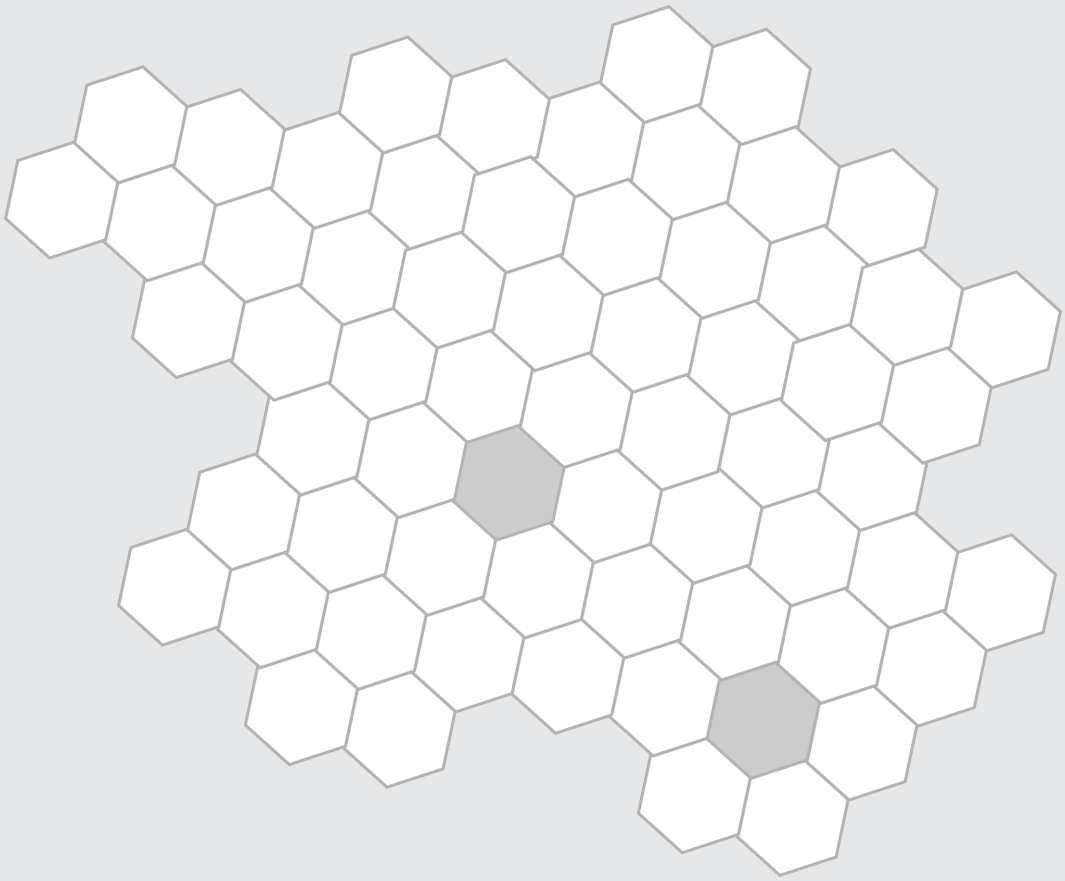
International Journal on

SOCIAL MEDIA

MMM: Monitoring, Measurement, and Mining



II, 2011, 1–2
ISSN 1804-5251

...OFFPRINT...

International Journal on SOCIAL MEDIA

MMM: Monitoring, Measurement, and Mining

II, 2011, 1–2

Editor-in-Chief: Jan Žižka

Publisher's website: www.konvoj.cz
E-mail: konvoj@konvoj.cz, SoNet.RC@gmail.com
ISSN 1804-5251

Development of Japanese WordNet Affect for Analysing Emotions in Text

Yoshimitsu Torii
Precision and Intelligence Laboratory, Tokyo, Institute of Technology, 4259 Nagatsuta-cho, Midori-ku,, 226-8502 Yokohama, Japan
e-mail: torii@lr.pi.titech.ac.jp

Dipankar Das
Department of Computer Science and Engineering, Jadavpur University, 188, Raja S.C. Mullick Road, 700032 Kolkata, India
e-mail: dipankar.dipnil2005@gmail.com

Sivaji Bandyopadhyay
Department of Computer Science and Engineering, Jadavpur University, 188, Raja S.C. Mullick Road, 700032 Kolkata, India
e-mail: sivaji_cse_ju@yahoo.com

Manabu Okumura
Precision and Intelligence Laboratory, Tokyo, Institute of Technology, 4259 Nagatsuta-cho, Midori-ku,, 226-8502 Yokohama, Japan
e-mail: oku@pi.titech.ac.jp

Abstract

This paper reports on the extended task of analysing emotions in Japanese based on sense weight based scoring techniques. The previous attempt was carried out in developing Japanese *WordNet Affect* from the English *WordNet Affect* lists with the help of English *SentiWordNet* and Japanese *WordNet*. Expanding the available synsets of the English *WordNet Affect* using *SentiWordNet*, we performed the translation of the expanded lists into Japanese based on the synsetIDs in the Japanese *WordNet*. A baseline system for emotion analysis of Japanese sentences was developed based on the Japanese *WordNet Affect*. The incorporation of morphology also improved the performance of the system. Overall, the system achieved average *precision*, *recall* and *F-scores* of 32.76%, 53% and 40.49% respectively on 89 sentences of the Japanese judgment corpus and 83.52%, 49.58% and 62.22% on 1000 translated Japanese sentences of the *SemEval 2007* affect sensing test corpus. Different experimental outcomes considering different ranges of emotion scores were conducted on the *SemEval 2007* corpus. The present attempt develops the Japanese SentiWordNet with the help of English SentiWordNet and Japanese WordNet and shows that the sense weight-based scoring techniques extracted from Japanese SentiWordNet outperform the word level baseline system even including the knowledge of morphology. The first method is based on the fixed sense-tag weights that are calculated using Japanese *SentiWordNet*. Instead of using the fixed sense-tag weights, the second method calculates the lexical tag weights for each in-

[1] This paper is a slightly modified version of the paper published in the Proceedings of WASSA-2011, see http://aclweb.org/anthology-new/W/W11/W11-1710.pdf.

dividual word using Japanese *SentiWordNet*. The last, namely hybrid, method combines both the first and the second methods. The hybrid method considers the fixed sense-tag weights of the first method when no lexical level match is found using the second method. An averaging technique is applied to produce six sense weight scores or emotion scores of a sentence by cumulating the sense-tag weights of its word level constituents. The best emotion tag corresponding to the maximum obtained sense scores is assigned to the sentences. Finally, the hybrid method followed by the post-processing technique outperforms the other two methods by achieving an average *F-score* of 67.89% on the 1,000 translated Japanese test sentences of the *SemEval 2007* affect sensing corpus with respect to six emotions.

Key words

Japanese WordNet Affect; SentiWordNet; Emotions; SemEval 2007; Judgment Corpus

Introduction

Human-machine interface technology has been investigated for several decades. Scientists have found that emotion technology can be an important component in artificial intelligence (Salovey and Mayer, 1990). Emotions, of course, are not linguistic things. However the most convenient access that we have to them is through language (Strapparava and Valitutti, 2004). Natural language texts not only contain informative contents, but also less or more attitudinal private information including emotions. In recent times, research activities in the areas of emotion in natural language texts and other media have been gaining ground under the umbrella of subjectivity analysis (Wiebe et al., 2005) and affect computing (Strapparava and Mihalcea, 2007). The reason may be the explosive growth of the social media content on the Web in the past few years. People can now post reviews of products at merchant sites and express their emotions on almost anything in discussion forums, emails, chat, blogs, twitter and on social network sites.

The classification of reviews (Turney, 2002), newspaper articles (Lin et al., 2007), Question Answering systems (Wiebe et al., 2005) and modern Information Retrieval systems (Pang and Lee, 2008; Sood and Vasserman, 2009) have already incorporated sentiment and/or emotion analysis within their scope. The majority of subjective analysis methods that are related to opinion or emotion are based on textual keywords spotting and therefore explores the necessity of building specific lexical resources. *SentiWordNet* (Baccianella et al., 2010), a lexical resource that is used in opinion mining and sentiment analysis assigns *positive*, *negative* and *objective* scores to each synset of *WordNet* (Miller, 1995). A subjectivity wordlist (Banea et al., 2008) assigns words with the strong or weak subjectivity and prior polarities of the types *positive*, *negative* and *neutral*.

Major studies on opinion mining and sentiment analyses have been attempted with more focused perspectives rather than fine-grained emotions (Quan and Ren, 2009). The extraction and annotation of subjective terms started with machine learning approaches (Hatzivassiloglou and McKeown, 1997). Some well-known

sentiment lexicons have been developed, such as the subjective adjective list (Baroni and Vegnaduzzo, 2004), English *SentiWordNet* (Esuli et al., 2006), Taboda's adjective list (Voll and Taboda, 2007), Subjectivity Word List (Banea et al., 2008), etc. The affective lexicon (Strapparava and Valitutti, 2004), one of the most efficient resources of emotion analysis, contains words that convey emotion. It is a small well-used lexical resource but valuable for its affective annotation.

Andreevskaia and Bergler (2006) present a method for extracting *positive* or *negative* sentiment-bearing adjectives from *WordNet* using the Sentiment Tag Extraction Program (STEP). The methods proposed in Wiebe and Riloff, 2006, automatically generate resources for subjectivity analysis for a new target language from the available resources for English. Two techniques have been proposed for the generation of a target language lexicon from the English subjectivity lexicon. The first technique uses a bilingual dictionary, while the second method is a parallel corpus-based approach using existing subjectivity analysis tools for English. In contrast, instead of using any dictionary or parallel corpus, we have used the Japanese *WordNet* (Bond et al., 2009) to accomplish the translation purpose. The methods proposed in Mohammad et al. (2008), help to measure the relative sentiment score of a word and its antonym. On the other hand, an automatically generated and scored sentiment lexicon, *SentiFul* (Neviarouskaya et al., 2009), its expansion, morphological modifications and distinguishing sentiment features (propagating, reversing, intensifying, and weakening) also shows contributory results.

To the best of our knowledge all of the above mentioned resources are in English and have been used in coarse-grained sentiment analysis (e.g., *positive*, *negative* or *neutral*). The proposed method in Takamura et al. (2005) extracts semantic orientations from a small number of seed words with high accuracy in the experiments on English as well as Japanese lexicons. However it was also aimed at sentiment-bearing words. There is always a demand for automatic text analysis tools and linguistic resources for languages other than English. A recent study shows that non-native English speakers support the growing use of the Internet[2]. Instead of English *WordNet Affect* (Strapparava and Valitutti, 2004), there are a few attempts in other languages such as Russian and Romanian (Bobicev et al., 2010), Bengali (Das and Bandyopadhyay, 2010), etc. Our previous and current approaches are similar to some of these approaches but in contrast, we evaluated our Japanese *WordNet Affect* on the *SemEval 2007* affect-sensing corpus translated into Japanese. The above mentioned approaches use a bilingual dictionary whereas we have used the Japanese *WordNet* for translation. Translation based on Japanese *WordNet* is more reliable than translation using a bilingual dictionary.

In recent trends, the application of Mechanical Turk for generating a emotion lexicon (Mohammad and Turney, 2010) shows a promising avenue of research. To avoid any monetary investment in developing an emotion lexicon, we have incorporated open source, available and accessible resources to achieve our goals.

In our previous attempt, we prepared a Japanese *WordNet Affect* from the already available English *WordNet Affect* (Strapparava and Valitutti, 2004). Entries in the English *WordNet Affect* are annotated using Ekman's (1993) six emotional categories (*joy, fear, anger, sadness, disgust and surprise*). The collection of the English *WordNet Af-*

[2] http://www.internetworldstats.com/stats.htm

fect[3] synsets that are used in the present work was provided as a resource in the '*Affective Text*' shared task of the *SemEval-2007* Workshop. The shared task focused on text annotation with affective tags (Strapparava and Mihalcea, 2007). We have not considered the problems of lexical affect representation or discussed the differences between emotions, cognitive states and affects in developing Japanese *WordNet Affect*.

The six *WordNet Affect* lists that were provided in the shared task contain only 612 synsets in total with 1,536 words. The words in each of the six emotion lists have been observed to be not more than 37.2% of the words present in the corresponding *SentiWordNet* synsets. Hence, these six lists were expanded with the synsets retrieved from the English *SentiWordNet* (Baccianella et al., 2010) to have an adequate number of emotion-related word entries. We assumed that the new sentiment-bearing words in English *SentiWordNet* might have some emotional connotation in Japanese. However, the part-of-speech (POS) information for each of the synsets was kept unchanged during expansion of the lists. The numbers of entries in the expanded word lists were increased by 69.77% and 74.60% at synset and word levels, respectively. We mapped the synsetID of the *WordNet Affect* lists onto the synsetID of the WordNet 3.0[4]. This mapping helps in expanding the *WordNet Affect* lists with the recent version of *SentiWordNet 3.0*[5] as well as translating with the Japanese *WordNet* (Bond et al., 2009).

Japanese *WordNet*[6], a freely available lexical resource, is being developed based on the English *WordNet*. The synsets of the expanded lists were automatically translated into Japanese equivalent synsets based on the synsetID. Some synsets (e.g., 00115193-a *huffy, mad, sore*) were not translated into Japanese as there were no equivalent synset entries in Japanese *WordNet* for those affect synsets.

Primarily, we developed a baseline system based on the Japanese *WordNet Affect* and carried out the evaluation on a Japanese judgement corpus of 89 sentences. The system achieved an average *F-score* of 36.39% with respect to six emotion classes. We also incorporated a morphological knowledge of the emotion words into the baseline system using an open source Japanese morphological analyser[7]. The performance of the system was increased by 4.1% in average *F-score* with respect to six emotion classes.

The lack of an emotion corpus in Japanese motivated us to apply an open source Google translator[8] to build a Japanese emotion corpus from the available emotion corpus in English. The English *SemEval-2007* affect-sensing corpus contains the trial and test sets of 250 and 1,000 sentences of news headlines. Each sentence of the corpus is annotated with six emotion scores for Ekman's six emotion types and three valence scores for *positive, negative* or *neutral* types. In the previous task, we considered that each sentence is to be assigned with a single sentential emotion tag based on the maximum emotion score out of six annotated emotion scores. The baseline system based on the Japanese *WordNet Affect* achieved the aver-

[3] http://www.cse.unt.edu/~rada/affectivetext/
[4] http://wordnet.princeton.edu/wordnet/download/
[5] http://sentiwordnet.isti.cnr.it/
[6] http://nlpwww.nict.go.jp/wn-ja/index.en.html
[7] http://mecab.sourceforge.net/
[8] http://translate.google.com/#

age *precision*, *recall* and *F-score* of 83.52%, 49.58% and 62.22%, respectively on 1,000 translated test corpus. It has to be mentioned that the inclusion of morphological processing improved the performance of the system. Different experiments were carried out by selecting different ranges of annotated emotion scores. It was observed that selecting lower emotion scores, the number of sentential instances in each of the six emotion categories was increasing and the performance of the system was showing subsequent improvement. Error analysis suggested that though the system performed satisfactorily in identifying the sentential emotions based on the available words of the Japanese *WordNet Affect*, the system suffered from the translated version of the corpus. In addition to that, the Japanese *WordNet Affect* also needs improvement in terms of coverage.

In our present extended task, the Japanese SentiWordNet is being developed by mapping the synsets of English SentiWordNet with Japanese WordNet via English WordNet. We have calculated the polarised sense weights of six emotion tags using Japanese *SentiWordNet*. Three different sense weight-based scoring techniques have been employed for assigning six emotion scores to each of the sentences based on their word level emotion-tagged constituents. The first method is based on the fixed sense-tag weights that are calculated using the Japanese *SentiWordNet*. Instead of depending on the fixed sense-tag weights, the second method calculates the tag weights of each individual word by directly searching them in the Japanese *SentiWordNet*. In contrast to these methods, the last method mimics the second method but the only difference is that the words that are absent in the Japanese *SentiWordNet* consider the fixed sense-tag weights of the first method. All of the methods assume the sense-tag weight of the *neutral* tag is zero. An averaging technique is applied to produce six sense weight scores or emotion scores of a sentence from the sense-tag weights of its word level constituents. Only one sentential emotion tag is assigned to each of the sentences based on the maximum emotion score obtained by the system. The evaluation of assigning emotion tags to the sentences achieves an average F-score of 64.71% on the development set of the *SemEval 2007* corpus. The post-processing technique has been applied on the development set for handling negation words and the F-score improved to 66.14%. The evaluation on 250 test sentences yields an overall F-score of 67.89%.

The rest of the paper is organised as follows. Different developmental phases of the Japanese *WordNet Affect* and Japanese SentiWordNet are described in Section 2. Preparation of the translated Japanese corpus, different morphology-based experiments on the Japanese judgment corpus and the translated corpus, experiments based on the annotated emotion scores of the translated corpus and subsequent evaluations are elaborated in Section 3. Section 4 discusses the sense-based scoring techniques for identifying sentence-level emotion tags. Finally Section 5 concludes the paper.

Development Phases

WordNet Affect

The English *WordNet Affect* (Strapparava and Valitutti, 2004), based on Ekman's (1993) six emotion types (*joy, fear, anger, sadness, disgust, surprise*) is a small lexical re-

Figure 1: Linking between the synsets of *WordNet Affect* and *WordNet*

WordNet Affect:
n#05587878 anger choler ire
a#02336957 annoyed harassed harried pestered vexed
WordNet:
07516354-n anger, ire, choler
02455845-a annoyed harassed harried pestered vexed
Linked *Synset ID* with *Affect ID*:
n#05587878 ↔ 07516354-n anger choler ire
a#02336957 ↔ 02455845-a annoyed harassed harried pestered vexed

source compared to the complete *WordNet* (Miller, 1995) but its affective annotation helps in emotion analysis. Some collection of *WordNet Affect* synsets was provided as a resource for the shared task of *Affective Text* in *SemEval-2007* (Strapparava and Mihalcea, 2007). The whole data is provided in six files named for the six emotions. Each file contains a list of synsets and one synset per line. An example synset entry from *WordNet Affect* is shown as follows.

a#00117872 angered enraged furious infuriated maddened

The first letter of each line indicates the part of speech (POS) and is followed by the *affectID*. The representation was simple and easy for further processing. We retrieved and linked the compatible synsetID from the recent version of *WordNet 3.0* with the *affectID* of the *WordNet Affect* synsets using an open source tool[9]. The linking of two *WordNet Affect* synsets with their corresponding synsets of *WordNet 3.0* is shown in Figure 1. The differences between emotions, cognitive states and affects were not analysed during translation. Our main focus in the task was to develop an equivalent resource in Japanese for analysing emotions.

Expansion of WordNet Affect using SentiWordNet

It was observed that the *WordNet Affect* (Strapparava and Valitutti, 2004) contains fewer emotion word entries. The six lists provided in the *SemEval 2007* shared task contain only 612 synsets in total with 1,536 words. The detailed distribution of the emotion words as well as the synsets in six different lists according to their POS are shown in Table 1.

Hence, we expanded the lists with adequate number of emotion words using *SentiWordNet* (Baccianella et al., 2010) before attempting any translation of the lists into Japanese. *SentiWordNet* assigns each synset of *WordNet* with two coarse-grained subjective scores such as *positive*, *negative* along with an *objective* score. *SentiWordNet* contains more number of coarse-grained emotional words than *WordNet Affect*. We assumed that the translation of the coarse-grained emotional words into Japanese might contain more or less fine-grained emotion words. One example entry of the *SentiWordNet* is shown below. The POS of the entry is followed by a *synset ID*, *positive* and *negative* scores and synsets containing sentiment words.

[9] `http://nlp.lsi.upc.edu/web/index.php?option=com_content&task=view&id=21&Itemid=59`

Figure 2: Expansion of *WordNet Affect* synset using *SentiWordNet*

Linked*Affect word:*
*n#05587878↔ 07516354-nanger choler ire*newline *SentiWordNet* synsets that include the word "*anger*":
07516354-n anger, ire, choler
14036539-n angriness, anger
00758972-n anger, ira, ire, wrath
01785971-v anger
01787106-v see_red, anger
SentiWordNet synsets that include the word "choler":
07552729-n fretfulness, fussiness, crossness, petulance, peevishness, irritability, choler
05406958-n choler, yellow_bile
Expanded*Affect word*:
n#05587878 ↔ 07516354-n anger choler ire 14036539-n angriness anger 00758972-n anger ira, ire wrath 01785971-vanger ... 05406958-n choler

SentiWordNet: a 121184 0.25 0.25
infuriated#a#1 furious#a#2 maddened#a#1 enraged#a#1 angered#a#1

Our aim was to increase the number of emotion words in the *WordNet Affect* using *SentiWordNet*. Both of the two resources were developed from the *WordNet* (Miller, 1995). Hence, each word of the *WordNet Affect* is replaced by the equivalent synsets retrieved from *SentiWordNet* if the synset contains that emotion word. The POS information in the *WordNet Affect* is kept unchanged during expansion. For example, in Figure 2, the word '*anger*' in synset '*07516354-n*' is linked with the synsets '*14036539-n*' "*angriness*, *anger*", '00758972-n' "*anger*, *ira*, *ire*, *wrath*", '*01785971-v*' "*anger*", '*01787106-v*' "*see_red*, *anger*", etc., and therefore the linked words and synsets are appended to the existing word '*anger*'. The distributions of expanded synsets and words for each of the six emotion classes based on four different POS types (*noun N*, *verb V*, *adjective Adj*. and *adverb Adv*.) are shown in Table 1 and Table 2. However we have kept the duplicate entries at synset level for identifying the emotion-related scores in our future attempts by utilising the already associated *positive* and *negative* scores of *SentiWordNet*. The percentage of entries in the updated word lists was increased by 69.77 and 74.60 at synset and word levels, respectively.

In case of word ambiguity during the replacement of the words in WordNet affect synsets, some spurious senses appeared in some synsets that represent a non-appropriate meaning. However, it was observed that in the case of emotion words, this phenomenon is not frequent because the direct emotion words are not very ambiguous.

Translation of Expanded WordNet Affect into Japanese

We mapped the *affectID* of the *WordNet Affect* to the corresponding *synsetID* of the *WordNet 3.0*. This mapping helps to expand the *WordNet Affect* with the recent version of *SentiWordNet* 3.0 as well as translating the expanded lists into Japanese using the Japanese *WordNet* (Bond et al., 2009).

Table 1: Number of POS-based Synset entries in six *WordNet Affect* lists before and after updating using *SentiWordNet*

	WordNet Affect List Synset Entries [After updating using SentiWordNet]			
Emotion Classes	Noun	Verb	Adjective	Adverb
anger	48 [*198*]	19 [*103*]	39 [*89*]	21 [*23*]
disgust	3 [*17*]	6 [*21*]	6 [*38*]	4 [*5*]
fear	23 [*89*]	15 [*48*]	29 [*62*]	15 [*21*]
joy	73 [*375*]	40 [*252*]	84 [*194*]	30 [*45*]
sadness	32 [*115*]	10 [*43*]	55 [*129*]	26 [*26*]
surprise	5 [*31*]	7 [*42*]	12 [*33*]	4 [*6*]

Table 2: Number of POS-based Word entries in six *WordNet Affect* lists before and after updating using *SentiWordNet*

	WordNet Affect List Word Entries [After updating using SentiWordNet]			
Emotion Classes	Noun	Verb	Adjective	Adverb
anger	99 [*403*]	64 [*399*]	120 [*328*]	35 [*50*]
disgust	6 [*21*]	22 [*62*]	34 [*230*]	10 [*19*]
fear	45 [*224*]	40 [*243*]	97 [*261*]	26 [*49*]
joy	149 [*761*]	122 [*727*]	203 [*616*]	65 [*133*]
sadness	64 [*180*]	33 [*92*]	169 [*779*]	43 [*47*]
surprise	8 [*28*]	28 [*205*]	41 [*164*]	13 [*28*]

As the Japanese *WordNet*[10] is freely available and it is being developed based on the English *WordNet*, the synsets of the expanded lists were automatically translated into Japanese equivalent synsets based on the *synsetIDs*. The number of translated Japanese words and synsets for the six affect lists are shown in Table 3 and Table 4, respectively. The following are some translated samples that contain word level as well as phrase level translations.

07510348-n surprise rightarrow 愕き, 驚き

*07503260-n disgust rightarrow*むかつき, 嫌悪

*07532440-n unhappiness, sadness rightarrow*不仕合せさ, 哀情, 悲しみ, 不幸せさ, 不幸さ, 不幸せ, 不仕合わせ, 哀しみ, 不仕合せ, 不幸, 悲しさ, 不仕合わせさ, 哀しさ

07527352-n joy, joyousness, joyfulness → ジョイ, 愉楽, うれしいこと, 慶び, うれしさ, 歓び, 悦楽, 歓, 嬉しさ, 欣び, 楽しいこと, 喜び, 楽しさ, 悦び, 愉悦

Translation of SentiWordNet into Japanese

In the present extended task, we have prepared the Japanese SentiWordNet using the English SentiWordNet and the Japanese WordNet. The English *SentiWordNet* (Baccianella et al., 2010), an important resource in opinion mining and sentiment analysis assigns three sentiment scores such as *positive*, *negative* and *objective* to each synset of *WordNet*. As the Japanese WordNet is also aligned with the English

[10] http://nlpwww.nict.go.jp/wn-ja/index.en.html

Table 3: Number of POS-based translated word entries in six Japanese *WordNet Affect* lists

Emotion Classes	Translated *WordNet Affect* list and SentiWordNet in Japanese (#Words)			
	Noun	Verb	Adjective	Adverb
anger	861	501	231	9
disgust	49	63	219	10
fear	375	235	334	104
joy	1959	1831	772	154
sadness	533	307	575	39
surprise	144	218	204	153
SentiWordNet	2856	346	12,102	233
SentiWordNet (pos/neg)	826	167	5,423	104

WordNet at synset level, we mapped the English synsets of SentiWordNet onto the Japanese WordNet using the intermediate synsetIDs of English WordNet. It was observed that the total number of non-translated synsets was significantly higher in comparison with the total number of translated synsets. The numbers of POS-based translated synsets, words and phrases are shown in Table 3 and Table 4. However, a crucial fact was found with respect to the subjective (i.e., *positive* and/or *negative*) and objective scores of the English *SentiWordNet* synsets. Only 17,996 synsets that contain *positive* and/or *negative* scores are present in the English *SentiWordNet* lexicon and out of these, 32.33% of synsets have been translated in Japanese. The overall translation yields 55.35% of the synsets that contain scores for either *positive* or *negative* or both types of sentiments. The reason for non-translated synsets may be that the Japanese WordNet is being developed and not yet completed with respect to the English WordNet.

Analysing Translation Errors

Some *SentiWordNet* synsets (e.g., 00115193-a *huffy, mad, sore*) were not translated into Japanese as there are no equivalent synset entries in the Japanese *WordNet*. There were a large number of word combinations, collocations and idioms in the Japanese *WordNet Affect*. These parts of synsets show problems during translation and therefore manual translation was carried out for these types. There are some of the English synsets that were not translated into Japanese. For example, the synset '07517292-n *lividity*' contains only one English word that was not translated into Japanese. However an equivalent gloss of the word '*lividity*' that is present in the Japanese *WordNet* is "*a state of fury so great the face becomes discoloured*". One of the reasons for such translation problems may be that no equivalent Japanese word sense is available for such English words.

WordNet Affect-based Evaluation

Knowledge resources can be leveraged in identifying emotion-related words in text and the lexical coverage of these resources may be limited given the informal nature of online discourse (Aman and Szpakowicz, 2007). In general, the identification of

Table 4: Number of *translated* and *non-translated* synset entries and *morphemes* including *words* and *phrases* in six Japanese *WordNet Affect* lists

	Japanese *WordNet Affect* list and SentiWordNet			
Emotion Classes	Translated (#Synset)	Non-Translated (#Synset)	Translated (#Word)	Translated (#Phrase)
anger	254	159	1033	450
disgust	57	24	218	97
fear	146	74	615	315
joy	628	238	2940	1273
sadness	216	97	846	519
surprise	112	25	456	216
SentiWordNet	10,513	1,07,146	15,537	3,107
SentiWordNet (pos/neg)	5,819	11,877	6,520	707

the direct emotion words incorporates the lexicon lookup approach. Hence, we evaluated the developed Japanese *WordNet Affect* on a small emotional judgment corpus and *SemEval 2007* affect-sensing corpus in Japanese.

Evaluation on Japanese Judgment Corpus

The judgment corpus that is being developed by the Japan System Applications Co. Ltd.[11] contains only 100 sentences of emotional judgments. However this corpus is not an open source as yet. We evaluated our Japanese *WordNet Affect*-based baseline system on these 100 sentences and the results for each of the six emotion classes are shown in Table 5. We also incorporated the morphological knowledge in our baseline system using an open source Japanese morphological analyser[12].

The algorithm is such that if a word in a sentence is present in any of the Japanese *WordNet Affect* lists, the sentence is tagged with the emotion label corresponding to that affect list. If any word is not found in any of the six lists, each word of the sentence is passed through the morphological process to identify its root form and the root form is searched for through the Japanese *WordNet Affect* lists again. If the root form is found in any of the six Japanese *WordNet Affect* lists, the sentence is tagged accordingly. Otherwise, the sentence is tagged as non-emotional or *neutral*.

It was observed that the average *F-Score* of the baseline system improved by 4.1% with respect to the six emotion classes. Due to the lower number of sentential instances in some emotion classes (e.g., *joy*, *sadness*, *surprise*), the performance of the system gives poor results even after including the morphological knowledge. One of the reasons may be the fewer word and synset entries in some *WordNet Affect* lists (e.g., *fear*). Another reason was the lower number of sentential instances in some emotion class (e.g., *sadness*). Hence, we aimed to translate the English *SemEval 2007* affect-sensing corpus into Japanese and evaluate our system on the translated corpus.

[11] http://www.jsa.co.jp/

[12] http://mecab.sourceforge.net/

Table 5: Precision, Recall and F-Scores (in %) of the Japanese *WordNet Affect*-based system per emotion class on the Judgment corpus before and after the inclusion of morphology.

	Judgment Corpus (in %) Before Morphology [*After Morphology*]		
Emotion Classes (#Sentences)	Precision	Recall	F-Score
anger (#32)	51.61 [*64.29*]	50.00 [*68.12*]	50.79 [*66.14*]
disgust (#18)	25.00 [*45.00*]	5.56 [*10.56*]	9.09 [*17.10*]
fear (#33)	NULL	NULL	NULL
joy (#3)	3.45 [*8.08*]	66.67 [*100.00*]	6.56 [*14.95*]
sadness (#5)	NULL	NULL	NULL
surprise (#9)	6.90 [*13.69*]	22.22 [*33.33*]	10.53 [*19.41*]

Evaluation on Translated SemEval 2007 Affect-Sensing Corpus

The English *SemEval 2007* affect-sensing corpus (Strapparava and Mihalcea, 2007) consists of news headlines only. Each of the news headlines is tagged with a valence score and scores for all six of Ekman's (1993) emotions. The six emotion scores for each sentence are in the range of 0 to 100.

We used the Google translator API[13] to translate the 250 and 1,000 sentences of the trial and test sets of the *SemEval 2007* corpus respectively. The experiments regarding morphology and emotion scores were conducted on the trial corpus. The final evaluation that was carried out on 1000 sentences of the test corpus produces the results shown in Table 6. The evaluation of our system is similar to the coarse-grained evaluation methodology of the *SemEval 2007* shared task on affective text. Though the evaluation was conducted for Japanese, the performance of the system improved significantly. In addition to the coarse-grained evaluation, we also carried out different experiments by selecting different ranges of emotion scores. The corresponding experimental results are also shown in Table 6. Incorporation of morphology improves the performance of the system.

On the other hand, it was observed that the performance of the system decreases by increasing the range of Emotion Scores (ES). The reason may be that the numerical distribution of the sentential instances in each of the emotion classes decreases as the range in emotion scores increases. This, in turn, decreases the performance of the system.

Japanese affect lists include words as well as phrases. We deal with phrases using a Japanese morphology tool to find affect words in a sentence and substitute an affect word into its original conjugated form. One of the main reasons for using a morphology tool was to analyse the conjugated form and to identify the phrases. For example, the Japanese word for the equivalent English word '*anger*' is '怒る (*o ko ru*)', but there are other conjugated word forms such as '怒った (*o ko tta*)' that means '*angered*' and it is used in the past tense. Similarly, another conjugated form '怒っていた (*o ko tte i ta*)' denotes the past participle form '*have angered*' of the original word '*anger*'. The morphological form of its passive sense is '怒られる (*o ko ra re ru*)' that means '*be angered*'. In addition to that, we identified the words into their original

[13] `http://translate.google.com/\#`

forms from their corresponding phrases by using the morpheme information. For example, the phrase '怒られる (*o ko ra re ru*)' consists of two words, one is '怒ら (*o ko ra*)', which is in an imperfective form, and the other is 'れる (*re ru*)', which is in an original form. The original form of the imperfective word '怒ら (*o ko ra*)' is '怒る (*o ko ru*)'.

It was found that some of the English multi-word phrases have no equivalent Japanese phrase available. Only the equivalent Japanese words were found in the Japanese *WordNet*. For example, the following synset contains a multi-word phrase '*see-red*'. But, instead of any equivalent phrases, only words are found in Japanese *WordNet*.

*01787106-v anger, see -red rightarrow*怒る, 憤る, 立腹

Sense Weight Score-based Evaluation

The present task also incorporates the sense weight score-based evaluation of the system. For this purpose, we have used the *positive* and/or *negative* scores of the words that are present in the synsets of Japanese *SentiWordNet*. Three different methods based on the sense weights have been considered for assigning emotion scores to the sentences. The methods consider the average weighting technique to identify the emotion tags for a sentence. Each of the sentences is assigned with a final emotion tag based on the maximum sense weight scores that are assigned by the system. Similarly, each of the sentences is already annotated with a sentence level gold standard emotion tag in the *SemEval 2007* corpus based on the maximum emotion scores that were assigned by the annotators. The system assigned emotion tags are evaluated with respect to the gold standard emotion tags and the results have shown satisfactory performance in coarse-grained evaluation.

Fixed Sense Weight-based Scoring (FSWS)

In the first method, we have chosen the basic six words in Japanese '悲しい' (*happy*), '幸せ' (*sad*), '怒り' (*anger*), '嫌悪' (*disgust*), '恐怖' (*fear*) and '驚き' (*surprise*) as the seed words corresponding to each type of emotion tag. The *positive* and *negative* scores for each synset in which each of these seed words appear are retrieved from the Japanese *SentiWordNet* and the average of the scores is fixed as the *Sense_Tag_Weight* (*STW*) of that particular emotion tag. The present sense weight-based scoring technique is based on the hypothesis that was considered in (Das and Bandyopadhyay, 2009). Table 7 shows the values of *STW* for six emotion tags. The *neutral* tag is assigned *zero* value as it does not carry any emotional sense. These sense-based tag weights (*STW*) are fixed value in nature. Each sentence is assigned with six sentence level sense weights (*SWS*) with respect to six emotions. Each of the weights is calculated by dividing the total *Sense_Tag_Weight* (*STW*) of an emotion type by the total *Sense_Tag_Weight* (*STW*) of all types of emotion present in that sentence. The sentence is assigned with a single emotion tag for which the sentence level sense weight score (*SWS*) is maximum.

$$SWS_i = (STW_i * N_i)/(\sum_{j=1}^{7} STW_j * N_j)|i \in j,$$

Table 6: Precision, Recall and F-Scores (in %) of the Japanese *WordNet Affect*-based system per emotion class on the translated Japanese *SemEval 2007* affect-sensing test corpus before and after the inclusion of morphology on different ranges of Emotion Scores (ES).

Emotion Classes (#Sentences)	Japanese Translated SemEval 2007 Test Corpus Before Morphology [*After Morphology*]		
	Precision	Recall	F-Score
	Emotion Score (ES) ≥0		
anger	61.01 [*68.75*]	18.83 [*31.16*]	28.78 [*42.88*]
disgust	79.55 [*85.05*]	8.35 [*16.06*]	15.12 [*27.01*]
fear	93.42 [*95.45*]	10.26 [*16.77*]	18.49 [*28.52*]
joy	69.07 [*72.68*]	57.03 [*80.30*]	62.48 [*76.29*]
sadness	83.33 [*84.29*]	10.58 [*19.54*]	18.77 [*31.67*]
surprise	94.94 [*94.94*]	7.84 [*13.65*]	14.48 [*23.99*]
	Emotion Score (ES) ≥ 10		
anger	44.65 [*52.08*]	25.54 [*33.32*]	32.49 [*40.35*]
disgust	40.91 [*41.46*]	9.89 [*18.07*]	15.93 [*24.97*]
fear	77.63 [*81.82*]	13.32 [*21.42*]	22.74 [*34.03*]
joy	53.89 [*55.61*]	56.50 [*96.22*]	55.17 [*70.40*]
sadness	67.78 [*69.87*]	11.78 [*19.88*]	20.07 [*30.86*]
surprise	72.15 [*74.58*]	8.25 [*15.87*]	14.81 [*26.30*]
	Emotion Score (ES) ≥ 30		
anger	21.38 [*28.12*]	39.08 [*62.45*]	27.64 [*38.59*]
disgust	2.27 [*5.04*]	3.70 [*6.72*]	2.82 [*6.15*]
fear	44.74 [*56.82*]	16.67 [*28.76*]	24.29 [*38.45*]
joy	31.48 [*33.42*]	56.86 [*97.08*]	40.52 [*50.53*]
sadness	37.78 [*69.86*]	15.60 [25.31]	22.08 [*37.22*]
surprise	17.72 [*20.34*]	8.14 [*18.56*]	11.16 [*20.35*]
	Emotion Score (ES) ≥ 50		
anger	6.92 [*10.42*]	57.89 [78.02]	12.36 [*18.26*]
disgust	NIL	NIL	NIL
fear	21.05 [*29.55*]	17.98 [*31.26*]	19.39 [*30.79*]
joy	12.04 [*24.98*]	61.32 [*87.66*]	20.12 [*39.10*]
sadness	13.33 [*23.07*]	12.12 [*22.57*]	12.70 [*18.71*]
surprise	3.80 [*8.50*]	7.50 [*12.50*]	5.04 [*10.11*]

where pojemSWS$_i$ is the sentence level sense weight score for the emotion tag i and N_i is the number of occurrences of the emotion tag i in the sentence. STW_j is the *Sense_Tag_Weight* for each emotion tag j including the emotion tag i. The emotion tag corresponding to the maximum sense weight score (*SWS*) is assigned to a sentence as the probable emotion tag. It has to be mentioned that only the magnitude, not the *polarity* (*positive/negative*) that is also attached with *STW* was considered in case of calculating *SWS*.

Table 7: Six Sense-tag Weights (STWs) for six emotion tags and neutral tags.

Emotion Classes	*Sense-tag Weights* (*STW*)
anger	0.0125
disgust	(−) 0.1022
fear	(−) 0.5
joy	(−) 0.075
sadness	0.0131
surprise	0.0625
neutral	0.0

Lexical Sense Weight-based Scoring (LSWS)

In the second method, we have considered the emotion-tagged words instead of their fixed assigned sense-tag weights (as mentioned in the first method). Each emotion-tagged word is searched in the Japanese *SentiWordNet*. The *positive* and *negative* scores of the word are retrieved from the Japanese *SentiWordNet* and the average of the retrieved scores has been fixed as the *Sense_Tag_Weight* (*STW*) for that emotion word. Morphological processing of the words has also been included into the search process. If the word as well as its stem form is not found in the Japanese *SentiWordNet*, the default value is assumed as zero. In this method, the total STW_i for each emotion tag i is calculated by summing up the *STW*s of all assigned emotion tags with type i.

Hybrid Sense Weight-based Scoring (HSWS)

The third method is similar with the second method. The main difference is that this method uses the fixed sense-tag weights instead of assuming zero values for the emotion words that are not present in Japanese *SentiWordNet* in its original as well as stem forms. If an emotion-tagged word is not found in the Japanese *SentiWordNet*, the default sense-tag weight that was used in the first method is assigned for that emotion tag.

The evaluation of these three methods has been carried out on the development and test sets. The results are shown in Table 8. It has been observed that the hybrid method significantly outperforms the other two methods. The hybrid method incorporates the knowledge of individual sense weight for an emotion-tagged word as well as using the default weight for the words that have no clue in the Japanese SentiWordNet lexicon. As the hybrid method shows better performance than the other two methods, it has been applied in identifying the sentence level emotion tags.

Pre-Processing for Handling Negations

The presence of negations and their number of occurrences are both significant in assigning the final emotion tag to a sentence. The consecutive occurrence of negation words does not reverse the assigned emotion type whereas the presence of a single negation may completely change the actual emotion. For example, the

Table 8: F-score (in %) of three sense-weight based scoring methods for six emotion classes.

Emotion Classes	Japanese Translated SemEval 2007 Test Corpus F-Score (in %) [Before Pre-processing for Negation Words]		
	FSWS	*LSWS*	*HSWS*
anger	56.78 [59.23]	58.22 [60.31]	65.12 [68.45]
disgust	52.09 [54.44]	54.76 [57.22]	61.07 [64.89]
fear	57.34 [59.02]	59.44 [62.10]	66.07 [69.07]
joy	53.21 [56.09]	59.38 [61.55]	63.10 [65.78]
sadness	57.02 [59.11]	60.21 [63.14]	67.36 [68.55]
surprise	58.53 [60.57]	61.37 [63.03]	66.28 [67.13]
Average	55.82 [58.07]	58.89 [61.22]	64.83 [67.31]

following sentence was tagged as "*sad*" by the system but in the gold standard *SemEval 2007* corpus, the maximum emotion score is given for "*happy*".

パリジャーナル：スモーキングなし長いトレスフランスのシック

Paris Journal: Smoking No Longer Tres Chic in France

Thus, considering the immediate presence and single occurrence of the negation word ない (*No*), the emotion tag of the sentence is reversed to "*happy*". It has to be mentioned that, the negations only play the roles in the case of two emotions such as "*happy*" and "*sad*". However in the case of other emotions, the single negation word has no role to play.

In the following sentence, two consecutive occurrences of negation words (ない (*No*) and ない (*Not*) do not change the actual emotion expressed by the sentence.

スナックで誘惑？いいえ、あなた

Seduced by Snacks? No, Not You

In this case, the system assigns the "*fear*" tag that is also the probable maximum scored emotion tag in the gold standard annotated corpus. Application of these rule-based post-processing strategies improved the F-score of the system for identifying sentence-level emotion tags. The results are shown in Table 8. Overall, the 2% 3% F-score has been improved by employing the post-processing techniques for handling negations.

Conclusion

The present paper describes the extended task of preparation of Japanese *WordNet Affect* and its evaluation on the Japanese Judgment corpus and SemEval 2007 affect-sensing corpus. The automatic approach to expanding, translating and sense disambiguation tasks reduces the manual effort. The resource is still being updated with more number of emotional words to increase the coverage. In addition to Japanese *WordNet Affect*, the Japanese SentiWordNet is also being developed and its sense-based scores have been used to identify sentential emotion tags. Our future task is to integrate more resources so that the number of emotion word entries in the Japanese SentiWordNet can be increased.

References

Aman S., Szpakowicz, S. (2007): Identifying Expressions of Emotion in Text. *TSD 2007, LNAI*, Vol. 4629, pp. 196–205.

Andreevskaia, A., Bergler, S. (2007): CLaC and CLaC-NB: Knowledge-based and corpus-based approaches to sentiment tagging. In: *4th International Workshop on Semantic Evaluations (SemEval)*. Stroudsburg (Philadelphia, USA) : Association for Computational Linguistics, pp. 117–120.

Baccianella, S., Esuli, A., Sebastiani, F. (2010): SentiWordNet 3.0: An Enhanced Lexical Re-source for Sentiment Analysis and Opinion Mining. In: *Proceedings of the Seventh International Conference on Language Resources and Evaluation (LREC'10)*. Valletta (Malta) : European Language Resources Association (ELRA), pp. 2200–2204. (ISBN 2-9517408-6-7.)

Banea, C., Mihalcea, R., Wiebe, J. (2008): A Bootstrapping Method for Building Subjectivity Lexicons for Languages with Scarce Resources. In: *The proceedings of the Sixth International Conference on Language Resources and Evaluation 2008 [CD-ROM]*. Marrakech (Morocco) : European Language Resources Association (ELRA), pp. 2764–2767.

Baroni, M., Vegnaduzzo, S. (2004): Identifying Subjective Adjectives Through Web-based Mutual Information. In: Buchberger E. (ed.) *Proceedings of the German Conference on NLP (KONVENS 2004)*. Vienna (Austria) : Österreichische Gesellschaft für Artificial Intelligence (OEGAI), pp. 613–618.

Bobicev, V., Maxim, V., Prodan, T., Burciu, N., Anghelus, V. (2010): Emotions in Words: Developing a Multilingual WordNet-Affect. In: Gelbukh, A. (ed.) *Computational Linguistics and Intelligent Text Processing (Proceeding of the 11th International Conference CICLing 2010, Iasi, Romania)*. Heidelberg : Springer, pp. 375–384. (ISBN 978-3-642-12115-9.)

Bond, F., Hitoshi, I., Sanae, F., Kiyotaka, U., Takayuki, K., Kyoko, K. (2009): Enhancing the Japanese WordNet. In: Riza, H., Sornlertlamvanich, V. (eds.) *Proceedings of the 7th Workshop on Asian Language Resources*. Singapore : Association for Computational Linguistics, pp. 1–8.

Das, D., Bandyopadhyay, S. (2009): Word to Sentence Level Emotion Tagging for Bengali Blogs. In: *Proceedings of Short Papers of ACL-IJCNLP*. Singapore : Suntec, pp. 149–152.

Das, D., Bandyopadhyay, S. (2010): Developing Bengali WordNet Affect for Analyzing Emotion. In: *23rd International Conference on the Computer Processing of Oriental Languages*. California (USA) : [s. n.], pp. 35–40.

Ekman, P. (1992): An argument for basic emotions. *Cognition and Emotion*, Vol. 6, No. 3–4, pp. 169–200.

Esuli, A., Sebastiani, F. (2006): SENTIWORDNET: A Publicly Available Lexical Resource for Opinion Mining. In: *Proceedings of the Language Resources and Evaluation Campaign*. Genoa (Italy) : European Language Resources Association (ELRA), pp. 417–422.

Hatzivassiloglou, V., McKeown K. R. (1993): Predicting the semantic orientation of adjectives. In: *Proceedings of the 35th Annual Meeting of the ACL and the 8th Conference of the European Chapter of the ACL*. Stroudsburg (Philadelphia, USA) : Association for Computational Linguistics, pp. 174–181.

Lin K. H.-Y., Yang C., Chen H.-H. (2007): What emotions news articles trigger in their readers? In: Kraaij, W., de Vries, A. P., Clarke, Ch. L. A., Fuhr, N., Kando, N. (eds.) *SIGIR 2007: Proceedings of the 30th Annual International ACM SIGIR Conference on Research and Development in Information* Amsterdam : ACM, pp. 733–734. (ISBN 978-1-59593-597-7.)

Miller, A. G. (1995): WordNet: A lexical database for English. *Communications of the ACM*, Vol. 38, No. 11, November, pp. 39–41.

Mohammad, S., Dorr, B. J., Hirst, G. (2008): Computing Word-Pair Antonymy. In: *Proceedings of Empirical Methods in Natural Language Processing and Computational Natural Language Learning Hawaii*. Stroudsburg, PA (USA) : Association for Computational Linguistics (ACL), pp. 982–991.

Mohammad, S., Turney, P. D. (2010): Emotions evoked by common words and phrases: Using Mechanical Turk to create an emotion lexicon. In: *CAAGET'10 : Proceedings of the NAACL-HLT 2010 Workshop on Computational Approaches to Analysis and Generation of Emotion in Text*. Los Angeles (CA) : Association for Computational Linguistics, pp. 26–34.

Neviarouskaya, A., Prendinger, H., Ishizuka, M. (2009): SentiFul: Generating a Reliable Lexicon for Sentiment Analysis. In: *Proceedings : 3rd International Conference on Affective Computing and Intelligent Interaction (ACII 2009)*. Amsterdam : IEEE, pp. 363–368. (ISBN 978-1-4244-4800-5.)

Pang, B., Lee, L. (2008): Opinion Mining and Sentiment Analysis. *Foundations and Trends in Information Retrieval*, Vol. 2, No. 1–2, pp. 1–135. (ISSN 1554-0669)

Quan, C., Ren, F. (2009): Construction of a Blog Emotion Corpus for Chinese Emotional Expression Analysis. In: *Proceedings of the Empirical Method in Natural Language Processing and Association for Computational Linguistics*. Singapore : Association for Computational Linguistics, pp. 1446–1454.

Salovey, P., Mayer, J. (1990): Emotional Intelligence. *Imagination, Cognition and Personality*, Vol. 9, No. 3, pp. 185–211.

Sood, S., Vasserman, L. (2009): ESSE: Exploring Mood on the Web. In: *Proceedings of the 3rd International AAAI Conference on Weblogs and Social Media (ICWSM) Data Challenge Workshop*. 8 pp.

Strapparava, C., Mihalcea, R. (2007): SemEval-2007 Task 14: Affective Text. In: *Proceedings of the Fourth International Workshop on Semantic Evaluations (SemEval-2007)*. Prague : Association for Computational Linguistics, pp. 70–74.

Strapparava, C., Valitutti, A. (2004): Wordnet-affect: an affective extension of wordnet. In: *Proceedings of the 4th International Conference on Language Resources and Evaluation*. Paris : ELRA – European Language Resources Association, pp. 1083–1086. (ISBN 2-9517408-1-6.)

Takamura, H., Inui, T., Okumura, M. (2005): Extracting Semantic Orientations of Words using Spin Model. In: *Proceedings of the 43rd Annual Meeting of the Association for Computational Linguistics*. Stroudsburg (Philadelphia, USA) : Association for Computational Linguistics, pp. 133–140.

Turney, P. D. (2002): Thumbs Up or Thumbs Down? Semantic Orientation Applied to Unsupervised Classification of Reviews. In: *Proceedings of the 40th Annual Meeting of the Association for Computational Linguistics (ACL)*. Stroudsburg (Philadelphia, USA) : Association for Computational Linguistics, pp. 417–424.

Voll, K. D., Taboada, M. (2007): Not All Words are Created Equal: Extracting Semantic Orientation as a Function of Adjective Relevance. In: Orgun, M. A., Thornton, J. (eds.) *Australian Conference on Artificial Intelligence*. Heidelberg : Springer, pp. 337–346. (ISBN 978-3-540-76926-2.)

Wiebe, J., Riloff, E. (2006): Creating Subjective and Objective Sentence Classifiers from Unannotated Texts. In: *International Conference on Intelligent Text Processing and Computational Linguistics*.

Wiebe, J., Wilson, T., Cardie, C. (2005): Annotating expressions of opinions and emotions in language. *Language Resources and Evaluation*, Vol. 39, No. 2–3, pp. 165–210.

The work reported in this paper is supported by a grant from the India-Japan Cooperative Programme (DST-JST) 2009 Research project entitled "Sentiment Analysis where AI meets Psychology" funded by Department of Science and Technology (DST), Government of India.