**Translations of Ambiguous Hindi Pronouns to Possible Bengali Pronouns**

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**ABSTRACT**

In a Hindi to Bengali transfer based machine translation system the baseline lexical transfer module replaces a Hindi word by its most frequent Bengali translation. Some pronouns in Hindi can have multiple translations in Bengali. The choices of actual translations have big impact on the accessibility of the translated sentence. The list of Hindi pronouns is small and their corresponding Bengali translations may be judged using a set of rules. In this paper, we are working on the translations of ambiguous Hindi pronouns to possible Bengali pronouns. We observed the uses of Hindi pronouns in a Hindi corpus and formulated the translation rules based on their translations in parallel Bengali corpus.

**1 Introduction**

Hindi and Bengali both originated from Old Indo-Aryan family of languages and are similar in structure. They have lot of similarities even though there are differences in the form of uses and positions of the words in corresponding sentences. According to Koul (2008), Hindi pronouns can be broadly categorized into seven types namely, Personal, Demonstrative, Indefinite, Relative-Correlative, Possessive, Interrogative and Reflexive. Among these Hindi pronouns some are used both as Personal, Demonstrative, and Relative-Correlative pronouns. In Bengali, there are different pronouns for each of these uses. As the list of Hindi such pronouns is small and their uses are limited, it is possible to differentiate each use and find their Bengali translations using a set of linguistic rules.

In a transfer based machine translation system source language words and phrases are transferred to suitable target language words and phrases. A baseline lexical transfer module transfers words and phrases to their most frequent translations. If a word is ambiguous then the module which finds its sense in the current context is referred to as Word Sense Disambiguator (WSD). Word sense disambiguation can be done using statistical and rule based approaches. Identifying uses of pronouns is one of the WSD tasks.

In this paper, we propose rules for disambiguating ambiguous Hindi pronouns which will be translated to different Bengali pronouns in different constructs. We have developed these rules by analysing the sentences in a large Hindi corpus taken from Hindi story books, newspapers, web etc. and their translations in the parallel Bengali corpus. The rules are discussed with example Hindi sentences and their corresponding Bengali translations. The effects of the rules applied in the Hindi to Bengali transfer based Machine Translation (MT) system are evaluated and analysed.
2 Related Work

The correlative clauses in Hindi correlative constructions are discussed and analysed by Bhatt (2003), Kachru (1973), Srivastav (1991), Dayal (1996), etc. They have given extensive study on the use of Dem-XP adjunction structures (a noun phrase headed by a demonstrative pronoun) in the correlative constructions. Similar correlative clauses are also available in Bengali as discussed by Dasgupta (1980), Bagchi (1994), etc.

Dash (2000) has developed a system to identify and analyse Bengali pronouns in corpus data. They have explored the morphological structure of Bengali pronouns in the corpus. The morphological structures of Bengali words (including pronouns) are also analysed by Bhattacharyya et al. (2005). Prasad (2000) have investigated the uses of Hindi pronouns in corpus data.

A few attempts have been made in formatting rules for translating pronouns for some language pairs. For example, Patel and Pareek (2010) have analysed the influence of grammatical properties in the translation of Hindi words (including pronouns) to Gujarati.

Some work has been done on the analysis of the pronouns which are used as anaphora in Hindi and Bengali languages. A shared task has been carried out on anaphora resolution on these languages in ICON 2011 and the results of the participants are discussed in Sobha et al. (2011).

3 Translation Rules for Ambiguous Hindi Pronouns

Most of the Hindi pronouns have single translation in Bengali. Some of such pronouns which occur frequently in the corpus are listed in Table 1 with the corresponding Bengali translations. The transliteration into Roman using Itrans and English translations of these examples are also included.

| Hindi Pronoun | Bengali Translation | English Translation | Hindi Pronoun | Bengali Translation | English Translation |
|---------------|---------------------|---------------------|---------------|---------------------|---------------------|
| (mai.N) मैं  | आमि (Ami)           | I                   | कौन (kauna)  | क (ke)              | who                 |
| (tui) तू    | तूहै (tui)          | you-familiar        | कबा (kaba)   | कब (kakhana)      | when                |
| (tuma) तुम   | तुम है (tumi)       | you-normal          | तबा (taha)   | तब (taba)          | then                |
| (Apa) आप    | आप है (Apani)      | you-formal          | तबा (taha)   | तब (taba)          | then                |

Table 1 – List of some Hindi pronouns that have single translations in Bengali.

Some Hindi pronouns are used to demonstrate both animate and inanimate nouns and as third person personal pronouns. For these three uses a single Hindi pronoun is used where in Bengali there are dedicated pronouns for each use. Given such a Hindi pronoun, we have to find its use in the corresponding sentence and translate it to corresponding Bengali pronoun. In this paper, we consider three such pronouns namely यह (yaha), बह (baha), and जो (jo) and identify their translation rules.
Unlike Hindi, in certain cases classifiers are added to Bengali nouns and pronouns. We discuss the rules of adding the classifiers and case markers (suffixes) with the Bengali translations of the Hindi pronouns.

### 3.1 Handling यहा (yaha)

Three different constructions of the Hindi pronoun यहा (yaha) are shown below.

1. The noun being demonstrated is present in the surface.
2. The noun being demonstrated is absent and the absent noun is inanimate.
3. The noun being demonstrated is absent and the absent noun is animate. In this case, the pronoun is usually a third person personal pronoun.

In the first two cases the corresponding Bengali pronoun is ए (ei). The singular classifiers टा (TA) or टि (Ti), the plural classifiers गुला (gulo) or गुलि (guli), and the case markers रा (ra), के (ke), टे (te), etc are added with the Bengali nouns being demonstrated in the first case and with the Bengali pronouns in the second case where the noun is not present in the surface.

In the third case the corresponding Bengali pronoun is ए (e). In this case, as the noun indicated by the pronoun does not follow it in the surface, the pronoun can be considered as personal pronoun. However, the features of the noun to which the pronoun is indicating is used when translated in Bengali. The singular classifier रा (Zero) and the plural classifier रा (rA) is added with this pronoun when the indicated noun is animate. The Bengali pronoun ए (ei) is used when the indicated noun is inanimate and the singular classifiers टा (TA) or टि (Ti) and the plural classifiers गुला (gulo) or गुलि (guli) are added with it.

Example sentences for each construction of this Hindi pronoun and their translations in Bengali and English are shown in Table 2.

| Hindi Pronoun | Uses | Hindi Example | Bengali Translation | English Translation |
|---------------|------|---------------|---------------------|---------------------|
| यहा (yaha)    | 1    | यहा वज्रना मेरा भाई है (yaha vaJna merA bhAi hai.) | ए (ए) वज्रना आमा सेभाई। (ei chheleTA AmAra bhAi.) | This boy is my brother. |
|               | 2    | यहा मेरा है (yaha merA hai.) | ए (ए) आमा। (eiTA AmAra.) | This is mine. |
|               | 3    | यहा फूल है? (yaha kauna hai.) | ए (के) (e ke?) | Who is he? |

Table 2 – Examples of different constructions of Hindi pronoun यहा (yaha).

### 3.2 Handling बहा (baha) in simple construction

The Hindi pronoun बहा (baha) has the similar constructions as mentioned in Section 3.1. The rules of adding the classifiers and case markers are also similar. In the first two cases the corresponding Bengali pronoun is ओए (oi) and in the third case the
corresponding Bengali pronoun is (o). Example sentences for each construction of this Hindi pronoun and their translations in Bengali and English are shown in Table 3.

| Hindi Pronoun | Uses | Hindi Example | Bengali Translation | English Translation |
|---------------|------|---------------|---------------------|---------------------|
| बह (baha)    | 1    | बह घर मेरा है (baha ghara merA hai) | ओई बाड़िया आमार (oi bA.DI TA AmAra.) | That home is mine. |
|              | 2    | बह मेरा है (baha merA hai) | ओईटा आमार (oITa AmAra.) | That is mine. |
|              | 3    | बह या रहा है (baha yA rahA hai) | ओ राज्य (o yAchchhc.) | He is going. |

Table 3 – Examples of different constructions of Hindi pronoun बह (baha).

### 3.3 Handling जो (jo) - बह (baha) in relative-correlative construction

The Hindi relative pronoun जो (jo) and the Hindi correlative pronoun बह (baha) have the similar constructions as mentioned in Section 3.1. The rules of adding the classifiers and case markers are also similar. In the first two cases the Bengali translations of these pronouns are य (yei) and लेन (sei) and in the third case these are य (ye) and लेन (se), respectively. In the third case when the Bengali plural classifier र (ra) is added with the pronouns then the orthographic changes are य+रा = यारा (ye+rA=yArA) and लेन+रा = लेन (se+rA=tArA). Example sentences for each of these constructions for Hindi pronouns जो (jo) and बह (baha) and their translations in Bengali and English are shown in Table 4.

| Hindi Pronoun | Uses | Hindi Example | Bengali Translation | English Translation |
|---------------|------|---------------|---------------------|---------------------|
| जो (jo) and बह (baha) | 1    | जो घर मेरा है बह घर तेरा भी है (jo ghara merA hai baha ghara terA bhI hai) | येई बाड़िया आमार येई बाड़िया तेहरॉ। (yeI bA.DI TA AmAra yeI bA.DI TA torao.) | My home is your home too. |
|              | 2    | जो बारे रहा है बह बारे करो (jo bala rahA hu.N baha karo) | येईटा बनाचि येईटा करा। (yeITa balachI setITa karo.) | Do what I am telling. |
|              | 3    | जो खड़ा है बह घरा भाई है (jo kha.DA hai baha merA bhAI hai) | ले पाड़िया आदे ले आमार भाई। (ye d.NA.DI Ye Achhe se AmAra bhAI.) | Who is standing is my brother. |

Table 4 – Examples of different constructions of Hindi pronouns जो (jo) and बह (baha)

The Hindi relative pronoun जो (jo) is sometimes followed by कुछ (kUchha), सब (saba), etc. to indicate an abstract amount of things. In these cases the pronoun is translated to Bengali pronoun शा (yA). An example of such construction is given below.

जो कुछ मैंने मारा नहीं है बह सब मिला है (jo kUchha mai.Nne mA.ngA hai baha saba milA hai.)
शा किछु आमि মানি মন না পেয়েছি। (yA kichhu Ami cheYechhi sei saba peYechhi.)
Those which I wanted I got.

According to Section 3.2 and the current section, different translations of Hindi pronoun बहू (baha) and its inflected forms are shown in Table 5. Each empty cell indicates that the corresponding inflected form does not have the corresponding construction.

|             | बहू (baha) | उस (usa) | उसका (usakA) | बो (bo) |
|-------------|-----------|----------|---------------|--------|
| **Simple 1**| उ (oi)    | उ (oi)   |               | उ (oi) |
| **Simple 2**| उस (eiTA) | उस (eiTA) |               |        |
| **Simple 3**| उ (oi)    | उ (oi)   | बो (uni)     |        |
| **Correlative 1**| उस (sei) | उस (sei) | स (se)        |        |
| **Correlative 2**| उस (sei) | उस (sei) | स (se)        |        |
| **Correlative 3**| उ (oi)   | उ (oi)   | बो (uni)     |        |

Table 5 – Translations of different forms of बहू (baha)

### 3.4 Handling Hindi pronominal suffixes

Hindi nominal suffixes को (ko), का (ka), से (se), ये (ye), etc. are also used with Hindi pronouns. Different uses of these Hindi pronominal suffixes have different Bengali translations. The most frequent corresponding Bengali pronominal suffixes are কে (ke), র (ra), থেকে (theke), এ (e), etc. The suffixes which have different translations can be disambiguated with the help of rules.

We have identified the rules of translating the pronominal Hindi suffix को (ko) as discussed below. Then, the rules for translating the Hindi suffix रे (se) are discussed.

The Hindi pronouns इसे (ise) and इसको (isako) as well as the Hindi pronouns उसे (use) and उसको (usako) are used interchangeably. Now, इसे (ise) and उसे (use) Hindi pronouns have different Bengali translations for the following two different cases.

1. If these pronouns indicate the things or persons to whom something is told, given, etc. then their corresponding translations are आ+क (a+ke) and आ+क (a+ke). In this case the Hindi word इसे (ise) is बहू+को (baha+ko) and उसे (use) is बहू+को (baha+ko). The corresponding Bengali translations are आ+क (e+ke) and आ+क (o+ke), respectively.

2. If these pronouns indicate the things (inanimate) which are being kept, given, etc. then their corresponding translations are उस (us) (alternatively उस (us)) and उस (us) (alternatively उस (us)). In this case the Hindi word इसे (ise) is बहू+О (baha+o) and उसे (use) is बहू+О (baha+o). The corresponding Bengali translations are आ+क (e+TA) and आ+क (o+TA).

The noun being indicated by these two pronouns can be animate or inanimate in the first case and are inanimate in the second case. Examples for each of these two uses of
Hindi pronouns and their translations in Bengali and English are shown in Table 6.

| Case | Hindi Example | Bengali Translation | English Translation |
|------|---------------|---------------------|---------------------|
| 1    | इसलिए इसे ब्रह्मकुंड कहा याता है। (isalie ise brahmaku.nDa kahA yAtA hai.) | ऐह्रेना ऐह्रक ब्रह्मकुंड बना रहा। (eijanya eke brahmakuNDa balA haYa.) | That's why it is called Brahmakund. |
|      | इसलिए उसे बुंटता हूँ। (isalie use DA.nTatA hu.N.) | ऐह्रेना ऐह्रक बकी। (eijanya oke baki.) | That's why I scold him. |
| 2    | इसे तुम रखो। (ise tuma rakhA lo.) | ऐह्रेना ऐह्रक साफ़ करो। (eRA tumi rekhe dAo.) | Keep it with you. |
|      | उसे ठीक से रखो। (use Thika se rakho.) | ऐह्रेना ऐह्रक साफ़ करो। (eRA Thika kare rAkho.) | Keep that carefully. |

**Table 6 – Examples of different uses of Hindi pronouns इसे (ise) and उसे (use).**

The Hindi pronoun इसे (use) is also used as correlative pronoun and then its Bengali translations are ऐह्रक (TAke) and ऐह्रेना (seiTAke) (alternatively ऐह्रेना (seiTAKe) (seITake)) for these two cases, respectively.

The Hindi pronominal suffix or postposition ऐ (se) can be translated to different Bengali suffixes and postpositions similar to the case on noun as discussed in Mukhopadhyay et al. (2008). Following are some examples of Hindi pronoun उसे (use) (बह+से (baha+se)) and its translations in Bengali and English, respectively.

| Case | Hindi Example | Bengali Translation | English Translation |
|------|---------------|---------------------|---------------------|
| 1    | उससे कुछ मत बनो। (usase kuchha mata kaho.) | ए | (e) | Don't tell him anything. |
|      | अक्ष कीपूर बाला ना। (oke kichhu bolo nA.) | ओ | (o) | |
| 2    | उससे कुछ ही दूरी पर मेरा घर है। (usase kuchha hi durI para merA ghara hai.) | ऐह्रेना ऐह्रक साफ़ करो। (eRA Thika kare rAkho.) | My home is near to that place. |
|      | अथाम ऐह्रक कीपूर बाला ना। (okhAne theke kichhu durei AmAra ghara.) | ऐह्रेना ऐह्रक साफ़ करो। (eRA Thika kare rAkho.) | |
| 3.5 | **Handling इस (isa), उस (usa), यहाँ (yahA.N) and उहाँ (uhA.N)** |

There are some pronouns which are translated differently when they occur as inflected form in the surface. The Hindi pronouns इस (isa) and उस (usa) are used as demonstrative pronouns when they are not inflected and then their Bengali translations are ऐ (e) and ऐ (oi), respectively. When they are inflected, then the roots are translated as 3 (e) and 3 (o), respectively.

Similarly, the Hindi pronouns यहाँ (yahA.N) and उहाँ (uhA.N) are translated to Bengali pronouns ऐह्रक (ekhAne) and ऐह्रक (okhAne) when they are not inflected and to Bengali pronouns ऐह्रक (ekhAne) and ऐह्रक (okhAne) when they are inflected.
The examples of uses of such pronouns are shown below with Bengali and English translations. In the first example, first उस (usa) is not inflected and second उस (usa) is inflected and the corresponding translations are ওই (oi) and ও (o), respectively. In the second example, first উহাঁ (uhA.N) is inflected and second উহাঁ (uhA.N) is not inflected and the corresponding translations are ওহা (okhAna) and ওহা (okhAne), respectively.

Don’t tell that boy about him.

Go from here to there.

4 Implementation

To apply the rules for translating Hindi pronouns to Bengali it is important to decide whether the noun being demonstrated is present in the surface and to identify the animacy (whether animate or inanimate) of the demonstrated nouns. Based on these observations and the suffix value given by the Hindi morphological analyzer we translate them using the proposed rules.

4.1 Identifying Animacy

If the demonstrated noun is absent, then the animacy is not implicit. In this case, generally, the verb and the dependency relations provide the clue. The subjects (karta) of some activities like खाना (khAnA), खेलना (khelanA), etc. are animate and their objects (karma) are inanimate. The indirect objects (gauna karma) of some activities like बोलना (bolanA), देना (denA), etc. are animate and their direct objects (mukhya karma) are inanimate. We have listed 2 such types of verbs to identify the animacy.

Sometimes we get the animacy information from other nouns or pronouns. The animacy of the noun of proposition (samanadhikaran) is same as the animacy of the corresponding subject (karta). Hindi question words also contain the animacy information which is same as the animacy of the corresponding subjects (karta). For example, कौन (kauna) is animate and क्या (kyA) is inanimate Hindi question words. We have copied the animacy features based on these agreements.

4.2 Deciding whether the demonstrated noun is present in the surface

Generally, if the demonstrated noun is present then it will immediately follow the pronoun. Sometimes, the demonstrative pronoun and the demonstrated noun are intervened by some adjectives. However, the nouns followed by these pronouns are not always the ones being demonstrated. In the following examples, the noun घर (ghara) is not being demonstrated. We hypothesize that if the immediately followed noun is not inflected (except pluralized) and no verb or conjunct immediately follow that noun then that noun is being demonstrated. We have implemented the decision module based on
5 Evaluation

We have used 100 Hindi sentences for testing the proposed rules. We are considering personal and demonstrative pronouns. There are 129 such pronouns in these test sentences. Out of them 19 are unique roots and remaining are the inflections of these 19 roots. The detailed analyses of translations of pronouns are discussed below.

5.1 Analysis

The baseline transfer based MT system replaces these pronouns by their most frequent translations. Among 129 pronouns 103 pronouns are translated correctly by this baseline system. Then, the rules proposed in this paper are used as the transfer grammar rules in this baseline system. The 103 correct translations of the baseline system are also translated correctly by the modified system. Among other 26 other translations 21 are modified correctly (total 124 correct translations) using the rules and 5 are either not modified or the modification is also incorrect.

Examples of input Hindi sentences from the 100 test sentences and their Bengali translations using the baseline and modified systems are shown and discussed below. Correct modifications are made boldface and others are underlined.

1. **Hindi Input:** जो पूजा भ्रामकुंड में खाने में मिलता है, वह कहीं नहीं मिलता है। (Jo puNya brahmaku.nDa me.n snAna se milatA hai, baha kahI.n nahlN milatA hai.)

   **English Translation:** The favour you will get by bathing in Brahmakunda, that is not available anywhere.

   **Baseline Output:** या पूजा भ्रामकुंड में खाने में स्नान के बाद, यह कोतो प्राप्त नहीं। (ya puNya brahmakunDe snAna theke mele, se kothao mele na.)

   **Modified Output:** यह पूजा भ्रामकुंड में खाने में स्नान के बाद, यह सेटी कोतो प्राप्त नहीं। (yei puNya brahmakunDe snAna theke mele, seiTA kothao mele na.)

2. **Hindi Input:** जो भी भक्त इन मंदिरों में दर्शन हेतु आते हैं, वे इसमें पूजा जरूर करते हैं। (jo bhI bhakta ina ma.ndiro.n me.n darshana hetu Ate hai.n, be inase pUjA jarUra karabAte hai.n.)

   **English Translation:** Whoever followers come in this temple for holy witness, those definitely worship by him.

   **Baseline Output:** ये भक्त तीन मंदिरों में दर्शन करते हैं, वे इसमें पूजा करते हैं। (yei bhakta e ke niHsandehe karAYa)

   **Modified Output:** ये भक्त तीन मंदिरों में दर्शन करते हैं, वे इसमें पूजा करते हैं। (yei bhakta e ke diYe pUjA niHsandehe karAYa.)
5.2 Evaluation of Effect of Rules in Machine Translation

The translations of the 100 sentences by the baseline and the modified MT systems are used for automatic evaluation. Three reference translations are used to calculate the BLEU and NIST scores. The averages of three scores with respect to three different reference translations are shown in Table 7.

|               | BLEU  | NIST  |
|---------------|-------|-------|
| Baseline MT system | 0.1660 | 4.2142 |
| Modified MT system      | 0.1669 | 4.2514 |

Table 7 – BLEU and NIST scores of the Baseline and Modified MT systems.

6 Conclusion

The problems in machine translation can be handled by capturing comprehensive and unified rules for different categories of words. This process is lengthy for some class of words like noun, verb, etc. where there are a large number of ambiguities. But the class of words in which the number of ambiguity is limited, there the rules may be helpful. For example, the proposed rules for translating ambiguous Hindi pronouns to Bengali may be implemented easily to solve the pronominal ambiguities.

The statistical way of learning the rules for each category is a quick solution for the overall translation problems. The automatically learned rules for translation of Hindi pronouns to Bengali can be compared with these manually created rules in future. The effect of these rules in other applications like, anaphora resolution, question answering, etc. should also be tested in future.

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