From Text to Emotional Facial Expression of Life-like Character

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Abstract- Type of emotion such as joy, sad, and angry have been known for a long time and become an important aspect of human behavior. In the recent years, there is an increasing body of research on understanding the human emotions. This paper proposes a model of emotion representation in the form of facial expressions of life-like virtual character using text classifier and Fuzzy Inference System (FIS). The proposed methods classify the emotional affinity of sentences from text input and to express associated emotions visually through a face of virtual character. This model is able to show facial expressions with admixture blending emotions. As a demonstration, examples of facial expressions with corresponding text input as results from the implementation of our model are shown.

Index Terms- Text Classification, Emotion Detection in Text, Fuzzy Logic, Facial Expression, Virtual Character

I. Introduction

In the recent years, there is an increasing body of research on understanding the human emotions. The interest in computational emotional expressions has been steadily growing in the agent research community. Several psychologists have acknowledged the role of emotions in intelligence [1].

Life-like character convincingly implements the "machine as social actor" metaphors as its modalities which include facial emotional expressions. It is designed to establish socio-emotional relationships with human user. Since lifelike character is endowed with some tools to express emotions, it is genuinely able to display (artificial) empathy to the human user.

In this paper, the machine is a life-like character which capable of "understanding" text input as part of a fully functional Embodied Conversational Agent (ECA). Other than its conversational skills, the non-verbal behaviour, i.e. facial expressions, and the appearance of ECA becomes more and more realistic mimicking human.

Application of this research can be found in the next generation of intelligent robotics, virtual human, NPC (Non Player Character) in game, and to support development of emotion-ware applications such as emotion-ware Text-to-Speech (TTS) engines for emotional reading of text.

II. From Text To Emotional Facial Expressions

Text is not only conveying information, but also able to trigger emotional response in the reader (listener) or writer (speaker). For example, if someone reads headline of news article "Plane carrying 51 crashes in Venezuela; 36 survive", he/she will feel sad and perhaps fear, then show related emotions with his/her face.

Mimicking human, the emotions carried by text-based sentence are classified by our proposed system, the virtual character will then respond appropriately using facial expressions through its face model. Facial expressions are controlled by mechanism which based on fuzzy logic.

Our proposed system as depicted in Fig. 1 is organized into two parts: (a) emotion classification based on text input using Naive Bayes (NB) supervised text classifier and (b) fuzzy based emotion expression of a face model.

Psychologists have tried to explain the human emotions for decades. A well known model of emotions is the work of [2]. He uses notion of basic emotions as building blocks for derived emotions. All other emotions are derivative states; that is, they occur as mixtures of the basic emotions. [3] believed there exists a relationship between facial expression and emotional state. For instance, when people are angry they frown and when they are happy they smile. The six basic emotions defined by [4] were associated with a set of facial expressions [5].

A. Naive Bayes Text Classifier for Emotion Classes

We employ `libbow` [6] as experiment tools for NB text classification. `Libbow` is a library of C code intended for statistical text processing, which includes `rainbow` that does document classification. `Rainbow` estimates the probabilities of any given text input based on training set.

The typical usage of text classification is to classify a text to one class of emotion and uses only highest value of probability to determine which class a classified text should belong to. However in our system, we utilize all of probability values resulted from NB classifier, that is, we assume probability values represent intensities of basic emotions. Hence, a final emotional facial expression of a life-like character will be triggered from a mixture of basic emotions.

For training set, we use dataset from ISEAR (International Survey on Emotion Antecedents and Reactions) [7] which was conducted in 1990s across 37 countries and had almost about 3000 respondents. This dataset contains text documents of about 3-4 sentences pre-classified into the categories of basic emotion. In our experiment, we pick 6 (six) basic emotions: joy, fear, anger, sadness, disgust, and shame.

B. Facial Expressions of Life-like Character "Ludwig"

In our system, the intensities of basic emotions i.e. probability values of emotion class, using fuzzy-based mechanism, control the expression of face model. We use

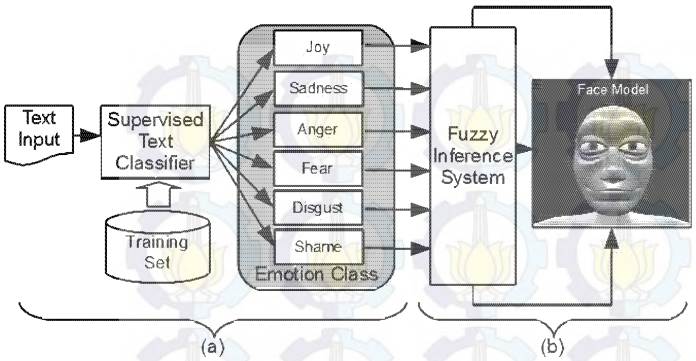

Fig. 1. Overview of our proposed system

Ludwig as face model for our experiments. Ludwig [8] is a full body fully rigged and animation ready character for Blender. Ludwig has many face controls. We utilize following facial control: EyesDirection, BrowPosition.R/L, BrowEmotion.R/L, BrowWrinkle, EyeOpen, Sneer.R/L and MouthSmile.R/L.

The process of fuzzy inference involves Membership Functions (MF), logical operations, if-then rules, aggregation and defuzzification to produce output. We implement it using Fuzzy Inference System (FIS) Mamdani written in java jFuzzyLogic which supports FCL (Fuzzy Control Language) file format.

As a demonstration of our system, Fig. 2 and Fig. 3 shows two samples of facial expression with their corresponding text input. These text input are unseen sentences (not from training set), taken from Internet news. In Fig. 3, life-like character looks somewhat in sadness and fear (worry?) as a result from basic emotions blending.

Fig. 2. Joy facial expression.

Previously using similar approach implemented in Matlab FIS, [9] have conducted a small scale survey by asking human viewers about the appropriateness of generated facial expression from 5 (five) basic emotions, consisted of joy, sadness, anger, fear, and disgust. Previous experiment used Indonesian translated from English ISEAR data-set, not entire dataset tough, but only a fraction. Twenty facial expressions of Ludwig along with 20 (twenty) corresponding Indonesian sentences, were showed to 100 (one hundred) respondents. They should choose one from two possible answers; "Yes, it is an appropriate expression" or "No". After survey, we got total number of "Yes" answer was 1,328 and "No" answer was 672, equalled to 66.4% accuracy.

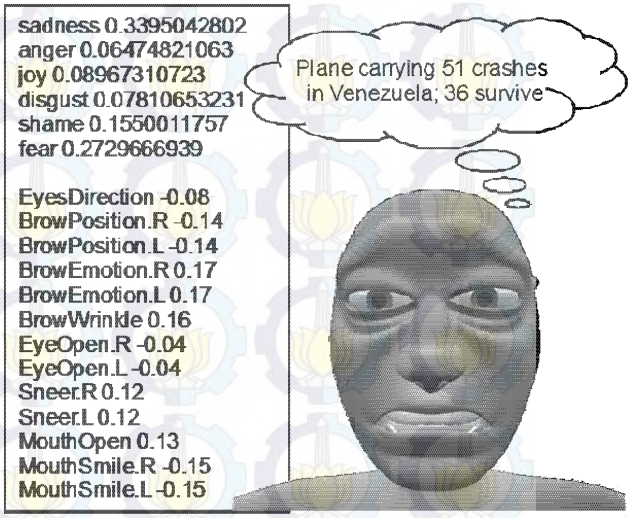

Fig. 3. Facial expression from a mixture of basic emotions

III. Conclusion

Using a supervised machine learning text classifier such as Naive Bayes, combined with FIS Mamdani, emotion representations can be displayed in the form of facial expressions of a character model as a life-like response from text input. Facial expressions are displayed from a blending mixture of emotions.

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