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# Android Platform for Machine Translation -A Focus on Yorùbá Language

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### Abstract

Android platform provides useful words and phrases in English language, with translations in Yorùbá language, for the use of visitors to places where the language is spoken; it can be likened to bilingual dictionary of English-Yorùbá. It is developed on Mobile platform for easier accessibility, convenience and portability. Rough Set Theory (RST) is the mathematical tool used in decision support and data analysis of words or phrases that are to be translated. Comparisons between query that is, word or phrase to be translated, are made with the created corpus, using RST. Programming tools employed for mobile platform are JDK 6, Apache Ant 1.8 or later, Android Software Development Kit, Eclipse Integrated Development Environment, Android Developer and Android Studio while latest technologies such as PHP, Mysql, net, Mssql 2005, 2008, Ajax techies, C#. It brings the usefulness of Information Technology to the doorstep of non- Yorùbá tourists or learners who wish to converse, make friends with Yorùbá people or transact business with Yorùbá indigenes that are not literate. It was found after its deployment to be intelligible and accurate with minimal errors. New words and expressions that are suitable for situations, legislation, science, engineering, commerce, computing, mass communication and other sphere of life were created in a large number.

## 1. Introduction

In the 21st century, it is reasonable to expect that some of the most important development in Science and Engineering would come about through interdisciplinary research. Android Yorùbá Platform cuts across Information Theory, Computer Science (System Design and Artificial Intelligence), Statistics and Lingual (Syntax and Semantics). Computers are applied in translating texts or speeches from one Natural language to another [22]. The design of machine translation system is directly affected by how the system translates a natural language (Source Language) to another natural language (Target Language). The design of the Android for foreign language users has one major aim which is to understand how certain Yorùbá words and phrases can be understood by visitors through electronic media. It must identify the inquisitiveness of a typical learner or tourist; promotes its ethical values to potential students, accept the enquiry of the readers of Yorùbá language, deliver the readers' or learners' request and support learners' use for non-Yorùbá tourists that wish to converse with Yorùbá speakers.

This application can be CD-ROM based or on network (intranet and internet) or mobile platform such as smartphones and Android devices which provides channels for communication between travellers (tourist) and their guide (tutor) in their respective destinations. Android app is a subset of translation which process and transform a text (phrase or word) from a source language into a target language. It involves translation of English language (lingua franca) to Yorùbá language (mother tongue). The app was designed with an easy to read and pronunciation guide for all the phrases and words, it would also assist readers (learners) that need to communicate effectively and efficiently in order to solve visitors-dwellers predicament while visitors are abroad or places where different languages are spoken [41]. In the time past, the quality of communication and fluency was linked to one's mother's tongue while in the future; the quality of communication would be linked to digital apps [38]. Thus, with the advent of internet which is becoming the most important source of information, tourist or prospective learners of any language can obtain all necessary words and phrases to communicate in Yorùbá while mobile phones would afford easier access at every point in time to intending learner.

Internet brings people together from any country in the world and reduces the distance between people in many ways [60]. This Android app would specifically use the internet and web facilities as its data transmission medium to bind different people together irrespective of their differences and distance. The web as a virtual environment helps learners and teachers of Yorùbá language to share a common interest by reducing the cost and increase the communication skills of intended tourists or learners. Today a web is frequently the first place teachers, learners or researchers go to conduct any research or find out any information. Any tourist to a Yorùbá nation would likely consult the web for a guide to have an enjoyable moment in Yorùbá speaking countries and the availability of an Android app for Yorùbá language would be an added value to Yorùbá nations and enhance better relationship between the visitors (learners) and dwellers. Prospective learner can use this app to learn a language that are geographically separated from them. It would enhance inter cultural existence of Nigeria nation during the compulsory programme of National Youth Service Corp (NYSC) with other non-Yorùbá speakers and would also portray and rebrand the images of Yorùbá nations well. Android Yorùbá platform increases the opportunities of conversing in other languages apart from one's mother tongue, web enhancement feature of the Android app would increase the speed and accuracy with which learners and teachers can exchange information and cost of learning are drastically reduced. It would provide wide range of phrases and words in Yorùbá language for any interested learner to read or study 24 hours a day in a multi-layer domain for different situations and actions. If distance education is making it possible for people to learn

skills and earn degrees no matter where they live or which hours they are available for study, so also is this app in teaching Yorùbá language and spoken Yorùbá language.

Yorùbá is a dialect of West Africa with over 50 million speakers. It is a member of Niger-Congo family of language and it is spoken among other languages in Nigeria, Togo, Benin and partly in some communities in Brazil, Ghana, Sierra Leone (where it is called Oku) and Cuba (where it is called Nago) [16]. Yorùbá is one of the three major languages in Nigeria and language being the principal means used by human beings to communicate with one another; it is spoken and considered as the third most spoken native African language. Yorùbá language has ancestral speakers who according to their oral traditions is Oduduwa (son of Olùdùmarè), the supreme god of the Yorùbá [21]. Yorùbá first appeared in writing during the 19th century and the first publications were a number of teaching booklets produced by John Raban in 1830 – 1832 and another major contributor to orthography of Yorùbá was Bishop Samuel Ajayi Crowther (1806 – 1891) who studied many of the languages of Nigeria [51], he wrote and translated some of the Yorùbá phrases and words. Yorùbá orthography appeared in about 1850 although with many inherent changes since then. In the 17th century Yorùbá was written in the Ajami script [49] and major development in the documentation of Yorùbá words and phrases were done by Anglican (CMS) missionaries that were working in places like Sierra Leone, Brazil, Cuba and they assembled the grammatical units in Yorùbá together which were published as short notes [5], in 1875 Anglican communion organized a conference on Yorùbá orthography. Johnson (1921) remarked that several fruitless efforts had been made to either invent new characters or adapt the Arabic, which was already known to Moslem Yorùbá. Finally, Roman character-based alphabets that were acquainted with Anglican (CMS) missionaries were adopted [43].

Yorùbá anthology can be traced to the publication of several Yorùbá newsprints in Lagos, Nigeria in 1920s such as Eko Akete in 1920 with Alaagba Isaac B Thomas as the editor, Akede Eko in 1922, Eletiofe in 1925 with E. A Akintan as the editor and many more which enhance the numerous usage of the language in the area of economic, political diplomatic and cultural relations. Yorùbá phrasebook will allow intending visitors or learners of the language to tap into numerous advantages to be derived in its usage but nonexistence of English – Yorùbá corpus can inhibits.

Translation is inevitable because communication is the lifeblood of business or transaction, hence the need for large-scale translation of one of African languages that is, Yorùbá language which has not received research attention like its European and Asian counterparts [19], [67], [36]. The efforts to build a viable, beneficial and good relationship have one source of motivation which is the potential to solve Visitors-Dwellers problems by developing Android Yorùbá platform

to assist in proffering solutions to problems associated with the language barrier.

The Android platform contained important expressions for situational communication between a foreigner and native Yorùbá speakers in the areas of bargaining, greetings, descriptions, numbers, colours, etc. Without doubt, whoever has Android platform to learn useful words and phrases will enjoy her stay than those who could not lay their hands on such facility, which is exactly what this present research work aims to achieve.

## 2. Research Objectives

There is no research work without its difficulties but its inherent advantages must outweigh the challenges hence the need to bring its merits to the society at large. The objectives of the research are to

- a. design a computational model for Android Yorùbá platform
  - b. implement the model in (a)
  - c. evaluate the performance with created Yorùbá corpus.
- To achieve all the objectives, a review of manually

composed translators such as French, German, Spanish, Italian and other languages are appraised. The transfer architecture is employed in order to produce syntactic and semantic translation that is both logical and meaningful rather than producing only lexical translation. The phrase is parsed, followed by target language mapping or selected-word from large corpus created.

The transfer architecture underpins the linguistic transfer model, thus, it re-frame rules for words and phrases which are divided into these tokens:

Source language parser which consists of rules for SL analysis (Syntactic/Semantic)

Transfer engine, this handles rules for source to target transfer and procedures covered between the lexical and structural ambiguity in the language formalism.

Target language generator, it consists of rules for generating the target language as

The transfer approach first of all, divides phrase into words, tags each word, translate each word using the corpus and generate the translation using rules of Target Language (TL).

*Table 1. Some of Rules generated for Transfer Approach.*

	ENGLISH	YORÙBÁ	DESCRIPTION
1	Adj+N	N+Adj (Oro Oruko + Eyan)	Adj+N<-> N+Adj
2	DA+N	N+DA (Oro Oruko + Afihan Aropo Oruko)	DA+N<->N+DA
3	V +Adv e.g Come quickly	V + Adv (Oro Ise + Eyan) Wa Kiakia	V+Adv<->V+Adv

The transfer approach was done on words. Rough Set Theory (RST) is applied to deal with vagueness and uncertainty in the Android app which enables information retrieval, decision rule generation and performance, set of words (phrases) are represented in information table with a finite set of attributes which can be expressed as

$$S = \{A \cup B: x_i \in A, x_i \notin B, y_i \in B, y_i \notin A\}, i = 1, 2, \dots, n \quad (1)$$

where **S** is a finite non empty set of words or phrases called Universe; **A** is a finite non-empty set of distinct words or phrases to be translated and **B** is a finite non-empty set of words or phrases with more than one meaning. Two words or phrases  $x_i$  and  $y_i$  in **S** are equivalent if and only if they have same values on all words or phrases to be translated, denoted by **E**, the equivalence is defined as  $[x] = \{y \in U \mid x \in y\}$ . The equivalence relation **E** induces a partition of **U** denoted by  $S \mid E$ , the subsets in  $U \mid E$  for rough set theory are lower and upper approximations of **C** (word or phrase to be translated)

$$\begin{aligned} \text{apr}(C) &= \{x \in U \mid [x] \subseteq C\}; \\ \text{apr}(C) &= \{x \in U \mid [x] \cap C \neq \emptyset\} \end{aligned} \quad (2)$$

Adopted from Pawlak, 1991

Assuming RST was applied to retrieve a word or phrase from its bilingual corpus, rough approximation would enhance its performance to make approximate matches

between word (phrase) and corpus. There are ways of picking an appropriate sample of phrase or word that matches. First, a corpus is considered as objects of universe, similar phrases (words) based on equivalence relation will be put into equivalence class. Second, the selection of appropriate translated word (phrase) is partitioned as a set of objects, each equivalence class contains similar queries (for example, those that contain common keywords). Third, the indexing terms of the corpus are tagged based on Part of Speech (POS). Yorùbá language being Subject-Verb-Object like English language helps in the transfer approach. This strategy provides maximum flexibility of what types of word or phrase one can check, for instance, both queries and corpus can be represented by POS tagging and the comparison can be done between corpus, between checks (queries) and between queries and corpus. Bilingual lexicon (corpus) was developed as a store house; the model was implemented using Windows, Apache, Hypertext Preprocessor (PHP) and MySQL.

## 3. Implementation

Digital Yorùbá app development tools on android platform comprise of one main module called Phrase with several methods such as Listen or Gbo, Like, Comment, Share etc. Here is the splash screen

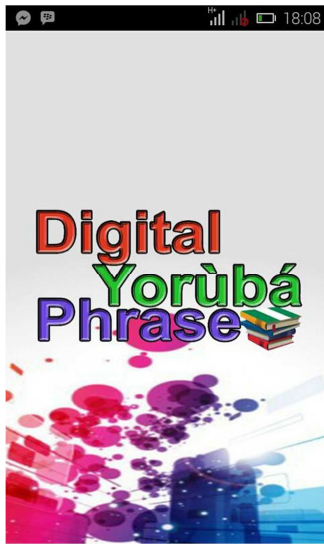


Figure 1. Splash Screen.

Phrase as a module, manages the entirely available phrases that are categories as Animals, Greetings, Name of places, Month, Day of Week and so on, below are some of the interfaces on Android platform.

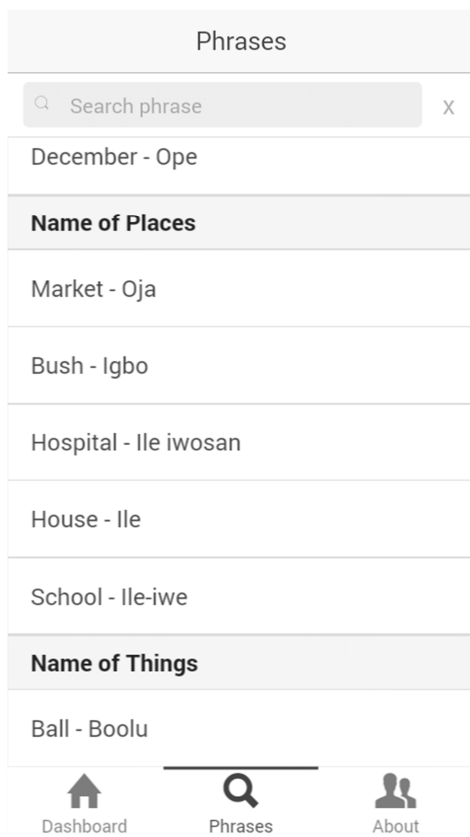


Figure 2. Phrase module.

This interface typifies one of the categorized main module phrase by using touch inputs that correspond to real world actions like swiping, tapping, pinching and so on, several other categories can be viewed

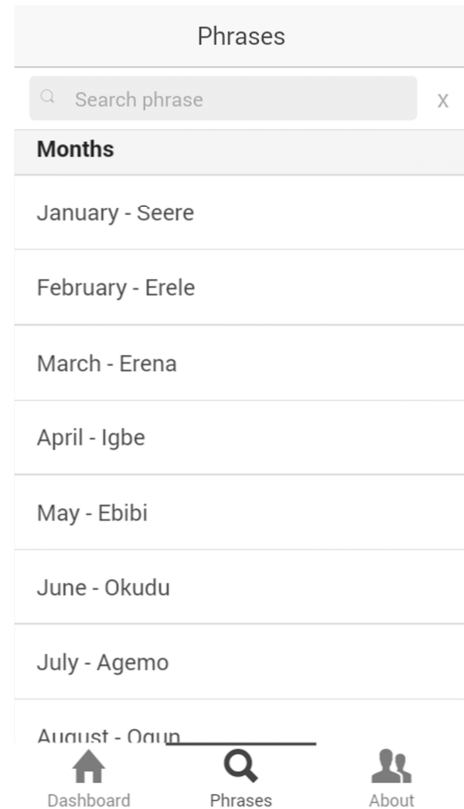


Figure 3. Search Screen.

Other samples are

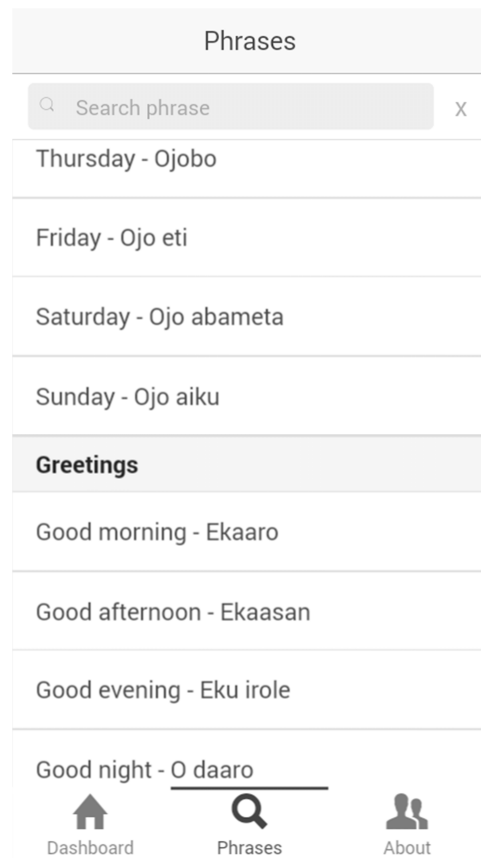


Figure 4. Another Search screen.

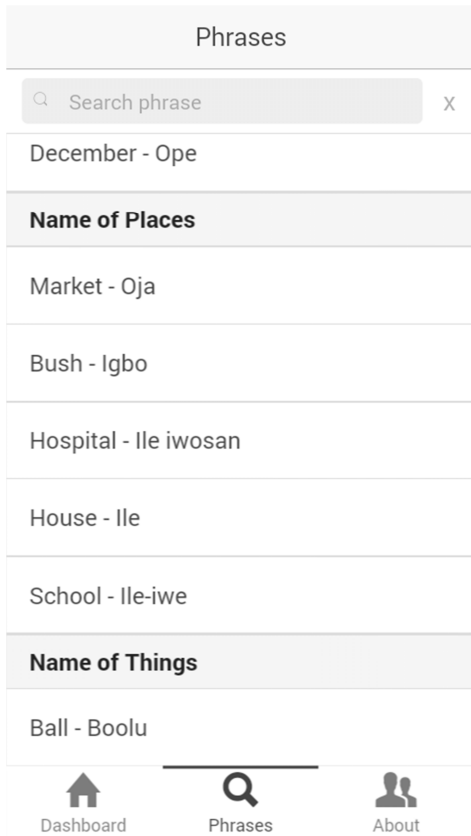


Figure 5. Another Search screen.

Once a word is selected, for example if “broom” is clicked, it will display as shown below

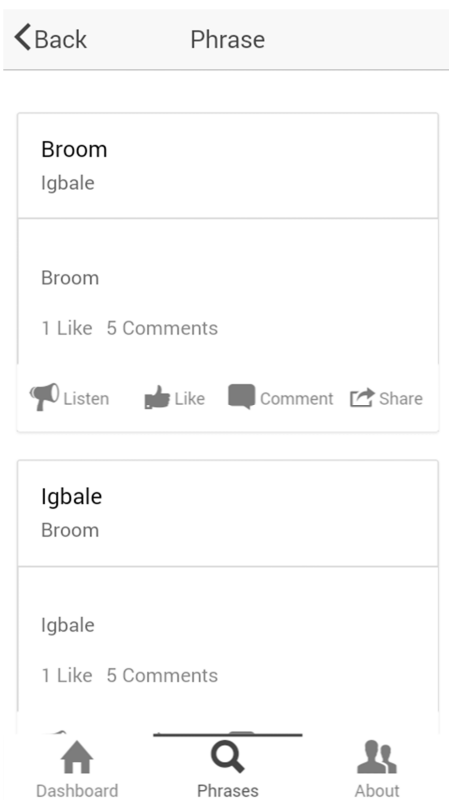


Figure 6. Listen Screen.

Other methods with their functions are discuss below  
*Listen* is a method that pronounces the equivalent of a particular English word or phrase

*Gbo* is a method that pronounces the equivalent of a English word or phrase in Yorùbá

*Like* is a method that allows the user to create awareness for the mobile app by displaying the research work on social media for other users to access and contribute to its further development as in the case of open source programs.

*Share* is a method that allows the user to share phrase and the app across social media as well.

Other features are

*Request* is a method that allows the user to make a request to the administrator if a particular phrase is not available on the app. It routes the request down via API (Application Programming Interface) and notify the admin of a new request from its app user.

Filter is a method that goes through or scans all phrases as user search through and group accordingly.

Note that the created corpus occupies more space and was not to be pre compiled with Android app.

#### 4. Findings

Testing is performed with 200 phrases and words and the survey was done by five (5) indigenous speakers of Yorùbá language who are illiterate and five (5) speakers who can speak both Yorùbá and English. Their ratings were based on two different criteria namely intelligibility and accuracy. At the end, based on intelligibility we have

50.1% phrases got the score 3 i.e. they are perfectly clear and intelligible.

25.4% phrases got the score 2 i.e. they are generally clear and intelligible.

10.5% phrases got the score 1 i.e. they are hard to understand.

14% phrases got the score 0 i.e. they are not understandable.

So we can say that about 75.5% phrases are intelligible.

Evaluation done on accuracy brought about

60% phrases got the score 3 i.e. they match perfectly.

15% phrases got the score 2 i.e. they match with more than 50% as against the correct translation.

14.4% phrases got the score 1 i.e. they match with less than 50% as against the correct translation.

10.6% phrases got the score 0 i.e. they found unfaithful.

So we can say that about 75.5% phrases are intelligible.

The overall score for accuracy of the translated text or phrase on Android app in percentage is found to be 75%.

After careful study of this mobile platform, it was found to be error prone that is some words are to be inserted, deleted or untranslated in the course of translation so as not to generate skewed translation.

#### 5. Conclusion

This research work formulated rules for English phrases

and words to be translated into Yorùbá phrases and words, the aim and objectives were achieved, its design and implementation were carried out on mobile platforms. Yorùbá language which is tending towards extinction were reawakened, this platforms promote indigenous African languages to native and non-native speakers, tourists and National Youth Service Corps (NYSC corps) from another ethnic groups in Nigeria that may want to associate with Yorùbá people during their service year. It serves as one of the collective efforts to expand words, phrases and expressions in Yorùbá language and make Yorùbá language normal and natural means of spoken and written communication for whoso ever desire, consequently the language will be more popular, gain value and prestige and no one will denigrate it. New words and expressions that are suitable for situations, legislation, engineering, commerce, mass communication, computing and other sphere of life will be created in a large number.

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