The Creation of a Chinese Emotion Ontology Based on HowNet

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Abstract

Full comprehension of language comes about by understanding the meaning and the emotion behind the communication. Understanding the meaning of language is the goal of natural language processing and research on semantic analysis. Understanding emotion is one of the goals of affective computing. The two areas of artificial intelligence have recently come together for understanding emotion in text. In order to help in this pursuit, this paper describes a Chinese emotion ontology based on HowNet and its construction. The ontology should go a long way in helping to understand, classifiy, and recognize emotion in Chinese. The ontology created in this paper is made up of Chinese emotion predicates that can help in understanding the emotion of the actors in sentences. The ontology was semi-automatically created using a simple three step process. The final ontology has just under 5,500 verb predicates covering 113 different emotion categories.

Keywords: Affective Computing, Natural Language Processing, Ontology, Emotion

1 Introduction

Effective communication between humans is only accomplished when both the meaning and the emotion of the communication are understood by all parties involved. Likewise, for machines to truly understanding language an understanding of both meaning and the emotion behind the language is needed. Understanding the meaning of language has widely been studied in natural language processing in the form of semantic analysis.

Until recently researchers have ignored the emotional message behind the communication. However, the understanding and expression of emotion is not only important for humans, but is also critical for human-computer interaction. Affective computing is a relatively new area of artificial intelligence that was created to deal with the understanding and expression of emotion. Recently, affective computing and natural language processing have come together as researchers see the need to understand the emotion behind language.

After the need for emotional understanding was seen, a good deal of research was done. English, especially has seen an increase in the research done over the past few years. Obrenovic et al. designed a predicate-based emotion ontology for English [9]. Bracewell et al. designed a simple emotion estimation system for English news articles [2].

Chinese, as well has seen research done in the past few years. Yu et al. examined detecting emotion in speech [12]. Wu et al. looked at using semantic labels and mixture models for recognizing emotion [11]. Even with all the research done there is still not many resources available like dictionaries, corpora, ontologies etc.

One resource that is much needed in solving the problem of emotion understanding is an ontology. Ontologies can help in determining the structure of knowledge and are often times the basis for knowledge based systems [3]. An emotion ontology can define the structure of emotion and can help determine the interaction of emotions. Moreover, the ontology can be extended by adding information such as semantic roles and the emotion they carry for verbs.

As such, this paper will describe an emotion ontology that was semi-automatically created using HowNet. HowNet is a Chinese lexical dictionary, which describes the inter-conceptual relations and inter-attribute relations among words and concepts as a network [4]. Using the event hierarchy in HowNet an emotion ontology is semi-automatically created. The final ontology contains 5,498 verb concepts.

This paper will continue as follows. First, in section 2 background information on emotion and related work will be discussed. Then, in section 3 the creation process is examined in detail. Next, in section 4 the results of manually evaluating the created ontology are given. Finally, in section 5 future work is discussed and concluding remarks made.

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2 Background

This section will take a look at some of the research done on emotion in different areas. First, the expression of emotion will be looked at to demonstrate why verbs are important. Then, the basic emotions will be examined and the reasons for choices this paper made discussed. Finally, a look at some of the work on emotion classification will be examined to show what researchers in this area have done.

2.1 The Expression of Emotion

Commonly, in cognitive psychology, emotion is defined as a mental state or a feeling that arises subjectively rather than through conscious effort. It is often accompanied by a transition in mental state when stimuli happens in the environment, such as joy, sorrow, respect, hate, love, etc. that reflects the personal affective event. The mental states and feelings are often expressed using nouns and adjectives in language. While they are important, the affective events are what cause the mental states and typically give the mental state and feeling of the actors. As such, they make a good first choice in dealing with emotion. Affective events are expressed as verbs in language. Therefore, understanding the emotion portrayed in verbs is necessary.

2.2 Basic Emotions

Since ancient Greek times philosophers, psychologists, etc. have debated what the basic human emotions are. Even with the heated debates that have take place there is still no prevailing theory and perhaps there never will. Because of this, researchers often find themselves choosing basic emotions that fit their current goals. Recognition, understanding and simulation of emotion close to humans' real feelings is what is needed to improve human-computer interaction.

The ontology presented in this paper is based on HowNet. To that end the basic emotions are also drawn from HowNet. In total there are 113 basic emotions. Leaving the ontology with this large number of basic emotions may be useful for the future as it is easier to combine emotions into one category than it is to split categories into smaller ones. As such, we believe, the ontology can be used when both a coarse and fine grain set of emotions are needed. This allows for simple applications that do not need the full expressiveness of human emotion and for the more complicated and desired applications of human-computer interaction.

2.3 Emotion Classification

Most of the research on emotion analysis has been done on the applications of machine learning to emotion classification. Much of the research done has used varying theories of emotions and as such different basic emotions. In [7], six basic emotions of anger, disgust, fear, joy, sorrow and surprise were used to classify facial expressions with Support Vector Machines. In [5], three emotion components, Valence (positive, neutral, negative), Activation (excited, neutral, calm) and Dominance (weak, neutral, strong) of spontaneous emotional speech utterances were used for emotion classifier estimation. [6] reported the progress in the classification of expressions of emotion in network-based chat conversations with 8 emotion tags (Neutral, Angry, Sad, Afraid, Disgusted, Ironic, Happy, Surprise). [8] did experiments with mood classification in blog posts in which top 40 occurring moods were tested. [10], used the primary emotion ontology proposed by [1], which has 38 categories defined and from which more complex combinations can be constructed.

3 Ontology Creation

Emotions have been used throughout human existence to enhance the expressiveness of language. Affective computing is involved with understanding the emotion and even creating emotion. However, this is still a difficult task, because emotion is a mental state that is difficult to describe and human emotion changes easily and quickly due to the effects of complex external stimuli. In order to have a deeper understanding of emotion, especially in text, an emotion ontology is needed. An emotion ontology will help in recognizing, classifying, and understanding emotion.

In this paper, an emotion ontology for Chinese is semi-automatically created using HowNet. HowNet is a Chinese lexical dictionary that describes the inter-conceptual relations and inter-attribute relations among words and concepts as a network [4]. HowNet is as widely used in Chinese natural language processing applications as WordNet is in English. Because of its importance and wide spread use, it makes a good basis for creating an emotion ontology.

An overview of the proposed approach can be seen in figure 1. The first step is to extract the affective event hierarchy from HowNet's event dictionary. The resulting affective event hierarchy contains event information such as the semantic roles that the event can have. After the affective hierarchy is extracted, emotions are manually assigned to the semantic roles of the events. This hierarchy of predicate structures with emotion information assigned is called the emotion predicate hierarchy. Finally, using the 120,496-words-scale knowledge dictionary in HowNet, verbs are automatically assigned to the emotion predicate hierarchy resulting in the final emotion ontology.

The following subsections will examine each of the parts of the approach in detail. First, how to extract the affective predicate hierarchy will be discussed. Then, how to transform the affective predicate hierarchy into an emo-

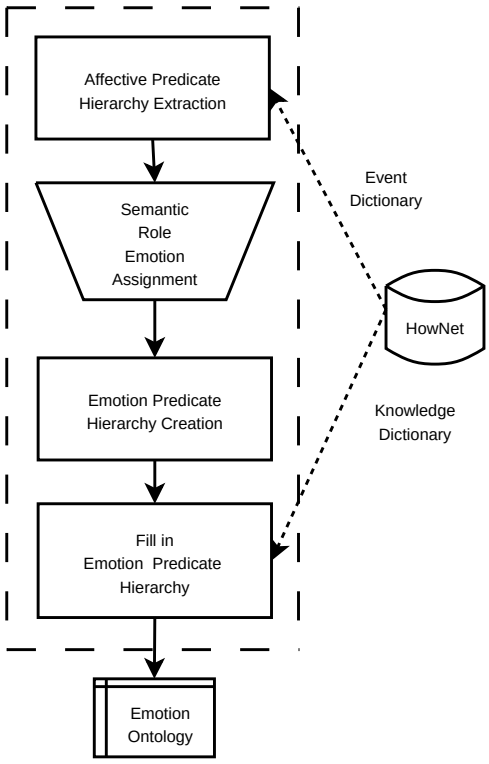

Figure 1: Overview of Proposed Approach

tion predicate hierarchy will be explored. Finally, how to create the final emotion ontology will be shown.

3.1 Affective Predicate Hierarchy Extraction

The first step in creating the HowNet based emotion ontology is to determine where affective information is stored in HowNet. To do this, we start at the top of the event hierarchy and work our way down. HowNet defines events as either being "static" or "act."

First, the "static" event hierarchy is examined. It contains both "relation" and "state." The "relation" event contains no affective information and as such is ignored. However, underneath the "state" event, there are physical states and mental states. The mental state (StateMental) includes "feeling," "Attitude," "volition" and "recognition" and was extracted as a part of the affective predicate hierarchy.

Next, the "act" event hierarchy is examined. Going down in the hierarchy an "AlterMental" event can be found. The "AlterMental" event includes "AlterEmotion", "ShowEmotion", "Alterknowledge" etc. The "AlterMental" event and its affective sub-events were extracted and added to the affective predicate hierarchy.

For our goals, the "StateMental" and "AlterMental" events make a good top level hierarchy for describing emotional events. As such, these affective predicate hierarchies along with their semantic role information were extracted for inclusion into the emotion ontology. In total, 113 affective predicates were obtained from HowNet's event dictionary. Figure 2 shows a tree representation of the the hierarchy.

Figure 2: Affective Predicate Hierarchy

3.2 Transformation into an Emotion Predicate Hierarchy

The next step is to transform the affective predicate hierarchy into an emotion predicate predicate hierarchy. This is done by assigning emotion information to the semantic roles of the affective predicates. The next few paragraphs will examine this process. First, the tag set used is dis-

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cherish|心怀            {experiencer (cherish), content (NULL)}
excited|激动            {experiencer (excited), ~degree (NULL), cause (desired)}
FeelingByGood|好情      {experiencer (FeelingByGood), ~degree (NULL), cause (desired)}
AtEase|安心             {experiencer (AtEase), ~degree (NULL), cause (desired)}
joyful|喜悦             {experiencer (joyful), ~degree (NULL), cause (desired)}
GuiltilyConscious|心虚  {experiencer (GuiltyConscious), ~degree (NULL), cause (undesired)}
love|爱恋               {experiencer (love), target (happy|desired), cause (desired)}
disgust|厌恶            {experiencer (disgust), target (sorrowful|undesired), cause (undesired)}
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Figure 3: Example Emotion Predicates

cussed. Then, the guidelines for tagging are given.

3.2.1 Emotion Tag Set

Three types of tags are used in assignment: emotion, optional, and NULL. The emotion tags, i.e. emotion categories, are chosen from the 113 predicates in the affective predicate hierarchy. The tags are only assigned to emotion capable entities like agents, experiencers, etc. The optional tag is made up of two categories: "desired" and "undesired." They are assigned to roles that, while not having any sense of emotion, make suggestions to whether the object, event, etc is desired or not desired by the subject. NULL tags are assigned to roles that have no emotion.

3.2.2 Tagging Guidelines

A set of rules were designed so that the tagging could be consistent from predicate to predicate. In total five rules were created and are shown below.

1. For each predicate in the hierarchy, annotation is done using the simplest and most general form that fills the semantic roles, i.e. "$\arg_1$ + verb + $\arg_2$ + $\arg_3 + \cdots +$ $\arg_n$." In every sentence $\arg_1$ is assumed to be the sentence's subject.
2. Emotion tags are only assigned to semantic roles that can be filled by animate beings.
3. The emotion of the subject's semantic role is typically the looked at affective predicate.
4. The emotion of non-subject animate being semantic roles are determine based on the most general case and are not necessarily the same as the subject.
5. Non-subject inanimate being semantic roles do not have emotion tags, but can have an optional tag based on its interaction with the subject.

The first rule states that the most simple and general case of each predicate is examined. The second rule simply states that only the semantic roles that can be filled by animate beings will have emotion assigned. Examples of such roles are agent, experiencer, patient, target, etc. The third rule states that in most cases the emotion of the subject is that of the predicate, i.e. if the verb is love then the emotion of the subject is "love." The firth rule states that non-subject animate being's emotion is based on the most general case of the predicate and may not be the same emotion as the predicate. For example, the emotion of the target of "laugh at," in the most general case, is "sad." In other situations it is possible that the emotion would be different, but only the most general case is examined. The final rule states that inanimate beings cannot have emotion tags. Figure 3 shows some examples of the emotion predicates.

3.3 Creating the Final Emotion Ontology

Creating the final emotion ontology is done in two steps. The first step is to fill in the ontology with verbs from HowNet's knowledge dictionary. The second step is to manually assign emotions to predicates whose semantic role information differs from its parent's.

To fill in the ontology, HowNet's knowledge dictionary which is made up of 120,496 words is used. Each of the words has a list of sememes defined. The first sememe in the list represents its basic meaning. In this paper, the focus is on emotion predicates and as such only the verbs are examined. The knowledge dictionary contains 44,699 verbs. Each of these verbs are examined to determine if they should be included in the ontology. Two rules, shown below, are used in determining where, if any, in the ontology the verb should be placed based on the first sememe of the verb.

1. If the verb's sememe matches a predicate in the emotion predicate hierarchy, then the verb will be assigned as a child node and will inherit the semantic roles and emotion tags of the parent.
2. If the verb's sememe does not match a predicate in the emotion predicate hierarchy, but one of the predicates is included in the verb's definition, then the verb will be assigned as a child node and will inherit the emotion of the subject only.

The first rule is the easiest and results in full inheritance. The second rule is more difficult in that the verb is usually an action that has as a side effect emotion. Figure 4

Word	Definition with Sememe
怒视	look|看, manner=angry|生气
发话	speak|说, manner=angry|生气
叹惜	sigh|叹气, cause=repent|懊悔
叹惋	sigh|叹气, cause=repent|懊悔
解围	rescue|救助, StateIni=embarrassed|为难
刮目相看	enjoy|享受, content=respect|敬佩
乞怜	request|要求, ResultEvent=pity|怜悯
摇尾乞怜	request|要求, ResultEvent=pity|怜悯
深表同情	ShowEmotion|表示情感, content=pity|怜悯
解恨	remove|消除, patient=hate|仇恨
记仇	cherish|心怀, content=hate|仇恨
记恨	cherish|心怀, content=hate|仇恨
饮恨	cherish|心怀, possession=hate|仇恨
慰劳	SayHello|问候, means=soothe|安慰
畅谈	speak|说, manner=joyful|喜悦

Figure 4: Examples of Indirectly Inherited Predicates

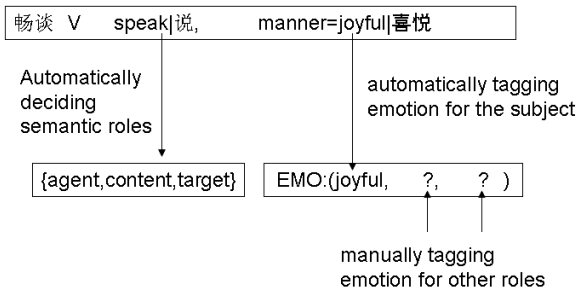

Figure 5: Sample of Assigning Emotion to Complicated Verb Definition

shows some of these verbs. For example, the last word is defined as "speak, manner=joyful." The second sememe describes that the manner of the speaking which has a side effect of being a "joyful" emotion. In order to make the ontology more complete, such words must be added. However, these verbs cannot inherit the semantic roles of their parent. Instead their roles are extracted from HowNet using the first sememe and only the emotion of the subject can be automatically assigned.

Figure 5 shows an example of using the second rule. The sematic roles are taken from the predicate "speak" resulting in agent, content, and target. The subject of the predicate, in this case "agent," is automatically assigned "joyful" as its emotion tag. The remaining semantic roles are left to be manually tagged.

After completing these two steps, a total of 5,498 verbs were added to the emotion predicate hierarchy to create the final ontology. 5,326 of these verbs followed rule 1 and had their semantic roles and emotions automatically assigned. 172 of the verbs were of type 2 and had their emotions manually assigned.

4 Evaluation

It is difficult to accurately evaluate an ontology. In this paper, a manual evaluation of the ontology was performed. All 5,498 verb concepts were examined to determine if they were indeed affective verbs and were in the correct place in the ontology. The manual evaluation found that all verbs were indeed affective and in the correct place. This was to be expected as the creation process used a controlled knowledge source, HowNet, which allowed an errorless extraction of the emotion ontology.

5 Conclusion and Future Work

In this paper, an approach for semi-automatically creating an emotion ontology using HowNet was presented. The emotion ontology has a large number of possible applications and can be used within a coarse or fine grain view of emotion. The process started by identifying the affective predicate hierarchy in HowNet and extracting it. The next step was to assign emotions to the semantic roles of the extracted predicates creating an emotion predicate hierarchy. The final step was to transform the emotion predicate hierarchy to an emotion ontology by filling the hierarchy with the verbs from HowNet's knowledge dictionary. In the end an ontology containing just under 5,500 verb concepts was created.

There are many possibilities for future work. First, we wish to extend the hierarchy by adding other parts-of-speech like nouns, adjectives and adverbs. We would also like to examine the use of the ontology in classifying the emotion of the actors in sentences and the overall sentence.

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