Carib.J.Sci.Tech

LOCALIZATION OF ANDROID CONTENT IN RUNYAKITARA

Authors & Affiliation:

Joan Byamugisha, Language Technologies Researcher, Bwebajja Entebbe, Uganda.

Peterson Asingwire, Runyakitara Language Expert, Uganda

Correspondence To:

Joan Byamugisha

Abstract

The Android17 SDK supports thirty-seven languages, none of which are indigenous to Africa. The limited progress of the localization of ICT in Africa has been identified by several authors as one of the reasons for the digital divide between Africa and the rest of the world. However, several technology companies have translated their software (ranging from entire operating systems to specific application software) to indigenous African languages such as Kiswahili in East Africa, isiZulu in South Africa, and Dinka in Central Africa. This paper discusses the implementation of localization in Africa, as well as the contribution to these current efforts by translating Android English content to Runyakitara (one of Uganda's indigenous languages). The paper explains the key parts of the translation process, which are: the translation of basic terms, nouns, and acronyms; vowel assimilation; and naturalization.

1. INTRODUCTION

According to the android17 SDK [3], thirty-seven languages for different locales are currently supported: Arabic, Bulgarian, Catalan, Chinese, Croatian, Czech, Danish, Dutch, English, Finish, French, German, Greek, Hebrew, Hindi, Hungarian, Indonesian, Italian, Japanese, Korean, Latvian, Lithuanian, Norwegian, Polish, Portuguese, Romanian, Russian, Serbian, Slovak, Slovenian, Spanish, Swedish, Tagalog, Thai, Turkish, Ukrainian, and Vietnamese (details of the locales can be found in appendix A). None of the above includes any indigenous African languages. This lack of localization in technology (and dependence on foreign languages) has been credited for the existence of the digital divide (the socio-economic difference between communities in their access to ICT [6, 9, 18]) in Africa [9].

Several authors have put forward major reasons for the digital divide in Africa: (1) the high cost of computers [9, 18]; (2) lack of adequate electricity supply, especially in rural Africa [6, 9, 18]; (3) low levels of literacy [6, 9, 18]; (4) lack of telephone lines for internet access [6, 9, 18]; (5)unfavourable education policies and varying local attitudes with respect to native African languages [6, 18]; and (6) foreign language dependency [9, 18].

However, an analysis of anecdotal evidence of the situation specific to Uganda indicates that reasons 1 to 5 are no longer as affective as they once were. Firstly, the cost of computers has greatly reduced over the last ten years, especially due to the use of open source software. Secondly, though a significant part of rural Uganda still remains without reliable electricity, majority of this rural population relies on their mobile telephones for access to ICT; these phones can have their batteries charged using solar power or bicycle dynamos. Thirdly, according to the 2009/2010 population statistics by Uganda Bureau of Statistics [22], 88% of the urban population and 69% of the rural population are literate. Coupled with the introduction of computer literacy skills in most primary and secondary schools, and in all universities, reason 3 does not hold true for Uganda. Fourthly, the lack of telephone lines is no longer a valid argument for poor internet access as almost all Ugandans access the internet through their mobile phone service providers. Uganda has also implemented a new education policy which promotes the exclusive use of indigenous Ugandan languages during the first four years of primary school [20]. This only leaves reason 6, the lack of localization of technologies, as a still existing major barrier to the spread of ICT in Uganda.

Localization has been defined as the process of "*adapting a product or service to a local or regional market*" [7]. In order to improve the spread of ICT in Africa, Kamau [9] recommended localizing in indigenous African languages as a means of breaking down the foreign language barrier, and spreading the use of Information and Communication Technology (ICT). This was supported by the research done by Byamugisha [4] where localized technologies were found to be better adopted by a specific indigenous group in Uganda.

This paper presents the details of the localization of Android content in Runyakitara-a combination of four indigenous Ugandan languages: Runyankore, Rukiga, Rutooro, and Runyoro [2, 4, 6]. The paper is structured as follows: section 2 discusses localization of technology in Africa specifically, section 3 explains the Runyakitara language and its importance to localization in Uganda, section 4 describes the key aspects associated with translating Android content from English to Runyakitara, and section 5 discusses future work.

2. LOCALIZATION

The online Oxford dictionary [12] defines the word "localize" as to "*make something local in character*;" where local means "*relating to a particular region*" [11]. Several authors have presented different definitions for the word "localization" according to different contexts: Alege and Osabuohien [1] define localization in terms of focusing economic trade among regional neighbours as opposed to global trade; Jimes et Al. [8] state that "localization involves adapting content to fit local cultural needs," where the adaption can include meeting local logistical constraints which affect the access to information (such as limited technology, distribution channels, infrastructure, and budgets); Conference [6] and Kamau [9] argue that localization includes the tailoring of European language content to local audiences; while Neves and EyonoObono [17] specifically refer to localization as the presentation of computer graphical user interfaces in non-English languages.

Though the definition by Jimes et al. [8] involves several important aspects of localization such as collaborative authorship with locals, collaborative local distribution, open access and licensing, and content rooted in the socio-economic aspects of the local culture and geographical context, it is not the working definition in this paper. Rather, the translation of ICT content from European to indigenous languages in Africa-as defined by [6, 9, 17]-will be the focus of this paper.

Throughout this paper, "indigenous African languages" will simply be referred to as "African languages," and literacy will be defined using the accepted definition in Uganda, "*one's ability to read with understanding and to write meaningfully in any language*" [22]. It is important to note however that this definition is not always applied in Uganda, as usually one who can not read and write in English, though may be able to do so in an indigenous language, is regarded as illiterate.

Localization in Africa

"*It is clear that African languages are not yet widely used in the content of computer applications and the internet*," which can be deduced from the lack of web content and localized software even for major African languages [18]. A supporting study revealed that even the few websites which present their content in African languages (10% of websites with a Tanzanian focus had at least some Kiswahili content) provide limited translations of their content [18]; the same was also observed for the Google search engine in Runyakitara [4]. It was therefore concluded that even the most widely spoken African languages (a hundred million Kiswahili speakers worldwide [10]) have less native language content compared to some minority European languages [18].

Importance of Localization in African Languages

Localization adds value to ICT in Africa through accessing more users since indigenous languages dominate on community level (especially in rural areas), providing localized interfaces and content for better access and relevance, and enhancing the utility of ICT for development and education in multilingual contexts [6]. Further, the use of African languages on computers and the internet is important because it provides an opportunity for native languages to be used in ICT, in addition to other spheres of daily life; it can be used in information and knowledge generation and dissemination; and it provides a means of preserving native languages for the future [18].

The sole reliance on European languages in ICT also disadvantages those who are not skilled in these languages [18]. This disadvantage has been termed as the "cognitive load," which refers to the additional load associated with first learning a European language, and then learning how to use the technology [17]. Kamau [9] asserts that "*in order for Africa and the rest of the developing world not to be left behind in the ICT sector, they need this technology in their own indigenous language so that most of their people who do not understand foreign languages can access it without the language barrier.*"

Concerns of Localizing in African Languages

Various reasons have been given against localizing technology in African languages, that: almost everyone in Africa speaks English, French, or Portuguese; Africa has too many indigenous languages (more than two thousand); African languages either have no writing or have no words for technical terms; the indigenous languages have no role to play in Africa's future anyway; emphasizing the use of indigenous languages will exacerbate socio-linguistic divisions among the peoples in Africa; and the amount of effort and resources required to localize for all African languages is too high [6].

The above reasons can be generally categorized into two main groups: the lack of motivation (the will to use them) and impediments caused by structural factors that affect access and use (the means to localize) [18]. The lack of motivation stems from: the inability of those with access to computers to use their African languages because they are more fluent in a European language, the inability of those who are fluent in their African languages to use computers because they are not fluent in a European language, the fact that the target audience of much online African content is external (outside Africa) and therefore tends to use European languages, and much of the content intended for an African Audience originates from outside Africa and is thus produced in European languages [18]. Impediments caused by structural factors include: standardization of orthography, special characters which require specialized fonts, the lack of intersection between language policies and ICT policies, and lack of resources to advance work on localization of ICT [18].

However, counter arguments have also been made in support of localization, that: English, French, and Portuguese are commonly used by the minority elite in cities, while they are either not spoken well or at all among the majority rural; localization is required in order to ensure serious access to technology in multi-lingual Africa ("*The spread and use of computer technology, which is the heart of ICT, is language dependent*" [13]); though Africa is estimated to have over two thousand indigenous languages, many of them are closely related and can be generalized (as Runyakitara was used to generalize four closely related languages[2, 4, 6]); it is a fallacy that African languages can not be used for ICT terms, especially since several technical terms in software have already been localized prominently in Kiswahili [9], isiZulu and isiXhosa [17], and Setswana [7]; though indigenous languages are not widely used outside the native speakers, a bilingual approach can be applied, especially using technology, to support multi-lingualism; ICT can be used to document previous undocumented oral languages; localization does not lead to disunity among Africans as one language does not have to dominate in the end; and the use of Unicode can resolve the technical hurdles (like creating special characters, diacritics, and non-Latin scripts) associated with digitally documenting African Languages, as has been done for Chinese and Arabic [6].

Localization Projects in Africa

Several technology companies-especially Microsoft, Google, and Linux-have undertaken projects to localize their software in Africa [6, 9]. These localization efforts are said to be driven by development concerns, and to give the use of ICT in Africa its own character [6] (as is evident from the evolution in the use of mobile telephony in East Africa). On the other hand, while such localization projects are, for Africans, aimed at bridging the digital divide, for the technology companies, they are aimed at expanding markets for their software [9].

Localization in Kiswahili

Kiswahili was chosen as the first African language to be localized for because it is, more than any other African language, already taught in several higher institutions of learning all over the world [9]; it has an estimated sixty million speakers in sub-Saharan Africa [15] and one hundred million users worldwide [10]. Kiswahili is phonetically easy to learn, both for members of any of the major language classifications in Africa and for other foreigners, and is the only African language which has been used internationally for broadcasting and publishing [9]. Perhaps most important to the localization of technology is that Kiswahili can easily coin new words and phrases to translate technological terms [9].

Software localization has been done in Kiswahili for Microsoft (Microsoft Office and Windows), Linux (Linux operating system, word processor, spreadsheet programme, a drawing and illustration programme, presentation creator, and a data source editor), Google (search engine at www.google.co.ke), an email programme, and a Text-To-Speech (TTS) engine which can be used to teach foreigners Kiswahili, aid visually impaired persons to read Kiswahili text, and be applied in cell phones and ATMS [9]. This made Kiswahili the first African language to ever be used in technology [9].

Though the localized software has been widely accepted in East Africa (especially in Kenya and Tanzania), Kamau [9] identified some problems associated with its adoption: some technical localized terms could not be understood by, or were difficult to understand for ordinary Kiswahili speakers; in some cases, a single English technology term can have several different translations in Kiswahili; and there exists a negative attitude of many Kiswahili speakers towards their language, a situation which has also been observed in Uganda for Kiswahili and other indigenous languages.

Localization in South African Languages

De Schryver [7] discussed the localization by Microsoft of Windows XP in Setswana and isiZulu, as well as the translation of the complete and freely available OpenOffice.org 2.0 suite, which includes: word processor Writer, spreadsheet software Calc, presentation application Impress, the graphics package Draw, the database programme Base, and the mathematical tool Math, in all eleven of South Africa's official languages (Afrikaans, English, Ndebele, Northern Sotho, Sotho, Swazi, Tswana, Tsonga, Venda, Xhosa, and Zulu [23]). This latter project was supervised by Dwayne Bailey, director of the Zuza Software Foundation [7].

Neves and EyonoObono [17] carried out a study aimed at analyzing the opinions of students regarding their perception on the usefulness of the localization of software compilers. Their study was made even more important by providing a need for the preservation of African languages, through applying them to ICT for both end-users and developers. They stated that one of the crucial benefits to be accrued from localized compilers is assisting in the identification, understanding, and correction of erroneous code during debugging; which would help to shed the image of programming courses as hard. Their research provided empirical evidence in support of software localization; specifically, in the perceived usability of software programme compilers in isiZulu, isiXhosa, and Afrikaans, as compared to English, irrespective of an individual's demographic, culture, language, and programming proficiency.

Localization in Other African Languages

Other localization efforts of ICT in Africa include: In north Africa, Egypt (Arabic) [6]; in west Africa, Nigeria (Hausa, Ibo, and Yoruba) [6, 18], Burkina Faso (Jula, Moore, and Fulde), Senegal (Wolof), and Benin (Fon) [6]; in central Africa, DRC (Lingala) [6] and South Sudan (Nuer and Dinka) [18]; in southern Africa, South Africa(Zulu) [6] and Zimbabwe (Shona) [17]; and in east Africa, Ethiopia (Ethiopic) [17], Ethiopia and Eritrea (Amharic), Kenya and Tanzania (Kiswahili) [6], and Uganda (Luganda [6]).

In conclusion, localization has generally had a positive effect in Africa, especially in terms of bridging the social divide, contributing to the effort to provide equal access to electronic information, enhancing the belief in the need for linguistic and cultural diversity, and the conviction that business needs to take a long-term approach and invest sensibly in new and emerging markets [7].

3.   RUNYAKITARA

Runyakitara is "*the name given to the four major dialects found in western Uganda*" and these include Runyankore, Rukiga, Runyoro, and Rutooro [2] spoken by the Banyankore, Bakiga, Banyoro, and Batooro respectively. According to the last population census carried out in 2002 by the Uganda Bureau of Statistics [21], the population of Uganda was 24.2 million persons; the average annual population growth rate was 3.2% for the period 1991 to 2002, which implies that Uganda's 2013 population can be estimated to be 34.2 million persons.

The Banyankore are the second largest ethnic group in the country (10% of the total population); the Bakiga were estimated to be more than a million persons, while the Banyoro and Batooro were estimated to be between half a million and a million persons in 2002 [21]. The current population of Runyakitara speakers in Uganda today is estimated to be six million [2]. This means that Runyakitara speakers make up 17.5% of Uganda's population, a very significant number.

The generalization of the four dialects into a single language has had the following advantages: it has increased the number of persons who speak Runyakitara, increasing the importance and significance of the language; it has made the planning and allocation of resources for indigenous language revitalization easier and more efficient, as a single group can be targeted; and it can increase the access of localized technologies to more than the population of a single language, providing greater relevance to localization efforts.

In a study by Byamugisha [4] on the effect of language (whether English or Runyakitara) on the adoption of the Google search engine, it was found that over 60the study population were: quicker to learn how to use the Google search engine, more efficient at completing tasks, and found technical terms easier to understand when using Runyakitara. Following the spread of mobile telephony in Uganda, the translation of Android from English to Runyakitara will provide an opportunity to not only localize the technology, but to also study this phenomenon further.

TRANSLATION OF ANDROID FROM ENGLISH TO RUNYAKITARA
The process of translating Android content from English to Runyakitara was aimed at contributing to the current localization efforts in Uganda, mainly by Mozilla Firefox in Acholi [14] and Google in Ikinyarwanda, Kiswahili, Luganda, Luo, and Runyakitara [24]. The default Android English language XML file (res/values/strings.xml) was manually translated to a Runyakitara XML file (res/values-ry-rUG) for the Uganda locale, where "ry" is the language code for Runyakitara and "UG" is the country code for Uganda. This process lasted for a month and Peterson Asingwire was the Runyakitara language expert who provided the appropriate meanings from English to Runyakitara. This section discusses the important and specific aspects associated with the translation process. A sample of the translated terms can be found in appendix B.

Basic Translations
The easiest and direct part of the entire activity was to translate from English words and/or phrases that had direct equivalent meanings in Runyakitara. Such words included: "phone" to "esimu," "name" to "eizina," and "person" to "omuntu." However, other words and/or phrases, especially technological terms, had to be translated according to the context in which they were applied. This was especially tedious for those terms that have every day uses in Runyakitara, but which had to be translated in the context of software or technology. They included: "app" or "application" to "ekikozesa," "Development tools" to "Oby'okukozesa kuhanga," "Power off" to "Yihaho esimu,", and "Calendar" to "ebiro bikuru." The terms "PIN," "PUK," and "password" were generally translated as "Enamba y'ekihama" which means "a secret number." This mode of translation was similar to that done when localizing in Kiswahili, where "database" was translated to "hifadhidata hazina data" and "spell-checker" was translated to "kikagua tahajia" [9].

Nouns
All nouns which have direct or equivalent translations from English to Runyakitara were appropriately translated as explained in section 3.1 above. However, some common nouns (nouns denoting classes of objects or concepts [5]) and all proper nouns (a name used for an individual person, place, or organization [19]) were not translated. These included: "Google," "Yahoo," "Emirate," "Skype," "Microsoft," "Sync," "Async," "serial port," and "Bluetooth." This was also similar to some aspects of the English to Kiswahili translation, where for example, "data" was left as "data" in Kiswahili [9]. However, two English words, "Ok" and "menu" were not translated to Runyakitara because they are properly understood and applied by all native speakers who are able to use an Android device.

Abbreviations and Acronyms

The Android English content contains several abbreviations and acronyms. Almost all these abbreviations were not translated because of three reasons: first, there are no direct translations for the abbreviated form; secondly, there was a fear of losing the true meaning of the abbreviation when trying to translate the full term; and finally, most of these abbreviations and acronyms are widely understood and used by the common man. They include: "MMS," "URL," "GPS," "PAD," "USB," "SD," "VPN," and "MTP". However, those abbreviations and acronyms which had equivalent meanings in Runyakitara were translated; for example, "SMS" was translated to "Obutumwa obugufu."

Vowel Assimilation

Vowel assimilation is "*the process of combining two adjacent words by omitting the vowel of the preceding word, and then using the vowel of the proceeding word to provide the pronunciation of the new combined word,*" Peterson Ansingwire. The omitted vowel is replaced with an apostrophe ('). Vowel assimilation was done a lot during the translation process because it reflects the correct way that Runyakitara words are pronounced when spoken. Consider the example of the words "and" and "others" which are translated in Runyakitara as "na" and "abandi." When written together however, "and others" becomes "n'abandi." Note that the vowel "a" associated with the word "na" is assimilated into the new word and is replaced with an apostrophe. There is evidence of this throughout the translated document.

Naturalization

The Oxford dictionary [16] defines "naturalize" as to "*alter an adopted foreign word so that it conforms more closely to the phonology or orthography of the adopting language.*" Several words which have been naturalized in speech were maintained in their naturalized state in the translated document, and they include: "internet" to "intaneeti," "tablet" to "tabureti," "radio" to "rediyo," "screen" to "sikurini," "file" to "fairo," "camera" to "kamera,", and "account" to "Akawunti." Naturalization was also used when translating from English to isiZulu ("internet" to "intanethi") [7] and from English to Kiswahili ("account" to "akaunti," "format" to "fomati," "computer" to "compyuta," "cursor" to "kasa," and "disk" to "diski") [9].

CONCLUSION AND FUTURE WORK

After justifying the importance of localization to the spread of ICT in Africa, there are future plans to use the translated Android content in the development of a new version of Android, where Runyakitara will be one of the supported languages. This version of Android is intended to also act as a research tool, to investigate the user experience of Runyakitara speakers, when their phones and/or tablets are in English or Runyakitara. The aim of this is to research whether the Runyakitara language option creates a preference for Android devices among native speakers, and the quality of learning of the use of Android devices among Runyakitara speakers who know little or no English.

APPENDIX A: List of all languages and Locales in Android

LANGUAGE	LOCALES
Arabic	Egypt, Israel
Bulgarian	Bulgaria
Catalan	Spain
Chinese	China, Taiwan
Croatian	Croatia
Czech	Czech Republic
Danish	Denmark
Dutch	Belgium, The Netherlands
English	Australia, Great Britain, Canada, India, Ireland, New Zealand, Singapore, USA, Zimbabwe

Finish	Finland
French	Belgium, Canada, France, Switzerland
German	Austria, German, Liechtenstein, Switzerland
Greek	Greece
Hebrew	Israel
Hindi	India
Hungarian	Hungary
Indonesian	Indonesia
Italian	Italy, Switzerland
Japanese	Japan
Korean	Korea
Latvian	Latvia
Lithuanian	Lithuania
Norwegian	Norway
Polish	Poland
Portuguese	Brazil, Portugal
Romanian	Romania
Russian	Russia
Serbian	Serbia
Slovak	Slovakia
Slovenian	Slovenia
Spanish	Spain, USA
Swedish	Sweden
Tagalog	Philippines
Thai	Thailand
Turkish	Turkey
Ukrainian	Ukraine
Vietnamese	Vietnam

APPENDIX B: Some Localized Android Terms

ENGLISH	RUNYAKITARA
Affects battery	Eine eki erikukora aha muriro
Android system	Enkorwa ya Android
Calendar	Karenda
Car	Emotoka
Card	Kada
Custom	Kasitomu
Data	Intaneeti (Data)
Day	Ekiro
Delete	Okushangura
Domestic Partner	Omukundwa
Done	Kyakorwa
Email	Emairo
Fax	Fakisi
Home	Omuka
Incoming caller ID	Akamanyiso k'omuntu owakuteerera
Incorrect password	Enamba ey'ekihama egwire
Me	Nyowe
Network	Netiwaaka
Others	Ebindi
Pictures/images	Ebishushani
Registration was successful	Okwehandikisa kwarabamu
Report	Rupoota
Ringer off	Esimu omukaceceko
Roaming	Akamanyiso k'okworeka ku ori ahabuhereza bw'eihanga erindi
Screen lock	Sikurini esibirwe
Service was enabled	Obuhereza bwabaasika

Silent mode	Omuringo ogu esimu erikuba eri omu kaceceko
Tablet options	Emiringo ei tablet erikuheereza
Untitled	Ekitahairwe eiziina
User interface (UI)	Omuringo gw'okutungamu ebikozesa
Vibrate (silent mode)	Esimu omukaceceko kwonka nezakwetigita
Voice	Eiraka
Voicemail	Obutumwa obw'eiraka
Work	Omurimo

REFERENCES

1. Alege, P. O. and S. E. Osabuohien. 2013. G-Localization as a Development Model: Economic Implications for Africa. International Journal of Applied Economics and Econometrics, Vol. 21, No. 1, PP. 41-72.
2. Asingwire, P. 2013. Preserving an Indigenous Philosophy-A Wiki-Culture Framework for Runyakitara. Bachelors Thesis (unpublished): Makerere University, Uganda.
3. Android SDK. Available from http://developer.android.com/sdk/index.html [Accessed on 12/08/2013].
4. Byamugisha, J. 2013. The Effect of Language on the Adoption of the Google Search Engine among the Banyankore. International Journal of Scientific Knowledge. Vol. 3, No. 4. PP 24 – 33.
5. Common Noun: Definition of Common Noun in Oxford Dictionary (British and World English), 2014. Oxford University Press. Available from http://www.oxforddictionaries.com/definition/english/common-noun [Accessed on 25/02/2014].
6. Conference, L. 2005. Localization in Africa: Introduction and Survey. Cairo, Egypt.
7. De Schryver, M. G. 2006. Internationalization, Localization, and Customization Aspects of the Dictionary Application TshwaneLex. 11th International Conference of the African Association for Lexicography, Tshivenda National Lexicography Unit, University of Venda for Science and Technology, Thohoyando, South Africa, PP. 5-7.
8. Jimes, C., S. Weiss and R. Keep. 2013. Addressing the Local in Localization: A Case Study of Open Textbook Adoption by Three South African Teachers. Institute for the Study in Knowledge Management in Education, South Africa.
9. Kamau, N. S. 2008. A Digital Africa Kiswahili Holds the Key. African Journals Online.
10. Katembo, I. B. 2005. Kiswahili, the Global Economy and the African American. International Symposium on Kiswahili Language and Globalization, University of Dar-es-Salam, Tanzania.
11. Local: Definition of Local in Oxford Dictionary (British and World English), 2014. Oxford University Press. Available from http://www.oxforddictionaries.com/definition/english/local [Accessed on 25/02/2014].
12. Localize: Definition of Localize in Oxford Dictionary (British and World English), 2014. Oxford University Press. Available from http://www.oxforddictionaries.com/definition/english/localize#localize__23 [Accessed on 25/02/2014].
13. Mohochi, E. 2002. Teknolojia ya mawasiliano na nafasi ya Kiswahili ulimwenguni in utafiti wa Kiswahili I.K Simala (ed), Maseno: Maseno University.
14. Mozilla Firefox-Download Firefox in your own Language. Available from https://www.mozilla.org/en-US/firefox/all/ [Accessed on 26/02/2014]
15. Msanjila, Y. P. 2002. Dhima ya Kiswahili katika karne ya 21. Kiswahili Vol 65, PP 16-23.
16. Naturalize: Definition of Naturalize in Oxford Dictionary (British and World English), 2014. Oxford University Press. Available from http://www.oxforddictionaries.com/definition/english/naturalize [Accessed on 25/02/2014].
17. Neves, A. A. M. and S. D. EyonoObono. 2013. On the Perceived Usefulness of the Localization of Compilers in African Indigenous Languages. International Journal of Information and Education Technology, Vol. 3, No. 1.
18. Osborn, Z. D. 2006. African Languages and Information and Communication Technologies: Literacy, Access, and the Future. In Selected Proceedings of the 35th Annual Conference on African Linguistics, Ed. John Mugane et al., Somerville, Ma: Cascadilla Proceedings Project, PP. 86-93.
19. Proper Noun: Definition of Proper Noun in Oxford Dictionary (British and World English), 2014. Oxford University Press. Available from http://www.oxforddictionaries.com/definition/english/proper-noun [Accessed on 25/02/2014].

20. Tembe, J. and B. Norton. 2011. English Education, Local Languages, and Community Perspectives in Uganda. Available from www.britishcouncel.org [Accessed on 25/02/2014].
21. Uganda Bureau of Statistics, 2002. Uganda Population and Housing Census, Population Composition. Kampala, Uganda.
22. Uganda Bureau of Statistics, 2010. Chapter 3: Education. Available from http://www.ubos.org/UNHS0910/chapter3_literacy.html [Accessed on 25/02/2014].
23.]Wikipedia-The Free Encyclopedia, 2014. Languages of South Africa. Available from www.en.wikipedia.org/wiki/Languages_of_South_Africa [Accessed on 25/02/2014].
24. www.google.co.ug [Accessed on 25/02/2014].