AnglaHindi:
An English to Hindi Machine-Aided Translation System

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Abstract
This paper presents a system overview of an English to Hindi Machine-Aided Translation System named AnglaHindi. Its beta-version has been made available on the internet for free translation at http://anglahindi.iitk.ac.in. AnglaHindi is an English to Hindi version of the ANGLABHARTI translation methodology developed by the author for translation from English to all Indian languages. Anglabharti is a pseudo-interlingual rule-based translation methodology. AnglaHindi, besides using the rule-bases, uses example-base and statistics to obtain more acceptable and accurate translation for frequently encountered noun and verb phrasals. This way a limited hybridization of rule-based and example-based approaches has been incorporated.

1 Introduction
India is a highly multilingual country with eighteen constitutionally recognized languages and several hundred dialects & other living languages. Even though, English is understood by less than 3% of Indian population, it continues to be the de-facto link language for administration, education and business. Hindi, which is official language of the country, is used by more than 400 million people. Therefore, machine translation assumes a much greater significance in breaking the language barrier within the country’s sociological structure. In this paper, we present a glimpse of our effort in this direction. Our work on machine translation started in the early eighties when we proposed using Sanskrit as an interlingua for translation to and from Indian languages (Sinha, 1984; Sinha, 1989). However, as English continues to be the link language, a machine translation system catering to English as the source language and the target language being all Indian languages, was considered to be a priority. Further, as the state of current technology is short of producing high quality automated translation and the human translators are unable to cope up with the volume, a machine-aided translation (MAT) system is an obvious answer. ANGLABHARTI (Sinha et al., 1995) is a rule-based MAT system with source language as English and uses a pseudo-interlingua to cater to all Indian languages. Although, the design methodology of Anglabharti, is geared to achieve an ‘acceptable’ translation at the first instance, it is recognized that the system will have inherent weaknesses of being short of producing ‘quality’ translation thus requiring post-editing. AnglaHindi is an English to Hindi version of the ANGLABHARTI translation methodology with a mixture of some example-based translation methodology. AnglaHindi system has been web-enabled and is available at URL: http://anglahindi.iitk.ac.in for free translation. This is first such system designed to our knowledge. This paper presents an overview of AnglaHindi system.

2 System Overview
As AnglaHindi is a derivative of Anglabharti, let us first look at the Anglabharti methodology. As pointed out earlier, Anglabharti is a machine-aided translation methodology specifically designed for translating English to Indian languages. English is a SVO language while Indian languages are SOV and are relatively of free word-order. Instead of designing translators for English to each Indian language, Anglabharti uses a pseudo-interlingua approach. It analyses English sentences only once and creates an intermediate structure with most of the disambiguation performed. The intermediate language structure has the word and word-group order as per the structure of the group of target languages. The intermediate structure is then converted to each Indian language through a process of text-generation. The effort in analyzing
the English sentences is about 70% and the text-
generation accounts for the rest of the 30%. Thus
only with an additional 30% effort, a new English
to Indian language translator can be built.

Anglabharti is a pattern directed rule based
system with context free grammar like structure for
analysis of English as source language. The
analysis generates a 'pseudo-target' applicable to a
group of Indian languages. A set of rules obtained
through corpus analysis is used to identify
plausible constituents with respect to which
movement rules for the 'pseudo-target' is
constructed. The idea of using 'pseudo-target' is
primarily aimed at incorporating advantages
similar to that of using interlingua approach
exploiting structural similarity. Indian languages
are verb ending, free word-group order, and a lot
of structural similarity. Indian languages can be
classified into four broad groups according to their
origin and similarity. These are Indo-Aryan family
(Hindi, Bangla, Assamiya, Punjabi, Marathi, Oriya,
Gujrati etc.); Dravidian family (Tamil, Telugu,
Kannada & Malayalam); Austro-Asian family and
Tibetan-Burmese family. Within each group, there
is a high degree of structural similarity. Paninian
framework based on Sanskrit grammar using
Karak (similar to 'case') relationship provides an
uniform way of designing the Indian language text
generators using selectional constraints and
preferences.

A block schematic diagram of the Anglabharti
methodology is depicted in figure 1. A brief
description of some of the major building blocks of
Anglabharti is given in the following paragraphs.

Rule-base: This contains rules for mapping
structures of sentence from English to Indian
languages. This database of pattern-
transformations from English to Indian languages
is entrusted the job of making a surface-tree to
surface-tree transformation, bypassing the task of
getting a deep tree of the sentence to be translated.
The data base of structural transformation rules
from English to Indian languages forms the heart
of the Anglabharti system. The system is designed
to cater to compound, complex, imperative,
interrogative and other constructs such as headings
etc. As mentioned earlier, by making a generic
rule-base for Indian languages, Anglabharti
exhibits a potential benefit while translating from
English. This module is also responsible for
picking up the correct sense of each word in the
source language to the extent feasible using
interleaved semantic interpreter. Further
disambiguation and choice of right construct and
lexical preferences are performed by the target
language text-generator module. Many a time,
multiple rules may get invoked leading to multiple
interpretation of the input sentence. The rules are
ordered in terms of their preferences and an upper
limit is put on the number of alternatives produced.
These multiple translations are available for further
post-editing.

Multi-lingual dictionary/ Lexical data-base and
Sense Disambiguator: The lexical database is the
fuel to the translation engine. It contains various
details for each word in English, like their
syntactic categories, possible senses, keys to
disambiguate their senses, corresponding words in
target languages with their tags. A number of
ontological/semantic tags are used to resolve sense
ambiguity in the source language. Most of the
disambiguation rules are in the form of syntacto-
semantic constraints. We use semantics to resolve
most of the intra-sentence anaphora/pronoun
references. Alternative meanings for the
unresolved ambiguities are retained in the pseudo
target language. The lexical database is
hierarchically organized to allow domain specific
meanings and also prioritize meanings as per
users' requirement.

Target text generators and Corrector for ill Formed
Sentences (Sinha, Srivastava and Agrawal, 1995;
Sinha and Sanyal, 1993): These form the tail end
of the system. Their function is to generate the
translated output for the corresponding target
languages. A text generator module for each of the
target languages transforms the pseudo target
language to the target language. These
transformations do lead to sentences which may be
ill-formed. The ill-formed sentences are target
language specific and are usually related to
incorrect placement of emphasizers, negation and
forms denoting cultural dependence (such as
plurals being used for persons whom you pay
respect). A corrector for ill-formed sentences is
used for each of the target languages. Finally, a
human-engineered post-editing package is used to
make the final corrections. It is our experience that
for more than 50% of the normal text, the human
post-editor needs to know only the target language
as the humans use a lot of contextual information in making the right choice. For resolving the structural ambiguity, one needs to consult the source language. It may be noted that by having different text generators using the same rule-base and sense disambiguator, a generic MT system is obtained for a host of target languages. We have used Paninian framework with verb-centric expectation driven methodology (Sinha, 1989) with selectional restrictions/semantic constraints for synthesizing the Indian language text.

**Figure 1: System Architecture of ANGLABHARTI**

The system architecture of ANGLABHARTI includes several modules. The English sentence is first subjected to morph analysis, which is then used to invoke pattern directed parsing. The rule base for pattern invocation and transformation is used to resolve structural ambiguities. The sense disambiguator resolves ambiguities in the meanings of the verb phrasals. The example-based approach developed by the author’s group, named ANUBHARTI (Jain, Sinha and Jain, 1995,2001), is invoked before the rule-based approach is applied. The example-base is statistically derived from the corpus. Ambiguities in the meanings of the verb phrasals are also resolved using an appropriate distance function in the example-base (Bhandari, Sinha and Jain, 2002). AnglaHindi accepts unconstrained text (Jain, Sinha and Jain, 2002; Sinha, 2001). The text may be made up of headings, parenthesized texts, text under quote marks, currencies, varying.
numeral & date conventions, acronyms, unknowns and other frequently encountered constructs. The performance of the system has been evaluated by human translators. The system generates approximately 90% acceptable translation in case of simple, compound and complex sentences up to a length of 20 words.

Current version of AnglaHindi is not tuned to any specific domain of application or topic. However, it has user friendly interfaces which allows hierarchical structuring of the lexical database leading to preferences on lexical choice. Similarly, it has provisions for augmenting its abstracted example-base specific to an application domain. This not only eliminates the alternative translations but also generates more accurate and acceptable translation. Currently, the alternate translations are being ranked with respect to the ordering of the rule-base. This can be further enhanced by using domain specific information and target language statistics. The alternate translations can be ranked based on hidden Markov model of Hindi in the specific domain. For each alternate translation, the language model yields a figure of merit reflecting preferences for style and lexical choice.

Overall, the AnglaHindi system attempts to integrate (Sinha, 2000) example-based approach with rule-base and human engineered post-editing. An attempt is made to fuse the modern artificial-intelligence techniques with the classical Paninian framework based on Sanskrit grammar.

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