah, & Kerstin, 2002).

In fact, there are wide ranges of human emotions, which can express the internal emotion; these emotions can be divided into two...
groups basic and secondary. The basic emotions consist of six emotions happy, sad, fear, disgust, angry and surprise, and the other emotions are secondary emotions (e.g., skeptical). In addition, each group is divided into two sets, positive and negative. The basic emotions classify as positive emotion and all other emotions as negative emotions (Miyamoto & Uchida, 2010).

Many studies try to improve the interaction between computer and human by recognizing the human emotions using face expressions (Fischer, 2004; Karthigayan et al., 2008; Ratliff & Patterson, 2008; Waller, et al., 2008), speech (Douglas-Cowie et al., 2003; Rudra et al., 2008) or etc. (Horlings, 2008).

Gender is one of the most important factors in emotion detection systems. Gender differences were important in a variety of cultures and ethnic groups. The gender was even more important than ethnicity in shaping people’s emotional ideology, emotional experience, and habits of emotional expression. Men and women may share roughly the same sorts of emotional experiences in their relationships, but they differ in how freely they express their feelings. Men tended to express their positive and negative emotions less frequently and less intensely than they were experienced. Women tended to be somewhat more direct in their emotional expression (Elain et al., 2009).

An ethnic group (or ethnicity) is a group of people whose members identify with each other, through a common heritage, often consisting of a common language, a common culture (often including a shared religion) and an ideology that stresses common ancestry or endogamy (Giger, Davidhizar, Purnell, Harden, Phillips, & Strickland, 2007). In general, emotional communication is generally more accurate among people who share similar cultural backgrounds (Beaupré, 2005; Elfenbein & Ambady, 2002). Appearance of emotions are universal across individuals as well as human ethnic and cultures, but the way of emotion expression is that vary from one ethnic group to another and the differences cross-cultural in the familiarity effect on recognition accuracy for different types of expressions. This is commonly known in biology (Beaupré, 2005), but never tests on computer systems.

In this paper, we use human face elements to build a recognition model for recognizing the human emotions based on facial feature considering various ethnic groups and gender using backpropagation neural network. We also study the effect degree of the ethnic group and gender on accuracy of emotion recognition models.

First some related works that build some models of human emotion recognition are presented. We then describe our proposed model and discuss how to implement each stage of our model. We present and explain the experiments afterwards. Next we present the results and we evaluate our model. Finally, the conclusion is in the last section.

RELATED WORKS

There are many of computer studies that focused on emotions recognition. Each study uses some factors that have an effect on expression of the emotions like voice, facial expressions, pulse, body movement or any factor. These factors can help in recognizing the human emotions and feeling. Usually recognition model has two stages, learning and testing stages. In learning stage some properties of factors - often called features- used to train the model. Then use the trained model to recognize the human emotion from an image or video or camera.

Akram, Zafar, Siddique Khan, and Mushtaq (2008) presented a fuzzy classifier system using Mamdani-style for facial expression recognition. Three modules are prepared in this classifier system, first module for Pre-Processing Module (PPM), the second for Region Extraction (REM), and the last module for Feature Extraction (FEM). PPM and REM used to detect eight facial elements eyes, eyebrows, nose, forehead, cheeks, lips, teeth and chin. FEM is used to find the facial action values for all facial action elements. Later a fuzzy module called Expression Recognition Module (ERM) is used, the inputs for this module are Membership Functions (MFs) for all facial action...
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