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# English to Yoruba short message service speech and text translator for android phones

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**Abstract**
Machine language translation (MLT) has acquired a substantial quantity of investigation consideration in Europe and Asia, but works on African languages, especially the Yoruba language, are rare. There is, however, a communication barrier between the people who solely speak Yoruba and foreign visitors and places where the language is not being said or understood. There is a necessity to focus on the glitches of English to Yoruba machine translations to bridge the communication gap. This study, therefore, implemented the rule-based machine translation technique. The method used involved formulating 20 computational rules for the translation process. Offline Android-based English to Yoruba short message service application was developed using the Android Studio IDE and the some of the available inbuilt android plugins alongside a locally produced bilingual dictionary. This paper also examined translations done by the developed mobile app contrary to human translation to explore why machine translation systems still give faults in interpreting natural human language. A questionnaire was designed for the translations; they were distributed to one hundred individuals. Eighty-one participants gave their feedbacks. The responses were dispensed to statistical examination using SPSS. Discoveries showed that human translation handled best-concerning precision and eloquence, which are knowledgeable by the quality and the quantity of the computational rules formulated.

**Keywords** Machine translation language · Language translator · Speech recognition · Android · Yoruba language · Natural language processing how to work with this template

## 1 Introduction

Since the start of the internet, English dialectal has dominated online speech as the "global language of communication." As of February 2020, WebTech3 stated that more than half of the websites are in English. It was recorded in 2016 that in about 67 countries worldwide, English is spoken, and the total number of people who speak English is 900 million approximately. In Nigeria, English is a lingua franca, widely spoken between the tribes of the country particularly, in schools or learning institutions as the primary communication medium. However, with more online speakers speaking various languages, a linguistic digital revolution has begun. Many scientists have recently made efforts to register for non-English words on the internet, paving the way for multiple languages to be digitized (Odoje, 2014).

Yorùbá is a West African dialect with more than 50 million rhetoricians. This dialect is articulated in Nigeria, Togo, Benin, including some regions in Brazil, Ghana. The language is called Oku in Sierra Leone and Nago in Cuba. (Osunnuga, 2016), among other languages. Among the more than four hundred languages, Yorùbá is among the 3 key dialects articulated in Nigeria (Ayenbi, 2014). The language of Yorùbá has ancestral rhetoricians, who are Oduduwa (son of Olodùmarè), the supreme deity of Yorùbá (Ibenegbu, 2017) according to their oral traditions. According to the 2006 populace count led by the National Population Commission of Nigeria, Yorùbá has a speaker population of approximately 30 million (predominantly spoken by Southwestern

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settlers in Nigeria) relative to other African languages. The Yorùbá dialectal has several parlances, but employing the basic Yorùbá (SY), which is the etymological for teaching and learning purpose, communication industry, and daily exchange of information, both speakers can communicate effectively. Yorùbá dialect consist of 3 contrastive phonologic qualities with extra 2 included: High (H), Mid (M), Low (L), rising (R) and falling (F). There are twenty-five letters in the Yorùbá alphabet, plus 18 consonants and 7 vowels. The language has 5 nasalized vowels and two plain nasal syllabic vowels. Yorùbá has a acknowledged writing system that (around 1843) has been prevalent for more than 10 years. The traditional style of greetings, government before colonization, marriage, naming, and religious modes of life are included in its community with a series of oral cultural renditions (orature).

However, as more people get online who speak different languages, there is a need for accurate translation. The translation is the communication of the meaning of a particular language text utilizing an equivalent target-language text. It helps in converting a set of written or spoken words in a language to another set of functionally equivalent words in a different language without losing the functional or logical structure of the original location of terms. Language translators are the medium through which these languages are being converted. This rise in the internet fostered a worldwide market for translation services and enhanced language localization (Glosbe, 2013). Machine translation can be described as a means of automating the more accessible, the challenging and more time-consuming part of a translator's job by performing extensive research to resolve ambiguities in the source text where the grammatical and lexical exigencies of the target language require resolution (Safiriyu & Odetunji, 2016; Ogundokun et al., 2021). The study must, however, serve as an introduction to pre-editing to provide input for the machine-translation process so that the output is not meaningless.

The processing of natural languages (NLP), a branch of machine learning, helps create efficient contact between computers and humans (Manaris, 1998). There have been significant breakthroughs in recent years in enabling computers to use human language to comprehend human languages (Harcourt, 2019). The biggest issue is the overload of information, which presents a significant problem with obtaining a particular, relevant piece of data from large datasets. Due to consistency and usability challenges, semantic and meaning awareness is essential and difficult for summary systems. It is also necessary to describe the significance of the interaction between entities and objects, especially for the use of high-dimensional, heterogeneous, complex, and low-quality data, as is the case for the Yoruba language (Odoje, 2014). Existing English to Yoruba Translators do not provide users with more accurate and specific results from Relational Databases (RDB) for their natural language queries like English. The requests have to be converted into formal database queries like SQL, to retrieve information from RDBs for user requests in natural language. Moreover, in practice, NLP queries are complicated to convert into structured DB requests or service request URLs due to factors such as complex DB-Layouts with table names, columns, restrictions, etc., or the semantic discrepancy between user vocabulary and DB-Nomenclature as in the Yoruba Language.

Over the years, the indigenous Nigerian languages and English have witnessed intense rivalry and hatred, with the former fighting for subsistence. The competition is additionally amplified by the widespread acceptance of mobile technology (Al-Maroof et al., 2020; Kagalkar & Gumaste, 2018; Karkar & Ja'am, 2016; Litzler et al., 2018), most of which is combined with instruments on paper in the English language. Consequently, this has posed a danger to the survival of Nigerian indigenous languages. As a result, most kids can't speak their mother tongue. Therefore, experts are worried that if a child does not express his or her mother tongue today, the child's sons and daughters may lose the language in the next 20–25 years. This means that the fate of Nigerian languages like Yoruba will be close to extinction in the next 50 years or more. In other words, English is the primary dialect language in Nigeria today (especially in educational institutions) that poses major intimidations to the sustained continuation of native dialects, such as the Yoruba language (Akeredolu-Ale, 2007).

In the Yoruba setting, it is so hard to come across parents who speak the Yoruba language to their children (Balogun, 2013). In the School, Language learning and speech has always been limited to language classes alone (Chaudron, 1988). It is, however, essential to discover worthwhile broadcast that will adopt steadiness to guarantee its permanence and approachability for the future Yoruba peer goups (Braimoh, 2012). One such choice is mobile devices (especially mobile phones) (Teo & Pok, 2003). The development of mobile applications has been shown to improve children learning (Adeniyi et al., 2020; Papadakis & Kalogiannakis, 2017; Papadakis et al., 2017, 2018). After President Olusegun Obasanjo introduced them to Nigeria in 1998, the use of mobile phones has increased considerably. Mobile phones are ubiquitous devices among the population of Nigeria today-young and old; rural and urban dwellers (Idongesit & Skouby, 2014); however, this has influenced the use of this channel in this investigation as an alternative to maintain the dialect Yoruba and compel it to be effortlessly approachable by individuals who as well wish to master the dialect. The

short service speech and a text translation will assist in making sure our naïve language, which is Yoruba, does not die a natural death to the English language. The translator is a significant player in the translation process, and eventually in cross-cultural contact in general. The translator's position gives him the authority to translate the source text (ST) into a new language and culture.

Although many authors have contributed to the research on machine translation, most of their presented ideas are behind translation and their applications but not their implementations (Fagbolu et al., 2018). In places where the implementations were available, they were implemented for general applicability and word-for-word translation. Furthermore, the challenges of the semantic gap between Yoruba Language and DB nomenclature still exist in most implementations. This paper reports a built android based translator that bridges the gap between user vocabulary and domain terminology, which can be used by people who want to translate text from English into Yoruba and listen to the reader via speech. The study proposed and implemented an offline Android-based English to Yoruba short message service text and speech translator application. The development of mobile applications has been shown to improve children learning (El-Sofany & El-Haggar, 2020; Kayode et al., 2019; Papadakis & Kalogiannakis, 2017; Papadakis et al. 2020b; Sadiku et al., 2019). Previous research shows that Mobile Assisted Language Learning (MALL) offers learning opportunities irrespective of time and location for second language learners (Akkara et al., 2019), this is also true for language translation. An effort was made to create a system that accepts English sentences and produce an output based on the computation of the words against a locally created dictionary.

The remaining part of the paper is sectioned as follows: Sects. 2 and 3 demonstrates the methodology and Testing with a discussion of results. Section 4 offers the Conclusion, while Sect. 5 discussed the limitations of the work and challenges for the future.

## 2 Methodology

Automated language translator techniques can be designed using three practical approaches; the rule-based, the data-driven, and the hybrid translation. The most realistic of the three (3) approaches, the rule-based technique (Akinwale et al., 2015; Evenlyn et al., 2019), was used in this work.

The framework for the proposed system, as shown in Fig. 1 can be conceptualized as an English to Yoruba automated system where three major actors are involved:

1. A non-Yoruba man or non-Yoruba speaking man who cannot pick calls in a particular place at a specific time needs to communicate urgent and essential information to someone who cannot read, write or understand English (for example, his mother in the Village).
2. A translator or translation device.
3. A core Yoruba man/woman who has no understanding of the English language.

Hence, the second actor has the sole and significant responsibility serving as a liaison officer. The process involved in the use of the proposed system is made up of the following steps:

1. Download or receive the application and install it.
2. Run the application on any android phone.
3. For security reasons, register a password if new on the app. If already registered log in.
4. At the interface, go to:

a. New message if you want to type and send a message.
b. Click a message from the synchronized messages (all messages available on the phone are being synchronized immediately, the log in detail is being sent in) to translate the message to Yoruba or enable the speech ability of the application to read out the statement.

The translation phase of this work extractable from Fig. 1 can be represented with the framework shown in Fig. 2. Table 1 displays the computational rules generated for the SMS sentences utilized for the developed system. At the SMS translation phase, the first step is to break the sentences in the SMS down into its smallest basic unit called tokens. This is followed by identifying the part of speech each of the permits falls into and later category ordering for the computational rules. The final stage is the morphological analysis for some exceptional cases.

In this work, 20 computational rules alongside their production rules based on Type 2 (context-free) grammar was formulated for both the English and Yoruba structures with the left-hand side (LHS) substituted with the right-hand side (RHS) till the terminals are reached.

The production rules for the English structures are**:**

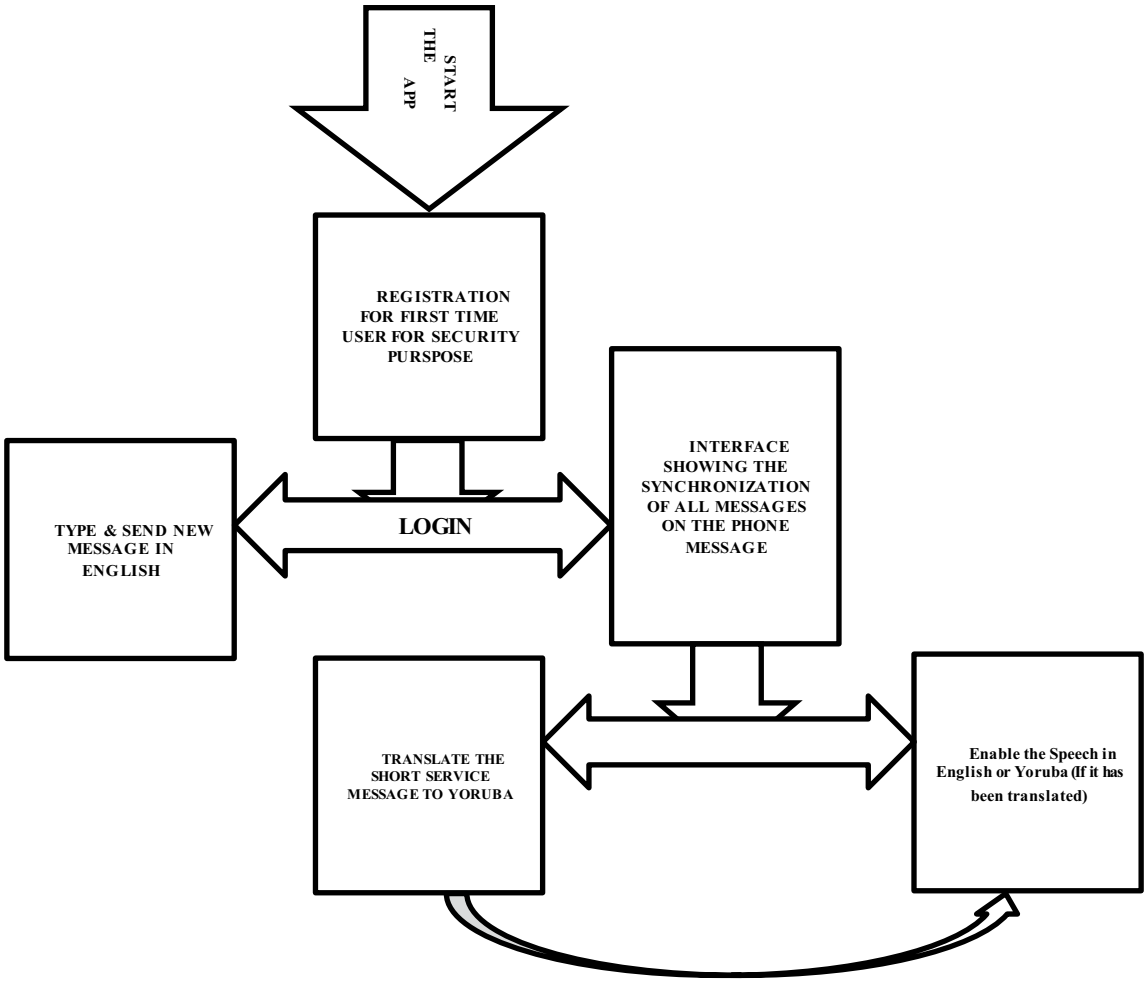



**Fig. 1** Data flow diagram for the translation system

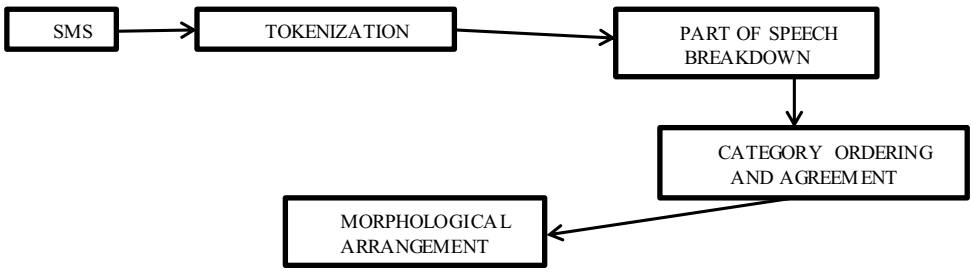



**Fig. 2** Data flow diagram for the translation process

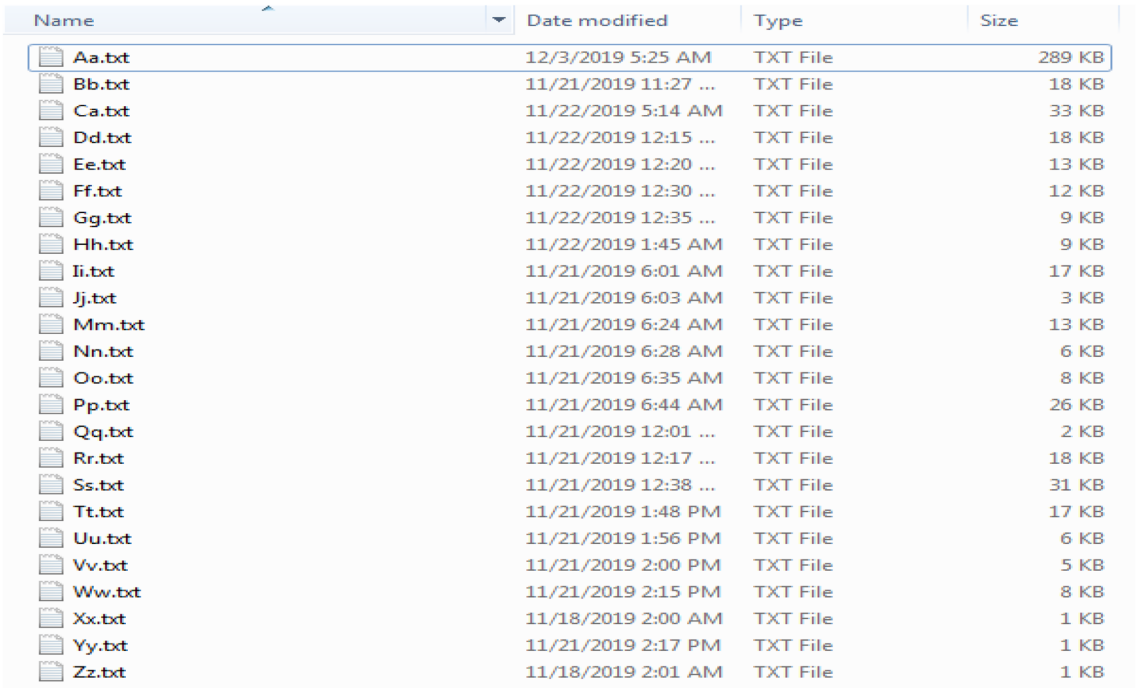
S <NP><VP> (<NP> <ADJP> <PP> <ADVP>)*
NP <N><ART> | <N> | <N><PP> | <DET><N> |
<DET><N><PP> | <N><AUX> | <N><TNS>
VP <V><NP> | <V> | <AUX> | <LV>
ADJP <DET><ADJ> <N> | <ADJ> | <DET><ADJ> | <ART><ADJ><NP>
PP <P>
ADVP <ADV><AUX>

**Table 1** Computational rules generated for the SMS sentences

| | English rules | | Yoruba arrangement of rules | |
|---|---|---|---|---|
| | SCHEMA | Schema's breakdown | Schema | Schema's breakdown |
| $R_1$ | AdjP = Det + Adj + N | | AdjP = N + Adj + Det | |
| $R_2$ | S = NP + VP | NP = N + FT. VP = V + (NP = N) | S = NP + VP | NP = N + FT. VP = V + (NP = N) |
| $R_3$ | S = NP + VP + NP | NP = N. VP = V. NP = N + (PP = P) + (NP = Det + N) | S = NP + VP + PP + NP | NP = N. VP = V. PP = P + (NP = N + Det) |
| $R_4$ | S = NP + Aux + VP + PP + NP + Adv | NP = N. VP = V. PP = P. NP = N | S = NP + Aux + VP + PP + NP + Adv | NP = N. VP = V. PP = P. NP = N |
| $R_5$ | S = NP + Aux + VP | NP = Det + N. VP = LV | S = NP + TNS + VP | NP = N + Det. VP = V |
| $R_6$ | S = Adj + Aux + Neg + NP | NP = Det + N + (PP = P) + (NP = Det + N) | S = Adj + Neg + Aux + NP | NP = N |
| $R_7$ | S = NP + VP + PP + NP | NP = N + TNS. VP = V. PP = P. NP = N | S = NP + VP + PP + NP | NP = V + FT. VP = V. PP = P. NP = N |
| $R_8$ | S = NP + VP + AdjP | NP = Det + N. VP = Aux. AdjP = Adj | S = NP + Aux + AdjP | NP = N + Det. AdjP = Adj |
| $R_9$ | S = NP + Neg + VP + PP + NP | NP = N + Aux. VP = V. PP = P. NP = N | S = NP + Neg + VP + PP + NP | NP = N. VP = V. PP = P. NP = N |
| $R_{10}$ | S = AdvP + NP + VP + PP | AdvP = Adv + Aux. NP = N. VP = V. PP = P | S = Adv + Aux + NP + Aux + TNS + VP | NP = N. VP = V |
| $R_{11}$ | S = NP + V + AdjP | NP = N AdjP = Adj | S = NP + AdjP | NP = N. AdjP = Adj |
| $R_{12}$ | S = VP + AdjP + NP | VP = V. AdjP = Det + Adj. NP = N | S = VP + NP + AdjP | VP = V. NP = N. AdjP = Adj + Det |
| $R_{13}$ | S = VP + PP + NP | VP = V. PP = P. NP = Det + N | S = VP + PP + NP | VP = V. PP = P. NP = N + Det |
| $R_{14}$ | S = NP + VP + NP | NP = N + FT. VP = V. NP = Det + N | S = NP + VP + NP | NP = N + FT. VP = V. NP = N + Det |
| $R_{15}$ | S = NP + VP + AdjP | NP = N. VP = V. AdjP = Art + Adj + (NP = N) | S = NP + VP + AdjP | NP = N. VP = V. NP = N + Adj |
| $R_{16}$ | S = NP + VP + AdjP | NP = Det + N. VP = V. AdjP = Adj | S = NP + AdjP | NP = N + Det. AdjP = Adj |
| $R_{17}$ | S = VP + PP + NP | VP = V. PP = P. NP = Det + N | S = VP + PP + NP | VP = V. PP = P. NP = N + Det |
| $R_{18}$ | S = NP + Adj | NP = N + Aux | S = NP + Adj | NP = N + Aux |
| $R_{19}$ | S = VP + NP | VP = P. NP = Det + N | S = VP + NP | VP = P. NP = N + Det |
| $R_{20}$ | S = NP + VP + NP | NP = N. VP = V. NP = Det + N | S = NP + VP + NP | NP = N. VP = V. NP = N + Det |

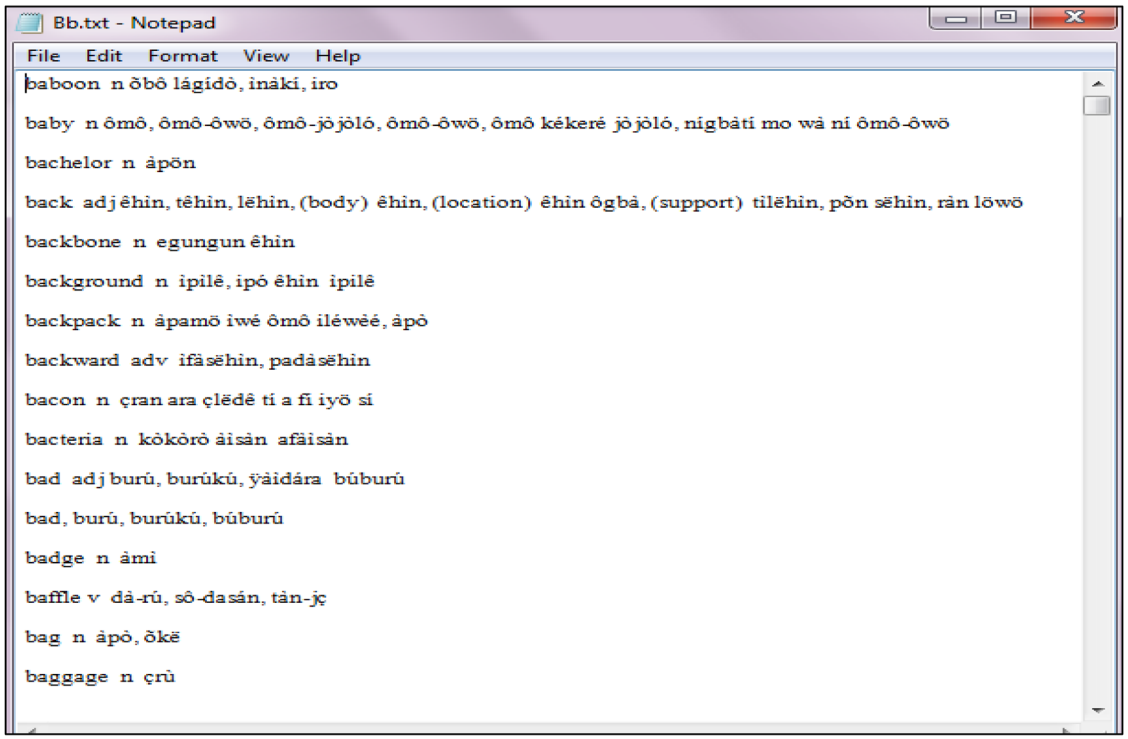
The production rules for the Yoruba structures are:

S ⟶ <NP><VP> (<NP> <ADJP> <PP>)*
NP ⟶ <N><FT> | <N> | <N><DET> | <DET><N><PP> | <N><ADJ>
VP ⟶ <V><NP> | <V>
ADJP ⟶ <N><ADJ> <DET> | <ADJ> | <ADJ><DET>
PP ⟶ <P>



| Name | Date modified | Type | Size |
|---|---|---|---|
| Aa.txt | 12/3/2019 5:25 AM | TXT File | 289 KB |
| Bb.txt | 11/21/2019 11:27 ... | TXT File | 18 KB |
| Ca.txt | 11/22/2019 5:14 AM | TXT File | 33 KB |
| Dd.txt | 11/22/2019 12:15 ... | TXT File | 18 KB |
| Ee.txt | 11/22/2019 12:20 ... | TXT File | 13 KB |
| Ff.txt | 11/22/2019 12:30 ... | TXT File | 12 KB |
| Gg.txt | 11/22/2019 12:35 ... | TXT File | 9 KB |
| Hh.txt | 11/22/2019 1:45 AM | TXT File | 9 KB |
| Ii.txt | 11/21/2019 6:01 AM | TXT File | 17 KB |
| Jj.txt | 11/21/2019 6:03 AM | TXT File | 3 KB |
| Mm.txt | 11/21/2019 6:24 AM | TXT File | 13 KB |
| Nn.txt | 11/21/2019 6:28 AM | TXT File | 6 KB |
| Oo.txt | 11/21/2019 6:35 AM | TXT File | 8 KB |
| Pp.txt | 11/21/2019 6:44 AM | TXT File | 26 KB |
| Qq.txt | 11/21/2019 12:01 ... | TXT File | 2 KB |
| Rr.txt | 11/21/2019 12:17 ... | TXT File | 18 KB |
| Ss.txt | 11/21/2019 12:38 ... | TXT File | 31 KB |
| Tt.txt | 11/21/2019 1:48 PM | TXT File | 17 KB |
| Uu.txt | 11/21/2019 1:56 PM | TXT File | 6 KB |
| Vv.txt | 11/21/2019 2:00 PM | TXT File | 5 KB |
| Ww.txt | 11/21/2019 2:15 PM | TXT File | 8 KB |
| Xx.txt | 11/18/2019 2:00 AM | TXT File | 1 KB |
| Yy.txt | 11/21/2019 2:17 PM | TXT File | 1 KB |
| Zz.txt | 11/18/2019 2:01 AM | TXT File | 1 KB |

**a**




**b**

**Fig. 3** **a** Screenshot of the manually designed dictionary. **b** Screenshot of the manually designed dictionary

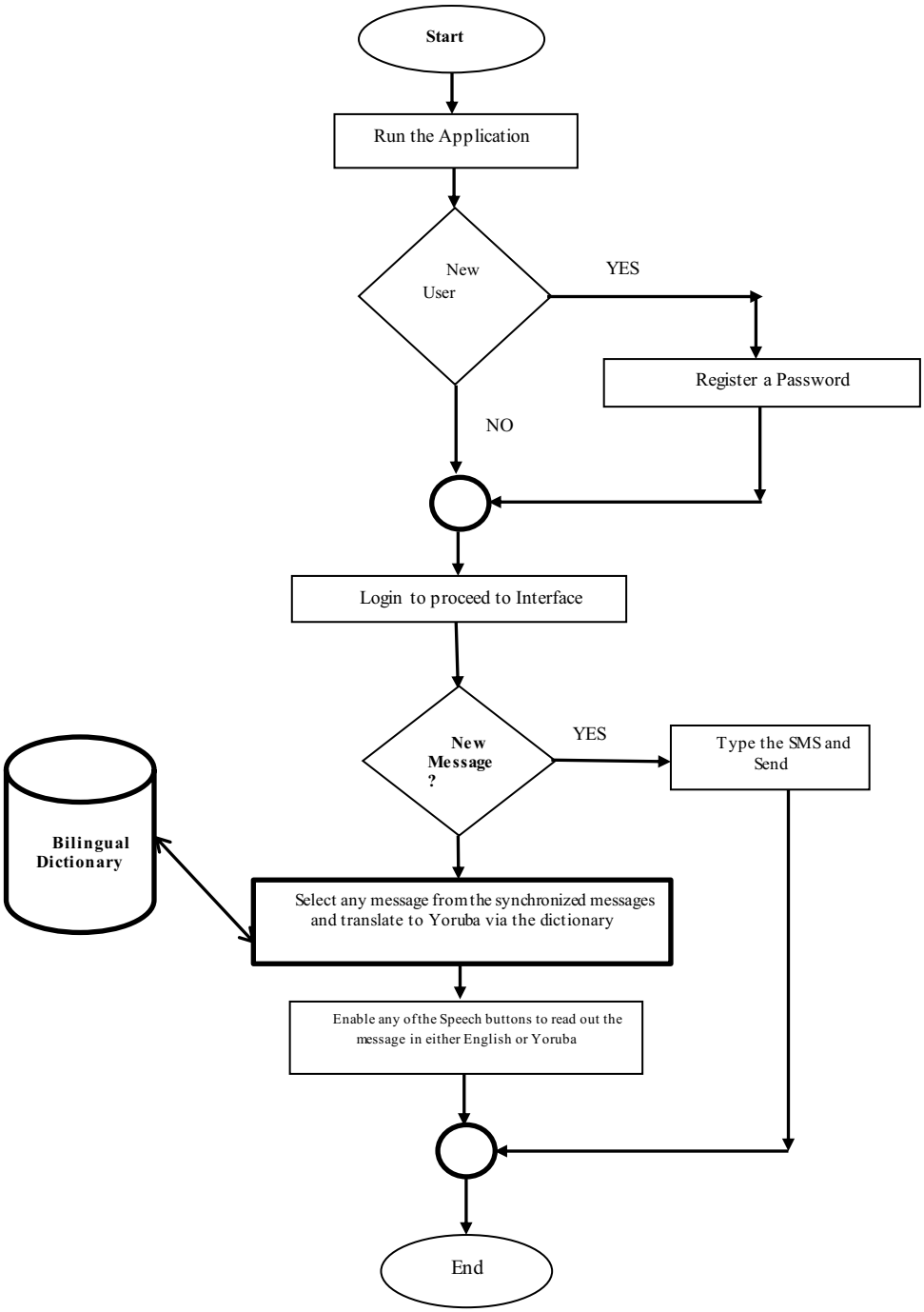



**Fig. 4** Flowchart for the translation system

S is the starting symbol and, in the case, stands for S. NP stands for Noun Phrase, VP stands for Verb Phrase, ADJP means Adjectival Phrase, PP stands for Prepositional Phrase, ADVP means Adverbial Phrase while the (*) stands for optional. N stands for Noun, FT for Future Tense, DET for Determinant, TNS for Tense, AUX for Auxiliary, ADJ stands for Adjective, ADV for Adverb, LV for Lexical Verb, P for Preposition, V for Verb, and ART for Article.

The proposed system is an offline application designed and implemented using Android Studio IDE with a locally created bilingual dictionary for the translation process. The manually created dictionary was, however, created into text files (sample screenshot of the created dictionary is shown in Fig. 3a and 3b) for each alphabet. In contrast, the Android text to speech functionality was used for the speech section. The program was compiled and tested with an emulator (Android device on the system) on the approach to avoid errors. The code was built to generate the installable.APK file so that the package can be installed and run efficiently on Android devices irrespective of the version of their operating

**Table 2** Demographic characteristics of the participants (n = 81)

| Variable | Frequency (n) | % |
|---|---|---|
| Gender | | |
| Male | 52 | 64.2 |
| Female | 29 | 35.8 |
| Age | | |
| Below 20 | 12 | 14.8 |
| Between 21–25 | 11 | 13.6 |
| Between 31–35 | 26 | 32.1 |
| Between 36–40 | 18 | 22.2 |
| Above 41 | 14 | 17.3 |
| Education level | | |
| Undergraduate | 12 | 14.8 |
| Bachelor degree | 36 | 44.4 |
| Master | 25 | 30.9 |
| PhD | 8 | 9.9 |
| Native language | | |
| English | 20 | 24.7 |
| Hausa | 13 | 16.0 |
| Yoruba | 48 | 59.3 |
| Fluency of native language | | |
| Poor | 17 | 21.0 |
| Average | 11 | 13.6 |
| Good | 53 | 65.4 |

system. The compiled program does not exceed 5 mb and will run effectively on any mobile phone which runs the Android operating system.

The process flowchart for the translation system is presented in Fig. 4. It shows in sequence what happens in the application from loading the application to the point messages translate to Yoruba or relayed as speech.

## 3 Evaluation, testing and discussion of findings

This section discussed the system implementation, testing, findings discovered and the system evaluation was discussed. In this study, the system was evaluated using questionnaire created for respondents to fill and the responses gathered were analyzed.

### 3.1 Sample

The evaluation process involved the design of a questionnaire, detailing the subject respondent's profiles who were mainly university students. Section B of the questionnaire asked the respondents to translate 10 Yoruba sentences to English on their interpretations of simple sentence translation and compare the result of the mobile app translator with those same sentences. The last section was focused on getting information on the applicability and ease of using the mobile application. The design of the questionnaire was based on two criteria, namely sentence syntax correctness and ease of use. The Yoruba short message service speech and text translator has been tested by recruiting 100 participants; however, the questionnaires were returned by 81 Respondents. Demographic characteristics of the participants is shown in Table 2.

The Table 2 shows the demographic characteristics of the participants. 64.2% of the respondents are male, and 35.8%

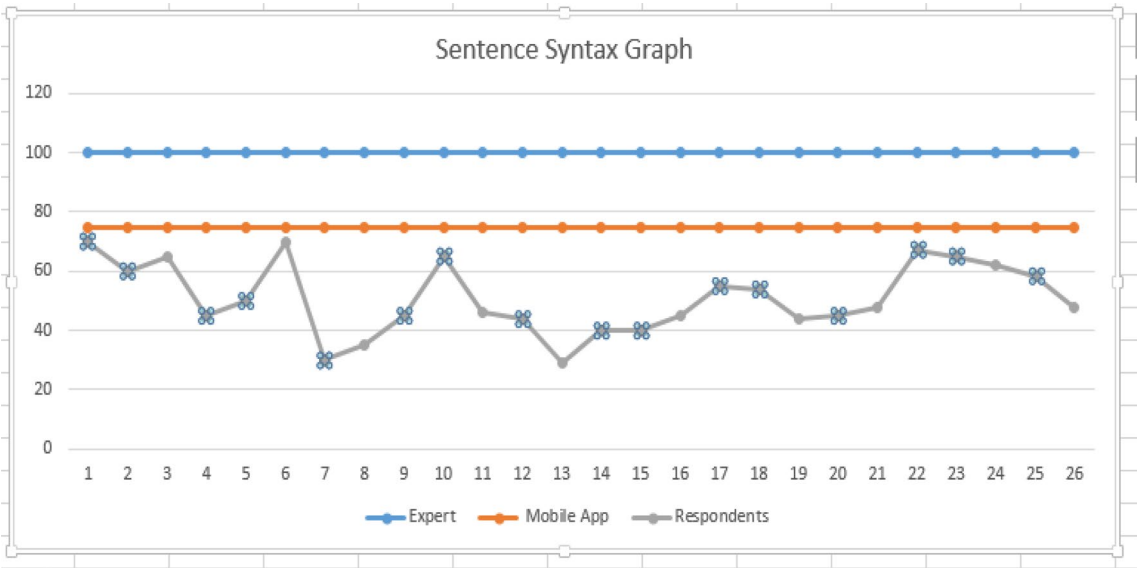



**Fig. 5** Sentence Syntax Graph

**Table 3** User/respondents evaluation results

| Rating | Ease of use | App translations accuracy |
|---|---|---|
| Excellent (5) | 70 | 77 |
| Very good (4) | 5 | 2 |
| Good (3) | 0 | 0 |
| Neutral (2) | 3 | 1 |
| Poor (1) | 2 | 1 |
| Very poor (0) | 1 | 0 |

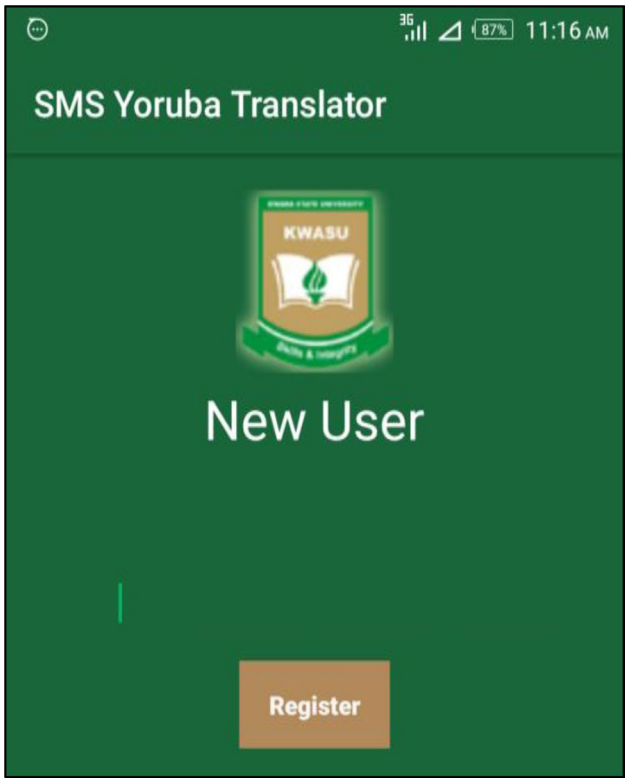



**Fig. 6** Registration interface for first-time users

are female. The age range of the respondents is such that 14.8% are below 20, 13.6% between 21–25, 32.1% between 31–35, 22.2% between 36–40, and 17.3% are above 41 years of age. The educational level of the respondents is 14.8% undergraduate, 44.4% B. Sc., 30.9% Masters, and 9.9% PhD holders. The respondent had three native spoken languages: 24.7% English speaking, 16% Hausa speaking, and 59.3% are Yoruba speaking individuals. The research also examined the respondents' fluency speaking, and we had 21% of the respondents had poor fluency, 13.6% are averagely native speaking, and good speaking individuals were 65.4% fluency.

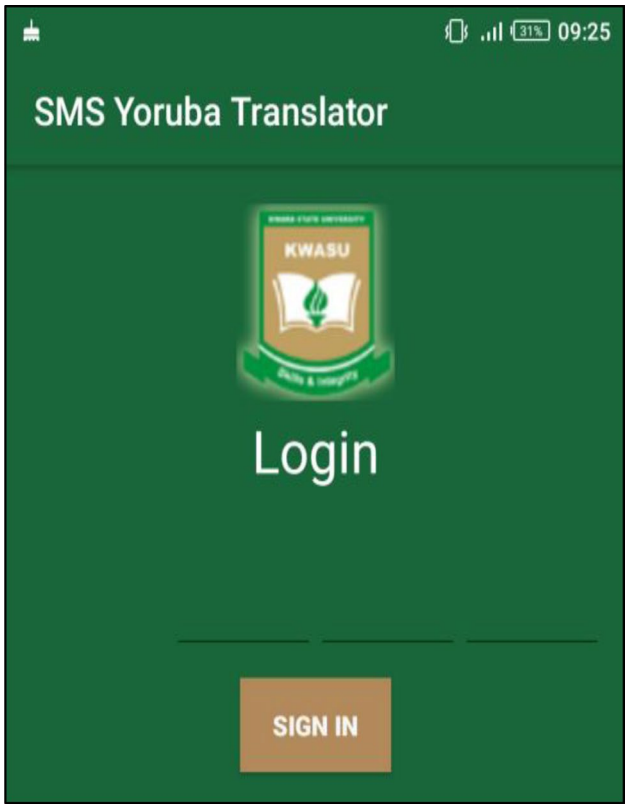



**Fig. 7** Login interface for existing users

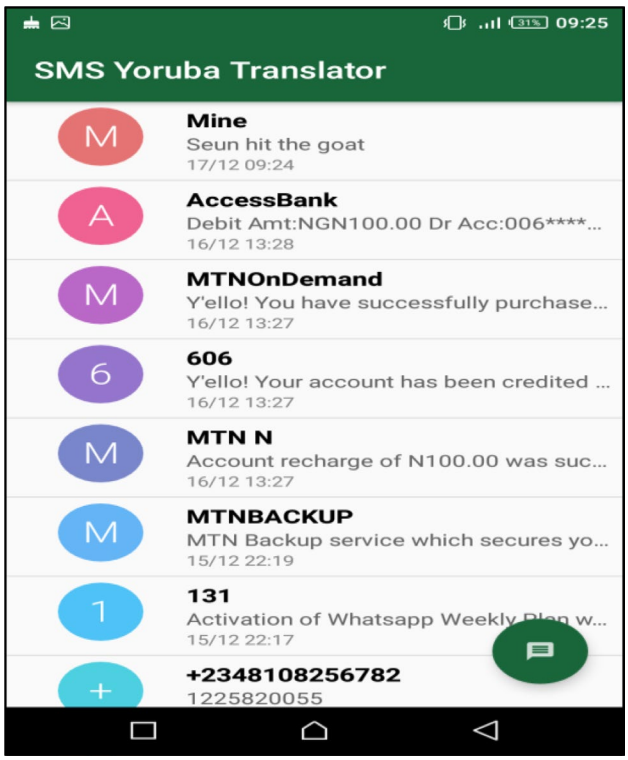



**Fig. 8** Synchronized messages

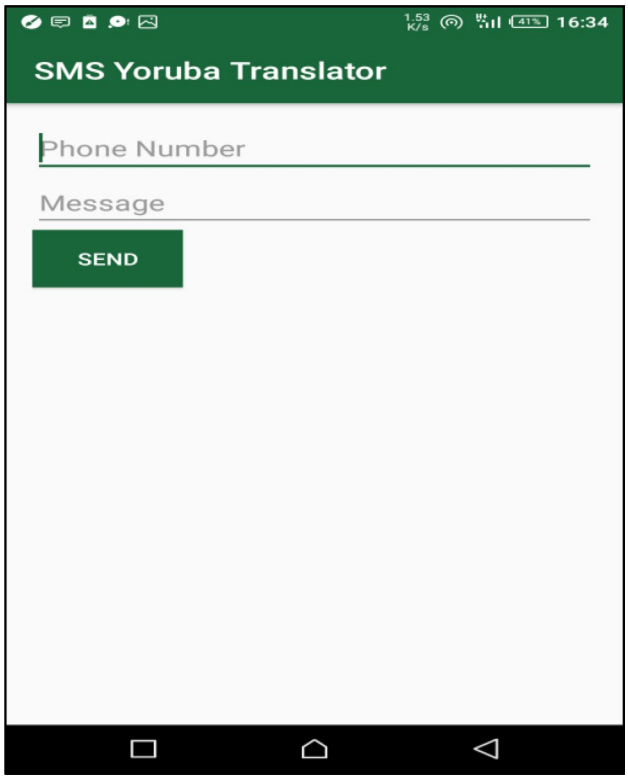



**Fig. 9** Interface for a new message

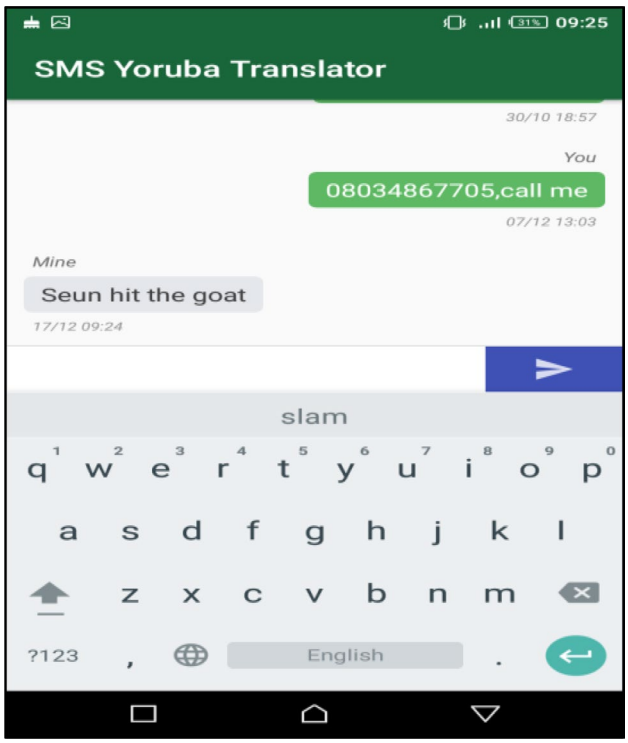



**Fig. 10** Conversation history of a recipient




**Fig. 11** The loaded message and the Yoruba translation

### 3.2 Sentence syntax correctness evaluation

By considering the sentences in the questionnaire, we tested the method of looking at the individual Respondents Translations and the Translations of the mobile app. Phrases were scored for both the respondent and the mobile app translation. The consistency of the sentence syntax was assessed based on the Target language sentence structure. In each sentence, we took into account the location of each word. A word in a sentence is well placed and draws good outcomes. The syntax correctness results for sentences 1–10 in the questionnaire are shown in Fig. 5. The machine translator scores are found to be the same as human scores. The average scores of the respondents were found to be less than the mobile app translations.

### 3.3 Respondent evaluation of the mobile application

The user answers are described in Table 1. 75 of the 81, 90% of the respondents, based on ease of use, scored the application above average (excellent or very good). The ease of use entailed how easy it was to use the mobile app for translations. On this basis, very few (3 in 81) respondents rated the app as bad or shallow (Table 3).

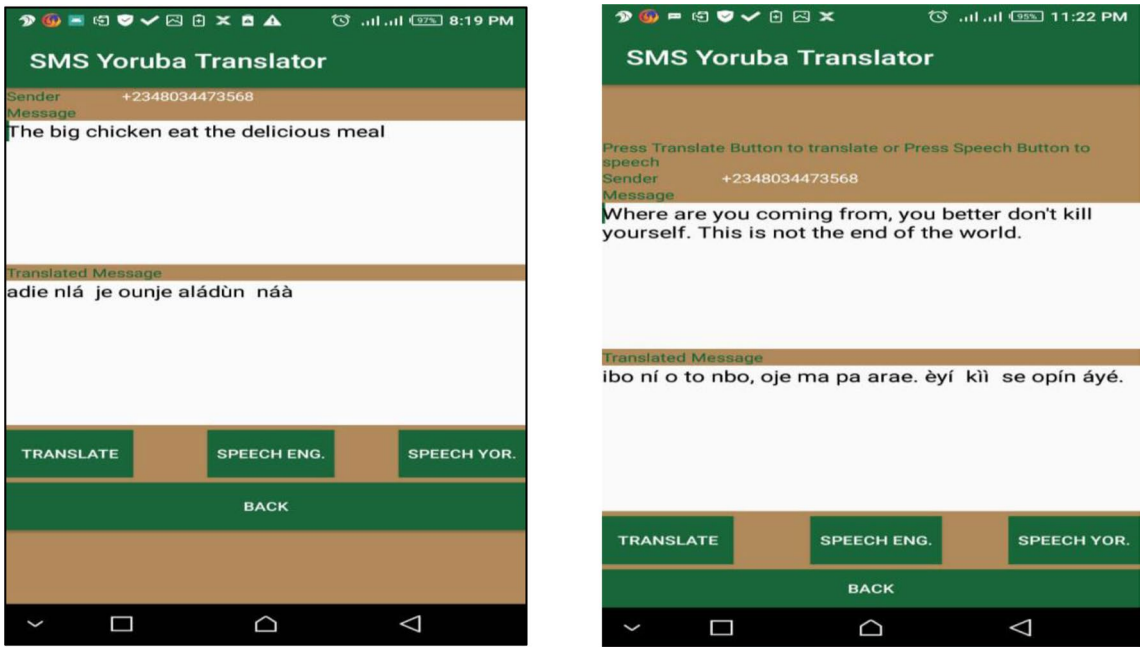



**Fig. 12** Samples of screenshot from the application

In a bid to have a secured application, the system requests the registration of first-time users and used SQL life for storing the password of login for the subsequent use of the application on that same Android phone. So, the system uses a single four (4) digit password per phone. Figures 6 and 7 show the interface of the application after running it for new and old users, respectively.

After a successful login, the user can either create messages and send to people on their contact list (or type the phone number of the intending recipient) or select a statement from the synchronized messages on the application for translation or speech in Yoruba/English. These are presented in Figs. 8 and 9.

From Fig. 8, immediately, a message is clicked by a user; all conversations with the recipient will be loaded for viewing. Any of the messages clicked from the conversation will be loaded for translation, as shown in Figs. 10 and 11, respectively. Other samples of screenshots from the system testing are shown in Fig. 12.

It is from the interface of the translated page that the user can further convert from text to speech. The speech (audio message) can be read in either English or Yoruba. The user can click on "Speech Eng." for English text-to-speech and "Speech Yor." for Yoruba text-to-speech. However, the message must be translated into the Yoruba language before the transmission can be read out as a speech in Yoruba.

## 4 Conclusion

This paper presents an offline Android-based English to Yoruba short message service text and speech translating application. The developed application accepts English sentences and produces output in the Yoruba language based on the selection of words against a locally created dictionary. The system was designed and tested within the Android Studio Integrated Development Environment (IDE) before being built into an APK file for installation on any Android phone of all versions. The system translated both words and phrases (one to one mapping and one to many mapping) of English to the Yoruba language. The implementation of the work was carried out in phases with the initial first phase centering on the design of the application and the second phase focusing on the accuracy of the translations with user expectations.

## 5 Future work

Although the presented work was able to achieve its set aim and objectives, the following limitations were recorded:

i. The English to Yoruba dictionary translator used in the research work was manually designed, and as such, not all words in the conventional dictionary are supported by the designed dictionary. Thus, words not listed in the manual dictionary will not be translated correctly; that is, words not present in the dictionary

will be repeated as English words in the translated Yoruba sentence.

ii. Unlike French, Spanish, etc., there is no available local Yoruba database on google or online, and thus, the translated Yoruba text is being read out like speaking English.

iii. Speech to text and Yoruba text to English text was not implemented with this application.

iv. The time taken for translation is high because words in sentences are being searched individually and matched back as sentences.

As a challenge for the future, the researchers will be working on the development of an enhanced version of this application that will be able to address at least three (3) if not all, the listed challenges.

**Data availability** The datasets used for the study is deposited in the Harvard Dataverse repository. https://doi.org/10.7910/DVN/FPWD3K. Babatunde et al., (2020).

## Declarations

**Conflict of interest** No organization has provided financial funding for the study. The authors claimed that they do not have recognized conflicting financial interests or personal relationships that could have affected the research described in this paper.

**Informed consent** Approval to conduct the survey was obtained from the Ethical Committee of Landmark University, Omu Aran, Nigeria and all informed consent were obtained for experimentation with human subjects.

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