

Development of Multilingual Assamese Electronic Dictionary

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Abstract— Language is the most important aspect in the life of all human beings. A language is one of the most important and effective modes of communication between the people belonging to different communities and cultures. The language acts as a bridge among us and helps in creating a bond among our cultures. Therefore, to learn mother language as well as other new languages is very important for us. The dictionary is one of the important tools that can be used for learning new languages. A word is basically an association of linguistic sound and meaning. The spelling does not always easily correlate with the sound of a word. A dictionary helps us both with the spelling and pronunciation of such words. Electronic dictionaries are very popular nowadays and many users can be accessed simultaneously on Online. This paper describes the Development of Multilingual Assamese Electronic Dictionary (MAED). The MAED contains four languages, namely Assamese, Bengali, English and Hindi. We have developed Assamese-Bengali, English and Hindi (A-BEH) Dictionary in MAED. The A-BEH Dictionary is a user friendly dictionary and user can easily look up the meanings of words and other related information of the words like word Id, POS, synonyms and examples from Assamese language to Bengali, English and Hindi languages on Online. This dictionary will be beneficial for Assamese people as well as other people living in India.

Keywords: Electronic Dictionary, Languages, Natural Language Processing, Sequential Search Technique.

I. INTRODUCTION

A. Electronic Dictionary

A dictionary is a very important component of any Natural Language Processing system. The word 'Dictionary' is derived from Latin word 'Dictionarium'. A dictionary is a book of words with one or more specific languages and the words are listed alphabetically with their meaning, synonyms, phonetics, POS, and examples [7]. It is one of the important tools to assist students in understanding as well as enlightening the skill of reading. There are mainly two types of dictionary, namely (1) *Paper Dictionary*: This dictionary is also known as hard or printed dictionary, and (2) *Electronic Dictionary*: This dictionary is also known as digital or Internet dictionary.

An Electronic Dictionary (E-Dictionary) is one kind of dictionary whose data exists in digital form and can be accessed through a number of different media. The E-Dictionary is a very important and powerful tool for any person who is learning a new language using Computer on both Online and Offline. It has the advantage of providing the user to access much larger database than a single book. The most important advantage of an E-Dictionary is that it is very convenient to use. In modern electronic form, electronic dictionaries have tremendous potential.

According to the languages involve, the dictionaries are found in three categories as below:

1. *Monolingual Dictionary*: In this dictionary, user can search the meaning of word and other related information of the word from one language to same language. English-English and Assamese-Assamese are some of the examples of Monolingual dictionary.
2. *Bilingual Dictionary*: In this dictionary, user can search the meaning of word and other related information of the word from one language to another language. Assamese-English and English-Bengali are some of the examples of Bilingual dictionary.
3. *Multilingual Dictionary*: In this dictionary, user can search the meanings of words and other related information of the words from one language to several languages. Assamese-English and Bengali and English-Assamese and Hindi are some of the examples of Multilingual dictionary.

According to Al-Rabi'i, the E-Dictionary can be divided into two different types [7] as follows:

1. *Online E-Dictionary*: This type of dictionary is provided on the World Wide Web and is also known as Internet dictionary. It is directly used in digital form through the Internet using web browsers from anyplace in the world. The advantage of using this dictionary is that it can be used at any place as long as there is Internet connection. Many users can be accessed simultaneously on Online. However, it takes up a lot of time caused by the busy Internet connection [7].

2. *Offline E-Dictionary*: This type of dictionary can be used in digital Computer, PDA (Personal Data Assistant), and mobile phone. This dictionary is also known as portable digital dictionary. We can carry and backup Offline E-Dictionary using CD, DVD, HD and pen drive. We can also download this type of dictionary from Internet and users can install or setup in his/her own Computer or in other devices. The advantage of using this type of dictionary is that users are free from the interruption of Internet connection and the disadvantage is that it requires expensive tools [7].

B. Natural Language Processing

Natural Languages are most prominently used by humans for communication purposes naturally. Natural Language Processing (NLP) is a field of Computer Science and Artificial Intelligence. The Natural Language Processing is linguistics concerned with the interactions between Computers and Natural languages [6]. Some examples of Natural languages are Assamese, Bengali, English, Hindi, and so on. The NLP is a very attractive method of human and Computer interaction. The NLP deals with Computer programs to understand human languages both written and oral form. The major goal of the NLP group is to design and build software that will analyze, understand, and generate languages that humans use naturally.

Natural Language Processing is an area of research and application that explores how Computer can be used to understand and manipulate Natural language text or speech to do useful things. Some of the most commonly researched tasks in NLP include Machine Translation, Electronic Dictionary, Morphological Segmentation, Natural Language Generation, Natural Language Understanding, Optical Character Recognition, Part of Speech (POS) Tagging, Parsing, Question Answering, Speech Recognition, Speech Processing, Information Retrieval (IR), and Speech Segmentation.

C. Language and Its Impact

The language can be considered as one of the most important ethno-cultural links between the people belonging to different communities. No community can survive without a language. We use language to express inner thoughts and emotions, to communicate with other people, and to establish rules and maintain our culture.

This paper describes about the four languages, namely Assamese, Bengali, English and Hindi which are used in Multilingual Assamese Electronic Dictionary (MAED) as follows:

1. *Assamese Language*: Assamese is an Eastern Indo-Aryan language used mainly in the state of Assam. It is the state language as well as official language of Assam. The Assamese language is also known as Asamiya (অসমীয়া (Oxomiya)). It is the mother tongue/language of Assamese

people. The Assamese language is spoken mainly by the people of Assam and by the some people of other North-East states. Nearly 15 to 20 million people speak the Assamese language. It is one of the recognized languages of India [8][15].

The word 'Assamese' is an English one based on the anglicized form 'Assam' from the native word 'Asam'. The word Assam was connected with the Shan invaders of the Brahmaputra valley during the 13th century. In modern Assamese, Shan invaders of the 13th century are termed as 'Ahoms' [9]. The Assamese language is evolved in the 7th century AD having its roots from the Sanskrit language. However, its vocabulary, phonology and grammar have been substantially influenced by the original inhabitants of Assam, such as the Boros and the Kacharis. Assamese script is derived from Brahmi script. The rock inscription and copper plate from 5th to 9th century showed the evolution of Assamese script. The Assamese language is written using Assamese scripts that are developed from the Gupta alphabets around 1200 AD and which closely resemble the Mithilakshar and Bengali alphabets.

2. *Bengali Language*: Bengali language is an Indo-Aryan language spoken mostly in the East Indian subcontinent. It is also known as Bangla language. It has evolved from the Magadhi Prakrit and Sanskrit language. The Bengali language is spoken by the people of Bangladesh and by the people of Indian states like West Bengal, Tripura and some people of Assam. It is the seventh most spoken language in the world and is the second most spoken language in India. The National Anthem of India, National Anthem of Bangladesh, National Anthem of Sri Lanka and the National song of India were first composed in the Bengali language. The Bengali language is written using Bengali scripts and is the 6th most widely used writing system in the world. The script with minor variations is shared by Assamese and is the basis for the other languages like Manipuri and Bishnupriya Manipuri [16].

The Bengali language is one of the recognised languages of India. It is the official language of West Bengal and Tripura [16]. It is also a major language in the Indian union territory of Andaman and Nicobar Islands. The Bengali is the national and official language of Bangladesh. In addition to differences in how the letters are pronounced in the different languages, there are some typographical differences between the version of the script used for Assamese language and that used for Bengali language. The Bengali alphabet is derived from the Brahmi alphabet. It is also closely related to the Devanagari alphabet, from which it started to diverge in the 11th century AD. The current printed form of Bengali alphabet was developed by Charles Wilkins in 1778.

3. *English Language*: English is the West Germanic language that was first spoken in early medieval England and is now a global lingua franca. The English language is spoken mainly by the people of Canada, Australia, United Kingdom, United States, Ireland, and New Zealand. It is an official

language of almost sixty (60) sovereign states. It is the third most common native language in the world. The word English is derived from the name of the Angles who along with the Jutes and Saxons founded settlement in England in the fifth and sixth centuries. It has become the leading language of international discourse [17].

Indian people learned in traditional method of education until the first half of 19th century. After the establishment of British colonial power in India, they thought about introducing the modern form of education system through the medium of English with the help of Christian Missionaries. Indian English is the group of English dialects, or regional language varieties, spoken primarily in the Indian subcontinent.

English was introduced in India in 1830 during the rule of the East India Company. During subsequent Crown Rule in India, or the British Raj, lasting from 1858 to 1947, English language penetration increased throughout India. At the time of Independence of India in 1947, English was the only functional lingua franca in the country. The Constitution of India (1951) declared Hindi is the primary official language and English is the associate official language of India. It has various dialects in India due to the influence of local languages.

4. *Hindi Language:* Hindi is the fourth most widely spoken language in the world. The Hindi language is spoken widely by the people of Indian states, including Delhi, Madhya Pradesh, Bihar, Uttar Pradesh, Chhattisgarh, Himachal Pradesh, Chandigarh, Haryana, and Rajasthan. It is the primary spoken language of Madhya Pradesh and Uttar Pradesh [18]. It is a standardised and sanskritised register of the Hindustani language. In the 2001 census of India, 258 million people in India reported Hindi to be their native language. The Hindi language is also spoken in the other neighbour countries of India, such as Bangladesh, Bhutan and Nepal.

The Indian constitution, adopted in 1950, declares Hindi will be written in the Devanagari script and will be the primary official language of the Government of India. Hindi derives its vocabulary from several major sources like Sanskrit, Persian, and Arabic.

D. Objectives

The primary objectives of this work can be summarized as follows:

1. To develop MAED in four languages namely Assamese, Bengali, English and Hindi on Online.
2. To develop user-friendly MAED that user can easily look up the meaning of word and other related information of the word like word Id, lexical item (POS), synonyms and example from Assamese language to Bengali, English and Hindi languages.

3. To type Assamese words using English hard Keyboard from any Computer on Online.
4. To ensure MAED will be a valuable dictionary and to be beneficial for young learners, students, researcher scholars and teachers.
5. To solve some of the problems faced by the Assamese language learners.
6. To improve the knowledge of Assamese, Bengali, English and Hindi language basically for the people of North-East states.

II. REVIEW OF RELATED LITERATURE

In this paper, we discuss the prior works of Assamese paper and electronic dictionaries. A lot of Assamese hard (or paper) dictionaries have been compiled by many lexicographers at different times. The first English-Assamese dictionary was compiled by American Baptist missionary Miles Bronson [10][19]. It contained almost 14000 words. It was published in the year 1867 from the Sivasagar mission press. The work of Miles Bronson was not really an etymological dictionary, but contained considerable collection of common words used by the local people. Hem Chandra Baruah compiled a dictionary called Hemkosh in the Assamese language. The Hemkosh is the second dictionary of Assamese language. It is the first etymological dictionary of the Assamese language based on Sanskrit spellings. It was first published in 1900 under the supervision of Capt. P. R. Gordon, ISC and Hemchandra Goswami. It contained about 22,346 words. This dictionary, still published by Hemkosh printers is considered to be the standard reference of the Assamese language [9].

The first Anglo-Assamese dictionary was compiled by a student of Cotton College in 1910. The Chandrakanta Abhidhan is the third dictionary of Assamese language [9]. It was a comprehensive Bilingual dictionary with words and their meanings in Assamese and English. It was originally compiled and published by Assam Sahitya Sabha in 1933. This dictionary contains 36,816 words. The third edition of this dictionary was also published by the Gauhati University in 1987 duly edited by Dr. Maheswar Neog and Dr. Upendranath Goswami. Another dictionary called Adhunik Asamiya Abhidhan has been published by Assam Prakasan Parishad in 1977 under the editorship of Dr. Maheswar Neog, Rajanikanta Deva Sarma and Nava Kanta Baruah for Assamese language. In recent years, due to expansion of Computer and Internet, a very few number of Assamese-English and English-Assamese Bilingual electronic dictionaries are available today on both Online and Offline. The Assamese-English and English-Assamese electronic dictionaries were developed by Dr. Pushpak Bhattacharyya, IIT Bombay [11].

Some other examples of Assamese dictionaries with their lexicographer names are mentioned below:

1. Assamese-Assamese-English Dictionary, compiled by Giridhar Sarma in 2010 [1].
2. Modern Hindi-Assamese Dictionary, compiled by Moheshar Mahanta, in 2010 [3].
3. English-Assamese Dictionary, compiled by Makhan Lal Chaliha, published in 2002.
4. Anglo-Assamese Dictionary, compiled by Siddhartha Barua in 2005 [2].
5. An Assamese Dictionary for Science and Technology terms with over 40,000 words was released by Dibrugarh University Vice Chancellor Dr Alok Kumar Buragohain, February 26, 2015 [20].

III. DATAFLOW DIAGRAM OF MAED

A Data Flow Diagram (DFD) is a pictorial representation of information flows in a system. The DFD is often used as a preliminary step to create an overview of the system [12]. It shows what kind of information will be input to and output from the system, where the data will come from and go to, and where the data will be stored. It is an attractive technique because it provides what users do rather than what computers do. It is intended to serve as a communication tool among system analysts, end users, database designer and system programmers. The DFD technique is very popular, because it is very simple to understand and use. We have used two types of DFD for the development of MAED which are as below:

A. Level 0 DFD

The Level 0 DFD is also known as Context Diagram (CD). A CD is the most basic form of the DFD. The CD shows the entire system as a single process. It aims to show how the entire system works at a glance. The CD demonstrates the interactions between the process and external entities. The CD is the most abstract data flow representation of a system. The CD of the MAED is shown in fig.1.

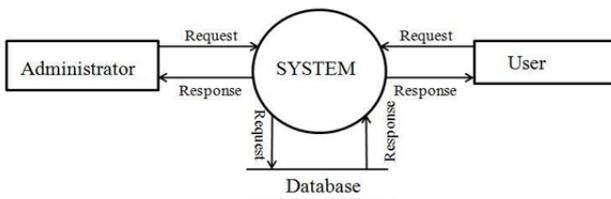


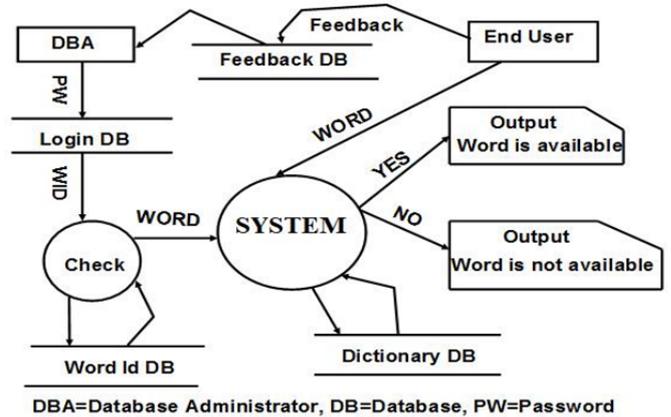
Fig.1: Context Diagram of MAED

In the context diagram, the Administrator and User are two external entities. The Administrator can enter data into the database of the system, whereas the User can search data from the database of the system.

B. Level 1 DFD

Level 1 DFD is the next level of CD that shows the overview

of the full system of the MAED. The Level 1 DFD is used to describe more details on how the data are processed and what type of data is needed in the system. It shows how the system is divided into sub-systems (processes), each of which deals with one or more of the data flows to or from an external agent and which together provide all of the functionality of the system as a whole. It also identifies internal data store that must be present in order for the system to do its job and shows the flow of data between the various parts of the system. The Level 1 DFD of the MAED is shown in fig. 2.



DBA=Database Administrator, DB=Database, PW=Password

Fig. 2: Level 1 DFD of MAED

In the Level 1 DFD, the Administrator and End-user are two external entities. The Administrator needs to login first; if the login is successful, then the Administrator can enter data into the MAED. But, before entering data of a word the Administrator needs to check word Id, if the word Id is not available in database, then he/she can enter the word Id and other related information of the word into the MAED. The End-user can search the meaning of word. In addition, the End-user can also give feedback to the Administrator about the performance of the MAED.

IV. IMPLEMENTATION

The implementation part of the MAED contains three phases which are:

A. Software Requirements

We have used PHP, HTML, CSS and JavaScript as Front-End and MySQL as Back-End for the development of MAED.

B. Data (or word) Entry

In the MAED, only the Administrator can enter data (or word). The Administrator needs to login first with proper username and password. If the login is successful, then he/she can be able to enter words into the dictionary based on the following word entry algorithm.

1. Enter word Id
If (found)

- ```

{
 Print- word Id already exists in the dictionary;
 Stop
}
Else
 Go to next step;
2. Search headword with its POS
 If (found)
 {
 Print- headword already exists in the dictionary;
 Stop
 }
 Else
 Go to next step;
3. Enter new word Id, headword and other related
 information of the headword (POS, synonyms and
 examples) of Assamese, Bengali, English and Hindi
 languages.
4. Submit.

```

According to this algorithm, suppose, an Administrator wants to enter a word (means headword or root word) into this dictionary. The Administrator needs to check desired word Id for the headword first. If the word Id is not available in the dictionary, then the Administrator needs to also check the headword with its POS in the dictionary. If the headword and its corresponding POS are not available in the system, then the Administrator can enter the desired word Id, the headword and other related information of the word like word meaning, POS, synonyms and example in the dictionary.

### C. Word Search (or look up)

There are lots of word search techniques are available for E-Dictionary. We have used Sequential Search Technique to look up (or search) the meaning of the word quickly and easily.

Sequential Search Technique (SST) is the simplest and most popular word search technique for electronic dictionaries [12][14]. It is very useful and efficient technique to look up the words easily and quickly. If we want to search a particular word in a database table using SST, then the SST checks each word one by one in sequence until the desired word is found in the table. It starts to compare with each word from the beginning of the database table. In SST, the database table need not be sorted. The average number of comparisons in SST is  $(N+1)/2$ , where N is the size of the row in the table. If the searching word is in the 1st position, the number of comparisons will be 1 and if the word is in the last position, the number of comparisons will be N. Its worst case cost is proportional to the number of elements in the list. The searching time for SST is  $O(n)$ .

1. *Architecture of SST:* Suppose, a user wants to look up (or search) an Assamese word “ভাল” from the database table of the MAED using the Sequential Search Technique, then the SST in this dictionary will work as below fig. 3.



| Word Id | Assamese | Bengali | English | Hindi | POS       |
|---------|----------|---------|---------|-------|-----------|
| 1001    | কাম      | কাজ     | Work    | काम   | Verb      |
| 1002    | ভাল      | ভাশো    | Good    | अच्छा | Adjective |
| 1003    | ভেওঁ     | তিনি    | He      | वह    | Pronoun   |

Fig. 3: Architecture of SST

In this database table, the given word will compare with each word exist in Assamese field (or column) one by one in sequence until the desired word is found in the table. If the given word is found in the table, then the given word and other related information of the word would be displayed. Otherwise, the word is not available in the database table.

2. *Algorithm of SST:* An algorithm is a self contained step-by-step set of operations to be performed. The algorithm of SST in the MAED is shown as below:

- ```

Step 1: Initialize sarray, kword, len;
Step 2: Initialize pos=0;
Step 3: Repeat step 4 until pos<=len
Step 4: if (sarray[pos])==kword)
        return pos ( Print kword is found);
        else
        pos=pos+1;
Step 5: if (pos>len)
        Print kword is not found;
Step 6: Stop
    
```

In this algorithm,
sarray= Search array (specific column or field of language)
kword=Keyword (headword or root word or searching word)
len=Length (number of words in specific language field of database table)
pos=Position (position of word in a specific language field of database table)

3. *Flowchart of SST:* A flowchart is a graphical representation of an algorithm. The flowchart is used to easily understand and implement the algorithm of SST. The flowchart of the SST algorithm in the MAED is shown in fig. 4.

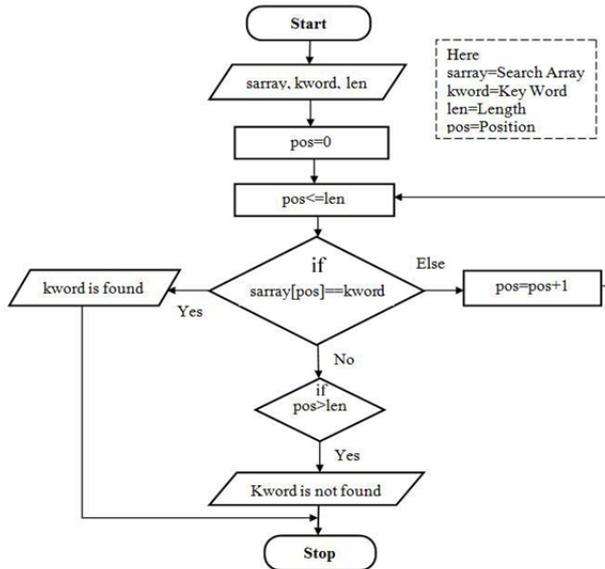


Fig. 4: Flowchart of SST

4. **Advantages of SST:** The advantages of Sequential Search Technique are as follows:
- The primary advantage of SST is its simplicity.
 - The SST is very simple to implement.
 - It is very easy to understand and is straightforward.
 - It provides good performance in small database.
 - In SST, database table need not be sorted as ascending or descending ordered.

V. RESULT AND USER INTERFACE

A. A-BEH Dictionary

We have developed Assamese-Bengali, English and Hindi (A-BEH) Dictionary in MAED. In the A-BEH Dictionary, user can search the meaning of Assamese word in corresponding Bengali, English and Hindi words. The user can also find word Id, word class (POS), synonyms and example of the headword (or search word) in Assamese, Bengali, English and Hindi languages. Some examples of Assamese words and their corresponding meanings in Bengali, English and Hindi words are shown in fig. 4.

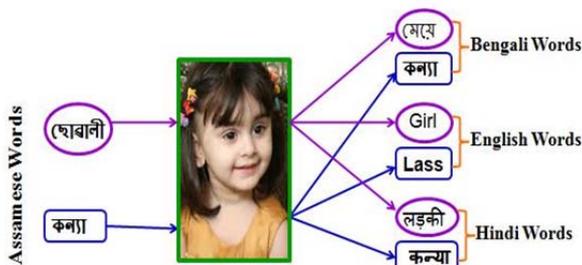


Fig.4: Example of A-BEH Dictionary

B. User Interface of A-BEH Dictionary

The following fig. 5 is the output snapshot of user interface of A-BEH Dictionary. In the A-BEH Dictionary, user can type Assamese word in the text box using English hard Keyboard from any Computer on Online. The user can also use Virtual Keyboard to type Assamese word in the text box. After typing the desired search word, the user can press the Enter key or Click on Look Up button, then the Assamese word and its corresponding meaning in Bengali, English and Hindi words and other related information of the headword will be displayed on the web page as shown in fig. 5.

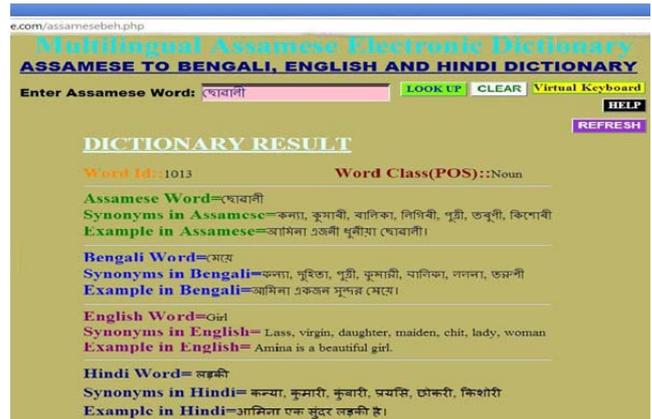


Fig.5: Snapshot of web page of A-BEH Dictionary

C. Keyboard

Keyboard is a very common input device of Computer. The Keyboard is the most essential component of E-Dictionary. Using Keyboard, we can be able to insert data, modify data, search data and other related operations in E-Dictionary. We have developed two types of Keyboard using Unicode (UTF8) for Assamese language in MAED which are:

- Assamese General Keyboard
- Assamese Virtual Keyboard

1. **Assamese General Keyboard:** The Assamese general Keyboard is used to type Assamese letters, words and sentences in the A-BEH dictionary with the help of English hard Keyboard. When a user wants to type Assamese words in text box using an English hard Keyboard, then the English hard Keyboard will automatically convert into Assamese general Keyboard. The typing instructions of Assamese words using English hard Keyboard are given in A-BEH dictionary (at HELP button).

2. **Assamese Virtual Keyboard:** The Assamese Virtual Keyboard is used to type Assamese letters, words and sentences in the A-BEH dictionary. The snapshot of Assamese Virtual Keyboard is shown in fig. 6.

LIST OF REFERENCES



Fig. 6: Snapshot of Assamese Virtual Keyboard

VI. CONCLUSIONS

The paper entitled “Development of Multilingual Assamese Electronic Dictionary” is carried out to find the meaning of the word from Assamese language to Bengali, English and Hindi languages through Online. This Multilingual E-Dictionary is developed in such a way that it makes the concepts of knowledge and provides to look up the accurate meaning of the Assamese words in corresponding Bengali, English and Hindi words. The Multilingual E-Dictionary plays an important role in not only translating the words from a source language to target languages, but also helping the learners to learn several new languages. It is also developed basically to solve some of the problems faced by the Assamese language learners.

The Multilingual Assamese Electronic Dictionary is developed in four languages, namely Assamese, Bengali, English, and Hindi on Online. The MAED is developed basically for North-East people as well as for other people living in India. It plays an important role to improve the knowledge of Assamese, Bengali, English and Hindi languages. The A-BEH is one kind of dictionary from which user can find the meanings of words and other related information about the words like word Id, POS, synonyms, and examples in Assamese, Bengali, English and Hindi languages. Using A-BEH Dictionary, user can easily look up the meanings of words and other related information of the words from Assamese language to Bengali, English and Hindi languages on Online. In this dictionary, the number of headwords of each language is 3,500 and every headword has many numbers of synonyms and one example of each language. It is an important part of Natural Language Processing tasks and computational linguistic work. This dictionary will save time and money in comparison to traditional paper dictionaries. It will be beneficial for students, research scholars, teachers, travelers and other people. Since, India is a multilingual country in the world; therefore the MAED will be helpful for Indian people and for the educational institutions.

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