

Application of Pronominal Divergence and Anaphora Resolution in English-Hindi Machine Translation

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Abstract—So far the majority of Machine Translation (MT) research has focused on translation at the level of individual sentences. For sentence level translation, Machine Translation has addressed various divergence issues for large variety of languages; the issue of pronominal divergence has been presented only recently. Since the quality of translation as required by users follows coherent multi-sentence discourse structure in a specific context, the pronominal divergence helps us in understanding the nuances of translation arising out of disparity in the languages. Subsequently using clues from this divergence, the anaphora resolution system can find the correct interpretation for the given pronominal referents and other entities by resolving the inter-sentential context. In the literature, researchers have examined the issue and have proposed ways for their classification and resolution of anaphora. However for Indic languages, not many studies are available. In this paper, we discuss different aspects of pronominal divergence that affects the anaphora resolution in English Hindi Machine Translation (EHMT). The study shall be helpful in developing approaches that can explicitly use inter-sentential information in order to resolve specific types of ambiguity and which can generate coherent multi-sentence discourse structure in the target language to produce higher quality of translation Machine Translation.

Index Terms—Pronominal, anaphora, machine translation, divergence.

I. INTRODUCTION

THE syntactic, semantic and discourse level divergence in natural languages poses difficulty in the translation within two languages. Most of the machine translation systems have tried to capture the syntactic and semantic divergence as the translation takes place at the sentence level. The progress at the level of discourse is still at its infancy stage as it requires multi sentence level translation. One of the most important aspects in successfully analyzing multisentential texts is the capacity to establish the anaphoric references to preceding discourse entities. The paper will discuss the issue of pronominal divergence between two languages and the

problem of anaphora resolution from the perspective of EHMT. The study shall be helpful in developing approaches that can explicitly use inter-sentential information in order to resolve specific types of ambiguity and which can generate coherent multi-sentence discourse structure in the target language to produce higher quality of translation MT.

Pronominal divergence between English and Hindi is expressed by the variation in the representation, e.g., English phrase “It is raining” has a corresponding translation as “*baarish ho rahi he*” (lit. “*rain is happening*”) in Hindi. Though typically, “it” has a corresponding translation as “*yeh*” or “*veh*”, in the given example “it” would have no mapping. For a native speaker or for an expert human translator, this may be a simple and obvious choice, the frequent occurrence of such divergence poses difficulty for the machine translation system. For example a good machine translation will be able to detect that “it” maps to “*veh*” or “*yeh*” in most of the cases, but it will be unable to detect the cases where the translation of “it” has to be dropped. Preliminary investigation on a sample text reveals that the divergence of this type is prevalent. Thus finding a way to deal with such a divergence shall help not only in the correct anaphoric resolution but also help in the quality translation.

In the literature ([1], [2], [3]), researchers have examined the issue and have proposed ways for their classification and resolution of anaphora. However for Indic languages, not many studies are available. In this paper we discuss different aspects of pronominal divergence that affect the anaphora resolution in English-Hindi Machine Translation (EHMT). We take classification of pronominal divergence approaches adopted by Mitkov in [2] and Gupta and Chaterjee in [4] as a starting point for our study about pronominal divergence and anaphora resolution in the translation of English and Hindi.

Once we are able to deal with the pronominal divergence between two languages, we shall be not only able to find the correct anaphoric references in the text but shall be able to generate the correct translation for the same. Section II presents the case of pronominal divergence between English and Hindi. Section III presents how pronominal divergence can be used in anaphora resolution. Section IV presents how machine translation systems can benefit from anaphora resolution. Finally, we conclude in section V with the future scope and the difficulties in employing anaphora resolution system for Hindi.

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II. PRONOMINAL DIVERGENCE IN EHMT

Pronominal divergence in EHMT as proposed by Gupta and Chatterjee in [4] pertains to the usage of “it”. Four types of the identified pronominal divergence are as follows:

1. Conversion of subjective compliment in English sentence into subject in the corresponding translation.
2. Conversion of adjectival compliment of the subject into subject.
3. Conversion of infinitive verb into subject.
4. Conversion of main verb into subject.
5. No divergence if “it” is a subject.

To illustrate these cases, let us have a look at the examples from Gupta and Chatterjee [4].

- 1) a) “It is morning.”
subaha ho gayii hai
morning become has
 b) “It was a dark night.”
ek andherii raat thii
one dark night was
- 2) “It is very humid today.”
aaaj bahut umas hai
today very humidity is
- 3) “It is difficult to run in the Sun.”
dhoop mein daudhnaa kathin hai.
Sun-shine in to run difficult is
- 4) “It is raining.”
barsaat ho rahii hai.
rain be ing is
- 5) “It is crying.”
veh ro raha/rahi hai.
He/she cry ...ing is

The pronominal divergence as shown for “it” reveals that if the subject of the English sentence is not “it”, or if the subject of the Hindi sentence is “veh” or “yeh” then pronominal divergence will not take place. However, depending upon the subjective compliment or main verb of the English sentence the type of the pronominal divergence can be identified.

III. ANAPHORIC PROPERTIES OF “IT”

The pronominal divergence discussed in Section II can handle only single sentence translation. Incorporating anaphora resolution component in machine translation enables us to handle the discourse correctly by enabling multisentential translation. From anaphoric point of view the pronominal divergence cases are actually the subset of anaphoric references. From anaphoric point of view “it” can have following anaphoric properties as classified by Evan in [5] (examples are taken from this work).

(i) Nominal Anaphoric
 “Do not sweep the dust_i when dry, you will only recirculate it_i.”

Pronoun “it” refers to nominal expression “the dust”.

(ii) Clause Anaphoric,
 “One day in 1970, fifty thousand women marched down Fifth Avenue in New York. It_i is said to have been the biggest women's gathering since suffrage days.”

Pronoun “it” refers to the preceding clause in the text.

(iii) Proaction
 “Mays walloped four home runs in a span of nine innings. Incidentally, only two did it_i before a home audience.”

Here “it” along with do refers to the preceding verb phrase.

(iv) Cataphoric
 “When it_i fell, the glass_i broke”.

The pronoun is coreferential with the next nominal expression in the text.

(v) Discourse Topic
 “Always use a tool for the job it was designed to do. Always use tools correctly. If it_i feels very awkward, stop.”

The interpretation of the pronoun depends upon the context in which the pronoun is used.

(vi) Pleonastic
 “It is worth having more than one size or a good-quality set with interchangeable bits.”

In this case no interpretation for the pronoun.

(vii) Idiomatic/stereotypic,
 “I take it you're going now.”

The pronoun is non-referential, but used in certain fixed expressions in the language.

TABLE I
 ANAPHORA AND PRONOMINAL DIVERGENCE

Anaphora	Translation of “it” in Hindi	Divergence
Nominal Anaphora	us-ko/use	Case-based
Clausal Anaphora	yeh	Case-based
Proaction	us-ko/use	Case-based
Cataphoric	veh	Case-based
Discourse Topic	-	Pronominal
Pleonastic	-	Pronominal
Idiomatic	-	Pronominal

Cases (i)-(iii) are anaphoric, which is to say that for a given pronoun an antecedent exist in the preceding text. Case (iv)

TABLE III
CORRESPONDING INTERPRETATION OF TRANSLATED SENTENCES

English	Google	AnglaHindi	MaTra2
<i>She voted for her.</i>	<i>He voted for himself</i>	<i>He/She selected for him/her</i>	<i>They voted for he/she</i>
<i>She voted for herself.</i>	<i>He voted for himself</i>	<i>He/She selected for himself/herself.</i>	<i>They voted for themselves</i>
<i>We voted for her.</i>	<i>We voted for him/her</i>	<i>We selected for him/her</i>	<i>We voted for he/she</i>
<i>The house had a fence around it.</i>	<i>The house had a fence around it</i>	<i>In the house, it had a fence around her.</i>	<i>This was a fence of the house</i>
<i>The house had a fence around itself.</i>	<i>Around the house only, there was a fence.</i>	<i>In the house, around itself, there was a fence.</i>	<i>The house had its own fence.</i>
<i>Susan wrapped the blanket around her.</i>	<i>Susan her around blanket wrapped around her</i>	<i>Susan blanket approximately her wrapped.</i>	<i>Susan wrapped that blanket.</i>
<i>Susan wrapped the blanket around her.</i>	<i>Susan of around herself blanket wrapped</i>	<i>Susan wrapped around herself blanket.</i>	<i>Susan wrapped blanket herself.</i>

V. CONCLUSION

Pronominal divergence can help in identifying anaphoric and non-anaphoric occurrences of pronoun. Case based divergence helps us in identifying the correct inflection form for the corresponding pronoun for EHMT. Our studies of “it” pronouns reveals that the pronominal divergence is a subset of anaphoric classification. Since majority of Machine Translation systems only handle one-sentence input, the use of pronominal divergence has limited application for MT. For the further improvement in the translation, processing of multiple sentences for resolving the correct antecedent and thereby generating the correct anaphor (pronoun) is much more useful. Perhaps looking at the complexity involved in understanding and incorporating anaphora resolution majority of the machine translation systems preserve anaphora ambiguities to be corrected by user latter on. Still, the challenge involved in the problem has not deterred the researcher. With the amount of research being conducted in the area of anaphora resolution since last decade, one can be optimistic to have quality automated translation work in the near future.

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