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Development of an English-to-Ebira and Ebira-to-English Machine Translation System

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Abstract

Ebira is a minority indigenous language in Nigeria. Ebiras (Ebira people) are found in Kogi, Nassarawa, Edo and Benue state, with slight variation in accent, diction, and etiology. Over the years, there has been a decline in the number of "Ebiras" that can speak Ebira language fluently and write it correctly with appropriate phonology, yet no machine-readable lexicon exists in Ebira language. The aim of this paper is to adopt the use of machine translation to support the documentation and preservation of Ebira language. Therefore, an English-to-Ebira and Ebira- to- English machine translation system was developed. A bilingual dictionary containing Ebira words was designed for a direct approach to machine translations for English to Ebira and vice-versa. Java programming language was used for the development of the system. The system was evaluated using expert-opinion in terms of translation of English text to Ebira language and Ebira terms to the English language (using words from the bilingual dictionary) by a good number of Ebiras in the Federal University of Technology Minna, Niger State, and its environs. The translation correlated relatively well with the translation quality when reviewed by Ebira native speakers. That is, the system correctly and successfully translates English text to Ebira and vice-versa using the words available in the created bilingual dictionary. A further improvement of the system to enhance its capacity for complex sentence analysis and the translation is recommended for the benefits of younger Ebiras to learn their native language.

Keywords: *Machine Translation (MT), language translator, Indigenous language, Ebira*

1. Introduction

Ebira (Igbirra) is considered as a minority language in Nigeria (Abiola, 2014). Historically, Ebiras (Ebira people) are considered to have migrated from the defunct Kwararafa kingdom. In the cause of several migrations, they left behind their erstwhile brothers and sisters in different parts of Nigeria with whom they still shared a common language. In contemporary Nigeria, the Ebira people are found in Okene (Ebira Tao) in Kogi state, Toto (Ebira Toto) in Nasarawa state, Kotonkarfe (Ebira Koto), in Kogi state, Igarra (Ebira Etuno) in Edo state, and Ebira Agatu in Benue State (Ododo, 2001). Each of the Ebira sub-ethnic groups derives its language from a corruption of the same Ebira mother tongue, with slight variation in accent, diction, and etiology (Sani, 1993).

There is a consistent decline in the number of "Ebiras" that can speak Ebira language fluently and write it correctly with appropriate notation and signs. This is a result of the adoption of major Nigerian Languages (Hausa, Igbo, and Yoruba) and the Nigerian lingua franca, English by the parent as their children's first language and the neglect of indigenous or native language from most Nigeria Educational system curricula. In addition, the bilingual and multilingual nature of

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Nigeria as a country, that necessitates the adoption of the English language as an official language has threatened the existence of some native languages (Osoba & Alebiosu, 2016), including Ebira language.

Inadvertently, the adoption of the major Nigerian languages (Hausa, Yoruba, and Igbo), depending on which part of the country an Ebira parent found himself or herself, and the use of the English language as an official means of communication in virtually all schools in Nigeria, has caused the neglecting of Ebira native language. Today, an average Ebira person would prefer to speak Hausa to his or her kinsmen if he lives in the Northern part of Nigeria, Yoruba if in the South-West and Igbo or English language if in the Eastern part of the country. This development has worsened and threatened the existence of Ebira native language in Nigeria. The dominance of major Nigerian languages and the English language over our native languages has become so deplorable that prominent linguists in Nigeria, are of the opinion that our native or indigenous language is endangered and may eventually go into extinction (Osoba & Alebiosu, 2016).

Indigenous languages play a vital role in allowing people to understand their place in the world, in terms of knowledge transfer to new generations and in building on achievements of their past ancestors. Human development depends largely on cooperation between languages, and their preservation is essential for humanity's survival. The extinction of indigenous or native languages implies the people who spoke them lose a piece of their identity (Muhammad-Bande, 2019), The importance of indigenous language, has prompted the United Nations to be raising awareness about indigenous languages and enacting measures to preserve them. Thus, they are urging indigenous communities to be inspired by the fact that their languages are an essential part of their heritage and mother tongue provides insights that can assist to move humanity towards development (Muhammad-Bande, 2019). In spite of the importance of the native language, Ebiras, especially the younger generations are adopting major Nigerian languages (Hausa, Yoruba or Igbo) to cope with the multi-lingual nature of the country (Nigeria). Without statistics, this is disturbing, and if urgent steps are not taken, the language might be arguably on its path of extinction. Machine translation offers hope for language documentation and preservation for 'about-extinct' languages (Orife, 2020). For speakers of minority Nigerian languages, like Ebira, it can facilitate documentation, preservation, and creation of social bonds and a shared sense of values.

Machine Translation (MT) is very relevant to the process of language documentation (Abney and Bird, 2010). The process involves the use of computer systems to decode and encode the meanings in a given input sentence from one language (the source language) to the other (the target language) (Ayogu, Adetunmbi & Ojokoh, 2018). MT is a subclass of artificial intelligence (AI) that deals mainly with the transformation from one human natural language to another through the application of digital devices such as computers to take up the task of translating texts from one human language to another (Okpor. 2014). Machine Translation systems are vital tools for the creation of culturally sensitive content (Ayogu, Adetunmbi & Ojokoh, 2018) and the preservation of indigenous languages on the web or in digital presence. In a machine translation system, an entire document is given to the computer system for automatic translation from one source language (Ebira) to another target language (English) or vice versa as it is done in this paper. When indigenous language texts are translated into a major language in a particular region, there is a guarantee that the language documentation will be interpretable even after the language has fallen out of the use or a surviving speaker can identify errors in the output of a machine translation system (Bird & Chiang, 2012).

Consequently, to prevent the extinction of Ebira indigenous language and to encourage its learning among the younger generation, Machine Aided Human Translator (MAHT) for Ebira to English or vice versa is developed in this work. This work will be of great assistance to an Ebira person to speak the language correctly and fluently, thereby promoting

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cultural norms and values of Ebira language and allowing the continuity of speaking and learning the Ebira dialect.

2. Literature review

2.1 Machine Aided Human-Translator

Machine Aided Human-Translator (MAHT) otherwise called Machine Translation (MT) is the use of computer software for automatically translating two natural languages. It is an application of natural, human language processing, and human language computation. Natural language researchers design and develop computational algorithms for the representation, understanding, and generation of natural languages by computer applications (Ayogu, Adetunmbi & Ojokoh, 2018). The MAHT process encompasses the usage of computer systems to decode and encode the meanings in a given input sentence from one language, the source language (Ebira) to the other(s), the target language (English), in the context of this paper.

The translation process can be viewed as a dual-stage process of decoding the source language input (to obtain the meaning) and encoding the meaning thus obtained into outputs in the target language. Though, there is a number of different approaches developed to perform these processes, the intuition, principles, requirements, and motivations for the use of each approach differ significantly. MAHT can be rule-based, empirical, or a hybrid of the initial two approaches (Costa-Jussa & Fonollosa, 2015). Each of these approaches is useful in its own right and capable of achieving good results but suitability depends largely on the research model.

Machine Translation (MT) is very essential to the process of human language documentation. When source texts are translated into a major language, there is a guarantee that the language documentation will be interpretable even after the language has fallen out of use. Furthermore, when a surviving speaker can identify errors in the output of an MT system, they could be timely evidence of those areas of grammar and lexicon that need better coverage while there is still time to collect more. These tasks of producing and correcting translations can be performed by speakers of the language without depending on the intervention of outside linguists (Bird & Chiang, 2012).

2.2 Alphabets in Ebira Language

Ebira language is made up of twenty-eight alphabetical letters, which consists of nine vowels and nineteen consonants. The vowels could be either dotted or un-dotted. The vowels are; a, ẹ, ị, ọ, ụ, e, i, o, u. The “a” is common to both un-dotted and dotted. The consonants include; b c h d g h j k m n ng ny p r s t v w y z.

Ebira, like many other languages, is tonal in nature, which implies that different tones can change a word's meaning. There are three tones: a low tone, mid-tone, and a high tone. Intonation has a significant effect in the Ebira language, which alters the meaning of a word/phrase. Below are the examples of different tones in Ebira language.

Uhi-animal fat a low tone

Uhì-shame a mid-tone

Uhí-story a high tone.

For effective communication, there is a need to observe some basic rules that guide the Ebira dialect pronunciation and constructs. The following are the basic rules guiding the Ebira as a language.

Online: ISSN 2645-2960; Print ISSN: 2141-3959

1. All words end with vowels.
2. Nouns, pronouns, and adjectives always begin with vowels.
3. Except in the case of compound words, all vowels in a word are either dotted or un-dotted.
4. Verbs and Adverbs always begin with consonants.
5. Letters ***f, l, q, and x*** are non-existence in the Ebira native language (Salami, 2014)

2.3 Related Studies

Sangeetha, Jothilakshmi and Kumar (2014) employed a Statistical Machine Translation system to translate from Punjabi to English. They utilize statistical machine translation in order to transliterate proper nouns that are written in the Gurumukhi script. The system is made to first acquire knowledge from the existing set of training samples stored in the database and then with the aid of N-gram methodology, transliterate the new proper nouns of Gurumukhi Script into its corresponding English Language.

Abiola, Adetunmbi, Fasiku and Olatunji (2014) worked on a Web-Based English to Yorùbá Noun Phrases machine translation system. Finite-state Automata was used whose operation was based on first set techniques that allow the parser to choose which production rule to apply based on the first input word of an input phrase. Similarly, Agbeyangi, Eludiora and Adenekan (2014) proposed rule-based English to Yorùbá translation system using a context-free grammar model within the context of the Noam Chomsky phrase structure grammar theory. Automata theory was used to model the computational process underlining the translation processes. The evaluation of the translation was based on the mean opinion score.

Abiola, Adetunmbi and Oguntimilehin (2015) designed a Machine Translator from English to Yoruba (Text to Text) using Hybrid Approach. They adopted the use of rule-based and statistical-based approaches. Rule structures are developed for every possible phrase in the Yoruba language, these rules were specified with a context-free grammar and computational model for the proposed system that was formulated using finite state automata. The Parse structure of a sentence was derived using the Stanford parser and Yoruba text editor was developed using an analyzer. The system was implemented using Python programming language.

In his other paper, Abiola, Adetunmbi and Oguntimilehin (2015) developed a computational model for translation of the English language to Yoruba language. They specified the number of rules for the noun phrases translations which are specified using a context-free grammar. Finite state automata are then modeled to understand the grammar of the language. In addition, the researcher developed a dual language lexicon which is made up of words in the English language and their corresponding meaning in Yoruba dialect. The system was implemented using Preprocessor Hypertext Programming (PHP) and structured Query Language (SQL). The evaluation of the system was performed using four hundred (400) randomly selected noun phrases and they reported an accuracy of 91%.

Akinwale, Adetunmbi, Obe, and Adesuyi (2015) developed a web-based English to Yoruba machine translation using a rule-based approach. Twenty-two (22) rules were formulated for the translation which is specified using a context-free grammar. A dual lexicon dataset containing English words and the corresponding translation in Yoruba language was used. The model was implemented using ASP.net and C# programming languages. The evaluation of the translator was reported to have an accuracy of 90.5%.

Eludiora, Afolabi and Sanusi (2016) adopted a rule-based method to develop machine translation of English to Hausa. The system is capable of translating simple home domain terminologies. They adopted the linguistics and computing theories for the translation process. Re-write rules were adopted for the two languages. Unified Modeling Language (UML) was used for the design while object-oriented programming language (Java) was used for the implementation.

Online: ISSN 2645-2960; Print ISSN: 2141-3959

The evaluation of the system was done using questionnaires. The system was reported to have performed better than the Hausa Google translator.

Ayogu, Adetunmbi and Ojokoh (2018), discussed an experimental result on translation systems between two Nigerian languages (Igbo and Yorùbá). The aim of the study is to build parallel corpora, train and experiment English-to-Igbo, English-to-Yorùbá, and Igbo-to-Yorùbá, using phrase-based statistical machine translation systems. The systems were trained on parallel corpora that were created for each language pair using text from the religious domain. Linguistic motivated machine translation error analysis method was adopted to perform an error analysis of the systems' outputs, the result of the error analysis revealed that the occurrence of errors is usually at the lexical, grammatical, and semantic levels.

Arikpo and Dickson (2018), designed and implemented a machine translation of English-to- Efik language using object-oriented methodology. The research explored the use of computational linguistics dispositions and potential methods to automate the natural language development of machine translators. The transfer-based method was adopted to model the translation with the objective of restoring the meaning of an English text in a translated verse. A bilingual dictionary of about 500 words and 25 corpora was developed to provide optimum direct translations regarding the Efik language. The evaluation of the system revealed that the system successfully translates English text to Efik using the words and corpuses available in a bilingual dictionary.

Anthony (2019), designed and implemented an offline android-based English to Igbo and Yoruba machine translation System. The English, Yoruba, and Igbo text were collected from digital resources and printed copies through administered questionnaires. The text was analyzed and corrected using Takada desktop Tone marker application and sublime text editor. The design was performed using the Unified Markup Language (UML) and implemented using Java programming language, Andriod studio, Extensible Markup Language (XML), and for the database services. Accuracy Test and Word Error Analysis evaluation revealed a high level of accuracy with minimal errors.

Orife (2020) maintained that for many speakers of indigenous languages, there are inequalities in terms of access to information, communications, health care services, security as well as active political participation and civic life. To mitigate this social exclusion and promote socio-linguistic and economic empowerment, he adopted the use of Neural Machine Translation (NMT) for the Edoid language family of Southern Nigeria, in Edo state. Python 3 machine translation toolkit was used to train the JW300 dataset. The result of the system evaluation revealed that out of the four languages, Urhobo and Isoko correlated well with the translation quality when reviewed by native speakers of the two languages.

Abiola, Adeyemo, Saka-Balogun, and Okesola (2020) developed a Yorùbá to English bilingual lexicon that targeted building technicians as the main users. The aim of the system is to reduce communication gaps, create an interactive platform, and enhance business transactions among building technicians of Yoruba extraction. The implementation of the architecture was based on the direct approach to machine translations. Web-based programming language tools were used for the development of the system and the frontend was designed using JavaScript and bootstrap, while Microsoft SQL serves as the database. The system shows the good capability to enhance building technicians to learn basic terminologies from Yorùbá to English.

Adewale, Agbonifo and Olaniyan (2020) explored the use of a multi-layer hybridized language translation approach of machine translation to create a mobile chat application that translates text from English to Yoruba language and Yoruba to the English Language. Computational rules were manually formulated and stored in the database for generating sentences in both languages. A bilingual dictionary was developed for each language, which stored words and their corresponding parts of speech in both languages. Java programming language was used to implement the application in

Online: ISSN 2645-2960; Print ISSN: 2141-3959

the Android Studio environment. The evaluation of the system shows 95% accuracy in comparison with Google Translation.

3. Methodology

The Rule-based approach of natural language translation was adopted. Lexicon based method of rule-based was used in the development of a dictionary consisting of the source language and its corresponding target language. Therefore, in constructing the bilingual dictionary, data from an Ebira –English dictionary were manually collected to develop the database. Any input term to be translated is checked in the developed bilingual lexicon, if found, it is replaced with the translated bilingual lexicon stored in the database. The architecture for the machine translation of Ebira – English and English – Ebira language system is as shown in Figure 1.

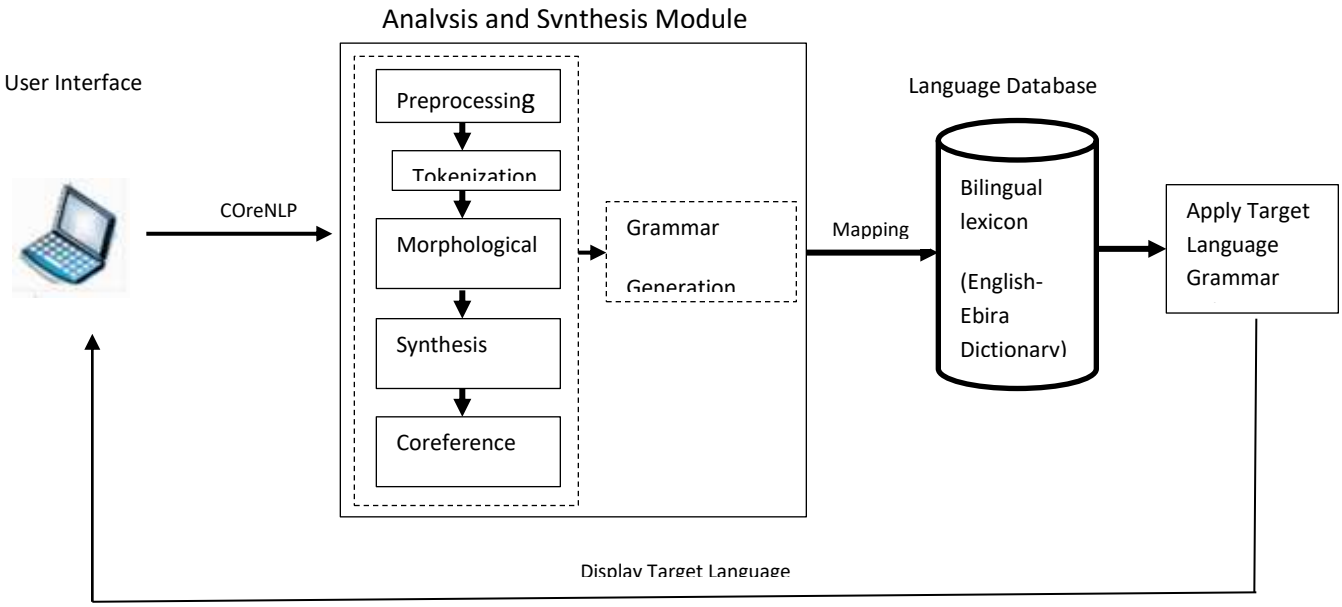

Figure 1: The Ebira-English and English – Ebira Machine Translation Architecture

As shown in Figure 1, the architecture has three (3) components; User interface, Analysis and synthesis module, and the language database.

The user interface is essential for user interaction with the system. The user types the source language through the interface and the result of the target language is also displayed through the same interface.

The Analysis and Synthesis module, CoreNLP(Core Natural Language Precessing), a JAVA API is used to perform the analysis of the input text from the user interface. CoreNLP was used to perform preprocessing, tokenization, morphological analysis, synthesis parser, and coreference resolution. Thereafter, the Grammer Generation Engine transfers the source text grammatical structure to fit the target language grammatical structure. Then, the output from the Grammer Generation engine is mapped with matching terms in the bilingual dictionary and with the application of the target grammar rules, generated the target language.

Online: ISSN 2645-2960; Print ISSN: 2141-3959

The architecture is design with the capability and scalability to store new text and the equivalent translation in the dictionary. This feature gives our proposed system an ability to learn new terms and their translation in both languages as shown in figure 2.

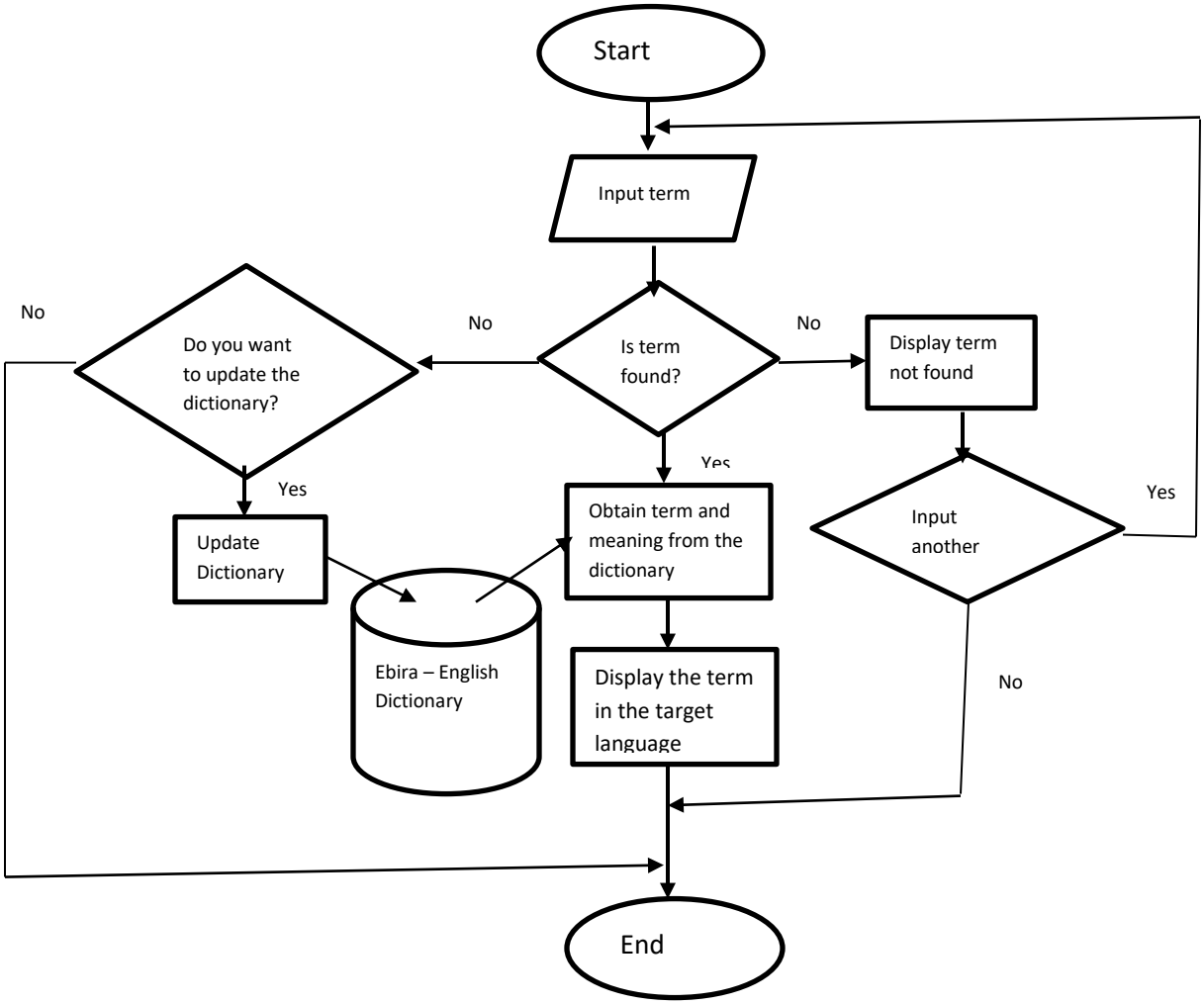

Figure 2: The Ebira-English and English – Ebira Machine Translation flowchart

3.1 Use Case Diagram of the system

A Use Case diagram is a software design tool that is used in software design methodology to represents the function of the system and the relationship between and among the actors in the intended system. The system has two actors; the user and the administrator (admin), as shown in Figure 3. The various privileges each actor can perform are as shown in Figure 3.

International Journal of Information Processing and Communication (IJIPC) Vol. 10 No. 1&2 [December, 2020], pp. 119-135
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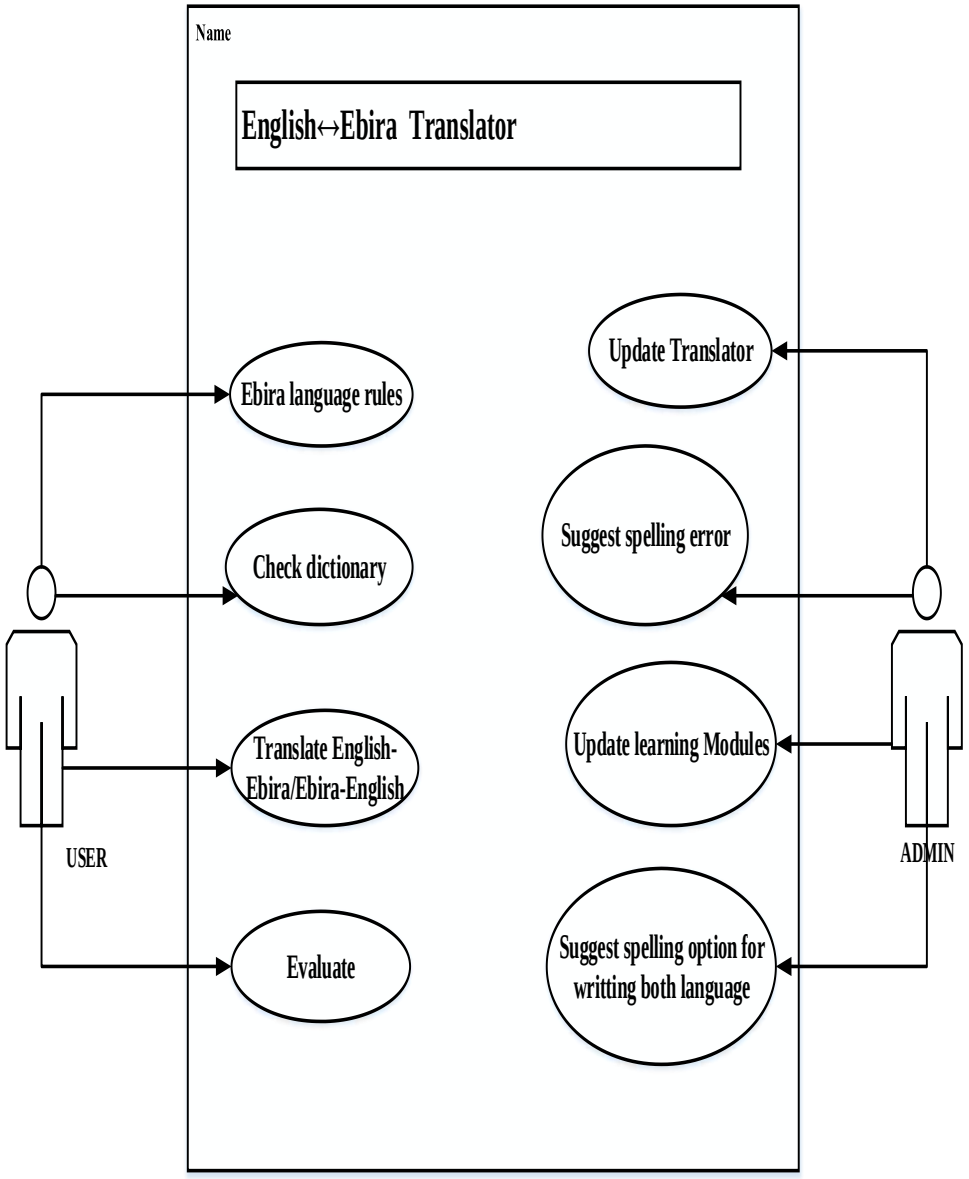

Figure 3: The Use Case Diagram

In addition to the user's functions, the user is given the privileged to input suggestion, whenever a search word is not found in the language database, however, this suggestion is saved in a temporal database for the admin to preview before updating the content to the bilingual lexicon. The admin is assumed to be knowledgeable in both English and Ebira language.

3.2 Activity Diagram

An activity diagram as a software design tool is used to show how the user interacts with the system and how the system interacts with itself when users select or make a request to the system. The activity diagram of the Ebira ⟷ English language machine translation is shown in Figure 4.

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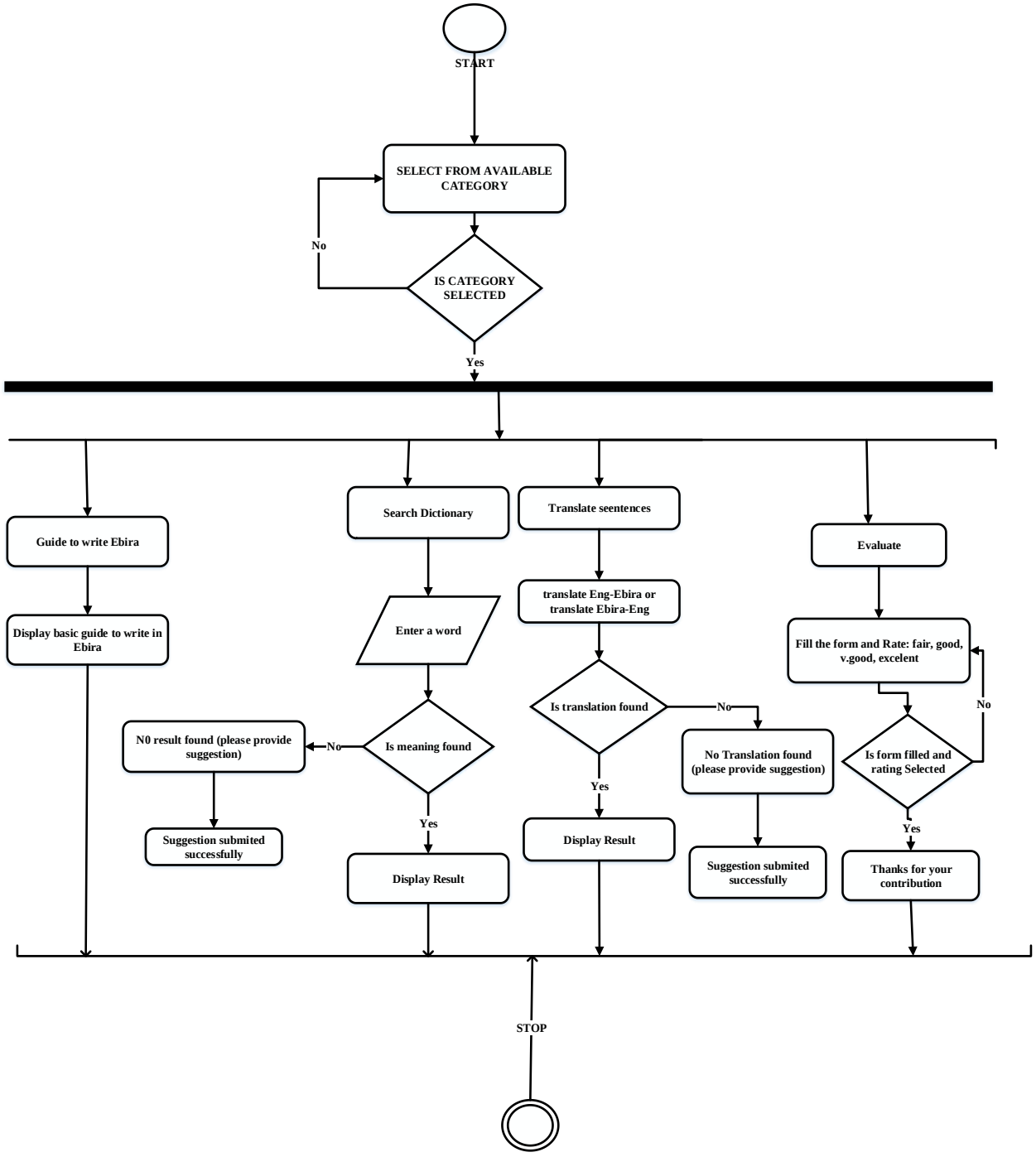

Figure 4: Activity diagram for machine translation of English↔Ebira system

International Journal of Information Processing and Communication (IJIPC) Vol. 10 No. 1&2 [December, 2020], pp. 119-135
Online: ISSN 2645-2960; Print ISSN: 2141-3959

3.3 The Corpus Database

The availability of a useful corpus is a prerequisite for machine translation task. Therefore, there is a need to have a digital text collection, from which a balanced corpus could be selected for machine processing. Ebira, as a minority Nigerian language lacks text collection in a machine-readable format, therefore, substantial effort was made to manually create a text collection for the purpose of this work. In constructing the corpus parallel texts used in this work, data from (Salami, 2014), the only available Ebira-English and English-Ebira dictionary were manually created and used as the database corpus for the work. Table 1 shows a sample segment from the created database corpus for common domestic animal names in English and their corresponding Ebira terms.

Table 1: Domestic animals names in English and their corresponding Ebira Equivalent

English	Ebira
Goat	ẹvụ́
Cow	ụ̀nọ́
Cat	ọ́vàn.chákụ, úmùsù
Ram	ịdẹbá
Sheep	atẹ́mẹ́
Hen	ọ̀nyị-ụ̀ụ̀hwẹ́
Pigeon	ịkarị.kade
Dove	àré.kùkù
Pig	ùrá
Horse	ùmáá.tà

4. Results and Discussion

The system was implemented using a java programming language. The system is a desktop application intended to be used for easy learning of simple terms and sentences in Ebira dialect. The main user interface of the system is as shown in Figure 5.

Figure 5: Ebira-English Machine Translation Interface

Online: ISSN 2645-2960; Print ISSN: 2141-3959

As shown in Figure 5, the first two icons are for a single term bilingual dictionary, and a simple machine translator, the third contains the rules for learning Ebira language and the fourth is for the user to rank the system after usage. In addition, there is a button for an administrator to manage the backend of the system. A click on the first dictionary would display Figure 6.

Figure 6: Ebira-English Dictionary selected by the user

As shown in Figure 6, the panel contains two languages (Ebira and English). The user has the choice of selecting either language as a source. If Ebira is selected as a source, English becomes the target and vice-versa. The search button is where the user enters the search term. A selection of Ebira as the source language is shown in Figure 7.

Figure 7: Result of selected Ebira as the source language

Online: ISSN 2645-2960; Print ISSN: 2141-3959

As shown in Figure 7, a user selects Ebira as the target language to search for the English meaning of an Ebira term 'Etu meyo ni' from the dictionary. The corresponding meaning of the selected term is display in English on the result panel. Similarly, a selection of English terms and a source for its equivalent meaning in Ebira is shown in Figure 8.

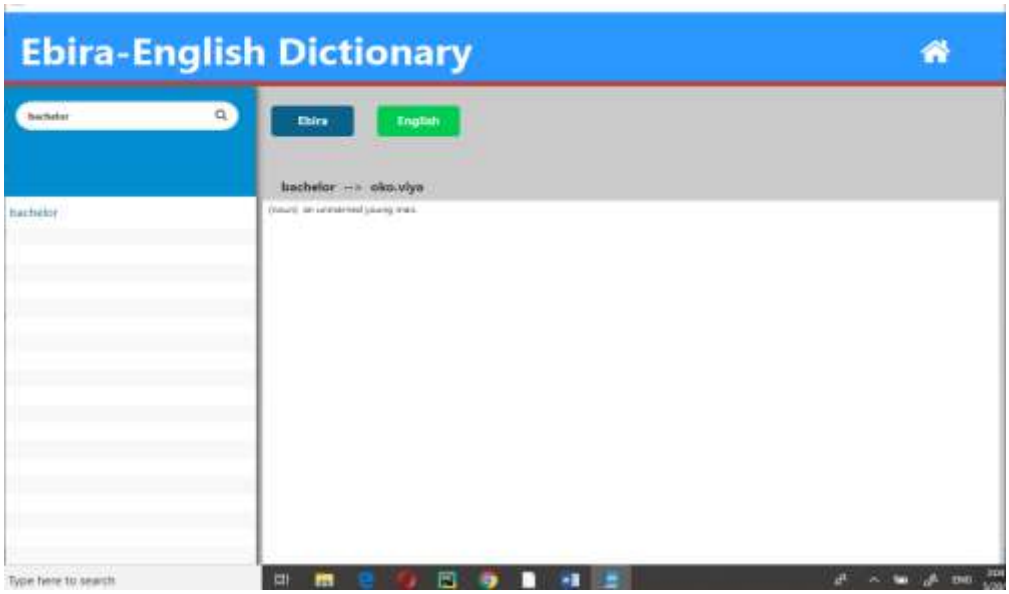

Figure 8: Result of selected English as the source language

A user searches for the term 'Bachelor' from the bilingual dictionary, its equivalence in Ebira is displayed in the result panel. In addition to a single term, users can equally search for the meaning of simple terms from the system. A sample of sentence search from English to Ebira language is shown in Figure 9.

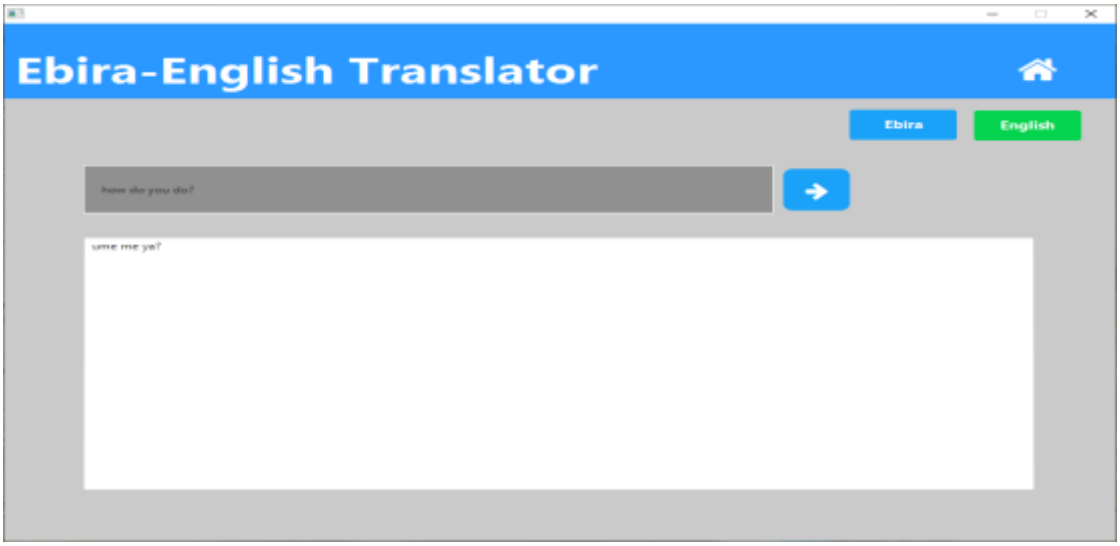

Figure 9: Result of simple sentence search in English as the source language

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The user search for the equivalent term of 'how do you do?' from the bilingual dictionary, it equivalent in Ebira is displayed in the result panel as shown in Figure 9. Similarly, if Ebira was selected as the source and English target, the result would be as shown in Figure 10.

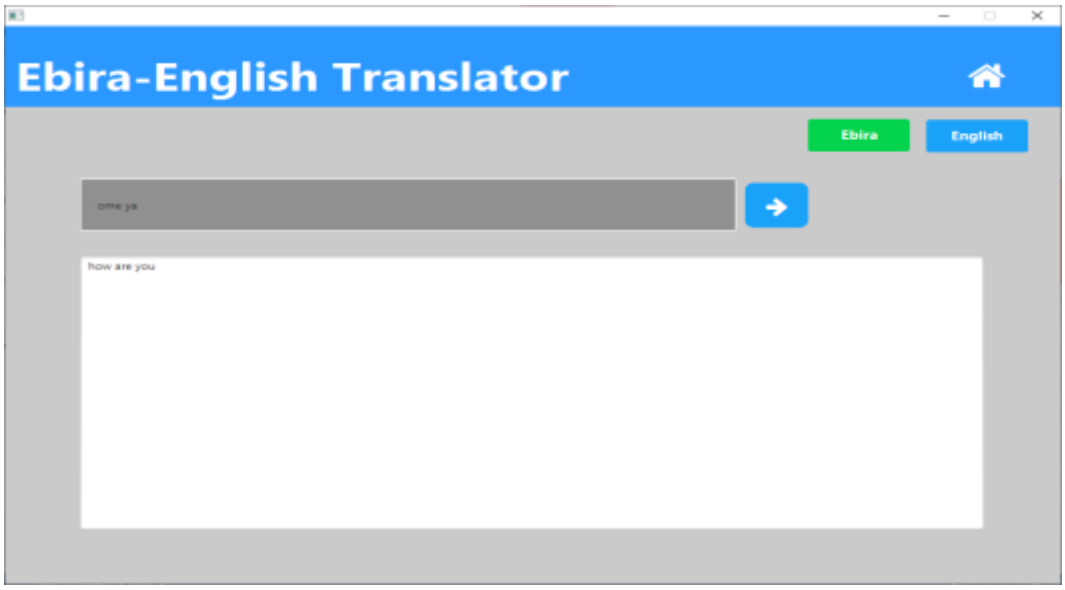

Figure 10: Result of simple sentence search in Ebira as the source language

The terms or words in the proposed system are far from being exhaustive, therefore there is a tendency that the user search term in both languages is not found in the database. In that case, the user can add the term, its corresponding meaning, and description into the database. Figure 11 shows a result of a term search that is not found in the database.

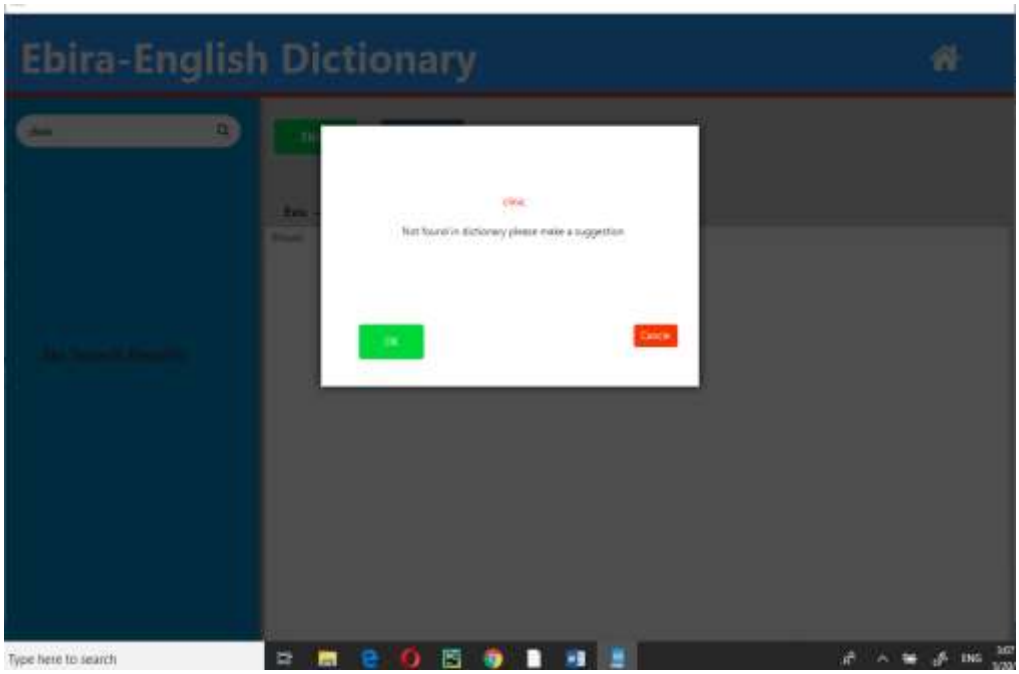

Figure 11: Result of term not found in the dictionary database

Online: ISSN 2645-2960; Print ISSN: 2141-3959

As shown in Figure 11, the term 'clinic' is not found in the system, but the user is asked whether to add it to the dictionary. If the user clicks 'ok', indicating agreement, Figure 12 is displayed.

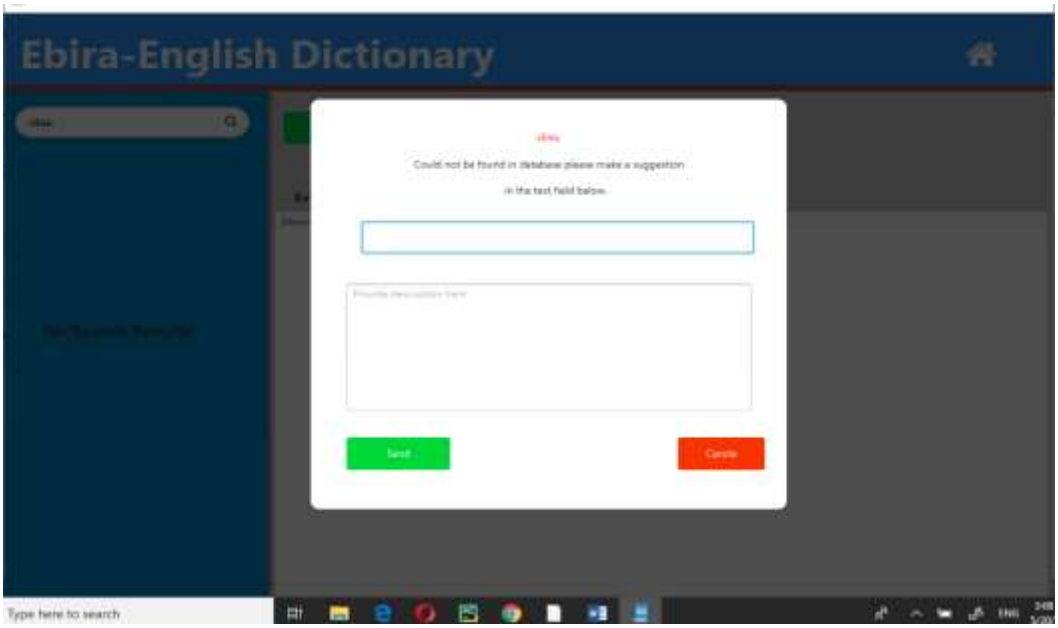

Figure 12: Panel display for adding a new term to the dictionary

As shown in Figure 12, the source language text is highlighted in red, the user is expected to type in the corresponding meaning in the target language (Ebira), along with a short description in the source language. Figure 13 shows the suggested meaning and description by the user.

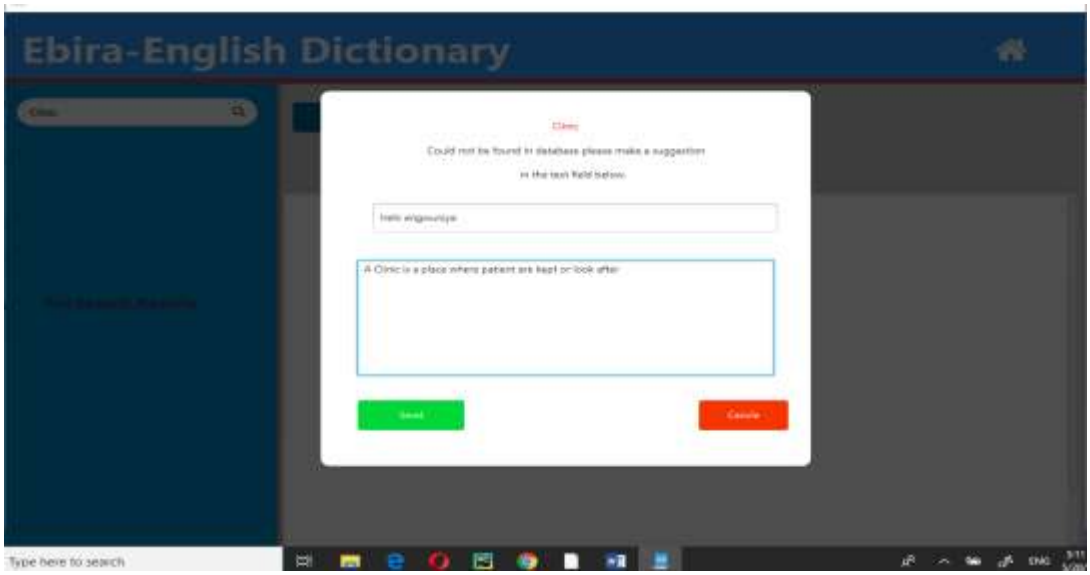

Figure 13: Suggested new term and description by the user

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After adding, the terms will be store in a temporary database, until the admin evaluates and approves it. This is to guard against adding unnecessary terms into the database. We assume that, the admin is knowledgeable in both languages. Every new term would be available in the admin panel for approval as shown in Figure 14.

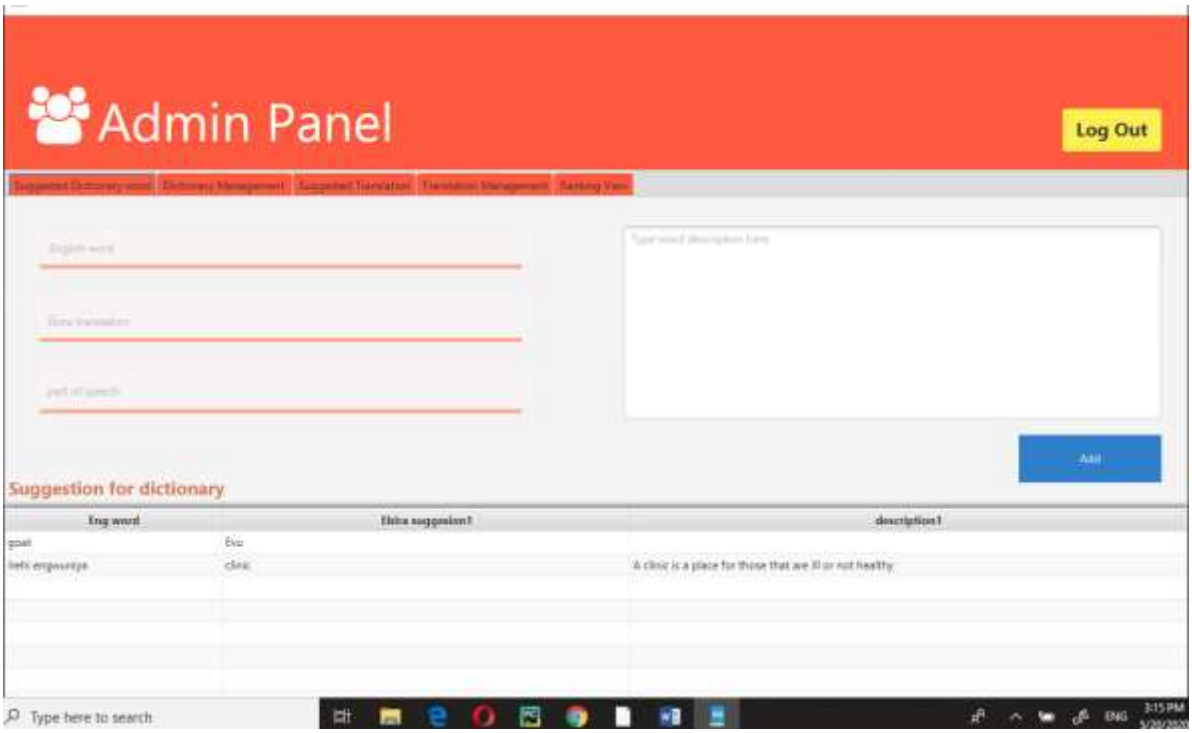

Figure 14: Admin panel showing suggested terms and their corresponding meaning

As shown in Figure 14, the suggested terms and their corresponding meaning a temporary store in the admin panel. An approval from the admin page will make the terms to be readily available in the dictionary. The Admin panel is exclusively accessible to the admin.

5. Conclusion

Machine translation of human natural languages is biased towards the world's most popular spoken languages; English, German, Arabic, Spanish, and French among other world dominant languages. Many minority African languages are not present in the electronic media or search engines. Language processing tools are therefore needed in the quest to create an online presence or even a search engine for indigenous African languages. This is what this work aimed to address by employing a machine translation approach. A simple machine translation of English to native Ebira and Ebira to the English language for preservation and easy learning of the indigenous Ebira language was developed. The experimental evaluation of the system shows a good translation equivalence of terms in both languages and it can produce a fair translation of simple sentences from Ebira to English and vice versa. The opinion of the Ebira native speakers was that the system translation correlates well. Though a complex sentence translation is beyond the capability of this system, nevertheless, the work demonstrated the feasibility of machine translation research in Ebira native language to address the decline in the number of Ebiras that speak the native language and to salvage the language from

Online: ISSN 2645-2960; Print ISSN: 2141-3959

possible extinction. A further improvement in the system to enable complex sentence analysis and translation as further work on the system may facilitate Ebira indigenous language learning and preservation.

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