MT Embedded E-Learning in India - Challenges for NLP/AI

Ritu Nidhi, Tanya Singh, D.K. Lobiyal

Abstract - Indian languages are spoken by more than 90% of its population while most of the higher education happens in English medium. The policy makers in Indian government have realized that by introducing multilingual education electronically, they can reach out to the remotest corner of India and educate all in their mother tongue. The New Education Policy (NEP) draft just released by the government puts a heavy focus on mother tongues in education. The recent initiatives and focus on Natural Language Processing/ Artificial Intelligence (NLP/AI) in education through e-learning is not too surprising in this context. The paper presents the current initiatives in these directions by the government of India, surveys available NLP technologies particularly those for automatic translation of educational content developed by academia and industry and focuses on the Maithili language community. India's education needs are diverse and the success of e-learning depends heavily on the availability of necessary NLP tools in all languages. Almost all of major scheduled Indian languages are considered "resource-poor". While some of these languages may have the basic tools, they lack quality translation tools for delivering education in native language. The situation is more challenging in those languages where even the most basic resources and tools do not exist. Maithili - a language of Bihar and Nepal is such a language. The paper also presents an effort to develop MT resources and tools for Maithili and its application in delivering multilingual content for education.

Keyword- E-learning, NLP, MT, Indian Language, Maithili

I. INTRODUCTION

India is one of the fastest growing markets in multilingual education technology because there is a need to reach out to the remotest regions of India covering a vast multilingual and socio cultural diversity. As per 2011 census report, there are 26 % of Indian population who are illiterate. The inherent socio cultural political diversity, exclusion, complexity etc in Indian education have been nicely presented by [1]. The potential growth, and opportunities for business has been summed up by [2], [3], and [4]. India's language scene can be described as follows - a vast multilingual and multicultural country with 22 national but resource poor languages and more than 1600 other languages with less than 10% English knowing population and significant illiteracy. This makes India a land of opportunities in the area of using language technology in education. Of the 22 scheduled languages, Hindi has the dual status of National and Official Language (NOL) and English as Associate Official Language (AOL).

All other 21 scheduled Indian languages enjoy national status but do not have sufficient language technology resources to compete with English. Factors like variability, language mixing, rich morphology, weak syntax, lack of technology standards have contributed to poor development of computer technologies in Indian languages. Maithili is one of the 22 schedule Indian languages spoken in the state of Bihar and neighboring Nepal and is extremely resource poor in terms of language technology resources. Lack of digital resources has resulted in a near absence of computer technologies in this language.

A. Landscape of Maithili

Maithili (ISO 639-3) is an Indo Aryan language spoken in Bihar and Nepal. It is also spoken in neighboring states of Jharkhand and West Bengal. As per the census of India (2011), we have more than 13 million Maithili speakers in India alone. Maithili is also spoken in the neighboring country Nepal where it is the second official language and the second most spoken language. A rough estimate puts the total number of Maithili speakers in the world to be around 34 million¹. Popularly written in Devanagari, Maithili has its own script called Mithilikshara. Maithili literature dates back to 8th century AD and has at least six varieties [5]. Maithili shows typical linguistic features of an eastern Indo Aryan language. With a rich inflection system, absence of agreement at the level of verb and reasonable scrambling due to weaker syntax, Maithili has its unique features like varying layers of pronominal and verbal honorifics. Maithili has typical Indo Aryan Subject-Object-Verb (SOV) word order, however flexibility in moving syntactic constituents with relative ease poses challenges for automated linguistic analyses [5].

Indo Aryan languages of north India can easily be contrasted with English which is a rigid syntax SVO language with little scope for scrambling. English also exhibits weaker morphology compared to Maithili. These and other contrasting features of the two languages create difficulties for automatic translation.

II. E-LEARNING IN INDIA

India's education is based on the colonial model established by Lord Macaulay during the British administration of India. Successful post independence governments in India have tried their best to adapt it to Indian diversity, but were not successful given the complexity and challenges therein. The question of languages, medium of instruction etc have been more difficult to implement in India than the content. Though the literacy rates have risen sharply, still there is a massive 26% population below this threshold. The 2001 and 2011 Census Report published by Government of India present contrasting literacy figures.

¹https://www.ethnologue.com/language/mai

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Table I: Literacy figures of Indian Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Literates (%) of total population</th>
<th>Illiterates (%) of total population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>65%</td>
<td>35%</td>
</tr>
<tr>
<td>2011</td>
<td>74%</td>
<td>26%</td>
</tr>
</tbody>
</table>


With one fourth of illiterate population speaking hundreds of languages, education becomes challenging. The technology needed will obviously be a range of language and speech tools that enable people to learn without having to be literate first.

A. Current status of e-learning in India

The government of India is realizing this developmental block and has identified major initiatives in both e-education and language technology with its planning body called NITI Ayog spearheading efforts in consolidating previous work and planning new projects. Many government and non-government organization are involved in e-learning. National Programme on Technology Enhanced Learning (NPTEL), Indira Gandhi National Open University (IGNOU), Talk to a Teacher, Consortium for Educational Communication (CEC), ePathshala, EDUSAT, Massive Open Online Course (MOOC) are some of the initiatives from the Indian government. Besides, there are a large number of private players which have taken initiatives in the e-learning area. The MHRD, Govt of India has started several key initiatives to promote anywhere anytime learning as follows [7].

- **e-pathshala** - National Council of Educational Research and Training (NCERT) has developed e-pathshala to disseminate educational materials which includes textbooks, audio, video through web portal.
- **SWAYAM** - The Study Web of Active Learning for Young Aspiring Minds (SWAYAM) is an online e-learning platform an initiative of MHRD, India. Currently, MOOC offers more than 1000 courses which is listed on SWAYAM [8].
- **SWAYAM Prabha** - It provides 32 high quality educational national channels through DTH-TV. All channels curriculum based course content for secondary and senior secondary school
- **ShaGun portal** - It is a web portal, which is a repository of newspaper article, photograph, videos etc. for elementary education.
- **National Repository of Open Educational Resources (NROER)** - is an open source where teachers and students can access digital educational content free.
- **National Digital Library (NDL)** - also a repository which has features for single-window search facility. More than 150 lacs digital books are available through NDL.
- **ShalaKosh** - is a repository of school data. It is used for school academic administrative work.
- **Saransh** - has been developed and launched by CBSE in 2015 is a self-reviewed tool which serves as an interface for enhancing communication between schools and parents. It offers data driven analytical solution for tracking performance of students [9].

ICT in Education Curriculum for School System: NCERT has launched Information and Communication Technology (ICT) curriculum, which focuses on students to developed their capacity in ICT skills.

B. Major players in the industry

The industry has realized the opportunity that lies in digitized education in India and is investing liberally in the field.

**BYJU's** is one of the top e-learning companies that offer educational technology for school students.

**Educomp** is an e-learning company that has 30 million learners across 65,000 schools in two decades. It is the largest education company in India.

**IGNOU** is the most popular public university offering distance learning in India. Run by the central government of India, it also happens to be the largest university in the world. It was established in 1985 has over 3 million active enrollment.

**NIIT** offers learning management, which develops e-learning platform and e-learning content.

**Meritnation** is an online portal for Indian school going kids. They provide very competitive live video lectures and interactive recorded videos.

**Edukart** offers 2000 courses in degree, diploma, certificate, entrance coaching and K12 categories. It is an online entrance coaching site that provides solutions to aspirants candidates.

III. NLP IN EDUCATION IN INDIA

NLP plays an ever bigger role in education today. It is being used to automate the tasks that were done manually earlier. Due to electronically available content, NLP in education is processing text and speech in useful manner [10]. There are several applications which come under NLP: Machine Translation (MT), Named Entity Recognition (NER), Optical Character Recognition (OCR), Parts-of-Speech Tagging (POS Tagging), Speech to Speech Translation, Text to Speech Translation etc.Cross lingual Information Access (CLIA) allows user to search query in the language he/she knows and the result will be given in different languages [11]. CLIA system has five sub systems: a. Input processing b. Search c. Processing of retrieved documents d. Output generation and e. UNL based search. Currently the CLIA systems have been developed only for a few Indian languages. A consortium of 11 institutions funded by Government of India, Ministry of Electronics & Information Technology (MEITY) was created for this purpose.

IV. ROLE OF MT AND LOCALIZATION IN INDIAN EDUCATION

MT driven localization is critical for delivering e-learning content in diverse India. There is a severe shortage of such platforms which can cater to diverse multilingual education needs in India. However, there have been some spade work in the area of MT as reported below –

A. Major developments in Indian language MT

**Work done by Govt. funding**

Indian government supports heavily for major scheduled languages and MT has been a prime concern considering the complex multilingual situation in India. Among major
supporters are the Ministry of Human Resource Development (MHRD) which supports projects in resource development through its nodal agencies like the Central Institute of Indian Languages (CIIL), Mysore and the University Grants Commission (UGC). The Ministry of Electronics and Information Technology (MEITY) through its flagship initiative Technology Development for Indian Languages (TDIL) supports technology development in major languages. The Department of Science & Technology (DST) of the Ministry of Science & Technology also funds technology development for Indian languages in application development and cognitive science related areas. The TDIL initiative of MEITY sponsors projects to develop MT systems and related resources for Indian languages. In recent times, the following mission mode projects have been given to leading institutes in the country [12].

- English to Indian Languages Machine Translation System (E-ILMT) to CDAC, Pune
- English to Indian Languages Machine Translation System with Angla-Bharti Technology (E-ILMT-ABT) to IIT Kanpur
- Indian Language to Indian Language Machine Translation System: (ILMT) to IIIT Hyderabad
- Sanskrit-Hindi Machine Translation (SHMT) to a consortium of University of Hyderabad, JNU and five other universities/institutes

The following table presents a chronological list of various attempts at developing MT Systems for Indian language pairs including English since the late nineties by Indian academia (funded by either TDIL or other govt. agencies)

<table>
<thead>
<tr>
<th>SN</th>
<th>System</th>
<th>Target Language</th>
<th>Year</th>
<th>Place</th>
<th>Method used</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Shiva and Shakti [21]</td>
<td>English-Hindi, Marathi, Telugu</td>
<td>2003</td>
<td>LLSc, Bangalore and IIT, Hyderabad</td>
<td>Transfer based</td>
<td>General</td>
</tr>
<tr>
<td>9</td>
<td>Google Translator</td>
<td>More than 100 languages (including foreign language)</td>
<td>2006</td>
<td>Google</td>
<td>Statistical based</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Hindi-Punjabi MT</td>
<td>Hindi – Punjabi</td>
<td>2009, 2011</td>
<td>University of Patiala</td>
<td>Direct based</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>English-Telugu MT System</td>
<td>English – Telugu</td>
<td>2004</td>
<td></td>
<td>Rule based</td>
<td>General</td>
</tr>
<tr>
<td>12</td>
<td>Tamil-Hindi MT system</td>
<td>Tamil - Hindi</td>
<td>2009</td>
<td>AU-KBC, Chennai</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B.  Indian language MT Systems by Industry
The few major players in private industries are Google translator, Microsoft Bing Translator, Linguee translation tool, SDL Trados Studio, Fluency Now, MemoQ, WordFast Pro. Google translator translates over 100 languages which includes 11 Indian and major foreign languages. [22] claims that more 500 million people use Google translator every day. A few years ago, Google translator launched app for Android and iOS which supports more than 100 languages and can translate 37 languages via photo, 32 via voice in “conversation mode”, and 27 via real-time video in “augmented reality mode” [22]. It is widely used translator which supports text, speech, images and video. Microsoft Bing Translator which was launched in 2007 is based on Statistical Machine Translation (SMT). It supports 10 speech translation systems that currently feature in Skype Translator and Skype for Windows Desktop, and the Microsoft Translator Apps for iOS and Android. The Linguee translation tool combines a dictionary with a search engine, so that user can search for bilingual texts, words and expressions in different languages to check meanings and contextual translations. The SDL Trados Studio is the most recommended computer-assisted translation (CAT) tool. This software features TM, terminology, Machine Translation, and software localization. Fluency Now is a professional and a premium CAT tool and translation memory software created for individual freelancers. This tool is compatible with Windows, Linux and Mac operating systems. This tool also provides an in-built proof reading software and project and document statistics. MemoQ is a translation software designed for freelance translators and offers a number of powerful functions that enable users to reuse previous translations. MemoQ also helps in improving quality, check consistency and ensure the use of correct terminology. The Wordfast Pro is a standalone, multi-platform TM tool designed to improve the translation process for project managers and freelance translators.

V.  ENGLISH-MAITHILI MT (EMMT) FOR EDUCATION
Historically, major MT efforts in India have been rule based depending heavily on hand crafted grammar and dictionaries. Some initial efforts in translating English to Indian languages used a Prolog based parser and mapped Indian language generation rules. Some of them even tried Paninian formalism for parsing the source language including English. The statistical methods have been tried recently and some systems have been developed. Most of these systems with the exceptions of those developed by Google and Microsoft are practically unusable and require significant improvements. Due to being an extremely less resourced language, digital content of Maithili is not available easily. The parallel English Maithili data was even more difficult to create. The source language (SL) English data was collected from various resources such as magazine, books and internet in different domains such as politics, cuisine, sports, Bollywood etc. This data then manually translated into Maithili (target language (TL)), aligned and validated to create a gold set using two methods - one to use Google translate to create Hindi output and then use a standalone Hindi-Maithili converter developed by the lead author to create English-Maithili data and then post edit it for quality, two to manually translate English into Maithili. The Maithili monolingual data was collected from similar domains as the English source data, cleaned and validated into the gold set.

MT Hub and Moses are both MT platforms for training SMT Systems for a pair of natural languages. The MT Hub has been developed by Microsoft to build translation systems and Moses is an open source software. Both the engines require parallel aligned corpora in the source and target language pairs along with the monolingual corpora for the target language. The EMMT system training was done for 10,000 parallel aligned corpora for the English-Maithili pair and 10,000 sentence corpora for the target language. The dataset used in these experiments were identical. The following section documents the results of both trainings - Moses

BLEU = 6.18, 30.2/6.6/2.2/0.9
### Table-III: Training data

<table>
<thead>
<tr>
<th>Brevity of penalty (BP)</th>
<th>Hypothetical length (MT output)</th>
<th>Reference data length</th>
<th>Ratio (hyp_len/re_len)</th>
<th>BLEU U Score</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.869</td>
<td>8815</td>
<td>10053</td>
<td>0.877</td>
<td>6.18</td>
<td>50 minutes</td>
</tr>
</tbody>
</table>

The four figures "30.2/6.6/2.2/0.9" are the precisions of 1-grams, 2-grams, 3-grams, and 4-grams, respectively and the global scores (BLEU 6.18) is computed as the geometric mean of these precisions multiplied by the Brevity Penalty (BP) calculated according to the length ratio (ration).

**MTHub**

Details of the training are given below –

<table>
<thead>
<tr>
<th>Type of the training data file</th>
<th>Extracted Sentence Count</th>
<th>Aligned Sentence Count</th>
<th>Used Sentence Count (training set)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monolingual (Maithili)</td>
<td>13,048</td>
<td>-</td>
<td>13,023</td>
</tr>
<tr>
<td>Parallel (English-Maithili)</td>
<td>10,334</td>
<td>7,562</td>
<td>6,427</td>
</tr>
<tr>
<td>Parallel (Maithili target)</td>
<td>10,758</td>
<td>-</td>
<td>6,427</td>
</tr>
</tbody>
</table>

The results obtained may be tabulated as follows

<table>
<thead>
<tr>
<th>Extracted sentences</th>
<th>Aligned sentences</th>
<th>Used sentences</th>
<th>BLEU</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>23,382</td>
<td>7,562</td>
<td>19,450</td>
<td>11.07</td>
<td>1 hour 31 minutes</td>
</tr>
</tbody>
</table>

BLEU Score: 11.07
Language Pair: English to Maithili

### VII. CONCLUSION AND FUTURE WORK

The paper has presented the current status of NLP applications in India's e-learning horizon and the challenges and opportunities in a socio-cultural, linguistically diverse nation with substantial illiteracy. The paper has also briefly surveyed current government and industry initiatives in e-learning and documented the status of MT research and applications in the country and their current and potential applications in e-education. The status of Maithili language in the technology space and the progress in the development of English-Maithili MT system for potential use in education have also been presented. The authors intend to work towards an integrated localization platform for Maithili with EMMT engine for use in adapting English content for education in Maithili.

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