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Towards Expressive Online Communication: Textual Affect Sensing and Visualization

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ABSTRACT
In this paper, we address the task of affect recognition from text messaging. In order to sense and interpret emotional information expressed through written language, rule-based affect analysis system employing natural language processing techniques was created. Since the purpose of our work is to improve social interactivity and affective expressiveness of computer-mediated communication, we decided to tailor the system to handle style and specifics of online conversations. Proposed algorithm for affect analysis covers symbolic cue processing, detection and transformation of abbreviations, sentence parsing, and word/phrase/ sentence-level analysis. Affect driven by text is classified into nine emotion categories and is expressed through animated avatar.

INTRODUCTION
Interpersonal communications play an important role in the development of genuine social relations between people. While communicating face-to-face, we perceive and interpret not only spoken information, but also concomitant social affective cues related to intonation, emotional facial expressions, gestures, and body movements. However, these informational cues are missing within the boundaries of such online social media as e-mail, Instant Messaging (IM), forums, and blogs. A social significance of these communication tools should not be underestimated, because "people in virtual communities do just about everything people do in real life, but we leave our bodies behind" [7].
Recent research on natural language has especially focused on recognition, classification and understanding of sentiment conveyed by text. Keyword spotting technique was employed by emotion detection system described in [6]. However, a simple word-level analysis model cannot output an appropriate emotional state in cases where affect is expressed by phrases requiring complex phrase/sentence-level analysis or when a sentence carries affect through underlying meaning. A pure affective keyword spotting technique will fail even with simple sentences like "*We started a working day without enthusiasm*". More advanced systems for sentence-level affect recognition are: Text-to-Emotion Engine [1] generating emotional output only if an emotional word refers to the person himself/herself and the sentence is in present continuous or present perfect continuous tense; and Empathy Buddy [4] employing large-scale commonsense knowledge to enable understanding of the underlying semantics of language.
In order to enrich social interactivity and affective expressiveness of computer-mediated communication (e.g. IM), we developed a rule-based system aimed at textual affect sensing and visualization. By contrast to the existing approaches dealing only with grammatically correct input, we considered informal aspects of online conversations while constructing our affect sensing model. Created affect database and details of affect sensing model are described in the following sections.

AFFECT DATABASE
For text categorization, we have decided to use nine emotional states taken from a set of ten emotions defined by Izard [3]: 'anger', 'disgust', 'fear', 'guilt', 'interest', 'joy', 'sadness' ('distress'), 'shame', and 'surprise'; and five communicative functions ('greeting', 'thanks', 'posing a question', 'congratulation', and 'farewell').
In order to enable the system to process the affective meaning of emoticons, abbreviations, acronyms, and words, a special database was created. We collected 364 emoticons, both of American and Japanese style (e.g. ":))" and "(^O^)" for laughing); 337 most popular acronyms and abbreviations (e.g. "LOL" for 'laughing out loud', and "4U" – 'for you'); and 1620 affective words taken from WordNet-Affect [8]. Interjections (e.g. "alas", "wow", etc.), and modifiers (e.g. "very", "greatly", "less", etc.) were added to the database as well. Emotion category labels and numerical values of intensity, which ranges from 0.0 to 1.0, were manually assigned to affect-related entries of the database by three independent annotators. Since some affective words may express more than one emotional state, annotators related those words to more than one category. As for the modifiers, coefficients for intensity degree strengthening or weakening were given to them (e.g. 1.4 for "very").

AFFECT SENSING MODEL
According to the developed affect analysis algorithm, the sentence processing is performed at five levels.
First level is devoted to symbolic cue analysis. The sentence is tested for occurrences of emoticons, abbreviations, acronyms, interjections, "?" and "!" marks, repeated punctuation and capital letters. If the system encounters an emoticon or abbreviation related to some emotional category, we assume that the affective meaning of that emoticon (or abbreviation) is dominant

for the entire sentence. Besides, there are two rules for cases when multiple such symbolic cues occur in the sentence: (1) when emotion categories of the detected emoticons (or abbreviations) are the same, the higher intensity value is taken for this emotion; (2) when they are different (e.g. 'sad': 0.5 and 'joy': 0.2), the category (and intensity) of the emoticon occurring last is dominant. As interjections are added to text to reflect feelings, they are analysed as well. The "!" mark, repeated punctuation and capital letters emphasize the communicated emotion, and cause its intensification.

At the *second level*, syntactical structure analysis is performed. Before parsing, non-emotional abbreviations and acronyms are replaced by their proper transcriptions found in the database. The used deep syntactical parser, Connexor Machinese Syntax [2], returns comprehensive description for analysed sentences, including word base forms, parts of speech, dependency functions, syntactic function tags, and morphological tags. From the parser output in XML style, we can read off the characteristics of each token and the relations between them in a sentence (e.g. subject, verb, object, and their attributes).

At the *third level*, the database is examined for a presence of analysed words. For each word detected, either the communicative function category is taken as a feature or the affective features of a word are represented as a vector of emotional state intensities e = [anger, disgust, sadness, fear, guilt, interest, joy, shame, surprise] (e.g. e = [0.2, 0, 0.7, 0, 0, 0, 0, 0, 0] for word "frustrated"). In the case of a modifier, the system identifies its coefficient. Since the database contains words only in their dictionary form, the emotional vector of an adjective in comparative or superlative form is multiplied by the values 1.2 or 1.4, respectively.

The purpose of the *fourth level* analysis is to detect emotion involved in phrases. We have defined general types of phrases, and rules for processing them with regard to affective content:

- adjective phrase ("extremely sad"): modify the vector of adjective;
- noun phrase ("wonderful peace"): output vector with the maximum intensity within each corresponding emotional state in analysing vectors (for instance, e1=[0..0.7..] and e2=[0.3..0.5..] yield e3=[0.3..0.7..]);
- verb plus noun phrase: if verb and noun phrase have opposite valences ("break favourite vase", "enjoy bad weather"), we consider the vector of the verb as dominant; if valences are the same, output vector with maximum intensities in corresponding emotional states for positive ("like honey"), and output null vector for negative;
- verb plus adjective phrase ("is very kind", "feel bad"): output vector of adjective phrase.

The rules for modifiers are as follows:

- intensifiers multiply or decrease emotional intensity values;
- negation modifiers such as "no" or "not", and connector "neither…nor" cancel vectors of the related words, i.e. "neutralize the emotional content";
- prepositions such as "without", "except", "against", "despite" cancel vectors of related words.

Conditional clause phrases beginning with "if", "when", "whenever", "after", "before" are disregarded by the system. Statements with words like "think", "believe", "sure", "know" and those with modal operators such as "can", "may", etc. are not considered either, because they express a modal attitude towards the proposition.

Sentence-level analysis is performed at the *fifth and final level*. In this stage, the overall affect of a sentence and its resulting intensity degree are estimated. The emotional vector of a simple sentence (or of a clause) is generated from emotional categories and their intensities resulting from phrase-level analysis. The important feature of the proposed analysis is the differentiation of the strength of the resulting emotion depending on the tense of a sentence and availability of first person pronouns. According to our proposal, the emotional vector of a simple sentence (or of a clause) is multiplied by the corresponding empirically determined coefficient of intensity correction. (Details are given in [5]).

The resulting vector of a compound sentence is estimated depending on a coordinate connector.

After the dominant emotion of a sentence is decided, parameters are sent to animation engine.

CONCLUSION

In this paper, we described a syntactical approach to textual affect sensing. Developed system employs a deep syntactical parser for sentence structure analysis, and is capable to recognize affect from informal text messages at different levels, including symbolic cue analysis and word/phrase/sentence-level analysis. Detected affective states, as well as communicative functions, can be visualized by animated 2D avatar, contributing thus to greater expressiveness of online communication.

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