A Preliminary Research of Chinese Emotion Classification Model

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Summary
There have been some studies about spoken natural language dialog, and most of them have successfully been developed within the specified domains. However, current human-computer interfaces only get the data to process their programs. Aiming at developing an affective dialog system, we have been exploring how to incorporate emotional aspects of dialog into existing dialog processing techniques. As a preliminary step toward this goal, we work on making a Chinese emotion classification model which is used to recognize the main affective attribute from a sentence or a text. Finally we have done experiments to evaluate our model.
Key words:
Emotion thesaurus, Emotion Classification, Image Value.

1. Introduction

The latest scientific findings have indicated that emotions lead an important role in human intelligence, such as decision-making, inter-communication and more. Researchers like Picard have recognized the potential and importance of affect to human-computer interaction, dubbing work in this field as 殿 ffective computing_ [1].Recent research has placed more emphasis on the recognition of nonverbal information, and has especially focused on emotion reaction. Many kinds of physiological characteristics are used to extract emotions, such as voice, facial expressions, hand gestures, body movements, heartbeat and blood pressure. In order for intelligent user interfaces to make use of user affect, the user's affective state must invariably first be recognized or sensed. Especially, affective information is pervasive in electronic documents, such as digital news reports, economic reports, e-mail, etc. With the help of natural language processing techniques, emotions can be extracted from textual input by analyzing punctuation, emotional keywords, syntactic structure, and semantic information. [2] It follows that the development of robust textual affect sensing technologies can have a substantial impact in trans-forming today's socially unkind text-based user interfaces into socially intelligent one.

In this paper, we use verbal information to make a model to acquire emotional information from text with the constructed thesaurus and to recognize the textual sensing of Chinese in a semi-automatic way. We classify the emotion of vocabulary into 12 basic emotion categories, then we give an affect sensing model and give a detailed introduction of all the parts in this model.

This paper will continue as follows, in section 2 we show how emotion words are classified, in section 3 there is an emotion classification model made and we experimented on our system, and gave an evaluation in section 4 and finally we go to the part of conclusion. We believe this research not only can be valuable for Chinese deeper understanding but also can do some help to our Chinese teaching for foreigners.

1.1 Chinese Natural Language Processing

NLP is a subfield of artificial intelligence and linguistics. It studies the problems inherent in the processing and manipulation of natural language, and, natural language understanding devoted to making computers "understand" statements written in human languages. The major tasks of NLP are text to speech, speech recognition natural language generation, machine translation, question answering, information retrieval, information extraction, text-proofing, automatic summarization etc.. In the last few years some researchers begin to pay attention to the emotion recognition in NLP. In American and Japan some researchers have begun to do some work about affect and they have gotten great achievements in natural language such as the famous MIT Media laboratory they work on with English, Tottori University some people work on with Japanese. There is also some progress in Chinese.

Computer application on Chinese NLP is still on the starting stage. The main difficulty is the lack of a comprehensive electronic Chinese thesaurus as a tool to help for analysis. The fundamental element of constructing a system which has the ability to sense the emotional information is the vocabulary that make up a sentence. We consulted many dictionaries for the information of affect such as xiandaihanyu dictionary, hanyuxingrongci dictionary, etc. In these dictionary resources we find the embodied knowledge is almost the same including phonetic, part of speech, semantic, examples and sentential component etc.

2. Emotion Word Classifying

Research on emotion is dogged by ad hoc selections of emotions to work with. There is no agreed benchmark, in the form of a range of emotion terms that a competent system should be able to apply. Without that, it is impossible to assess the performance of emotion detection systems in a meaningful way. In the past emotion has been divided into two categories by some people: pleasure / displeasure. But the classified pleasure/displeasure is too ambiguous to consider the user's emotion.

In psychology and common use, emotion is an aspect of a person's mental state of being, normally based in or tied to the person's internal (physical) and external (social) sensory feeling. Love, hate, courage, fear, joy, sadness, pleasure and disgust can all be described in both psychological and physiological terms.

In contemporary Chinese the emotion word based on psychology and susceptibility can be divided into 24 kinds [3]. But in all these kinds of emotions there are only part of them being used in our everyday life. We are trying to identify the main compounds (if such they are) that actually occur in everyday life. We have done that by trying to identify a relatively small vocabulary of words that people regard as sufficient to describe most emotional states and events that are likely to occur in everyday life. Using the 7 universal emotion categories defined by Ekman[4], and plus some categories which we have identified important in our research, such as nervous, regretful, love, for the reason of their frequency of being used, and strong sensation. Here we classified emotion into 12 categories. When there is no emotion we call this state equable. The kinds of emotion are shown in the Table 1.

Table 1: 13 kinds of emotion.

Emotions			
Love	Sad	Fearful	Disgusted
Angry	Surprised	Love	Expectant
Nervous	Regretful	Praiseful	Shy
Equable			

3. Emotion Classification Model

The most popular method for performing emotion recognition from text is to detect the appearance of emotional keywords. Generally, not only the word level but also the syntactic and semantic levels may contain emotional information. We make a model of sentence analyzing system. The flow chart is as (Fig1). In our

model there are five parts. They are: Lexical analysis, Syntax analysis, Emotion sensing, Emotion tagging, and Emotion computing. In this model two kinds of database are included in, because they are the basic elements of our research.
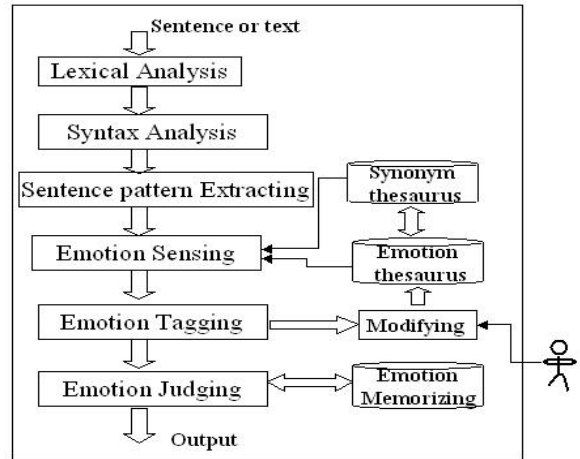

Fig. 1 Flow chart of the emotion classification model.

3.1 Lexical Analysis

In this part we select the ICTCLAS system for our research. Because it is considered to be one of the best lexical analyzers in the Chinese natural language with the high segmentation accuracy reaching to 97.58%. Basing on the Chinese Lexical Analyzer named ICTCLAS (Institute of Computing Technology, Chinese Lexical Analysis System) of using hierarchical hidden Markov model (HHMM). [5] As everyone know, Hidden Markov model (HMM, L.R. Rabiner, 1989)[6] has become the method of choice for model-ing stochastic processes and sequence in natural language processing, because HMM is very rich in mathematical structure and hence can form theo-retical basis for use. However, compared with the sophisticated phenomena in natural language, traditional HMM seems hard to use due to the multiplicity of length scales and recursive nature of the sequences. Therefore Shai Fine et al (1998)[7] proposed hierarchical hidden Markov model, which is a recursive and generalized HMM. They apply to word segmentation class-based HMM, which is a generalized approach covering both common words and unknown words. Suppose |LEX| to be the lexicon size, then the total number of word classes is |LEX|+9.

This Chinese lexical analysis is based on Shai's work given a formal description of HHMM. For convenience, they also use the negative log probability instead of the proper form. That is:

$$W^{\#} = \arg\min_{W} \sum_{i=1}^{m} [-\ln p(y_i \mid x_i) - \ln p(x_i \mid x_{i-1})] \quad (1)$$

According to the word class definition, if y_i is listed in lexicon, then x_i is y_i, and p($y_i \mid x_i$) is equal to 1.0. Otherwise, p($y_i \mid x_i$) is probability that class x_i initially activates y_i, and it could be estimated in its child HMM for unknown words recognition [8].

3.2 Syntax Analysis

This part is inspired by the model of the structural context conditioned probabilistic parsing put forward by the Institute of Computing Technology. There are three probabilistic parsing models, which are successive augmentations of the conventional PCFG(probabilistic context-free grammar) . In this sequence of models outlined, wider and wider structural context is taken as the conditioning events to condition the derivations.

Before emotion classification, there is another important point of our system we have to mention in advance. It is how to construct a database to ensure our system runs smoothly.

3.3 Database Construction

Computer application on Chinese NLP is still in the starting stage. The main difficulty is the lack of a comprehensive electronic Chinese thesaurus as a tool to help for analysis. Thus, to overcome the problem we mentioned above, we intended to construct a machine tractable and readable Chinese emotion thesaurus to help the analysis of Chinese NLP.

Here we constructed a database filled with emotional information of Chinese words in order to help the next part of emotion sensing. On the other hand, due to needing a thesaurus to acquire directly the emotional information of a word we also make this database able to be used singly as a thesaurus. There are about 4800 words collected from various dictionaries such as 鼎 hangYong BaoBianYi XiangJie dictionary_ [6] and People's Daily tagging corpus of the Institute of Computational Linguistics of Peking University. For each emotional word, the corresponding emotion descriptor is manually defined. The emotion descriptor is a set of descriptions of the emotion reactions corresponding to the keywords. Basically, it contains an emotional state label and an image value, which ranges from –2 to 2.

Database Structure. Base on the statistics result in People's Daily tagging corpus of the Institute of

Computational Linguistics of Peking University, the word emotional trends are described and formulized in our dictionary. When constructing the database of emotional information we select the phonetic, part of speech, the image value, and the category of emotion is called emotional attribute. Sometimes the word is not only in one of the 12 categories of emotion, it is in two or three kinds of those emotions. In such an instance every emotion is recorded in our dictionary. Especially in our research, we define the concept of 妬 mage value_ that is used to express the affective intensity of the emotional words. Many authors agree that emotions can be organized roughly into a two-dimensional space whose axes are evaluation (i.e. how positive or negative the emotion is) and activation (i.e. the level of energy a person experiencing the emotion is likely to display) [9]. That provides a useful basic continuum in which to embed emotion words. Worse than negative or better than positive we defined it as derogatory or commendatory and between them we use neutral as a median. Here are the five levels we have defined:

derogatory -> negative -> neutral -> positive -> commendatory

3.4 Emotion Classification

Emotion classification has four processes consisting of sentence pattern extracting, emotion sensing, emotion tagging and emotion judging. Firstly, the sentence pattern will be extracted from the sentence which had been syntactically analyzed. Then how many emotion words in the sentence will be calculated and with this result the selected words will be tagged with the emotion attribute. At last, there will be a judgment of the sentence, which will express the central emotion of the whole sentence.

Sentence Pattern Extracting. From the results shown in 4.2, we found it is difficult to recognize emotion if the Sentence pattern is not examined. We also found in different sentence patterns, headwords to be extracted are different. For instance, S+V+P pattern 天_ is used as copular, such as 都 hi(是) _, 徒 anqilai(看起来) _, 塗 aoxiang(好像) _,and so on. So the 撤_ composition of the sentence will be the main part expressing emotion. We look at this 撤_ part as our studying point. That is to say the final emotional state is determined based on all emotional keywords which are estimated based on the emotion thesaurus which is a collected emotion corpus we have made. There is also another element in syntax analysis. Conjunction plays a very important role in analyzing emotion sentences. From the grammatical knowledge-base of contemporary Chinese, we classify the connectives into six categories from 97 conjunctions. They

are: parataxis, transition, concession, alternative, hypothesis and causation.

Emotion Sensing. Basing the part of 撤_ mentioned in the section above we can use our database to recognize the emotion category of the sentence in the text. Sometimes there are more than one main word. All these main words are evaluated by their image values, and the average will determine the characteristic of the sentence. The accuracy of this type of sentence can reach 90%. The result of our first step proves our research is effective and feasible. On the other hand, in analyzing complicated sentences relying on The Grammatical Knowledge-base of Contemporary Chinese published by Peking University is also considered to be a good way. By using the grammatical knowledge-base we can get to know which word can be used in which sentence pattern basing on the component of the word.

One more thing we have done is use the synonym thesaurus made by the Information Retrieval Laboratory of HIT (Harbin Institute of Technology University) in order to reduce the query of words, because words can be well classified.

Emotion Tagging. For every possible emotional word and its related intensity, the system also requires particular marks. Unless there is an emotional word in the sentence, all of the sentences will be disregarded. If the emotional word refers to the person himself / herself and it is referring to present continuous, then the parser might generate the output.

After the part of emotion sensing having been analyzed, this part of emotion tagging will apply the result of the Lexical Analysis part which splits sentence into words and detects through the emotion thesaurus to find the corresponding tag category of each word. In the following, tag all the emotional keywords by the image values and the features of emotion. There are five levels in that value form –2 to +2.

In a general way there is more than one emotional keyword in the sentence and all the keywords we have selected have an image value and are arranged in succession according to the order of appearance by the reference frame graph.

Emotion Judging. To extract the emotional state from the text, we assume that every input sentence includes one or more emotional keywords and emotion modification words. The final emotional state is the combination of the three outputs: the emotion descriptors of the emotional keywords, the image values of the emotion keyword and the memory graph of the context sensitivity. Using the image value and memory graph of the keywords which

have been tagged over, we can consider the average value of sentences inputted as the sentence's image value. By considering the memory curve of context sensitivity we can also get the emotion features of the sentences. First, we gather all the kinds of the emotion appeared in sentences according to the result of Emotion Tagging. Using the context-sensitive knowledge we can eliminate the most impossible emotion and sort out several kinds of most primary emotions, then finish the part of emotion computing and get the result of computing. Commonly the result is not only the singleness of one kind of emotion, but the admixture of several kinds of emotion.
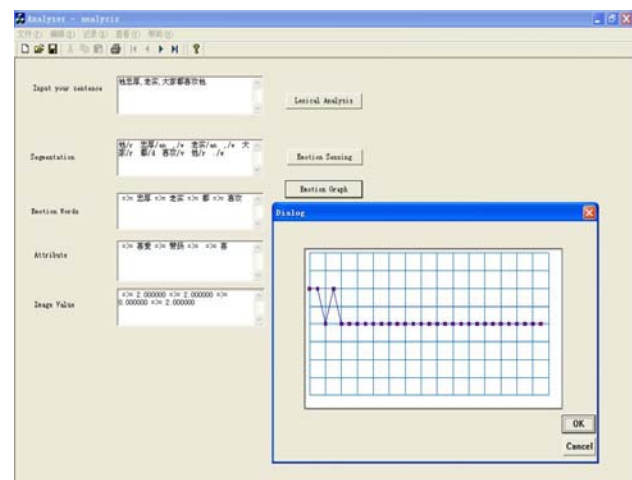

Fig. 2 Interface of emotion classification model.

The interface of our model is shown in Fig.2 above. People can catch an intuitionistic image from the figure.

4. Experiments and Evaluation

In order to indagate the correct extent of our system we have done two kinds of experiments. One is about the emotion definition extracted from the sentences. The other one investigated the definition of the emotion extracted from the text.

4.1. Emotion classification from sentence

News (http://www.people.com.cn/) (about 410 sentences) pulled out from web is as testing data used to the system which we have constructed, and the experiment that classify emotions from every one sentence was done. Whether the output of our system is correct is checked by person manually. Here is the table:

Table 2: The accuracy of our model on sentence.

	Sentence pattern	Sentences
Sentences (Emotional expression is contained.)	" · hi(是) · h : 120 " · ou(有) · h : 30 Others : 50	200
Number of correct answers	" · hi(是) · h : 110 " · ou(有) · h : 25 Others : 25	160
Number of incorrect answers	" · hi(是) · h : 10 " · ou(有) · h : 5 Others : 15	30
Number of indetermination	" · hi(是) · h : 0 " · ou(有) · h : 0 Others : 10	10

From Table 2. we can see the accuracy is divided into three parts according to the sentence pattern. In Chinese sentence pattern 套 you · is like the 套 is · sentence pattern of English. This pattern is used to show speaker's view, opinion, and attitude chiefly. The predicate usually used to express the explanation and the explanation to the subject. When emphasizing or concluding, a hard will is expressed, sometime a soft tone or a euphemistic tone is also shown. The result of the experiment obtained by " · hi_" sentence pattern was very high, and the accuracy can reach to 92%(110/120).

Successful examples:
1. 今天的报告真是太精彩. (Today's lecture was indeed wonderful.) output-->praiseful
2. 这真是件好事. (This is really a good thing.) output-->happy

Faulty example:
这孩子淘气是淘气,可并不是一点也不听话. (This child is persuasible although he is naughty.) output-->praiseful correct answer-->love

The meaning of sentence pattern 套 you · in Chinese is same like the pattern of 镀 here is/are 俳 r 都 b./sth. has/have_. _. This is also a sentence pattern which expresses the attribute of the subject and has the secondary accuracy reaching to 83.3%.

Successful examples:
1. 教书这个工作很有意义. (Teaching is a meaningful work). output-->praiseful
2. 这家伙有一肚子坏水.(He has lots of evil plans in his brain) output-->disgust

Faulty example:

去年国民收入有了增长. (National income has increased last year.) output-->equable   correct answer-->happy

There is a possibility that the judgment is not accurate when the particle is modified by the adverb and put in the last.

From this experiment we can find that the system can not interpret from the character when vague information came out, so there are often sentence that was not able to be understood. The ability of man "Common sense" is necessary.

4.2. Emotion Classification from Text.

Various kinds of information were selected from the internet (http://www.people.com.cn, http://www.sina.com.cn/) for our experiment. In this experiment we will test the accuracy of emotion classification when the resources are the texts including more sentences than one. In those 250 texts we find three kinds of information stand out from the others.

Table 3: Accuracy of our model on text.

Sentences	Kind of text	Number
Randomly selected	News Business Story	100 80 70
Emotional expression is contained.	News Business Story	78 45 57
Number of correct answers	News Business Story	69 37 31
Number of incorrect answers	News Business Story	9 8 26
Accuracy	News Business Story	88.5% 82.2% 54.4%

The result of this experiment is also divided into three on the type of the text. From the experiment the highest accuracy is from the news type of the text that can reach to 88.5%. In the successful results, the received accuracy when emotional words in the text which have the same emotion attribute is higher than that emotion caused phenomenon was included in the text. The most difficulty in emotion analyzing text is when there are several kinds of emotion in judging which ones play the strong role but in news and business such trouble like above is few and the alteration of emotion is also few, so the result is not confused by them. It is why the accuracies of them are higher.

5. Conclusion

In this paper we have firstly talked about our emotion thesaurus and how we constructed it, then we using the already constructed thesaurus as our emotion database constructed the emotion classification model which was used to conjecture the emotion one or more in the sentence or text and whether is positive or negative the text or sentence is used to express. At last we have done two experiments and from the results we work on evaluation.

So far we have outlined is in order to prove the model we have tried constructing is feasible and useful although now is on the preliminary stage. This research can be used in special domain such as E-mail quick look user can chose which mail he needs to read firstly. We also think it could be used for the language applications someday in the future.

Acknowledgments

Insert acknowledgment, if any.

References

[1] Picard, R. W.: Affective Computing, The MIT Press, Mass., 1997.

[2] Subasic, P. and A. Huettner: 鄭 ffect Analysis of Text Using Fuzzy Semantic Typing,_ IEEE Transactions on Fussy System, vol. 9, no. 4, 2001, pp.483-496

[3] Xiaoying Xu，Jianhua Tao: 摘 motion dividing in Chinese emotion system_ The 1st Chinese Conference on Affective Computing and Intelligent Interaction(ACII'03)， 8-9 December, 2003 Beijing China pp.199-205, 2003

[4] Ekman, P., Friesen, W.V., and Elsworth, P.: (1982) Research foundations In P. Ekman (Ed.), Emotions in the Human Face. London: Cambridge University Press

[5] HuaPing Zhang et al 鼎 hinese lexical analysis using Hierarchical Hidden Markov Model_ Second SIGHAN workshop affiliated with 41th ACL; Sapporo Japan, July, 2003,pp.63-70

[6] L.R. Rabiner. 鄭 Tutorial on Hidden Markov Models and Selected Applications in Speech Recognition_. Proceedings of IEEE 77(2), pp.257-286

[7] Shai Fine, Yoram Singer and Naftali Tishby. 典 he hierarchical Hidden Markov Model: Analysis and applications. Machine Learning, 32(1), July 1998 "

[8] Xianzhen Guo, Chang Yong: BaoBianYiXiangJie dictionary 1996   The Commercial Press

[9] Plutchik, R.: The psychology and biology of emotion. Harper Collins, New York, p.58, 1994

[10] Changle Zhou，Mental Computing, pp147-176, 2003.3

[11] Shiwen Yu, Xuefeng Zhu et al: The Grammatical Knowledge-base of Contemporary Chinese – A Complete Specification Tsinghua University Press Apr 1998

[12] Hugo Liu et al 鄭 Model of Textual Affect Sensing using Real-World Knowledge_ Proceedings of the 2003 International Conference on Intelligent User Interfaces, IUI 2003, January 12-15, 2003, Miami, FL, USA. ACM 2003, ISBN 1-58113-586-6, pp. 125-132.

[13] Cowie, R. Douglas-Cowie, et al 摘 motion recognition in human-computer interaction_ Signal Processing Magazine, IEEE Jan 2001 Volume 18, pp. 32-80

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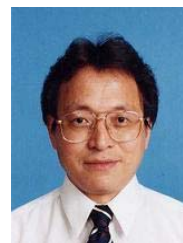
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