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Genitive constructions in English to Swahili machine translation

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Abstract

English has two methods of constructing genitive expressions. In one method, the suffix *s* is added to the end of the possessor, and the subject of possession, together with its arguments, is located after the possessor. In another method, the possession preposition *of* is used, whereby the possessor comes after the subject of possession and its arguments. The basic rule is that the first method is used when the possessor is a human being. Nevertheless, this rule is profusely broken. Swahili uses only the latter type of genitive constructions, and all English constructions must be converted into this format. This report discusses the methods of doing this.

Key Words: *genitive constructions, machine translation*

1 Introduction

When English uses *of* in genitive expressions, the translation into Swahili is not particularly problematic, because also Swahili uses the corresponding structure. Yet there are minor problems, such as the noun class concordance of the preposition and the word order of the arguments of the possessed.

When English uses the suffix *s* after the possessor, translation becomes more difficult, because Swahili does not have the corresponding structure. Text must be modified to meet the Swahili requirements. This can be done as a series of several phases. This report demonstrates these phases as well as discusses problems involved.

2 Genitive constructions using the suffix *s*

When the possessor is a human being, English usually uses the method, where a suffix *s* is attached to the possessor, preceded by an apostrof (e.g. *Anna's book*). This method applies to human possessors, but also non-human possessors are found to use the same method. There seems to be no rule for defining when this is allowed and when not. Especially non-native speakers often use the structure also in unexpected contexts.

Swahili does not have such a structure. Therefore, the constructions must be converted into the structure allowed by the language. Consider the simple sentence in (1).

(1)

Anna's books were sold.

This is analysed as in (2).

(2)

```
"<Anna's>"
  "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<books>"
  "book" { 8PL tabu } %SUBJ N PL NOM DEF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { uzA } HUM-V SVO %-FMAINV V EN
"<.>"
  "."
```

The possessor Anna is interpreted as a noun (N) with genitive case (GEN). Only nouns and proper names may have this combination of tags, if they are in the position of a possessor in sentence. Therefore, these tags are a key in identifying such genitive structures, which do not use the *of*-structure in genitive.

In order to get the corresponding structure of Swahili, we must add the preposition *of* to the appropriate place, it is, after the word *books*. We do it with a rule (3).

(3)

```
"<Anna's>"
  "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<books>"
  "book" { 8PL tabu } %SUBJ N PL NOM DEF "<of>" "of" { -a }
%<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { uzA } HUM-V SVO %-FMAINV V EN TAM-li
"<.>"
  "."
```

The preposition *of* together with its analysis is now on the same string with the word *books*. We move it to the same format as other words (4).

(4)

```
"<Anna's>"
  "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<books>"
  "book" { 8PL tabu } %SUBJ N PL NOM DEF
"<of>"
  "of" { -a } %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
```

```
"<sold>"
  "sell" { uzA } HUM-V SVO %-FMAINV V EN TAM-li
"<.>"
  "."
```

The preposition was added with a CG rule as in (5).

(5)
 ADD ("<of>" "of" { -a } %<NOM-OF PREP-OF) TARGET N (*-1 N +
 (GEN) BARRIER CLB OR N);

The rule reads: Add the string "<of>" "of" { -a } %<NOM-OF PREP-OF to the word, which has a tag that belongs to the set with the name N. Somewhere on the left there should be a word with the tag GEN. Do not scan beyond the clause boundary of a word, which has a tag that belongs to the set N.

We can now add further inflection tags. Note that also the Swahili stem -a must have a noun class tag, which will be chosen according to the noun (6).

(6)
 "<Anna's>"
 "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
 "<books>"
 "book" { 8PL tabu } %SUBJ N PL NOM DEF
 "<of>"
 "of" { -a } %<NOM-OF PREP-OF G-8
 "<were>"
 "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
 "<sold>"
 "sell" { uzA } HUM-V SVO %-FMAINV V EN TAM-li SP-8 PASS
 "<.>"
 "."

The tags are then moved to the appropriate place (7).

(7)
 "<Anna's>"
 "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
 "<books>"
 "book" { 8PL tabu } %SUBJ N PL NOM DEF
 "<of>"
 "of" { G-8+a } %<NOM-OF PREP-OF
 "<were>"
 "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
 "<sold>"
 "sell" { SP-8+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
 "<.>"
 "."

Note that also the passive suffix *w* was added to the verb stem. In surface form the tags are as in (8).

```
(8)
"<Anna's>"
  "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<books>"
  "book" { vi+tabu } %SUBJ N PL NOM DEF
"<of>"
  "of" { vya }} %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
```

The Swahili words are now in correct format, but the word order must be changed. First, we must put the sentence on one line (9).

```
(9)
( N "<Anna's>" { anna } FEM CAP %A> CAPINIT SG GEN ) ( N "<books>"
{ vitabu } PL NOM DEF ) ( PREP-OF "<of>" { vya }} %<NOM-OF ) ( V
"<were>" { AUX } MONOSLB PAST PL COND-CAND ) ( V "<sold>" {
viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
```

We see that the POS tags have been moved as first elements in each word. This makes the rule writing less complex, because we mainly deal with POS tags in formulating the reordering rules. For example, the rule for reordering the constituents in the above sentence is as in (10).

```
(10)
perl -pe 's/ (\( N [^\)]+\ GEN \)) (\( N [^\)]+\)) (\( PREP-OF
[^\)]+\))/ :$2 $3 :$1/gm'
```

After applying this rule, the sentence has the format as in (11).

```
(11)
:( N "<books>" { vitabu } PL NOM DEF ) ( PREP-OF "<of>" { vya }}
%<NOM-OF ) :( N "<Anna's>" { anna } FEM CAP %A> CAPINIT SG GEN ) (
V "<were>" { AUX } MONOSLB PAST PL COND-CAND ) ( V "<sold>" {
viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
```

When unnecessary elements are removed, the translation is as in (12).

```
(12)
Vitabu vya Anna viliuzwa.
```

So far, we have been dealing with a minimal sentence. We will try the translation with a set of more complex sentences (13).

(13)

Anna's all books were sold.
Anna's old books were sold.
Anna's old and bad books were sold.
Anna's all old books were sold.
Anna's all old and bad books were sold.

First, we test whether the preposition *of* will be added to each sentence (14).

(14)

```
"<Anna's>"
    "anna" { anna } FEM CAP %OBJ CAPINIT N SG GEN
"<all>"
    "all" { -ote } %DN> DET
"<books>"
    "book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
    "of" { -a } %<NOM-OF PREP-OF
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND TAM-li
"<sold>"
    "sell" { uzA } HUM-V SVO %-FMAINV V EN TAM-li
"<.>"
    "."
"<Anna's>"
    "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<old>"
    "old" { -a zamani A-INFL } %A> A ABS
"<books>"
    "book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
    "of" { -a } %<NOM-OF PREP-OF
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND TAM-li
"<sold>"
    "sell" { uzA } HUM-V SVO %-FMAINV V EN TAM-li
"<.>"
    "."
"<Anna's>"
    "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<old>"
    "old" { -a zamani A-INFL } %A> A ABS
"<and>"
    "and" { na } %CC CC
"<bad>"
    "bad" { -baya } A-INFL %A> A ABS
"<books>"
```

```
"book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
  "of" { -a } %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND TAM-li
"<sold>"
  "sell" { uzA } HUM-V SVO %-FMMAINV V EN TAM-li
"<.>"
  "."
"<Anna's>"
  "anna" { anna } FEM CAP %<P CAPINIT N SG GEN
"<all>"
  "all" { -ote } %AD-A> ADV
"<old>"
  "old" { -a zamani A-INFL } %A> A ABS
"<books>"
  "book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
  "of" { -a } %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND TAM-li
"<sold>"
  "sell" { uzA } HUM-V SVO %-FMMAINV V EN TAM-li
"<.>"
  "."
"<Anna's>"
  "anna" { anna } FEM CAP %<P CAPINIT N SG GEN
"<all>"
  "all" { -ote } %AD-A> ADV
"<old>"
  "old" { -a zamani A-INFL } %A> A ABS
"<and>"
  "and" { na } %CC CC
"<bad>"
  "bad" { -baya } A-INFL %A> A ABS
"<books>"
  "book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
  "of" { -a } %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND TAM-li
"<sold>"
  "sell" { uzA } HUM-V SVO %-FMMAINV V EN TAM-li
"<.>"
  "."
```

We see that the preposition *of* has been added to each sentence regardless the number of arguments of the noun. We skip some phases and look at the phase, where the Swahili words have been formulated (15).

(15)

```
"<Anna's>"
  "anna" { anna } FEM CAP %OBJ CAPINIT N SG GEN
"<all>"
  "all" { vyote } %DN> DET
"<books>"
  "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
  "of" { vya }} %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
"<Anna's>"
  "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<old>"
  "old" { vya zamani A-INFL } %A> A ABS A-8
"<books>"
  "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
  "of" { vya }} %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
"<Anna's>"
  "anna" { anna } FEM CAP %A> CAPINIT N SG GEN
"<old>"
  "old" { vya zamani A-INFL } %A> A ABS A-8
"<and>"
  "and" { na } %CC CC
"<bad>"
  "bad" { vi+baya } A-INFL %A> A ABS A-8
"<books>"
  "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
  "of" { vya }} %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
"<Anna's>"
  "anna" { anna } FEM CAP %<P CAPINIT N SG GEN
"<all>"
  "all" { vyote } %AD-A> ADV
```



```
"<old>"
  "old" { vya zamani A-INFL } %A> A ABS A-8
"<books>"
  "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
  "of" { vya } %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
"<Anna's>"
  "anna" { anna } FEM CAP %<P CAPINIT N SG GEN
"<all>"
  "all" { vyote } %AD-A> ADV
"<old>"
  "old" { vya zamani A-INFL } %A> A ABS A-8
"<and>"
  "and" { na } %CC CC
"<bad>"
  "bad" { vi+baya } A-INFL %A> A ABS A-8
"<books>"
  "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
  "of" { vya } %<NOM-OF PREP-OF
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
```

In the next phase we test whether each sentence gets the correct word order. First, we move each sentence to its own line (16)

(16)

```
( N "<Anna's>" { anna } FEM CAP %OBJ CAPINIT SG GEN ) ( DET
"<all>" { vyote } ) ( N "<books>" { vitabu } PL NOM ) ( PREP-OF
"<of>" { vya } %<NOM-OF ) ( V "<were>" { AUX } MONOSLB PAST PL
COND-CAND ) ( V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV EN PASS )
( "<.>" "." )
( N "<Anna's>" { anna } FEM CAP %A> CAPINIT SG GEN ) ( A "<old>" {
vya zamani A-INFL } ABS A-8 ) ( N "<books>" { vitabu } PL NOM ) (
PREP-OF "<of>" { vya } %<NOM-OF ) ( V "<were>" { AUX } MONOSLB
PAST PL COND-CAND ) ( V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV
EN PASS ) ( "<.>" "." )
( N "<Anna's>" { anna } FEM CAP %A> CAPINIT SG GEN ) ( A "<old>" {
vya zamani A-INFL } ABS A-8 ) ( CC "<and>" { na } ) ( A "<bad>" {
vibaya } A-INFL ABS A-8 ) ( N "<books>" { vitabu } PL NOM ) (
PREP-OF "<of>" { vya } %<NOM-OF ) ( V "<were>" { AUX } MONOSLB
```

```
PAST PL COND-CAND ) ( V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV
EN PASS ) ( "<.>" "." )
( N "<Anna's>" { anna } FEM CAP %<P CAPINIT SG GEN ) ( ADV "<all>"
{ vyote } ) ( A "<old>" { vya zamani A-INFL } ABS A-8 ) ( N
"<books>" { vitabu } PL NOM ) ( PREP-OF "<of>" { vya } } %<NOM-OF )
( V "<were>" { AUX } MONOSLB PAST PL COND-CAND ) ( V "<sold>" {
viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
( N "<Anna's>" { anna } FEM CAP %<P CAPINIT SG GEN ) ( ADV "<all>"
{ vyote } ) ( A "<old>" { vya zamani A-INFL } ABS A-8 ) ( CC
"<and>" { na } ) ( A "<bad>" { vibaya } A-INFL ABS A-8 ) ( N
"<books>" { vitabu } PL NOM ) ( PREP-OF "<of>" { vya } } %<NOM-OF )
( V "<were>" { AUX } MONOSLB PAST PL COND-CAND ) ( V "<sold>" {
viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
```

When reordering rules for each sentence type are applied, the result will be as in (17).

(17)

```
:( N "<books>" { vitabu } PL NOM ) :( DET "<all>" { vyote } ) :(
PREP-OF "<of>" { vya } } %<NOM-OF ) :( N "<Anna's>" { anna } FEM
CAP %OBJ CAPINIT SG GEN ) ( V "<were>" { viAUX } MONOSLB PAST PL
COND-CAND TAM-li ) ( V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV EN
PASS ) ( "<.>" "." )
:( N "<books>" { vitabu } PL NOM ) :( A "<old>" { vya zamani A-
INFL } ABS A-8 ) :( PREP-OF "<of>" { vya } } %<NOM-OF ) :( N
"<Anna's>" { anna } FEM CAP %A CAPINIT SG GEN ) ( V "<were>" {
viAUX } MONOSLB PAST PL COND-CAND TAM-li ) ( V "<sold>" { viliuzwa
} HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
:( N "<books>" { vitabu } PL NOM ) :( A "<old>" { vya zamani A-
INFL } ABS A-8 ) ( CC "<and>" { na } ) ( A "<bad>" { vibaya } A-
INFL ABS A-8 ) :( PREP-OF "<of>" { vya } } %<NOM-OF ) :( N
"<Anna's>" { anna } FEM CAP %A CAPINIT SG GEN ) ( V "<were>" {
viAUX } MONOSLB PAST PL COND-CAND TAM-li ) ( V "<sold>" { viliuzwa
} HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
:( N "<books>" { vitabu } PL NOM ) :( ADV "<all>" { vyote } ) :( A
"<old>" { vya zamani A-INFL } ABS A-8 ) :( PREP-OF "<of>" { vya } }
%<NOM-OF ) :( N "<Anna's>" { anna } FEM CAP %<P CAPINIT SG GEN ) (
V "<were>" { viAUX } MONOSLB PAST PL COND-CAND TAM-li ) ( V
"<sold>" { viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
:( N "<books>" { vitabu } PL NOM ) :( ADV "<all>" { vyote } ) :( A
"<old>" { vya zamani A-INFL } ABS A-8 ) ( CC "<and>" { na } ) ( A
"<bad>" { vibaya } A-INFL ABS A-8 ) :( PREP-OF "<of>" { vya } }
%<NOM-OF ) :( N "<Anna's>" { anna } FEM CAP %<P CAPINIT SG GEN ) (
V "<were>" { viAUX } MONOSLB PAST PL COND-CAND TAM-li ) ( V
"<sold>" { viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
```

Each sentence has now a new word order, which meets the requirements of Swahili. The translation is in (18).

(18)

Vitabu vyote vya Anna viliuzwa.

Vitabu vya zamani vya Anna viliuzwa.
Vitabu vya zamani na vibaya vya Anna viliuzwa.
Vitabu vyote vya zamani vya Anna viliuzwa.
Vitabu vyote vya zamani na vibaya vya Anna viliuzwa.

We can test the translation with another noun class. We change the word *books* with *lamps*.

(19)
Taa zote za Anna ziliuzwa.
Taa za zamani za Anna ziliuzwa.
Taa za zamani na mbaya za Anna ziliuzwa.
Taa za zamani zote za Anna ziliuzwa.
Taa zote za zamani na mbaya za Anna ziliuzwa.

3 Genitive constructions using the preposition *of*

The standard method to form genitive constructions in English is the use of the preposition *of*. Swahili also has this method, and it is the only method. Therefore, we should expect that the translation proceeds without problems. However, two things must be taken into consideration. The preposition must be in concordance with the noun class of the head noun. Also, the word order is different. We will use the same examples as above, but we change the English sentences into another format (20).

(20)
The books of Anna were sold.
All books of Anna were sold.
The old books of Anna were sold.
The old and bad books of Anna were sold.
All old books of Anna were sold.
All old and bad books of Anna were sold.

Morphological tags of Swahili are added to their appropriate places (21).

(21)
"<books>"
 "book" { 8PL tabu } %SUBJ N PL NOM DEF
"<of>"
 "of" { G-8+a } %<NOM-OF PREP
"<Anna>"
 "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
 "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
 "sell" { SP-8+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
 "."

"<All>"
"all" { O-8+-ote } %DN> CAPINIT DET
"<books>"
"book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
"of" { G-8+a }} %<NOM-OF PREP
"<Anna>"
"anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
"be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
"sell" { SP-8+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
".."
"<old>"
"old" { A-8+a zamani A-INFL } %A> A ABS DEF A-8
"<books>"
"book" { 8PL tabu } %SUBJ N PL NOM DEF
"<of>"
"of" { G-8+a }} %<NOM-OF PREP
"<Anna>"
"anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
"be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
"sell" { SP-8+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
".."
"<old>"
"old" { A-8+a zamani A-INFL } %A> A ABS DEF A-8
"<and>"
"and" { na } %CC CC
"<bad>"
"bad" { A-8+baya } A-INFL %A> A ABS A-8
"<books>"
"book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
"of" { G-8+a }} %<NOM-OF PREP
"<Anna>"
"anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
"be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
"sell" { SP-8+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
".."
"<All>"
"all" { O-8+-ote } %DN> CAPINIT DET
"<old>"
"old" { A-8+a zamani A-INFL } %A> A ABS A-8

```
"<books>"
    "book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
    "of" { G-8+a }} %<NOM-OF PREP
"<Anna>"
    "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { SP-8+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<All>"
    "all" { O-8+-ote } %DN> CAPINIT DET
"<old>"
    "old" { A-8+a zamani A-INFL } %A> A ABS A-8
"<and>"
    "and" { na } %CC CC
"<bad>"
    "bad" { A-8+baya } A-INFL %A> A ABS A-8
"<books>"
    "book" { 8PL tabu } %SUBJ N PL NOM
"<of>"
    "of" { G-8+a }} %<NOM-OF PREP
"<Anna>"
    "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { SP-8+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
```

The Swahili words are converted to surface form (22).

```
(22)
"<books>"
    "book" { vi+tabu } %SUBJ N PL NOM DEF
"<of>"
    "of" { vya }} %<NOM-OF PREP
"<Anna>"
    "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<All>"
    "all" { vyote } %DN> CAPINIT DET
```

```
"<books>"
    "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
    "of" { vya } %<NOM-OF PREP
"<Anna>"
    "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<old>"
    "old" { vya zamani A-INFL } %A> A ABS DEF A-8
"<books>"
    "book" { vi+tabu } %SUBJ N PL NOM DEF
"<of>"
    "of" { vya } %<NOM-OF PREP
"<Anna>"
    "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<old>"
    "old" { vya zamani A-INFL } %A> A ABS DEF A-8
"<and>"
    "and" { na } %CC CC
"<bad>"
    "bad" { vi+baya } A-INFL %A> A ABS A-8
"<books>"
    "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
    "of" { vya } %<NOM-OF PREP
"<Anna>"
    "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<All>"
    "all" { vyote } %DN> CAPINIT DET
"<old>"
    "old" { vya zamani A-INFL } %A> A ABS A-8
"<books>"
    "book" { vi+tabu } %SUBJ N PL NOM
```

```
"<of>"
  "of" { vya } } %<NOM-OF PREP
"<Anna>"
  "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
"<All>"
  "all" { vyote } %DN> CAPINIT DET
"<old>"
  "old" { vya zamani A-INFL } %A> A ABS A-8
"<and>"
  "and" { na } %CC CC
"<bad>"
  "bad" { vi+baya } A-INFL %A> A ABS A-8
"<books>"
  "book" { vi+tabu } %SUBJ N PL NOM
"<of>"
  "of" { vya } } %<NOM-OF PREP
"<Anna>"
  "anna" { anna } FEM CAP %<P CAP N SG NOM
"<were>"
  "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
  "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  "."
```

The words are reordered and the final translation is produced (23).

(23)

Vitabu vya Anna viliuzwa.
Vitabu vyote vya Anna viliuzwa.
Vitabu vya zamani vya Anna viliuzwa.
Vitabu vya zamani na vibaya vya Anna viliuzwa.
Vitabu vya zamani vyote vya Anna viliuzwa.
Vitabu vyote vya zamani na vibaya vya Anna viliuzwa.

We see that the translation is precisely the same as in (18).

4 Possessive pronouns

The translation of possessive pronouns requires the two standard operations, that is, the production of the correct concordance to the pronoun and the change of word order. In (24) there are examples of possessive pronouns in all six persons.

(24)

```
"<My>"
    "i" { G-7+-angu } %A> CAPINIT PRON PERS GEN SG1
"<chair>"
    "chair" { 7SG ti } %SUBJ N SG NOM DEF
"<was>"
    "be" { SP-7+AUX } MONOSLB %+FAUXV V PAST
"<sold>"
    "sell" { SP-7+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<Your>"
    "you" { G-7+-ako } %A> CAP PRON PERS GEN
"<chair>"
    "chair" { 7SG ti } %OBJ N SG DEF
"<was>"
    "be" { AUX } MONOSLB %+FAUXV V PAST
"<sold>"
    "sell" { SP-7+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<His>"
    "he" { G-7+-ake } %A> CAP PRON PERS GEN SG3
"<chair>"
    "chair" { 7SG ti } %OBJ N SG DEF
"<was>"
    "be" { AUX } MONOSLB %+FAUXV V PAST
"<sold>"
    "sell" { SP-7+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<Our>"
    "we" { G-7+-etu } %A> CAP PRON PERS GEN PL1
"<chair>"
    "chair" { 7SG ti } %OBJ N SG DEF
"<was>"
    "be" { AUX } MONOSLB %+FAUXV V PAST
"<sold>"
    "sell" { SP-7+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN TAM-li
PASS
"<.>"
    "."
"<Their>"
    "they" { G-7+-ao } %A> CAP PRON PERS GEN PL3
"<chair>"
    "chair" { 7SG ti } %OBJ N SG DEF
"<was>"
    "be" { AUX } MONOSLB %+FAUXV V PAST
"<sold>"
    "sell" { SP-7+TAM-li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
```


". "

Morphological tags are converted to surface form in (25).

(25)

```
"<My>"
  "i" { ch+angu } %A> CAPINIT PRON PERS GEN SG1
"<chair>"
  "chair" { ki+ti } %SUBJ N SG NOM DEF
"<was>"
  "be" { ki+AUX } MONOSLB %+FAUXV V PAST
"<sold>"
  "sell" { ki+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  ". "
"<Your>"
  "you" { ch+ako } %A> CAP PRON PERS GEN
"<chair>"
  "chair" { ki+ti } %OBJ N SG DEF
"<was>"
  "be" { AUX } MONOSLB %+FAUXV V PAST
"<sold>"
  "sell" { ki+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  ". "
"<His>"
  "he" { ch+ake } %A> CAP PRON PERS GEN SG3
"<chair>"
  "chair" { ki+ti } %OBJ N SG DEF
"<was>"
  "be" { AUX } MONOSLB %+FAUXV V PAST
"<sold>"
  "sell" { ki+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
  ". "
"<Our>"
  "we" { ch+etu } %A> CAP PRON PERS GEN PL1
"<chair>"
  "chair" { ki+ti } %OBJ N SG DEF
"<was>"
  "be" { AUX } MONOSLB %+FAUXV V PAST
"<sold>"
  "sell" { ki+li+uz+w+A } HUM-V SVO %-FMAINV V EN TAM-li PASS
"<.>"
  ". "
"<Their>"
  "they" { ch+ao } %A> CAP PRON PERS GEN PL3
"<chair>"
  "chair" { ki+ti } %OBJ N SG DEF
"<was>"
  "be" { AUX } MONOSLB %+FAUXV V PAST
```

```
"<sold>"  
  "sell" { ki+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS  
"<.>"  
  "."
```

The word order is changed and the final translation then produced. In these simple sentences, only the possessive pronoun and its head need to be switched (26).

(26)
Kiti changu kiliuzwa.
Kiti chako kiliuzwa.
Kiti chake kiliuzwa.
Kiti chetu kiliuzwa.
Kiti chao kiliuzwa.

Note that because English does not make difference between the second person possessive pronouns in singular and plural, it is not possible to translate such structures reliably without sufficient context.

Let us take some more complex examples (26).

(26)
My black chair was sold.
My black and white chairs were sold.
These my black and white chairs were sold.
These my three black chairs were sold.

The examples in (26) display various combinations of modifiers of the noun. First, we test, whether the concordance of these modifiers is correct (27).

```
(27)  
"<My>"  
  "i" { ch+angu } %A> CAPINIT PRON PERS GEN SG1  
"<black>"  
  "black" { ch+eusi } A-INFL %A> A ABS A-7  
"<chair>"  
  "chair" { ki+ti } %SUBJ N SG NOM  
"<was>"  
  "be" { AUX } MONOSLB %+FAUXV V PAST  
"<sold>"  
  "sell" { ki+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS  
"<.>"  
  "."  
"<My>"  
  "i" { vy+angu } %A> CAPINIT PRON PERS GEN SG1  
"<black>"  
  "black" { vy+eusi } A-INFL %A> A ABS A-8  
"<and>"  
  "and" { na } %CC CC
```

```
"<white>"
    "white" { vy+eupe } A-INFL %A> A ABS A-8
"<chairs>"
    "chair" { vi+ti } %SUBJ N PL NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<These>"
    "this" { h+ivi } %OBJ CAPINIT PRON DEM PL
"<my>"
    "i" { vy+angu } %A> PRON PERS GEN SG1
"<black>"
    "black" { vy+eusi } A-INFL %A> A ABS A-8
"<and>"
    "and" { na } %CC CC
"<white>"
    "white" { vy+eupe } A-INFL %A> A ABS A-8
"<chairs>"
    "chair" { vi+ti } %SUBJ N PL NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
"<These>"
    "this" { h+ivi } %OBJ CAPINIT PRON DEM PL
"<my>"
    "i" { vy+angu } %A> PRON PERS GEN SG1
"<three>"
    "three" { vi+tatu } INFL PL %QN> CARD NUM NUM CARD
"<black>"
    "black" { vy+eusi } A-INFL %A> A ABS A-8
"<chairs>"
    "chair" { vi+ti } %SUBJ N PL NOM
"<were>"
    "be" { AUX } MONOSLB %+FAUXV V PAST PL COND-CAND
"<sold>"
    "sell" { vi+li+uz+w+A } HUM-V SVO %-FMAINV V EN PASS
"<.>"
    "."
```

We see that the concordance in each sentence is correct. The reordering of words in these complex structures is not simple. Each type requires its own rule. Also, the rules must be in strict order, the longest first. The sentences before reordering are in (28).

(28)

```
( PRON "<My>" { changu } CAPINIT PERS GEN SG1 ) ( A "<black>" {
cheusi } A-INFL ABS A-7 ) ( N "<chair>" { kiti } SG NOM ) ( V
"<was>" { AUX } MONOSLB PAST ) ( V "<sold>" { kiliuzwa } HUM-V SVO
%-FMAINV EN PASS ) ( "<.>" "." )
( PRON "<My>" { vyangu } CAPINIT PERS GEN SG1 ) ( A "<black>" {
vyeusi } A-INFL ABS A-8 ) ( CC "<and>" { na } ) ( A "<white>" {
vyeupe } A-INFL ABS A-8 ) ( N "<chairs>" { viti } PL NOM ) ( V
"<were>" { AUX } MONOSLB PAST PL COND-CAND ) ( V "<sold>" {
viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
( DEM "<These>" { hivi } CAPINIT PRON PL ) ( PRON "<my>" { vyangu
} PERS GEN SG1 ) ( A "<black>" { vyeusi } A-INFL ABS A-8 ) ( CC
"<and>" { na } ) ( A "<white>" { vyeupe } A-INFL ABS A-8 ) ( N
"<chairs>" { viti } PL NOM ) ( V "<were>" { AUX } MONOSLB PAST PL
COND-CAND ) ( V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV EN PASS )
( "<.>" "." )
( DEM "<These>" { hivi } CAPINIT PRON PL ) ( PRON "<my>" { vyangu
} PERS GEN SG1 ) ( CARD "<three>" { vitatu } INFL PL %QN> CARD NUM
NUM ) ( A "<black>" { vyeusi } A-INFL ABS A-8 ) ( N "<chairs>" {
viti } PL NOM ) ( V "<were>" { AUX } MONOSLB PAST PL COND-CAND ) (
V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
```

After applying the reordering rules, the sentences are as in (29).

(29)

```
:( N "<chair>" { kiti } SG NOM ) :( PRON "<My>" { changu } CAPINIT
PERS GEN SG1 ) :( A "<black>" { cheusi } A-INFL ABS A-7 ) ( V
"<was>" { AUX } MONOSLB PAST ) ( V "<sold>" { kiliuzwa } HUM-V SVO
%-FMAINV EN PASS ) ( "<.>" "." )
:( N "<chairs>" { viti } PL NOM ) :( PRON "<My>" { vyangu }
CAPINIT PERS GEN SG1 ) :( A "<black>" { vyeusi } A-INFL ABS A-8 )
( CC "<and>" { na } ) ( A "<white>" { vyeupe } A-INFL ABS A-8 ) (
V "<were>" { AUX } MONOSLB PAST PL COND-CAND ) ( V "<sold>" {
viliuzwa } HUM-V SVO %-FMAINV EN PASS ) ( "<.>" "." )
:( N "<chairs>" { viti } PL NOM ) :( PRON "<my>" { vyangu } PERS
GEN SG1 ) :( DEM "<These>" { hivi } CAPINIT PRON PL ) :( A
"<black>" { vyeusi } A-INFL ABS A-8 ) ( CC "<and>" { na } ) ( A
"<white>" { vyeupe } A-INFL ABS A-8 ) ( V "<were>" { AUX } MONOSLB
PAST PL COND-CAND ) ( V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV
EN PASS ) ( "<.>" "." )
:( N "<chairs>" { viti } PL NOM ) :( PRON "<my>" { vyangu } PERS
GEN SG1 ) :( DEM "<These>" { hivi } CAPINIT PRON PL ) :( A
"<black>" { vyeusi } A-INFL ABS A-8 ) :( CARD "<three>" { vitatu }
INFL PL %QN> CARD NUM NUM ) ( V "<were>" { AUX } MONOSLB PAST PL
COND-CAND ) ( V "<sold>" { viliuzwa } HUM-V SVO %-FMAINV EN PASS )
( "<.>" "." )
```

The final translation is in (30).

(30)

Kiti changu cheusi kiliuzwa.

Viti vyangu vyeusi na vyeupe viliuzwa.

Viti vyangu hivi vyeusi na vyeupe viliuzwa.

Viti vyangu hivi vyeusi vitatu viliuzwa.

5 Conclusion

Although English has two methods and Swahili only one method of constructing possessive expressions, possessive constructions can be reliably translated from English to Swahili. This requires a carefully planned sequence of operations. So far, no overwhelming problems have been encountered.