The Improvement of Negative Sentences Translation in English-to-Korean Machine Translation

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Abstract: This paper describes the translation algorithm of English negative sentences in rule-based English-Korean Machine Translation (EKMT). The proposed algorithm is based on the comparative study of the linguistic characteristics of English and Korean negative sentences. The earlier versions of machine translation system which is under development by our research team, failed to translate English negative sentences into accurate Korean equivalents. On the basis of the comparative linguistic research on negation in English and Korean, a new translation algorithm of the English negative sentences was established and evaluated.

Keywords: Machine Translation, Negative Sentence, Negation, EKMT, Rule-Based Machine Translation

1. Introduction

Translating English negative sentences into Korean is not simple since the ways of expressing negation in the two languages are not exactly the same. The generally accepted way of the negative sentence translation in EKMT is to simply negate the predicate of its corresponding affirmative sentence, which produces inaccurate Korean equivalents for some English negative sentences, e.g. partial negatives. The comparative study on the ways of expressing negation in English and Korean provides the basis of a new algorithm for the exact Korean equivalents to the English negative sentences in EKMT.

2. Linguistic Comparison of English and Korean Negation

Linguistically, negation refers to a grammatical construction with negative polarity [1]. The negative sentence and its affirmative correspondent are closely related in English and so are they in Korean. Therefore, the English negative sentences should be analyzed in close relation with their affirmative correspondents and Korean equivalents.

English and Korean negative sentences have the following common characteristics;

a. The negative sentences are declaratives, interrogatives or imperatives in both languages.
b. The negative sentences have their affirmative correspondents, which can be made negative by adding negation words.
c. Negation words are relatively restricted in number.
d. In some cases, the negation words are used with other words (e.g. adverbs) to intensify or soften their meaning.
e. Negation is subdivided into general negation, partial negation, double negation and intensified negation.

Despite these common characteristics, there are still differences, the most important one of which is the way of adding negation words to the affirmative sentences. The table below gives the comparison between English and Korean negative sentences. The underlined words are the negation words and the bold words are the negation-related words (the adverbs or other words to intensify or soften the negative meaning) in English and Korean.
Table 1. Comparison between English and Korean negative sentences.

| Part of Speech | Negation Words | English Negative Sentences | Korean Equivalents | Corresponding Affirmative Sentences |
|----------------|----------------|----------------------------|-------------------|-----------------------------------|
| Adverb         | not            | I did not believe at all that he was coming. | 나는 그가 온다는 것을 전혀 믿지 않았다. | I believed that he was coming. |
|                | never          | He has never been there. | 그는 아직 어디서도 대답할 수 없었다. | He has been there. |
|                | hardly         | I can hardly believe it. | 나는 그것을 거의 믿을 수 없다. | I can believe it. |
|                | little         | Little did I know that my life was about to change. | 나는 나의 생활이 변하리라하는 것을 거의 알지 못하였다. | I knew that my life was about to change. |
|                | nowhere        | He has nowhere to live. | 그는 아무데도 가지 않는다. | He has somewhere to live. |
|                | nothing        | She's nothing like her brother. | 그는 자기 동생과 전혀 비슷하지 않다. | She's like her brother. |
| Pronoun        | none           | She seems none the worse for her experience. | 그는 자기 경험에 비하여 한심해 보이지 않는다. | She seems the worse for her experience. |
|                | no one         | No one could hear me. | 그 누구도 나의 말을 듣지 못하였다. | Someone could hear me. |
|                | nobody         | I knocked on the door but nobody answered. | 내가 문을 두드렸지만 그 누구도 대답하지 않았다. | I knocked on the door and somebody answered. |
| Determiner     | no             | No food is left in the fridge. | 우리는 그에 대하여 아무것도 말하지 않았다. | We said something about her. |
|                | few            | Few people knew he was ill. | 내 친구들은 그 누구도 나에게 더 이상 전화하지 않는다. | Some of my friends phone me. |
|                | little         | I paid little attention to what the others were saying. | 그는 다른 사람들한테 말에 거의 관심을 들리지 않았다. | Some people knew he was ill. |

As the table shows the negation words in English include adverbs, pronouns and determiners, therefore the subject, predicate, object, adverbial modifiers or attributes can be negated, while in Korean the negation is expressed by adding agglutinative suffixes (the underlined words in Korean sentences) to the predicates and by adding other negation-related words (the bold words in Korean sentences) to the sentences in some cases. This significant difference poses a main problem for the translation of the English negative sentences into Korean.

3. Classification of English Negative Sentences

Some English sentences with negation words in them don’t carry negative meaning, so they are not translated into negative sentences in Korean.

*He just stopped working for no reason.* (그는 아무리도 없이 일을 그만두었다.)

*The victory was nothing less than a miracle.* (그 승리는 그야말로 기적이었다.)

Also, the following examples show that there is a marked difference in word order between the negative sentence and its corresponding affirmative sentence in English (a.1 and a.2), while their Korean equivalents (b.1 and b.2) have no more difference than the negation words and the negation-related words.

- a.1 Little did I know that my life was about to change.
- a.2 I knew that my life was about to change.
- b.1 나는 나의 생활이 변하리라하는 것을 거의 알지 못하였다.
- b.2 나는 나의 생활이 변하리라하는 것을 알고 있었다.

Considering the features described above, we conclude that it is necessary to decide whether the sentence with a negative word is really a negative sentence and what sort of negative sentence it is.

- a. If the subject, predicate or the object of a sentence is negated or a negation word itself, it is a negative sentence.
- b. If an idiom by an expression (e.g. for no reason, be nothing less than, etc), the Korean equivalent might not be a negative sentence.

| Sentences | Korean Equivalents | Corresponding Affirmative Sentences |
|-----------|--------------------|-----------------------------------|
| He just stopped working for no reason. | 헤어트는 왜 그만두었나요? | 그는 아무리도 없이 일을 그만두었다. |
| The victory was nothing less than a miracle. | 승리한 것이 그야말로 기적이라고 했다. | 그 승리는 그야말로 기적이었다. |
b. We subdivided the English negative sentences into single negative (one negation word in the sentence) and double negative sentences (two or more negation words in the sentence) according to the number of negation words, and also into general negative, partial negative and intensified negative sentences according to the parts of sentence which are negated.

The Korean equivalent of the general negative sentence is made from its corresponding affirmative sentence by adding agglutinative suffix, while those of the partial negative and intensified negative sentences require other negation-related words as well.

4. Translation of English Negative Sentences

4.1. The Identification of English Negative Sentence

To translate English negative sentence in EKMT, the parser should clarify;

a. whether the sentence with negation words in it is negative sentence or not.

According to which part of the sentence is negated, we subdivided the negative sentences into six categories;

- Negative Subject – Affirmative Predicate – Affirmative Object (NS-AP-AO)
- Negative Subject – Negative Predicate – Affirmative Object (NS-NP-AO)
- Negative Subject – Affirmative Predicate – Negative Object (NS-AP-NO)
- Affirmative Subject – Affirmative Predicate – Negative Object (AS-AP-NO)
- Affirmative Subject – Negative Predicate – Negative Object (AS-NP-NO)
- Affirmative Subject – Negative Predicate – Negative Object (AS-NP-NO)

If the sentence with negation words matches one of the above sentence structures, the parser decides that it is a negative sentence. If not, it is not a negative sentence, but an affirmative sentence, which should be translated into affirmative sentence in Korean.

b. the types of negative sentences.

According to the number of negation words and the part of sentence which is negated, we conclude that;

- Single negative sentence is general negative, partial negative or intensified negative.

The negative sentence with negative subject, negative object or negative predicate which is modified by the words like ‘every, all, always, entirely, necessarily, etc’ is a partial negative sentence.

- Single negative sentence with negative predicate which is not a partial negative sentence is a general negative sentence.

If an auxiliary verb is negated in a partial negative sentence, the suffixes “~지는 않다” or “~수가 없다” is added to the Korean equivalent of the lexical verb and change it according to the tense of the English predicate.

The particles will not necessarily move the same way under identical conditions.

4.2. Negative Agglutinative Suffixes to Korean Predicate

The negative agglutinative suffixes to Korean predicate is decided by;

a. The kind of predicate verb in English sentence and its tense

If the predicate is “a copular verb + noun”, add “-이/가 아니다” or “-이/가 없다” to the predicate of the Korean affirmative sentence, and if the predicate is a lexical verb and the auxiliary verb do is used, add “-지/가 없다” or “-지/가 못한다”.

b. The kind of English negative sentence

If the negative sentence is a general negative, the above rule is applied to choose a suffix to Korean predicate.

If it is an intensified negative, the Korean negative suffix is added as general negative sentence.

No trains will be affected by this accident.

If it is a partial negative, the agglutinative suffix “~-L것은 아니다” is added.

It is not always true that combining two substances into one releases energy.

If it is a copular verb, add the agglutinative suffix “-~L것은 아니다”.

Korean language has various negative agglutinative suffixes to the predicate such as “-이/가 아니다”, “-지/가 못한다”, “-지/가 없다” and “-지/가 말이다”. It is not easy to decide which one makes a natural expression in Korean. In 3.2 and 3.3, we describe the principles to choose correct suffixes and related words to the corresponding Korean affirmative sentences.
verbs or adjectives. According to the characteristics of Korean verb or adjective collocation, the suffix “–지 않다” or “–지 못하다” is added.

Their effort accomplished little or nothing.

The Korean equivalents of some English negative predicates are completely different from their Korean affirmatives, thus making them impossible to be negated by adding agglutinative suffixes. In this case, the Korean predicate is replaced by appropriate word in the dictionary.

I don’t know what these symbols mean.

4.3. Negation-Related Words

Some negatives sentences (e.g. intensified negatives and double negatives) are not accurately translated in Korean by adding negative suffix to the Korean predicate only. Some adverbs should be added and the particles to the subject or object changed to make correct and natural Korean equivalent.

a. If it is a single negative (one negation word in the sentence), the negation-related words are added according to the English negation word.

- If the predicate verb is negated by adverb “not”, no words are added.

The rooms don’t have air-conditioners.

- If the negation word in the sentence is “never”, “little” or “few”, adverbs are added to the Korean equivalent.

She never looked like her photograph.

b. If it is a partial negative, the particle added to the subject of a Korean equivalent changes from 는(은) to 가(이).

c. If it is an intensified negative in which the subject or the object is negated, the particle to the Korean subject or object noun should be changed or other words added.

- If the subject or object is a negative pronoun or is negated by the determiner “no”, the particle to the Korean subject or object noun should be changed.

Not one person remembered my birthday.

Not all my friends were at the wedding.

- If the subject or object is negated by the determiner “little” or “few” to make a quasi-negative, negation-related words are added.

Few students could answer the question.

Few students could answer the question.

He showed little interest in my suggestion.

I never said nothing about the plan.

5. The Improved Algorithm for the English Negative Sentences

On the basis of the linguistic study described above, we established an improved algorithm for the English negative sentence translation in EKMT. The following diagram shows it.

![Figure 1. Algorithm for the English negative sentence translation.](image-url)
6. Evaluation

We applied the improved algorithm to English-to-Korean Translation System “Ryongnamsan” to improve its translation accuracy. The sample text was about the computer operating system. The sentences with negation words are 518 or 8.2% of the whole 6377 sentences. The following table shows the number of negative sentences of each kind.

| Single Negative | Double Negative | Others |
|-----------------|-----------------|--------|
| NS-AP-AO        | AS-NP-AO        | 56     |
|                 | AS-AP-NO        | 408    |
|                 | NS-NP-AO        | 41     |
|                 | NS-AP-NO        | 0      |
|                 | AS-NP-NO        | 0      |
|                 | AS-AP-NO        | 13     |

There were 5 partial negative sentences among 505 single negatives. The following examples show the translation results of the partial negative and intensified negative by the proposed algorithm (a2 and b2), in comparison with the earlier one (a1 and b1).

When a process is executed, it is not always executed at the site in which it is initiated.

a1: 프로세스가 실행될 때 그것은 언제나 호출이 시작된 곳에서 실행되지 않는다.

b1: 그들이 의뢰자의 요청들에 대한 지식을 가지고 있기 때문에 병사들은 그렇게 할 수 없다.

When a process is executed, it is not always executed at the site in which it is initiated.

a2: 프로세스가 실행될 때 그것이 언제나 호출이 시작된 싱크로에서 실행되는것이 아니다.

b2: 그들이 의뢰자의 요청들에 대한 그 어떤 지식도 가지고 있기 때문에 병사들은 그렇게 할 수 없다.

As the examples show, the proposed algorithm improved the translation of negative sentences, giving accurate and natural Korean equivalents, similar to the human translation.

7. Conclusion

Negative sentences don’t account for large proportion in English text, but their translation is important. A comparative study on the negation in English and Korean provides a new translation algorithm, which is introduced to English-to-Korean Machine Translation System “Ryongnamsan”. The conclusion from the evaluation result is that the proposed algorithm improves the negative sentence translation.

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