

An Approach of Handling Verbal Inflections of Bengali Text: Conversion of Sadhu to Cholito Form of Language

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Abstract—Bengali language follows Subject-Object-Verb (SOV) structure for constructing sentences where verb plays a crucial role. Machine translation for Bengali becomes easier if the verb is identified correctly in a semantically valid sentence. However, Bengali verbs are affected by various complex inflections while using in a sentence. Those inflections are determined according to tense (time of occurring event), person (nature of the subject), Sadhu and Cholito forms (historic evolution of writing styles of Bengali) of language. In this study, we propose an algorithm to identify different inflections of Bengali verbs to retrieve verb roots and present an approach to convert Sadhu to Cholito form of writing Bengali sentences. The methodology shows satisfying accuracy and fluency in the context of language evaluation.

Keywords—Bengali language, Bengali verb, Verb root, Verbal inflection, Conversion of Sadhu to Cholito, Shadhu, Cholito.

I. INTRODUCTION

Bengali, also known as Bangla, evolved from Indo-European language family through Eastern Indo-Aryan and later on, via Magadhi Apabhraṃsha. It is primarily spoken by the people in the region of South Asia, which comprises of Bangladesh and some states of India including West Bengal, Tripura, Assam and the Andaman and Nicobar Islands [1]. Bengali is the sixth most spoken language considering the number of native speakers and the seventh most spoken language by the total number of speakers in the world [2].

Bengali language and literature have the most prominent and diverse tradition in the world, which is developed over the course of more than 1,300 years. The modern version of Bengali literary has been developed extensively during the 18th to 20th centuries. During this period, Bengali language exhibits a strong case of *diglossia* (also known as linguistic duality), a situation in which two forms of dialects are used in a single language [1]. The two distinct varieties are named:

1. Sadhu Bhasha (সাধু; also spelt as Sadhu):
A form of Bengali dialect for written purpose only.
2. Cholito Bhasha (চলিত; also spelt as Chalita, Colito):
An informal vernacular form of Bengali language.

The standard and formalized Sadhu bhasha came into usage in Medieval period of Bengali language in 16th century while the colloquial Cholito form came into vogue in the early of 19th century with a purpose of spoken dialect. The Cholito bhasha exhibits preponderance over Sadhu bhasha for both written and colloquial use by the influence of prominent writers— Pramatha Chaudhuri, Rabindranath Tagore etc. Although the Sadhu bhasha differs greatly from the Cholito style [1,3], an enormous number of literary works— prosas, poetries, novels, have been written in Sadhu bhasha. Some

pioneer writers of 19th century— Ishwar Chandra Vidyasagar, Haraprasad Shastri, Bankim Chandra Chattopadhyay, Mir Mosharraf Hossain etc. wrote notable literature in Sadhu bhasha [3].

In this paper, we formulate an algorithm to find out the verb roots and verbal inflections hence to convert text of Sadhu form to Cholito language. To the best of our knowledge, it is the first time to deal with this kind of research work in Bangla language to convert from Sadhu to Cholito writing format, whereas finding verb root is accomplished by some researchers in different ways. This work has been investigated in phases:

1. Identify the verb root and verbal inflection
2. Convert the Sadhu form of language to Cholito

A few research works had been conducted to identify verb root and word root of Bengali sentences. The authors in [4] proposed an algorithm to reveal the relation between subject and verb by analyzing Bengali persons and verbal inflections. They reached 99.67% accuracy in generating accurate relationship between subject and verb. A methodology to extract the root form of Bengali verbs using the *Paninian* grammar rules is explored in [5]. Panini was a renowned Sanskrit grammarian, philologist in ancient India who lived in the 6th to 5th century BCE. He is known for the *Astadhyayi*, a sutra-style(formula) treatise on Sanskrit grammar with 3,959 rules on linguistics. The authors revived the rules to extract root forms of verbs at the surface level using supervised learning. Another procedure for finding semantically valid verbs during machine translation from English to Bengali is proposed in [6].

II. BENGALI VERBS

Each language including Bengali, has two different forms: 1. Written and 2. Colloquial. Bengali Language follows two styles of written format: 1. Sadhu bhasha (elegant or chaste) and 2. Cholito bhasha (current or colloquial).

Bengali is complicated in the context of sentence structure. Mainly, it follows SOV (subject-object-verb) format [7]. Verb plays the vital role to express the meaning of the sentences. It also inflected or changed its form very frequently rather the other constituents of the sentence i.e. subject, object. More than 1,500 verbs exist in Bangla language and it contains to add or vanishes to the list [8]. As it mentioned, Bangla language has two styles of writing: Sadhu and Cholito, we illustrate this with some examples:

Sentence 1: আমি ভাত খাইতেছি (IPA: Ami B^hat K^haitechi)

Sentence 2: আমি ভাত খাচ্ছি (IPA: Ami B^hat K^hacchi)

TABLE I. TWENTY VERB CLASSES (COMPILED FROM [9])

No.	Root Class	IPA Pronunciation	No. of Verbs	Some Examples
1.	হ	ho	3	হ (হওয়া), ল (লওয়া)
2.	খা	kha	4	খা (খাওয়া), যা (যাওয়া)
3.	দি	di	2	দি (দেওয়া), নি (নেওয়া)
4.	শু	shu	8	নু (নোয়ানো), ছু (ছোঁয়া)
5.	কর	kr	200+	কর (করা), গড় (গড়া), চল (চলা)
6.	কহ	kh	4	কহ (কহা), সহ (সহা), বহ (বহা)
7.	কাট	kat	150+	গাঁথ, চাল, আঁক, বাঁধ, কাঁদ
8.	গাহ	gah	4	চাহ, বাহ, নাহ
9.	লিখ	likh	28	কিন, ঘির, জিত, ফির, চিন
10.	উঠ	uth	80+	উড়, শুন, খুঁজ, খুল, ডুব, তুল
11.	লাফা	lafa	200+	কাটা, ডাকা, বাজা, আগা
12.	নাহা	naha	2	গাহা
13.	ফিরা	fira	40+	ছিটা, শিখা, ঝিমা
14.	ঘুরা	ghura	53+	উঁচা, লুকা, কুড়া
15.	ধোয়া	dhoya	27+	শোয়া, খোঁচা, গোছা, যোগা
16.	দৌড়া	doura	3	দৌড়া, পৌঁছা
17.	চটকা	chtka	100+	সমঝা, ধমকা, কচলা
18.	বিগড়া	bigra	12+	হিচড়া, ছিটকা, সিটকা
19.	উলটা	ulta	27+	দুমাড়া, মুচড়া, উপচা
20.	ছোবলা	chhobla	4	কোঁচকা, কোঁকড়া

In the above two sentences, subject and object are identical while only the verb changes its form of writing. However, the meaning of the sentences is indifferent.

খাইতেছি (IPA: K^haitechhi) — Sadhu form

খাচ্ছি (IPA: K^hacchi) — Cholito form

If we closely observe the verbs, we see that the verbs are inflected differently, remaining the root unchanged:

খা+ইতেছি (খা/K^ha: Verb root, ইতেছি/itechhi: Verbal inflection)

খা+চ্ছি (খা/K^ha: Verb root, চ্ছি/cchi: Verbal inflection)

Therefore, we can say that the verb of Bengali language has two parts: verb root (খা) and verbal inflection (ইতেছি/চ্ছি).

A. Verb Root (ক্রিয়া মূল, IPA: Kriya mul)

The atomic part of verb which cannot be divided further [9]. Two issues are to be considered to determine the class of a verb [4]:

1. Number of letters in the verb root
2. The vowel that attached with the first letter of the verb root

More than 1,500 verbs are found in Bengali language which are classified into twenty groups according to verb roots. Table I enlists the twenty verb root classes with some examples.

B. Verbal Inflection (ক্রিয়া বিভক্তি, IPA: Kriya Bivokti)

The verb in a sentence is formed with a suffix at the end of the verb root. The suffix is called verbal inflection [9]. This inflection in Bangla verb is determined by following three conditions:

1. Change in tense and person
2. According to Sadhu or Cholito form
3. According to the role of factitive verb (প্রযোজক ক্রিয়া)

There are more than 150 verb inflections found in Bengali [10]. Table II enlists some of them according to the tense and person in the form of Sadhu and Cholito bhasha.

III. IDENTIFICATION OF THE VERB ROOTS

A semantically valid Bengali sentence may have multiple syntactically correct verb forms. For example, the sentence—

করিম কাজটি করিতেছে (IPA: Korim kajti Koriteche)

In this sentence, the only verb is করিতেছে. To identify the verb, algorithm 1 is applied. According to the algorithm, at the first step, the sentence is segregated into words which are known as tokens. These tokens are filtered through a list of verb roots. If any of the tokens matches with a verb root from the list, it is retrieved for further processing. For the example sentence, the token করিম and করিতেছে matches the verb root কর। Now, the inflections of the tokens are separated using grammar rules.

করিম → কর+িম (IPA: Korim → Kor+im)

করিতেছে → কর+িতেছে (IPA: Koriteche → Kor+iteche)

At this step, the right inflections are identified and stored while other wrong inflections are discarded. So, the final verb word(s)—করিতেছে is correctly identified with verb root (কর) and inflection (িতেছে) separately.

An algorithm (Algorithm 1) is developed according to the new proposal.

Algorithm 1: IndentifyVerbRoot(token)

Input: Individual words of a sentence as token

Output: verb root, verbal inflection

Corpus: List: Kriyamul (Sadhu Bivokti, Cholito Bivokti)

Procedure:

1. For i=1 to size(Kriyamul_list)
2. If isSubString(Kriyamul_list[i], token) == TRUE
3. temp_Bivokti = token — Kriyamul_list[i]
4. If isBivokti(sadhuBivokti) == TRUE
5. bivokti = temp_Bivokti
6. End If
7. kriyamul = Kriyamul_list[i]
8. End If
9. End For

IV. CONVERSION OF SADHU TO CHOLITO FORM

The difference between Sadhu and Cholito form is observed in the inflection of verbs attached-with in a sentence. The Sadhu form is strictly followed according to grammar rules while Cholito is flexible in this case. Sadhu form usually comes with longer inflections. Table II compiles some of the Sadhu inflections with corresponding Cholito inflections according to three persons— first, second. and third persons; seven tenses—present continuous, present perfect, simple past, past continuous, past perfect, simple future and imperatives.

The following rules are followed in case of conversion of Sadhu to Cholito form [9]:

1. Elimination of ই-sound or ি-কার (-i- sound)
Example: পাইব > পাব, আসিবে > আসবে
2. Elimination of উ-sound (-u- sound)
Example: হউক > হোক
3. Elimination of হ-sound (-h- sound)
Example: যাহা > যা, চাহিবে > চাইবে
4. Change of উ- sound (-u- sound)
Example: শুন > শোন, উঠে > ওঠে

TABLE II. DIFFERENT FORMS OF VERBAL INFLECTIONS

Tense	1st Person		2nd Person		3rd Person			
	আমি (I)		তুমি (You)		সে (He/She)		আপনি (You)	
	Sadhu	Cholito	Sadhu	Cholito	Sadhu	Cholito	Sadhu	Cholito
Present Continuous	+ ইতেছি + itechi	+ চি + echi	+ ইতেছ + itecho	+ চছ + echo	+ ইতেছে + iteche	+ চে + eche	+ ইতেছেন + itechen	+ চেন + echen
	+ িতেছি + itechi	+ ছি + chi	+ িতেছ + itecho	+ ছ + cho	+ িতেছে + iteche	+ ছে + che	+ িতেছেন + itechen	+ ছেন + chen
Present Perfect	+ িয়াছি + iyachi	+ েছি + echi	+ িয়াছ + iyacho	+ েছ + echo	+ িয়াছে + iyache	+ েছে + eche	+ িয়াছেন + iyachen	+ েছেন + echen
Simple Past	+ িলাম + ilam	+ লাম + lam	+ িলে + ile	+ লে + le	+ িল + ilo	+ ল + lo	+ িলেন + ilen	+ লেন + len
Past Continuous	+ ইতেছিলাম + itechilam	+ চিলাম + echilam	+ ইতেছিলে + itechile	+ চিলে + echile	+ ইতেছিল + itechilo	+ চিল + chilo	+ ইতেছিলেন + itechilen	+ চিলেন + echilen
	+ িতেছিলাম + itechilam	+ ছিলাম + chilam	+ িতেছিলে + itechile	+ ছিলে + chile	+ িতেছিল + itechilo	+ ছিল + chilo	+ িতেছিলেন + itechilen	+ ছিলেন + chilen
Past Perfect	+ িয়াছিলাম + iyachilam	+ েছিলাম + echilam	+ িয়াছিলে + iyachile	+ েছিলে + echile	+ িয়াছিল + iyachilo	+ েছিল + echilo	+ িয়াছিলেন + iyachilen	+ েছিলেন + echilen
Habitual Past	+ িতাম + itam	+ তাম + tam	+ িতে + ite	+ তে + te	+ িত + ito	+ ত + to	+ িতেন + iten	+ তেন + ten
Simple Future	+ িব + ibo	+ ব/বো + bo	+ িবে + ibe	+ বে + be	+ িবে + ibe	+ বে + be	+ িবেন + iben	+ বেন + ben

* IPA pronunciations are included.

5. Change of আ-sound or া-কার (-a- sound)

Example: দিয়া > দিয়ে, পিঠা > পিঠে

6. Effect of mutation, synchronization of vowels

Example: করিয়া > করে, ছুটিয়া > ছুটে

From the previous example, assume the same sentence for Sadhu to Cholito conversion:

করিম কাজটি করিতেছে (IPA: Korim kajti koriteche)

As the verb করিতেছে is identified with the root কর and the inflection িতেছে are separated, now the task is to validate the inflection in Sadhu form is correct or not. After passing the validation, the inflection is replaced according to the mapping of corresponding Cholito inflection of the grammar.

িতেছে → ছে (IPA: iteche → che)

At the last step, the sentence is bind together again with the replacement for the ultimate output.

করিম কাজটি করিতেছে → করিম কাজটি করছে
(IPA: Korim kajti koriteche → Korim kajti korche)

To achieve this goal, the algorithm 1 is rewritten as the algorithm 2.

Algorithm 2: ConvertSadhu2Cholito(token)
Input: Sentence with Sadhu inflection
Output: Sentence with Cholito inflection
Corpus: List: Kriyamul, (Sadhu Bivokti, Cholito Bivokti)
Procedure:
1. For i=1 to size(Kriyamul_list)
2. If isSubString(Kriyamul_list[i], token) == TRUE
3. sadhuBivokti = token — Kriyamul_list[i]
4. If isBivokti(sadhuBivokti) == TRUE
5. Replace the Sadhu Bivokti with the corresponding Cholito Bivokti
6. End If
7. End If
8. End For

V. HANDLING EXCEPTIONAL CASES

A. Different forms of verb root

No language is following exact rules while it is developing by evolution and continuously of being used by its speakers.

So, some exceptional cases are found while the research is being conducted. For example, the verb root যা,

It changes the form to গি/গে (IPA: gi/ge) in present perfect (e.g. গিয়াছি, IPA: giyachi), simple past (গেলাম, IPA: gelam), and past perfect (গিয়াছিলাম, IPA: giyachilam) tense for the first person. Similar changes are noticed for other types of persons. Another verb root শু (IPA: shu), it shows alternative form শোব/শোবো (IPA: shobo) in simple future tense.

These exceptions are solved using a manual mapping of corresponding forms. We have conserved a list of exceptional verb roots while these are not supposed to be filtered according to our new proposed algorithm. Table III shows some of the exceptional verb forms.

TABLE III. EXCEPTIONAL VERBS

Verb Root	Changed Form	Verb – Person/Tense
যা	গি/গে	গিয়েছিলাম – 1 st Person/Simple past
শু	শোবো	শোবে – 1 st Person/Simple future

B. Other words except verb

Some more exceptional cases are noticed except verbs. Many nouns, pronouns, prepositions of Sadhu bhasha changes their forms differently in Cholito bhasha. For example,

A sentence in Sadhu bhasha বৃক্ষে বৃক্ষে পুষ্প ফুটিয়াছে (IPA: brikhe brikhe pushpo futiyache) will be converted as গাছে গাছে ফুল ফুটেছে (IPA: gache gache ful futeche) in Cholito language. These kind of exceptions are resolved by direct replacement method with their suffix— বৃক্ষ+এ → গাছ+এ, পুষ্প+ও(null inflection) → ফুল+ও(null inflection)।

The writers in Sadhu bhasha used such nouns in different form in an elegant sense. These words tends to be less important for practical use by native speakers. In general, pronouns and prepositions in Sadhu bhasha are longer in length rather than the words in Cholito bhasha.

C. Intransitive verbs

One of the main feature of our research is to consider maximum verbs in Bengali. We also study intransitive verbs which is overlooked by most of the researchers while finding verb roots. These verbs are followed by a regular pattern of

conversion with almost fixed inflections. So, we incorporate some more rules to handle intransitive verbs in our algorithm. Table IV displays some examples of intransitive verbs.

TABLE IV. INTRANSITIVE VERBS

<i>Sadhu</i>	<i>Cholito</i>	<i>Sadhu</i>	<i>Cholito</i>
+ ইয়া + iya	+ ে + e	+ িয়া + iya	+ ে + e
+ ইলে + ile	+ চ্ছি + cchi	+ িলে + ile	+ লে + le
+ ইতে + ite	+ এছি + echi	+ িতে + ite	+ তে + te

D. Facitive verbs

We also study factitive verbs (প্রযোজক ক্রিয়া) in this research. Facitive verbs indicate the state of a person (direct object) caused by the action of verb. In Bengali, factitive verbs are used in a Sadhu sentence with an extra আ (a) inflection in between verb and regular inflection. The form in Cholito is constructed by keeping the extra আ (a) inflection unchanged. So the rule is being simple to implement. To illustrate,

Example sentence: শিক্ষক ছাত্রকে পড়াইতেছেন

পড় + আ + ইতেছেন (Sadhu) → পড় + আ + ছেন (Cholito)

In Cholito: শিক্ষক ছাত্রকে পড়াছেন

VI. CORPUS SETUP

We propose algorithms to identify Bengali verb root and to convert Sadhu to Cholito form. To achieve the purpose, first, we need to build a monolingual corpus of Sadhu bhasha. Sadhu bhasha was considered for writing literary works by renowned writers. Some prominent writers have great contributions to enrich Bengali literature in the 16th century and onwards. To name, Ishwar Chandra Vidyasagar, Bankim Chandra Chattopadhyay etc. were notable. Besides literary works, the popular newspapers and periodicals of the 18th centuries were also written in Sadhu bhasha, like, the daily Ittefaq, Sangbad, Anandabazar Patrika etc. To build our corpus, we consider both literary works of famous writers and articles and editorials of popular newspapers. Almost 70% of our corpus is collected from literary and 30% comes from newspapers. A statistical overview of our corpus is given in Table V. Moreover, a glimpse of our corpus will be available for publicly use at [11].

TABLE V. CORPUS STATS

<i>Items</i>	<i>Quantity</i>
Total sentences	100,316
Total words	700,552
Inflected verbs	400,245
Other inflected words (Pronouns, prepositions and others)	100,542

VII. RESULT ANALYSIS

A. Evaluation Results

After building the corpus, we have tested the algorithms. Evaluation measures the number of correctly identified verb roots with their inflections as a scale of accuracy percentile which is noted in Table VI (a). For the evaluation of Sadhu to Cholito conversion, the fluency of Cholito text is measured manually in a scale of 0 to 5. Three expertise linguists and Three normal native speakers marked the test and an average

of user is considered as final score which is given in Table VI (b). Table VI (c) shows the percentage calculation of results.

TABLE VI. EVALUATION RESULTS

(a)		
<i>Items</i>	<i>Manually Counted</i>	<i>Identified by Algorithm 1</i>
Inflected verb words	400,245	398,245
(b)		
<i>Items</i>	<i>Manually Counted</i>	<i>Identified by Algorithm 2</i>
Inflected verb words	400,245	390,245
Other inflected words (Pronouns, prepositions and others)	100,542	86,542
(c)		
<i>Items</i>	<i>Percentage accuracy (%)</i>	
Identification of verb words	99.500%	
Conversion of Sadhu to Cholito	96.805%	

B. Sample output

Here are some sample outputs:

Text in Sadhu language:

পরদিন প্রাতে হেডমাস্টার সাহেবের প্রস্তুত লিস্ট অনুসারে যে তিনজন শিক্ষক সাহেবের সহিত সাক্ষাৎ করিবার অনুমতি পাইয়াছিলেন, তাঁহারা আটটায় পূর্বেই ডাকেবাংলায় উপস্থিত হইলেন। একটু পরে আবদুল্লাহ আসিয়া হাজির হইল। তাহাকে দেখিয়া একজন শিক্ষক জিজ্ঞাসা করিলেন- আপনি যে! আপনার নাম তো হেডমাস্টার লিস্টে দেন নাই।

(Writer: কাজী ইমদাদুল হক)

Text in cholito language:

পরদিন সকালে হেডমাস্টার সাহেবের প্রস্তুত লিস্ট অনুসারে যে তিনজন শিক্ষক সাহেবের সাথে দেখা করার অনুমতি পেয়েছিলেন, তাঁরা আটটায় আগেই ডাকেবাংলায় উপস্থিত হলেন। একটু পরে আবদুল্লাহ এসে হাজির হল। তাকে দেখে একজন শিক্ষক জিজ্ঞাসা করলেন- আপনি যে! আপনার নাম তো হেডমাস্টার লিস্টে দেন নাই।

VIII. CONCLUSION AND FUTURE DIRECTIONS

In this paper, we study an approach to handle verbal inflection finding verb root and to build a method to convert Sadhu to Cholito form of Bengali language. The novelty of the research to work with Sadhu to Cholito conversion as it's first of its kind. We propose a systematic algorithm to achieve our goal which has been tested using a rich corpus with a satisfying accuracy and fluency. The source code along with relevant corpus and system output can be found at <https://github.com/themasudur/Sadhu2Cholito>.

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