

# Some essential features in developing a Text To Speech System in Kiswahili

By

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## 1. Introduction

This paper discusses the important aspects to be considered when developing A Text To Speech System (TTS) in Kiswahili. These include linguistic features such as the phoneset, stresses and intonation. The choice of the standard dialect is also discussed. TTS features such as the text normalisation and the lexicon for Kiswahili are discussed.

## 2. Kiswahili grapheme

Kiswahili uses the normal English alphabet minus the three letters: c, x, q. It also has borrowed consonants from Arabic and Persian: gh and kh. There is quite a lot materials written in Kiwashili that include poems (mashairi), newspapers (magazeti), novels (riwaya), Bible (Bibilia) and the Quran (Kurani). Most of the material is now available in computer format and it is therefore easy to collect a corpus of the 10,000 sentences, needed in development of the TTS.

## 3. Kiwahili Phoneset [1,2]

The phoneset is well developed and typically appear as follows:

Vowels	Phoneme	As in
a	/a/	<b>baba</b> (father)
e	/e/	<b>pembe</b> (horn)
i	/i/	<b>mti</b> (tree)
o	/o/	<b>tano</b> (five)
u	/u/	<b>ɗugu</b> (brother)

### Stressed Vowels

a1  
e1  
i1  
o1  
u1

Consonants	Phoneme	As in
b	/b/	<b>bata</b> (duck)
ch	/tʃ/	<b>chumba</b> (room)
d	/d/	<b>ɗeni</b> (debt)
dh	/ð/	<b>ɗhoruba</b> (storm)
f	/f/	<b>fimbo</b> (club)
g	/g/	<b>goti</b> (knee)
gh (borrowed)	/ʒ/	<b>lughā</b> (language)
h	/h/	<b>hewa</b> (air)
j	/j/	<b>jengo</b> (building)
k	/k/	<b>kazi</b> (work)
kh (borrowed)	/x/	<b>nuskha</b> (duplicate)
l	/l/	<b>aIama</b> (mark)
m	/m/	<b>mama</b> (mother)
n	/n/	<b>nazi</b> (coconut)
ng	/nŋ/	<b>kupanga</b> (arrange)

ng'	/ŋ/	<b>ng'</b> ombe (cow)
ny	/ɲ/	<b>ny</b> umba (house)
p	/p/	<b>p</b> aka (cat)
r	/r/	<b>r</b> adi (thunder)
s	/s/	<b>s</b> amaki (fish)
sh	/ʃ/	<b>sh</b> ule (school)
t	/t/	<b>t</b> angu (since)
th	/θ/	<b>th</b> umni (fifty cents)
v	/v/	<b>v</b> azi (dress)
w (semi-vowel)	/w/	<b>w</b> ali (rice)
y (semi-vowel)	/j/	<b>y</b> ai (egg)
z	/z/	<b>z</b> awadi (present)

Stressed consonants

n1  
m1

#### 4. Kiswahili Dialects

Kiswahili has several dialects that include the three main ones: Kiugunja, Kimvita, and Kiamu. Kiugunja is spoken in Zanzibar, while the other two are spoken on the Kenyan coast. In general, newscasters and official speeches use kiugunja which was adopted as the standard language in East Africa in 1928 [3]. It is the dialect chosen here for this work.

#### 5. Kiswahili Syllables

Kiswahili syllables comprise of:

- Consonant followed by a vowel
- Consonant followed by a semi-vowel then a vowel (eg *kwa* in *kwanza* to start)

- a single vowel on its own.
- Or n and m. (this occurs whenever either is followed by a consonant eg *nchi* for nation or *mtu* for a person.)

Syllabification for Kiswahili rules are therefore as follows:

- A consonant or a vowel preceded by a vowel is the start of a syllable
- A consonant (other than a semi-vowel) preceded by a consonant is the start of a syllable (this only happens for n,m or borrowed words)
- All syllables beginning from a consonant end at the next vowel.
- Whenever a syllable begins at vowel, then the vowel is the syllable. For example *ua* (flower) has two syllables *u* and *a*.

#### 6. Stress in Kiswahili

Stress in Kiswahili is only done on vowels or n,m whenever they occur as syllables. Usually stress in a syllable will be by increasing the duration of the vowel in that syllable or n,m whenever they are present as syllables and require stressing. However in borrowed words say 'dhambi (sins) the stress may appear on the first syllable.

#### 7. Kiswahili intonation

Usually this will be done on the last word in an utterance by stressing the penultimate syllable.

"Wakati wa kujenga nchi." transcribed will appear as:

(w a k a t i) (w a) (k u j e n g a) (n1 ch i)

The rest of the utterance will be of uniform energy. Even for “? , ! ;” the stress is carried out in the same way on the last word though, the energy on the word changes. Further research is being undertaken to provide detailed intonation rules.

### 8. Text normalisation in Kiswahili (Tokenization)

Kiswahili uses the English format of dates, time and currency. However these are pronounced differently and different words are generated in tokenisation. Homographs occur in Kiswahili in words like: ba'rabara (exactly) and bara'bara (highway). All Kiswahili homographs are distinguished by stressing some of the phones, even though all of them remain the same.

### 9. Kiswahili Lexicon

To begin with the lexicon will contain the alphabet and the way it is pronounced, including c (*se*), x (*eks*) and q (*ku*). Others will include punctuations, peoples names eg Roger (*rojā*) and names of places. Borrowed words will also be put into the lexicon as they are not many.

### 10. Conclusion

Although Kiswahili has borrowed very heavily from Arabic, most of the borrowed words have been “swahili-nised”. It is expected that further “swahili-nisation” may be carried out on words that may prove hard to deal with. This of course will be done within what is

deemed acceptable. What is presented here however is a very simple treatment of the desired features. Issues like intonation and stresses will be dealt with more rigorously. However, this treatment can provide a elementary TTS in Kiswahili.

### 11. References

- (1) Mohammed M.A. 'Modern Swahili Grammar', East African Educational Publishers , Nairobi, 2001.
- (2) Ellen Contini-Morava, “Swahili Phonology”, University of Virginia, <http://rosettaproject.org/work/rosetta>
- (3) Iraki F.K. “LECTURE PRAGMATIQUE DES MORPHEMES TEMPORELS DU SWAHILI”, Phd dissertation, University De Geneve, 2002. [www.unige.ch/cyberdocuments](http://www.unige.ch/cyberdocuments)