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This is to certify that the thesis prepared by *Ermiyas* WeldeYohanes titled: *Design and Implementation of Online Këtaniña–Amharic–English Multimedia Dictionary* and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Computer Science complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

This study presents the design and implementation of an online Këwhile–Amharic–English Multimedia Dictionary (KAEMD). The dictionary can help its users get dictionary meaning for a word in one of Këwhile, Amharic, English language with equivalent meanings of the other two languages including illustration with Këwhile pronunciation and image/video and usage examples in the respective language and the morphological properties of the Këwhile word. In addition, the system has a page that can provide with visual dictionary services which can also address the need for hearing disabled person. There are also search service, suggest add new wordlist service, register and manage user and managing existing wordlist. The study also uses manually prepared morphological analysis for Këwhile language for wordlists which are found in the dictionay since it is dificult to add all possible word forms in the dictionary

The prototype is developed using a sample wordlist of 2000 Këwhile wordlist with illustrations with multimedia file and usage examples of the wordlists. We have tested it for its functionality and usability through questionnaire distributed to 30 different people who are native speakers and who are not speakers of the language.

Data obtained from the respondents revails that the overall system is relevant and more than 85% of the respondent provide positive aspects of the system as a comment which supports the useability and shows that the overall system is useable and important. The results have shown that the online dictionary system evaluation result has good reflection, to save searching time that make simpler than using paper based dictionary. It is easy to use and secure. It is also seen that from the evaluation, the system in general can address the problems of language revitalization through documenting the Këwhile language.

Keywords: Kistane, Këwhile, Multimedia Dictionary, Online Dictionary, Kistane Language, Kistane Dictionary.

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CHAPTER 1: INTRODUCTION

1.1 Overview

With the increase in production of information, documents and knowledge in different languages and increase in electronic and online sources of documents, need for natural language processing tool increases. In addition, the increase in development and usage of software in different languages, the need for natural language processing software becomes more essential than ever before.

Everyone in this modern world has been touched by technology and the propagation of the Internet. Hence, electronic multimedia information has become more popular, that the development of online application and resources provide a "one stop shop" that can offer resources for everyone.

Computational dictionaries which provide mappings between words and lexical information are of important in all branches of Natural Language Processing (NLP) being a base for automatic speech recognition.
Dictionary is an important tool in human life, especially in day to day communication and education. Electronic multimedia dictionaries provide more illustrative power than printed version. It can be a talking dictionary as well as visual in which the voice, picture, and video clips help to better understand difficult notions of a language [1].

Al-Rabi'i *et al*. [2] state that the use of computers in dictionary has started since the 20th century at the time when the research on computer aided translation or machine translation was carried out. According to [3], an online electronic dictionary or Internet dictionary is a dictionary provided on the World Wide Web.

1.2 Këtaniña Language

The Kistane tribe which has more than 300,000 populations is one of Guraghe Zone tribes approximately 100 km from Addis Ababa. They inhabit an area which has Tiya World Heritage Site (Stelae) that is well-known land mark.
The Guraghe Zone is found South-West of Addis Ababa, Ethiopia. It is surrounded by Oromo speakers in North, North-East and North-West; Yemsa speakers in the West, and Hadiyya speakers in the South and South West.

Kistane is bordered by Oromo speakers in North and East; Wolane speakers in the West; and Mesqan speakers in the South. The occupation of the local people is farming. They predominantly cultivate the staple food Enset/□ሰት.

In this study, the name of Këwhile is used to designate the language and Kistane to refer to the people who speak this language.

Like most indigenous languages of Ethiopia, Këwhile is the language of everyday communication of the Kistane people, but it is not used as the primary medium of instruction in schools and it is not taught as a subject in the schools in the Kistane tribe to fulfill the need to teach children in their first language and to keep language and culture originality. Këwhile is written using Amharic alphabet named fidel (ፊደል) that grew out of the Ge'ez (ግዕዝ) writing system.

1.3 Motivation

Over the years, various language tools and electronic dictionaries are developed for different languages including Amharic. To the best of our knowledge there is no work for the under resourced Këwhile language.

The Këwhile language has similar common characteristics with other Semitic languages such as Amharic for which a number of attempts are done and have solved some problems in the area. So, a need to have practical experience to develop online multimedia dictionary for Këwhile language and need to extend attempted and tested approaches used for other Semitic languages like Amharic for integration of their progress to Këwhile language is the motivation for the study.

1.4 Statement of the Problem

The role of online multimedia dictionary is unquestionable. The rapid increase in production of documents such as written, recorded, published, unpublished, electronic and online documents requires language processing tools to translate the information to different languages. In addition, increase in development of software in other languages and the need for using the language for technology transfer are some of the reasons for the need to have language processing tool development for the languages which does not get attention.

It is also known that Amharic and English are the working languages of the Federal government and English is medium of instruction at high schools and universities. To

address usability of the study by tourists who do not speak Amharic we will include English equivalent meaning.The existing problems that can lead us to the need for the development of this dictionary is

- There are no dictionaries available for Këwhile ta niña language both printed and electronic version.

1.5 Objective

General Objective

The general objective of this study is to design and implement online Këwhile ta niña-Amharic-English multimedia dictionary.

Specific Objectives

To undertake the general objective, the following specific objectives are drawn

- Assessing similar works on other languages.
- Studying the structure of Këwhile ta niña language.
- Collecting and organizing Këwhile ta niña word list and prepare multimedia file for the wordlist based on Amharic - English visual dictionary.
- Developing transliteration tool based on International Phonetic Alphabet (IPA).
- Developing a multimedia trilingual dictionary for Këwhile ta niña -Amharic-English prototype.
- Evaluating the prototype.

1.6 Scope and Limitations

The scope of this study is to

- Provide pronunciation based on IPA, parts of speech (POS) of the word, Amharic and English meaning with possible multimedia file.
- Provide searching facilities.

Due to time limitation and budget constraint only limited number of word list and their related information are used to develop the prototype and test the functionalities of the system.

1.7 Methodology

To develop the study we will employ the following methodology

Literature Review

Literature review on related works for other languages and linguistic researches on Këséetaniña will be reviewed thoroughly. We will also observe the methods, views, findings, and the tools used in previous researchers on the development of online dictionary for other languages.

Data Collection

Since there are no published works on Këséetaniña language to date, we will use the following data collection methods

- Discussion with the language speakers, Kistane Development Association Office staff and linguistic experts on Këséetaniña language for gramanatical classification.
- Preparation of wordlist from the horse mouse (the language speaker through interview), and prepare multimedia files for computer input based on the existing Stoddart Amharic- English visual dictionary [4] and the Këséetaniña wordlist that will be collected at the development of the work.
- Recording of picture, voice, and video to have illustrative multimedia data collection.

Evaluation

To test the functionalities of the system different participants will be selected and we will conduct usability test with the selected users using the given questionnaires.

1.8 Application of the Results

Due to the new technologies, nowadays the multimedia electronic dictionaries provide more opportunities and possess high illustrative power due to its multimedia content. In addition, the development of KAEMD dictionary will play a significant role in promoting and documenting the language, cultural knowledge of the Kistane Guraghe language and in encouraging forth coming works on the language.

The familiarity of today's young people with electronic devices will eventually play significant role to promote the advantages of electronic dictionary. Most researchers of offline and online electronic dictionary have provided evidence of an overall usefulness and advantages of the dictionaries in comparison with paper dictionaries.

Internet dictionaries, undoubtedly, have advantages. The results of this study will also be used

- To provide translation of words from Këséetaniña to Amharic and English equivalents online.
- As quick reference for travelers while they are on a trip, and help as a learning tool for Këséetaniña words for tourists who are visiting the Tiya steal stone heritage, which is found in the Kistane people woreda.
- It will also help users to understand difficult notions, words which are unique to Këséetaniña language and to pronounce the words accurately and encourage them to use the dictionary.
- To teach young children to speak, read, write, and understand their native language.
- To teach both children and adults basic vocabulary of languages that is not native to them.
- To get updated wordlist, web based materials can be updated and expanded in a way that materials available on other media cannot.

1.9 Organization of the rest of the Thesis

The study report is organized into Seven Chapters including the current one. The Second Chapter presents a review of literature related to the study. The Third Chapter reviews related works. The Fourth Chapter describes the System Requirements and Analysis. The Fifth Chapter describes System Design. The Sixth Chapter describes tools and system implementation. The Seventh Chapter presents the conclusion, and future works.

CHAPTER 2: LITERATURE REVIEW

2.1 The Kësëtaniña Language and the Kistane People

2.1.1 Overview of Kësëtaniña Language

Scholars who are engaged in Ethio-Semitic studies agree on three major sub-divisions within the Guraghe language group: Northern, Eastern and Western Guraghe. However, as to the members constituting each branch, there are different views among scholars. In [5], Leslau classifies the languages as follows: Silt'e Wolane and Zay belong to East Guraghe; Chaha, Geto, Ezha, Gumer, Endegegn Muher, Mesqan and Dobbi as belonging to Western Guraghe and Kistane belongs to North Guraghe. In [6,7], Hetzron classifies Kistane, Dobbi and Muher as members of Northern Guraghe based on typological ground.

In [8], the author describes consonant and vowel phonemes together with their allophones. The author recognizes seven vowels and twenty-three consonants as dipicted in Tables 2.1 [9] and 2.2 [5] respectively. The author states that the vowel ኣ/ə is used for breaking initial consonant clusters and three-term consonant clusters in any other position. The author also deals with supra segmental, such as consonantal length, pitch, stress and intonational patterns of the language. In general, the author gives a comprehensive phonological description of the language.

Table 2.1: The Vowel Phonemes of Kësëtaniña

	Front	Central	Back
High	i/ኢ	ዅ/ä	u/ኡ
Middle	ኤ/e/	ɛ /ኧ	o/ኦ
Low		a/ ኣ	

Table 2. 2:The Consonant Phonemes of Kësëtaniña

		Bilabial	***Labiodental***	***Alveolar***	***Palatal***	***Velar***	***Glottal***
Stop	*Vl*			*t*		*k* k^w	
	Vd	*b*		*d*		*g* g^w	
	Ejec			*t'*		*k'* k'^w	
Affricate	*Vl*				*č*		
	Vd				*ǧ*		
	Ejec				*č'*		
Fricative	*Vl*		*f*	*s*	*š*		*h*
	Vd			*z*	*ž*		
Nasal		*m*		*n*	*ň*		
Liquid				*l, r*			
Semi-vowels		*w*			*y*		

The script of the language is phonetic. Këssëtaniña words are written from left-to-right. Like Amharic language writing, a single fidel involves combination of one or more English characters as the fidels (ፊደል) are created by consonant vowel (CV) fusion. This is used for transcription purpose.

The Kësëtaniña fidels together with their forms and sounds are shown in Table 2.3 (adopted from [11]) the remaining part is annexed see Appendix C.

Table 2.3: Kësëtaniña fidels and their sound

ሀ	ሁ	ሂ	ሃ	ሄ	ህ	ሆ
Ha	hu	hi	ha	he	hë	ho
ለ	ሉ	ሊ	ላ	ሌ	ል	ሎ
l«	lu	li	la	le	lë	lo
መ	ሙ	ሚ	ማ	ሜ	ም	ሞ
m«	mu	mi	ma	me	më	mo
ረ	ሩ	ሪ	ራ	ሬ	ር	ሮ
r«	ru	ri	ra	re	rë	ro
ሰ	ሱ	ሲ	ሳ	ሴ	ስ	ሶ
s«	su	si	sa	se	së	so
ሸ	ሹ	ሺ	ሻ	ሼ	ሽ	ሾ
š«	šu	ši	ša	še	šë	šo
ቀ	ቁ	ቂ	ቃ	ቄ	ቅ	ቆ
k'«	k'u	k'i	k'a	k'e	k'ë	k'o
በ	ቡ	ቢ	ባ	ቤ	ብ	ቦ
b«	bu	bi	ba	be	bë	bo
ተ	ቱ	ቲ	ታ	ቴ	ት	ቶ
t«	tu	ti	ta	te	të	to
ቸ	ቹ	ቺ	ቻ	ቼ	ች	ቾ
č«	ču	či	ča	če	čë	čo
ነ	ኑ	ኒ	ና	ኔ	ን	ኖ
n«	nu	ni	na	ne	në	no
ኘ	ኙ	ኚ	ኛ	ኜ	ኝ	ኞ
ñ«	ñu	ñi	ña	ñe	ñë	ño
አ	ኡ	ኢ	ኣ	ኤ	እ	ኦ
a	u	i	a	e	ë	o
ከ	ኩ	ኪ	ካ	ኬ	ክ	ኮ

The sound of Këtaniña helps to include pronunciation information to the dictionary and there is an international standard of writing sounds in IPA (International Phonetic Alphabet). This standard helps users how to pronounce Këtaniña words and to understand simply the pronunciation information that is attached with the word. As can be seen from Table 3.3, there are some fidels with the same sound like ሠ and ሰ, which have the same sound which is sä and ሀ, ሐ, ኀ whose sound is hä. Therefore, they are being used interchangeably as a single consonant even though they have different labels.

Gemination in a language can be described as lengthening of the consonant to represent different meanings for a given word. In Këtaniña language, we use a special symbol to indicate gemination which is a dot at the top of each character which can be achieved through using AmdePhonetics like the character ግ in ችግሬ (**č**ëggre)/ቢላ ምላጭ/ razor blade. It helps solve problem for non-speakers of the language to clearly understand and pronounce those Këtaniña words. For example, the word "ችግሬ" can be read as "**č**ëggre" 'razor blade' in English "ቢላ ምላጭ" in Amharic. Gemination may occur in medial or final position of Këtaniña words and represented with the mark using AmdePhonetics font on the character.

Dictionary has a role in NLP(natural language processing) system to provide information about words. To be effective, dictionary need to contain lexical and other information, such as morphological information.

Computational morphology is one of the components of NLP analysis tasks which studies the componential properties of words. Morphological processing is an essential tool to analyze the internal structure of the words of a language. It takes input showing the root of the word with its grammatical feature, such as gender, number, person, tense, modality etc.

The morphology of Këtaniña words has been more or less studied by linguists [5, 9, 10]. In this study, we only try to see the morphology of the language and morphological processing which can be used as a base to process the morphology of the language using words which are found in the dictionary as an example by using mannually prepared morphological properties since there is no automatic morphology analyzer for the language.

Morphological information is crucial for the dictionary to help the learners identify and use the word in its word category, in its right context and to know specific morphological characteristic and information of the language. It is more essential for the person who is trying to speak or understand a foreign language than the native speaker. According to [10], the morphological information for Këwhile is as discussed below.

2.1.2 Noun morphology in Këtaniña

The nouns in Këtaniña are generally characterized by inflectional categories like number, gender, case, definiteness, person and other relevant morphological information. Këtaniña nouns can be simple or complex based on their morphological structures. Simple nouns are not result of only morphiological processes. The complex nouns are nouns that are results of derivation process and combination of two or more simple nouns (i.e. through noun formation, derivation and combination). Table 2.4 shows example of simple and complex nouns in këtaniña.

Table 2.4: simple and complex nouns in Këtaniña

Simple nouns	Complex nouns
ge- house	yičam- testy
abi- Father	dərisama- singer
wesä- dog	simat- urine
adare- friday	bayinət- childhood
gunan- head	wolgaja- stiring rod
atabuyə- aunt (father side)	

Këtaniña nouns have two genders, masculine and feminine, which affect verb concord. Nouns which are definite objects (direct or indirect) are both marked with the prefix yä- or nä-: e.g. yä-zämmih^{w}an abännət "he gave it to his brother" yä-ətitew abännat "he gave to his sister", näšäkkət/ "let me do". Këtaniña noun qualifiers, as in most Ethiopian languages, generally follow the noun. The definite article is expressed by the suffix -i, e.g.: goš "boy" goš-i "the boy"; ätit "sister", ätiti "the sister"; bayyočč "children", bayyočč-i "The children". If the noun ends in -a or -ä, it normally loses this vowel when -i is suffixed: angačča "cat", angačč-i "the cat". A noun ending in -i usually stays the same, abi "(the) father, proprietor". A noun ending in -e, -o, -u adds a y before the suffix i ge "house" ge^{y}i "the house"; wälläho "neighbor" , wälläho^{y}i "the neighbor". If the noun has a qualifier, the

article is used with the first element: maläk' ge "big house", maläk'-i Ge "the big house"; yä-šum-i ge "the house of the official"; yä-mät't'-i məss "the man who came".

Inflectional Morphology for Kësëtaniña nouns

Inflection is the addition of affixes to the base word, to obtain linguistic forms, which enter the grammatical relations and carry out functions. Inflectional morphology derives words from another word acquirer certain grammatical features but maintaining the same POS (part of speech). Kësëtaniña nouns are morphologically inflected for numbers, gender definiteness, and cases. In this section, the inflection of nouns for number, gender, definiteness and case will be discussed with Kësëtaniña words from the dictionary as an example.

i. Gender

For Kësëtaniña nouns where gender inflection occurs on a word based on natural gender for animate nouns, inanimate nouns lack gender that they are marked on the verb by 3MASC (Masculine). SG(singular) marker. For animate nouns the gender is indicated by personal pronoun affixes attached to the verb referring to the noun. Table 2.5 shows example of gender inflection in kësëtaniña.

Table 2.5: Gender Inflection in Kësëtaniña

əmari alaf-att-i : the donkey went	3Feminine.singular
amar-i alaf-au- : the donkey	3MASC.SG
Alemu ya amar-i tiger-anet	3MASC.SG
Zanu' ye amar-i tigaratt-ut	3Mass.SG
Zanu` ye-jar-i tig:ar-att-wa’t	3FEM.SG.

In the above example, the subject is not marked for gender. The gender is indicated by subject agreement marker suffixed to the verb -att indicates 3FEM.SG subject and object agreement suffixes –u (masc) and (FEM) -wa next to subject agreement marker indicates different genders.

Kinship in Kësëtaniña has nouns specific to gender which distinguish the gender by suppletion.

Example:

im:it Vs abi => (Mother Vs father)
atabuy:ə Vs ansabi => (aunt/ uncle father side)
indotyə Vs əmay's =>(aunt/uncle mother side)
goš Vs garad=>(boy/girl)
mišt Vs miss =>(wife/ husband /woman/ man)
əlam Vs bora =>(cow/ox)

In Kësëtaniña, a noun to refer animals has masculine gender when it is bare noun and it indicates feminine gender when it has the adjective ga˛it.

Example:

əmar Vs ga˛it əmar	mal/female donkey
bičl Vs ga˛it bičl	male/female muel

ii. Case

Case is a grammatical function, which characterizes the syntactic relationships of nouns in a sentence. Kësëtaniña nouns occurring as an accusative object in the genitive or in the vocative are morphologically marked for case. Nominative case is usually unmarked. Proper names and personal pronouns are obligatorily marked for accusative case.

Accusative case in Kësëtaniña is marked by ya- or nə-. When a noun is marked for accusative case in a sentence, it needs to be referred by object agreement suffixes on the verb. Table 2.6 shows example of accusative case in Kësëtaniña.

Table 2.6:Accusative case in Kësëtaniña

Accusative case in Kësëtaniña	Meaning
adi ya-wainitu až:a-hu-n:a-t (PV 1SG. 3FEM)	I saw wainitu
Abem k^{y}a sadəb-ə-nat (PV 3MASC SG)	Abem insulted her
Birnesh ya-Kasa wad- att-u-t (PV 3FEM.SG.)	Birhesh told Kassa
daš k^{w}a wad-ad-š-nn-t. (PV-2FEM.SG)	You loved him (you FEM)
Karsema ya- əmar-i t'igar-ə-m mat`t`a-w	Karsema sold the donkey and come

Obligatorily, common nouns require the definite article when they are morphological marked for accusative case. But proper names and personal pronouns are semantically definite. They don't require definite articles. Table 2.7 shows Këšëtaniña Proper Names and Personal Pronouns for accusative Case.

Table 2.7: Proper Names and Personal Pronouns for Accusative Case

Accusative case	Meaning
Molash Ya-wiss-i agadd-att-u-t: Acc-dog-DEF tie: pv-3FEM.SG	Molash tied the dog
Abem ge-i arašš-a-nn-t: pv- 3MASC.SG	Abem build the house
Dinato goš-i wak'k'-a-nnt: PV-3FEM.SG.	Dinato hit the boy

When accusative marker ya-is attached to a definite object, it has additional pragmatic information which gives emphasis to the object.

Example:
ya-bor-i agadd-att-u-t => she tied the ox.
ACC-OX-DEF- PV-3FEM.SG.
When both direct and indirect objects overtly occur, the direct object is not marked for accusative case as shown in the example below.

Example:

Dinato ya-zerfa bor-i t`ig`-ar-a-1-a-t

Dinato sold the ox to zerfe. PV.3MASC.SG.

In Këšëtaniña possession is expressed by the genitive morpheme ya- prefixed the noun expressing the possession.

Example: -

ya-Dinato əmare=> Dinato`s donkey

ya-ge čiban=> pillar of a house.

ya-k^{y}a zam:i=>her brother (

Note. When ya- come with personal pronouns, it has more emphasis.

ya-adi ged:i (my house)shows double possession.

To specify particular possession singluative suffix -ni is issued with nouns referring to people.

Example:

ya-Dinato-ni garad=> Dinato`s girl

ya- daš-ni bɨčtl=> your muel (SNG).

When preposition is added before a noun marked for genitive case, the genitive marker ya-will be omitted as follows:

b-abi-d:i farazlala (poss.1SG)=>on my father's horse back
stl-abi-d;i wazala=> about my fathor's job

In Kësëtaniña nouns referring to kinship have suppletive and vocative form which is usually identified by word final vowel -o and some with-ole. Table 2.8 shows kinship in Kësëtaniña and table 2.9 shows the general most frequent affixes in Kësëtaniña.

Table 2.8: kinship in Kësëtaniña

Base	Vocative	gloss
abi	ab:o	father
ɨ`ndotiya	indoto	aunt (mother side)
atabuy:a	adado	aunt (father side)
metty:a	ɨmole	grand mother

Table 2.9:The General most frequent affixes in Kësëtaniña

ya -	recipient
yə-...hom	similative
ba-	locative
ta-	comitative

iii. Number

In Kësëtaniña, nouns are morphologically inflated for numbers. It is unmarked in the singular and marked by the suffixes-očč and -ačč and by reduplication. Almost all nouns referring to animals form their plural by reduplication. Nouns referring to kinship status have plural suffix -ačč restricted to it, other nouns take the plural marker-očč.

Most Kësëtaniña nouns form their plural forms by adding after the plural morpheme -očč to their singular forms.

Example:

bay- bay:očč (baby/babies)

Sab- sabočč (person/ people)

nagda- negdočč /nagdawočč (gust/gusts)

ge- ge wočč (house/ houses).

When the morpheme -očč is attached to a noun ending with a vowel, it may cause either deletion of the vowel or insertion of the semivowel **w** which is common morpho-phonemic phenomenon in other guraghe languages [10].

Pluralization by reduplication is restricted to derivation of plural adjective in most Ethio-semitic languages. In Kësëtaniña reduplication is widely used in plural formation of nouns. It is the last consonant of the singular noun which is reduplicated. Consider the examples given below.

Example:

jara => jarara: (hen/hens)

bora=>borara: (ox/oxen)

gača=>gačača: (hyena/ hyenas)

bus:a=>bus:asa: (leopard/ leopards)

In reduplication process, the vowel **a** precedes the reduplicated consonants and -a follows i.e. -aCa. The nouns garad (girl) and goš (boy) have two plural forms exceptionally i.e. garad- gi̇rid /gi̇ridada (girls) and goš-agušt/ aguštata (boys).

In Kësëtaniña, na- ..... -si̇ru are association marker when it is attached to proper names to express association.

iv. Definiteness

In Kësëtaniña definiteness is marked by the suffix –i such as goš: goš-i (boy/ the boy), sabočč:- sabočč-i (people/ the people), əmar: əmar-i (donkey/ the donkey). In the case of noun that have adjective, the definite article –i is added after the qualifier as shown in the example below

Example:

malak' -i ge => the big house

Big DEF house

Noun formation

In Kësëtaniña, nouns can be formed by insertion of vowels and derivation to get a stem /lexeme from consonant roots we will use the following pattern. Table 2.10 shows some of the formation of nouns in Kësëtaniña.

Table 2.10: Noun formation

Pattern	Root	Nouns	Meaning
cca	b-š	beša	Wiping/mourning
ccac	z-n-m m-r-t	zinam mɨrat	Rain Blessing
cɨcc	t'-k'-m	t`ɨk`m	importance
cacc	d-r-s	dars	song
cacac	k`-r-t`	k`arat	Tax
cac	s-č	Sač`-	Drink
cacac	s-b-r	Sabar-	Break
C_1:C_2aC_2aC_3	s-b-r	s:ɨbabar	Break

Derivation of nouns by adding suffix to the base noun can be done in Kësëtaniña as follows. Abstract nouns in Kësëtaniña is derived by the affix -n:at

Table 2.11: Derivation of nouns in Kësëtaniña

From nominal bases	bay=> bay:ɨnat: child /childhood zam:i=>zam:in:at: brother/brotherhood k'anža=>k`anžin:at : virgin/virginity nagda- nagdɨn: at: guest/being a guest
From adjective bases	Malkama=> malkamanat: beautiful/beauty malak`=> malk`ɨnat: big/greatness t`ɨfo=> t`ɨfon:at: bad/being bad

Residual nouns, a nouns that describe residue of an action is derived by the suffice -oč:a in Kësëtaniña from stem bases.

tɨff-=>tɨf:oč:a (vomit)

Agent nouns in Kësëtaniña are derived by adding Suffix -at/ať:a/ to the base -ataň:a/-ať:a

Example:

Mɨt`at=>Mɨt`ať (ill person)

Wazala=> wazalataň:a (worker)

(No base) =>dengaň:a- (rich)

No base noun- azabaňa (attendants of weeding)

Membership nouns/nominal's are derived from noun to refer association/group by -atan:a

ɨ`k`ub=>ɨ`k`ubatan:a: member of the association economic

mabar=>mabarataň`:a : member of social association.

In Kësëtaniña, nouns also are formed by affixation of morphemes to a bound stem. Table 2.12 shows Kësëtaniña noun formation by affixation of morphemes

Table 2.12: Noun formation by affixation of morphemes

Suffix –e to Consonantal bound stem	Suffix-i to Bound stem	Suffix-at
dɨ`b:al=> d ɨ`b:aye: additional k`ɨb`ut`=>k`ɨbače: lack dɨ`ngat`- dɨ`ngače: frightening	Sabar=> sabari: breaker Gadal=>gadayi: killer	mɨk=> mɨkat- problem gɨr=>gɨ`rat- full up kuč=>kučat: fear

The prefix at- derives manner nouns from bound stem as shown below, where the t of at- assimilate the opening consonant of the stem.

Example:

-sbabar as:ɨbabar / manner of breaking

-gdadal agdadal/ manner of killing.

The prefix wo- in Kësëtaniña derives action nominal's from bound stem.

Example:

-gud => wogud: to pour

-mut=> womut: to die

-mt`a=> womt`a: to come

Kësëtaniña has independent personal pronouns which can be used for noun phrases. The pronouns can distinguish gender. Table 2.13 shows the different personal pronouns in Kësëtaniña.

Table 2.13 Kësëtaniña personal pronouns

	Singular	Meaning	Plural	Meaning
1	□ዲ/ ädi/	I (እኔ)	እኛ/ əññа/	we (እኛ)
2 MASC.SG	ደሽ/ dähä /	You (አንተ)	dahm	You (እናንተ ለወንድ)
2 FEM.SG	ደሽ/ däš/	You (አንቺ)	dahma	You (እናንተ ለሴት)
3MASC SG	ኳ/ kʷa /	He (እሱ)	ክነማ/ kənnäma/	they (እነሱ ለወንድ)
3FEM.SG	ኪያ/ *kiya/*	She (እሷ)	ክነም/ kənnäm/	they (እነሱ ለሴት)

Kësëtaniña has demonstrative pronouns which have no number and gender distinction.Table 2.14 shows some example of Kësëtaniña demonstrative pronouns.

Table 2.14: Kësëtaniña Demonstrative Pronouns

Kësëtaniña	English
zi	this/these
za /za goš(garad)/	that/those /that boy/girl/
za-ni (-ni is used to emphasize)	that (particular)

Kësëtaniña has indefinite pronouns which have no number and gender distinction. Table 2.15 shows Kësëtaniña indefinite pronouns.

Table 2.15: Some of Kësëtaniña Indefinite Pronoun

Kësëtaniña	Amharic	English
yähonä säb/የሆነ ሰብ	የሆነ ሰው	someone, somebody
mannəm säb/ማንም ሰብ	›ማንም ሰው	any one(no one"with negative verb)
አትሙ /att³mmu/	ማንም	Any("nobody, no one" with negative verb/ as pronoun/)
አትም/att³m/	ምንም	nothing, none
ሌላ ሰብ /lela säb	ሌላሰው	Other
yäk'irrä k'äy/የቂረ ቃይ	የቀረ ነገር	other (lit. "Remaining thing")

2.1.3 Adjective formation and derivation

Adjective are formed/derived in Kësëtaniña from roots/ nouns as follws. Table 2.16 shows adjective formation and derivation in Kësëtaniña.

Table 2.16: Adjective formation and derivation

Root	Adjective	Meaning
s-b-r	si`bur	broken
g-l-f	gal:ɨf	tall
g-l-f	gal:af-	be tall

Kësëtaniña adjectives inflect for number, case and definiteness but not for gender. It is also formed by reduplication.

Examples:

ya- malas -i at`ay tig:ar-a-nt : he sold the small sheep Acc Adj DEF sheep sold
(singular) t`ɨfo-=> t`ɨfowočč(plural): bad
(singular) malkama=> malkam:očč(plural): beautiful:
gɨd:ir=> gɨdɨd'ɨr : big
K`ɨs:ɨn=>k`ɨs`ɨs: ɨn: small
Malas=> malas malas- small
k`all=> k'all k`all- few

2.1.4 Verb morphology in Këšëtaniña

Këšëtaniña verbs are morphologically rich and complex. They are formed form consonant roots. According to [10], the verbs in Këšëtaniña are classified in to A,B and C categories. Type A are verbs which geminate (by a) the second medical in perfect form only. Type B verbs have germination of second radical in perfect and imperfect form by vowel i. Type C geminate second radical affer the first radical by the vowel a following first radical.

Këšëtaniña verbs has negative marker al-, t- and a(n) with non perfective verb. The verbs in Këšëtaniña are formed by vowel insertion, affixation, reduplication of consonant, affirmative verb markers, agreement market, tense, aspect, verb negation, and in personal (which is formed by stem with object pronoun suffixes) [5, 10]. Table 2.17 shows verb formation in Këšëtaniña by vowel insertion.

Table 2.17: Example of verb formation in Këšëtaniña by vowel insertion

Pattern	Root	Item	Meaning
$C_1aC_2:aC_3$-	s-b-r g-f-r	sabar gaf:ar	Broke Left
$C_1 C_2:a C_3$	t`-g-r z-b-r	t`ɨg:ar zibar	Sold returned
$C_1a C_2:a C_3$	g-b-z	gab:az	Invited
$C_1aC_2:a$-	b-š	baš:a-	Cried
$C_1i C_2:a$-	K`-n	k`in:a-	Made
- C,a $C_2 C_3$ $C_1iC_2:C_3$	s-b-r t`-g:r š-k`-t	-sabr -tig: ɨr -šik:tt	Break Sale make

In Këšëtaniña, verbs also are formed by affixation ɨn/tan-an-, a-/at- for causative verbs and ta- for passivization. Table 2.18 shows the formation of verbs by affixation.

Table 2.18: Example of verb formation in Këstaniña by affixation

pattern	root	Item	Meaning
C1aC2:aC3 C1aC2aC3 C1aC2aC3	lisa1a sač:a sabar -1bis -arat' tig:ar zib:ar t`lat`al	alsalas asača- atsib2r atitbs atir:at`- tat`ig:ar tazib:2r int'ilat`al ant'ilat`al	Make soft Make to drink Facilitate to break Facilitate to wear Facilitate to cut Was sold Be suspended Suspend

In Këstaniña, some verbs also are derived by reduplication which shows multiplication of action/ objects. Table 2.19 shows the formation of verbs by reduplication.

Table 2.19: Example of Verb Formation In Këstaniña by Reduplication

root	Item	Meaning
wak`:a	wikaka	Hit again and again
sač:a-	sičač:a	Drink again and again
sabar	sibabar	Break repeatedly
šikat	sikak:at	Do so many things
kafal	kifafal	Divide in to pieces
sabar	sibribr	Break in to pieces

Formation of verbs also can be done by inflection for subject and object marker to show person, number or gender. Table 2.20 shows the formation of verbs by inflection for subject and object.

Table 2.20: Verb Formation in Kësëtaniña by Inflection for Subject And Object

	Singular	**Plural**	
1	Sabark-i I broke	Sabar-na-u We broke	Subject marker
2MASC	Sabarkau You broke	Sabar-k-m-u You broke	
2FEM	Sabar-š-i-n He broke	Sabar-k-m-a-n You broke	
3MASC	Sabarau He broke	Sabar-m-u-n They broke	
3FEM	Sabar-atti She broke	Sabar-m-a-n They broke	
Past tense	Sabar-atti She broke	Sabar-k-im-a-n You broke	
	Plural	**Singular**	
	Sabarattm She has broken	Sabarattm She had broken	
Future and negation	Sabar-a-m He has break	al-sabar-a He didn't breake	
	Yi-sabr-u He will break		
Relative	ya-sabar-ku I who broke	ya-sab ar-ka You who broke	
Impersonal	t`igarmu-ňu They sold me		

2.1.5 Preposition in Kësëtaniña

Kësëtaniña preposition is a word that doesn't take any kind of suffix and prefix, that can't be used to create other words and which doesn't have meaning by itself but can represent different adverbial roles when used with nouns. The different propositions include በ ፡ ለ ፣ ተ፣ ስለ ፣ እንደ…etc.

Prepositions in Kësëtaniña precede noun or adjective. The following are Kësëtaniña prepositions ya-,ba-ta, st`la, tala- (በ ፡ ለ ፣ ተ፣ ስለ ፣ እንደ)…etc.. Table 2.21 shows examples of prepositions in Kësëtaniña.

Table 2.21: Examples Of Prepositions In Kësëtaniña

Kësëtaniña	**English**
ta-malak'-i/ ተማለቂ	with the big
tala-adi /ታለዲ	except me
ba-gabaya/በገበያ	from market
ba-malak`-i/በማለቂ	on the big
ya-amit-di/የእምትዲ	for my mother

2.2 Types of Dictionary

In [12], Seargeant defined a dictionary as a record of a language. Soannes and Stevenson quoted in [12] defined dictionary as a book that lists the words of a language in alphabetical order and gives their meaning. In addition, Atkins and Rundell in [13] defined a dictionary as a database and as a set of components such as definitions, etymologies, and pronunciations that can be dealt with discretely.

Dictionaries can be classified into many different types based on:

- Size (small, medium, large).
- Type of files used to make it (picture, audio, text, and video).
- The intended users namely child dictionaries and adult dictionaries.
- The subject matter it is compiled for, that is, dictionary of law, economics, linguistics, etc.
- The number of languages in which it is compiled (that is, monolingual, bilingual, multilingual), and
- Media on which it is produced (published, electronic, offline, online) and so on.

2.3 Dictionary Making in Ethiopian languages

Based on the review document in [14], there are many monolingual as well as bilingual paper dictionaries compiled and published by different foreigners and Ethiopian authors. There are also some online and offline dictionaries for some of the Ethiopian languages like Amharic, Afan-Oromo and Tigrigna [15, 16]. Some of the monolingual, bilingual and trilingual paper dictionaries that had been published for some Ethiopian languages are listed in the Table 2.22, which is adopted from [14]. In [14], the author

pointed that many Ethiopian dictionaries were compiled for different purposes. They were published for colonization, trade, evangelization and education. The author states that dictionary making is introduced in Ethiopia with the Geez-Latin dictionary, compiled by Maryanne Victorious and Aba Tesfatsion, published in 1638. This was the first dictionary compiled in Ethiopia. In the study, the author also states the existence of the trilingual Afaan Oromo-Amharic-English, Silte-Amharic-English and Amharic-English-Tigrigna languages dictionary. It states that the dictionaries can give some lexical information about the languages and the researcher investigates three dictionaries compiled on three Ethiopian Languages and other foreign languages. In addition, the research tries to point out some of the problems in the dictionaries published since 1995 in Ethiopia and provide lists of the dictionaries compiled in Ethiopian languages along with the dates of their publication, which are presented in Table 2.22, which is adopted from [14].

Table 2.22: List of dictionaries compiled in Ethiopia from 1638- 2006

	Name of the Dictionary	Author Complier (es)	Year Published	Type
1	Geez- Latin	Maryanne Victorious and Abatsion	1638	Bilingual
2	Amharic- Latin	Eyob Ludwolf	1698	Bilingual
3	English – Amharic	Chrles William Izenburg	1841	Bilingual
4	Oromo Dictionaries	Karl Tutvek	1844	monolingual
5	French- Amharic	Antuwan Dabadi	1881	Bilingual
6	Italy- Amharic	Ignatyo Gwidi	1901	Bilingual
7	Geez- Latin	Fredric Augest Dulman	1865	Bilingual
8	Italy Amharic	Armbruster,C.H.	1910	Bilingual
9	Italy – Amharic	A. Bevilakua	1917	Bilingual
10	English – Amharic	Chales Armbrus	1910	Bilingual
11	Amharic – English	Charles Armbrus	1920	Bilingual
12	English – Amharic	C.H. Walker	1928	Bilingual
13	Amharic – French	J. Pitman	1929	Bilingual
14	Amharic Itatiano	Igntyo Gwidy and others	1940	Bilingual
15	Russian –Amharic (Meskob)	Imanuel Ganky and kebede Desta	1965	Bilingual
16	Amharic – Russian	Imanuel - Gancy	1969	Bilingual
17	Japanese – Amharic	Tomoko Susiki	1970	Bilingual
18	Amharic – English-English – Amharic	Wolf Leslaw	1976	Bilingual
19	English – Amharic contextual	Wolf Leslaw	1973	Bilingual
20	Russian – Amharic student dictionary	Imanuel Ganky, E. Kedieten &	1983	Bilingual
21	English- Amharic-Amharic –English	Thomas Leper	1990	Bilingual
22	Konso- English	Shako Otto	1980	Bilingual
23	Oromo – English	Tilahun Gemta	1989	Bilingual
24	Gelmee Jechota Afaan Oromoo-	Abera Nefa	2004	Trilingual
25	Jambo English Amharic	Wesene Beshah Yadete	2006	Trilingual
26	English Amharic dictionary for	Daniel Worku	2003	Monolingual
27	Foy English Amharic pocket	Daniel Worku	2003	Bilingual
28	Polyglot English Amharic –Afaan	Ephrem Assefa	2000	Bilingual
29	Silte Amharic – English Dictionary	Hussen Mohaned Eeva.H Gutt	1995	Trilingual
30	Harmony English Afaan Oromo	Ephrem Assefa	2003	Trilingual
31	English – Amharic Oromifa	Alamin Saadaa	2002	Trilingual
32	Merit English Amharic	Ephrem Assefa	2002	Bilingual

2.4 Online Multi-Language Multimedia Dictionaries

A number of online dictionaries for several languages are becoming available over the WWW whether monolingual or multilingual. A number of companies working on linguistic area are also providing dictionary applications with vast number of words of some languages for sale.

Nowadays, some application software including online dictionary applications are being developed for local languages to be used on desktop computers and mobile devices. But they are small and only for some of Ethiopian languages such as Amharic, Afan-oromo and Tigrigna. However, there is no published and electronic dictionary application designed and developed for Këtaniña language.

Due to the emergence of WWW technology and its capability for development of multimedia application makes the web ideal medium for the global infrastructure of the Internet which can provide tool for modernity to develop online multilingual multimedia dictionary. The technology also provides a potential for including multimedia content such as picture, audio, video and text that will help us to have illustrative and more user friendly dictionary.

Languages are essential components for expressing identity, communicating ideas, attaining educational, economic and political autonomy, and promoting peace and sustainable human development. It is also important for sharing information and knowledge and for transmitting unique cultural wisdom across generations and nations. According to [17], a number of languages are at risk of disappearing. About 97 percent of the world's population speaks about 4 percent of the world's languages. The author also states that about 96 percent of the world's languages are spoken by only about 3 percent of people around the world. It shows that at least half of more than 6,000 languages worldwide are losing their speakers.

A Formosan Multimedia [18], which is a Dictionary Designed via a Participatory Process, states that developing multimedia dictionary is an important work for an endangered language, because if an endangered language disappears, associated cultural assets will disappear altogether. Its support to include audio and images with sound recordings of a mother-tongue speaker pronouncing a word can help dictionary end-users to listen to the correct pronunciation. The author also describes that

computational dictionaries, which implement mappings between words and lexical information, are of fundamental importance in all branches of NLP.

Multilingual information access is a functionality allowing any one to find information that is expressed in any language [19]. In [20], the author states that development of a flexible web based lexicon tool is important for endangered language documentation.

CHAPTER 3: RELATED WORK

This Chapter presents overview of previous works on online or offline dictionaries and multimedia dictionaries. It describes some online dictionaries, which may help us illustrate what achievements have been obtained in the area.

3.1 Overview of Some Existing Dictionaries for other Languages

Over the years, several works had been done regarding the publication, design and implementation of both monolingual and multilingual print, online and offline multimedia dictionaries for different natural languages including some Ethiopian languages.

Kordic [21], Korean-English multimedia dictionary is an online web based multilingual multimedia dictionary available on the web, which is developed at Indiana University. It has pictures; audio and text files which can help learn Korean language easily. The dictionary's wordlists are categorized into transportation, family, fruit, body parts, places, activities, etc.

Chinese-English multimedia dictionary [22], is a multimedia dictionary on the web that help users to listen, speak, read, and write Chinese and to get Chinese culture and history. Lexipedia [23], which is in English, Greek, French, German, Russian, and Bulgarian is a multilingual multimedia dictionary available on the web for children.

An Italian Language Dictionary [24], which is available on CD-ROM is a multimedia dictionary developed for children studying Italian either as a native or as a foreign language.

English—Serbo-Croatian Electronic Dictionary [25], is a bilingual and bidirectional on-line Serbo-Croatian (SC)-English dictionary. It has been available on the Internet since 1999.

The Papillion project [26], is another research work that establishes a French-English-Japanese multilingual lexical database dictionary system on the Web to extract digital bilingual dictionaries from it. The project built the multilingual or pivot dictionary by linking each sense or meaning of each entry of the monolingual dictionaries using monolingual dictionaries of each language. The authors also state that several monolingual as well as multilingual dictionaries can be extracted from the project.

3.2 Online Dictionary in Ethiopian Languages

There are many bilingual as well as multilingual dictionaries online on the web developed for several languages spoken all over the world. However, there are some Ethiopian language dictionaries that can be used for free such as dictionaries of Amharic-English, Tigrigna-English and Afaan Oromo-English languages. Some of the existing online dictionaries are discussed below.

Abyssinica Dictionary [16], is another online multilingual dictionary developed for Amharic Dictionary and reference with over 300,000 entries, which works on all platforms; Desktops, Mobile devices, Tablets, Cloud, Office 2013, Office 365, etc. It is available on Microsoft Office 2013 Word, PowerPoint, and Excel. It could be used as a knowledge source especially for students, professionals and translators. The dictionary provides comprehensive definitions in Amharic, English, Afaan Oromo, Tigrinya, Arabic and Hebrew languages, audio pronunciation, and related Amharic proverbs, wax and gold for a search and Wikipedia encyclopedic content search for Amharic and English languages.

There are also few dictionary websites that host dictionaries of Amharic-English, Tigrigna-English and Afaan Oromo-English languages [16, 27, 28, 29, 30], which can be an example for the development of web based dictionary for some Ethiopian languages.

Another online multilingual dictionary developed for Amharic, Afaan Oromo, English and Tigrigna languages for smart phones [30], which help for language learning is developed and tested on emulator of an Android based platform. Ahmed Argaw's dictionary [31], is the only web based multimedia dictionary developed for Ethiopian Languages. The author developed and implemented an online English-Amharic, Amharic-English multimedia dictionary for his MSc research work at Addis Ababa University that provides online dictionary services for translation, searching words and display meaning of words with multimedia content. The author used web development tools like Asp.net, IIS web server and MS SQL server 2005.

3.3 Summary

The above related works show the existing state of the art in the area and existence of a number of multimedia dictionaries and computational linguistic works in different languages including some Ethiopian languages. However, to the best of our knowledge none of them are for Këwhile tanïña language, which needs extending the existing technologies on dictionary to Këwhile tanïña language. Hence, a research is required to solve the existing problem through extending attempted and tested works of similar languages. Therefore, in this study we will design and implement an online Këwhile tanïña-Amharic-English multimedia dictionary.

CHAPTER 4: SYSTEM REQUIREMENTS AND ANALYSIS

In this Chapter the functional and non-functional requirements of the proposed system will be described and modeled using the Object Oriented UML models.

4.1 Overview of the Proposed System

The system will contain module like dictionary search service, available dictionary word list with alphabetical appendix that can let the user see the dictionary meaning on click, details of dictionary word list, visual dictionary service, and manage users, records, etc. The proposed online multimedia dictionary system should then search for Kësëtaniña word and display the lexical category, its pronunciation, the appropriate meaning of the word with Amharic and English languages including usage example if exists, and multimedia content (picture, audio or video).

4.2 System Requirements

To develop the proposed system, Online KAEMDS (Kësëtaniña -Amharic-English Multimedia Dictionary System), we need to specify the required functional and non-functional requirements.

4. 2.1 Functional Requirements

These requirements consist of all those which are necessary for the complete functioning of the system. The following requirements have been identified during elicitation.

- The system should allow to create user account.
- The system should let the user select input language to enter Kësëtaniña/Amharic or English input word to use searching facility.
- The system should display list of suggested words that might match the word the user is looking for while the user is typing.
- The system should search for the equivalent of a given word and should display its definition, pronunciation, POS and multimedia content using the equivalent meaning with the two languages, and usage example if available.
- The system should generate report for list of dictionary word lists in the database.
- The system should provide the functionality to send users suggestion to add new word entries.

- The system should provide the functionality to send users comment.
- The system should provide validation for users' input.
- The system should notify the users if the word is not available in the database.
- The system should allow the user to login to the system with a username and password to open administration page or encoder page to edit existing wordlist.
- The system should provide the functionality to edit, delete and activate user account in the database with administrator account.
- The system should provide the functionality to view visual dictionary.
- The system should give the functionality to view detail information, add, edit, and delete dictionary data.
- The system should provide the functionality to view, add, edit and delete the word category.
- The system should have the functionality to view, edit, verify and delete users' word list suggestion.
- The system should have the functionality to generate and print dictionary word list report.

4.2.2 Non Functional Requirements

Nonfunctional requirements describe user interface and other aspects of the system that are not directly related with the functional behavior of the system. These requirements include constraints on design and implementation like:

- User should expect simple and easily understandable navigational interface, which is more user friendly.
- The user should be provided with user help page.
- The system should respond in a minimal period of time to look-up a word.
- The system should include basic error handling and it should include some checking methods for business rule violation as well.
- The system should provide accurate and complete information for the user.
- All features should be accessed through links that appear on the screen.
- The system shall only allow registered users to access management parts of the system except for using search and visual dictionary pages.

4.3 System Models

In this section, the system's and subsystems' functionality is described using a use case diagram. The system's static behavior is described by class diagram, and its dynamic behavior through sequence diagram. In addition, the different activities involved in the system are depicted using the activity diagram. System analysis model is used to produce a model of the system that is correct, complete, unambiguous, consistent, realistic, and verifiable.

4.3.1 Use Case Model

A use case describes a function provided by the system, which can be defined as a way in which a user interacts with a given system in order to achieve its goal. Use cases provide a means to capture system requirements, communicate with the end users, professionals and test the system.

By taking the major functionalities undertaken in the system, we have identified the following major use cases.

- Login
- Send comment
- Logout
- Suggest new wordlist
- Search Dictionary word information
- Display visual dictionary
- View wordlist Appendix
- Create user
- Add new wordlist
- Manage user
- View comment
- Change password
- Manage Suggested wordlist
- Manage wordlist
- Generate and print dictionary wordlist

4.3.2 Actors

An actor describes any entity that interacts with the system. For the system, we identified the following actors: Administrator, Data Encoder, and Dictionary User are shown in Table 4.1.

Table 4.1: List of Actors with Description

Actors	**Description**
Administrator	Authorized person who is responsible for the proper functioning of the system and to administering the system users and managing every record in the database.
Data Encoder	Authorized user of the system to encode word list.
Dictionary User	A person who uses the dictionary search facility and post new wordlist suggestion to add new records.

4.3.3 Use Case Diagram

The use case diagram is used to define the core elements and processes that make up a system. The key elements are termed as "actors" and the processes are called "use cases". The use case diagram shows the actors who interact with which use case. It is also the representation of the functionality of the system that describes a function provided by the system and yields a visible result for an actor. Figure 4.1 shows the use case diagram of the system.

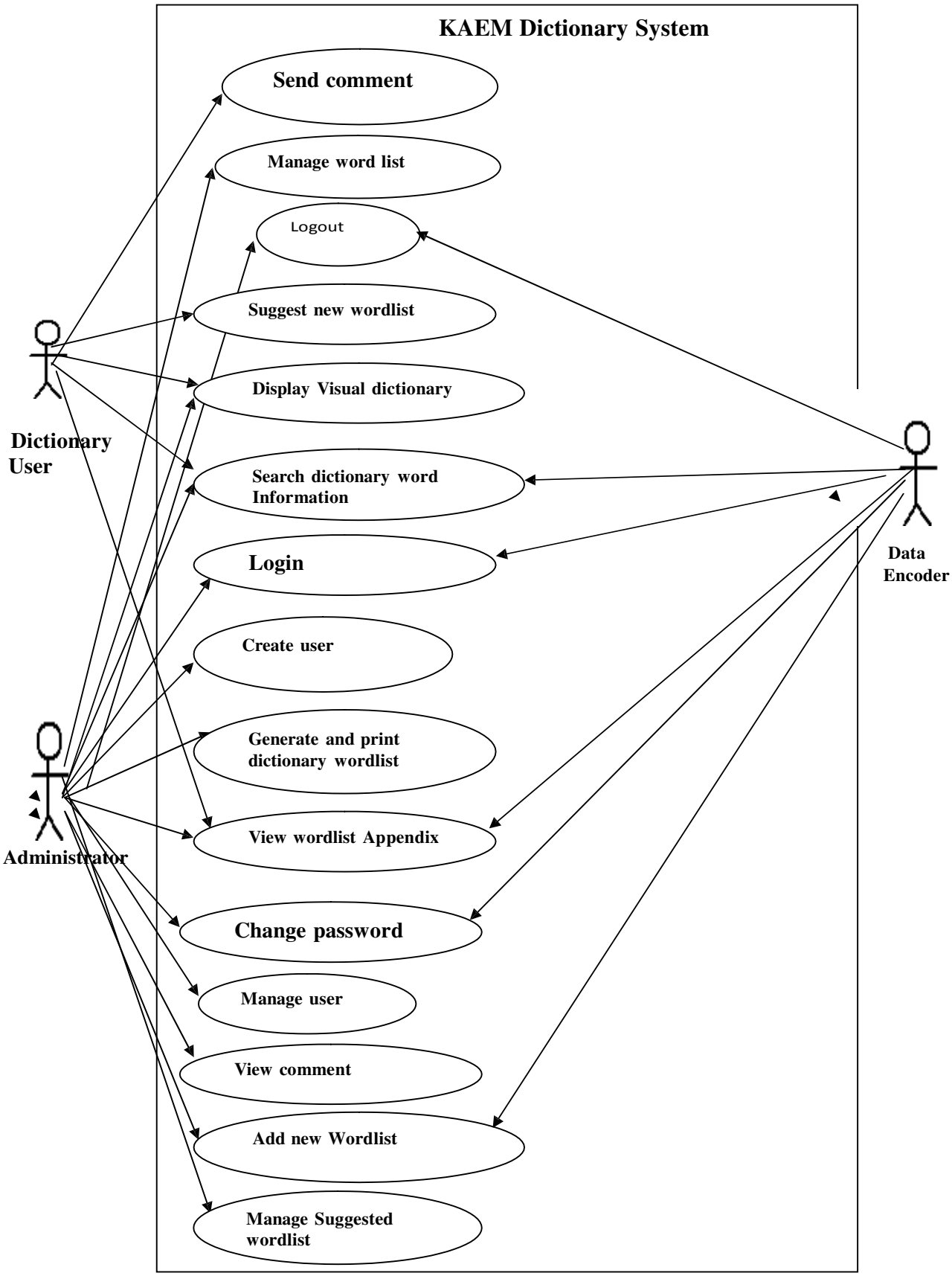


Figure 4.1: Use Case Diagram for the Dictionary System

Use Case Description

Use Case Name: Search dictionary word information

Purpose: The use case searches for a definition of a given word and displays the result, if found.

Actor: Dictionary User, Administrator, Data Encoder

Trigger: When the user wants to search dictionary word information.

Precondition: The Dictionary Search Page is displayed and the word is already found in the dictionary list.

Flow of Event:

1.The user selects input language she/he can use to enter the word he searches for.

2. The user enters the word and clicks on search button.

3. System displays the detail information about the word [A3].

Alternate Flow:

A3: If the word is not found, the system displays a message that the word doesn't exist and let the user maintain suggestion to include the wordlist.

Post Condition: search result information is displayed if the word is found in the dictionary otherwise the user may post suggestion if the word is not available.

Use Case Name: Manage word list

Purpose: This use case is used to view, add, modify or delete dictionary data.

Actor: Administrator

Trigger: When the administrator wants to manage dictionary data.

Precondition:

1. The user is successfully logged in.
2. The Dictionary Admin Page is displayed.

Flow of Event:

2.1 To add new wordlist

1. The user clicks on Manage word List link.

2. The system displays Manage word List page and the user clicks on Add New Word.

3. The user enters all the required information and presses the Save button.

4. The system validates the input data and displays confirmation message.

Post condition: New Dictionary wordlist information is saved.

2.2 To edit existing word list

1. The user clicks on Manage word List link.
2. The user selects a data from the list of dictionary words and clicks on "Edit" .
3. The system populates the specific word information in the Edit page.
4. The user performs the required modification and presses the Update button.
5. The system validates the data and displays update confirmation message.

Post condition: Dictionary data information is modified

2.3 To delete existing word list

1. The user clicks on Manage word List link.
2. The user selects a data from the list of dictionary words and clicks on "Delete"
3. The system displays Delete confirmation message.
4. If the user confirms deletion the data will be deleted and delete confirmation message is displayed.

Post condition: The record of dictionary word list information is deleted permanently

Includes: Login (Administrator)

Use Case Name: **Manage user**

Actors: Administrator

Purpose: This use case is used to add, edit, authorize (Activate/Deactivate) or delete user accounts.

Trigger: When the Administrator wants to manage user accounts.

Preconditions:

1. The user is successfully logged in
2. The Dictionary Admin Main Page is displayed

Flow of Event:

2.1 To create new user

1. The user clicks on create User Link item from Main Page.
2. The system displays Create new user page.
3. The user enters account information such as username, password, confirm password, status and presses the Save button.
4. The system validates the data and displays confirmation message.

2.2 To modify the record of existing User

1. The user selects an account from the list of available users.
2. The system populates detail user information.
3. The user performs the required modification and presses the Save button.
4. The system validates the data and displays confirmation message.

Post condition: The record of user account information is modified.

2.3 **To activate/deactivate the record of existing User**

1. The user selects an account from the list of available users.
2. The system populates detail user information.
3. The user Click on the Activate / Deactivate from the detail of the user information to change status.
4. The system displays confirmation message.
5. The user clicks on ok to see the change in status.

Post condition: The record of user account information is modified to Activated/Deactivated status.

2.4 To delete the record of existing User

1. The user selects an account from the list of available users.
2. The user presses the Delete button.
3. The system displays confirmation message.

Post conditions: The record of user account information is deleted permanently.

Includes: Login

Use Case Name: **Change password**

Actors: Administrator, Data Encoder.

Purpose: This use case is used to change user password.

Trigger: When the user wants to change password.

Preconditions:

1. The user is successfully logged in

Flow of Event:

1. The user clicks on change password link.
2. The system displays change password page.
3. The user enteres the old password and the new password and clicks on save.
4. The system validates the data and displays confirmation message.

Post condition: The user password is changed.

Use Case Name: Logout

Purpose: To Logout a user from the system.

Actor: Administrator, Data Encoder.

Precondition: The user must be registered on the system and login to the system.

Flow of event:

1. The user clicks on logout link.
2. The system exits and displays the home page.

Post condition: The authenticated person gets out of his management page.

Use Case Name: **Login**

Purpose: To login a user to the system/to authenticate the user.

Actor: Administrator, Data Encoder.

Precondition: The user must be registered on the system.

Flow of event:

3. The user types the URL of the system and clicks on login link.
4. The system displays the login form.
5. User fills user name and password.
6. The System Validates user name and password.
5. If the user is a valid user, the system displays the appropriate page for the respective user. [A5]
6. Use case ends.

Alternative course of action / flow (If the username and password is incorrect)

A5: The system displays incorrect user name and password message.

- The system redirects to go to action 3, i.e., to enter the username and password

Post condition: The authenticated person gets the appropriate page.

Use Case Name: **Manage suggested wordlist**

Actors: Administrator

Purpose: This use case is used to view, modify, verify or delete user request.

Preconditions:

1. The user is successfully logged in.
2. The Dictionary Admin Page is displayed.

Flow of Event:

1. The user clicks on “view user suggestion” page.

2. The system displays user suggestion information.

3. The administrator evaluates the user request and presses verify, edit or delete button.

To modify the suggestion list when the administrator presses Edit **button**

1. The system populates the suggestion detail to data page for approval.

2. Administrator performs the required modification/additional information and presses the save button.

3. The system validates the data and displays confirmation message.

Post conditions: The user suggested word list information is added to the dictionary list.

To delete the user suggestion when the administrator presses delete option

1. The system displays confirmation message

2. The user clicks on ok to confirm deletion.

Post conditions: The user suggestion is deleted permanently

Includes: Login (Administrator)

Use Case Name: Send Comment

Purpose: User can send comment.

Actors: User

Flow of event:

1. The user initiates to give comment.
2. The user clicks on the comment link.
3. The user fills all the required information. [A3]
4. The system displays the comment page.
5. The system validates the entered information.
6. The system displays confirmation which indicates that comments have been sent.

Alternative course of action: (if the user fills wrong/incorrect information)

[A3]:1.The system displays error message and gives a chance to retype. Go to event3.

Post condition: The user sends comment to the system.

Use Case Name: Display Visual Dictionary.

Purpose: To Display Visual Dictionary.

Actor: Administrator, Data Encoder, Dictionary user.

Precondition: There is image information for the dictionary list in the database Work Flow.

Flow of event:

1. User opens the system.
2. The system displays the home Page.
3. User clicks on Visual Dictionary link.
4. The system displays visual dictionary page.
5. The user clicks on the different category view or searches with word entry to see the detail.

Post Condition: visual dictionary displayed

Use Case Name: View comment

Purpose: To View users comment

Actor: Administrator

Precondition: The Administrator is successfully logged in and the comment is already found in the dictionary database.

Flow of event:

1. User opens the system.
2. The system displays the home Page.
3. User clicks on login page link.
4. The system displays login page.
5. The user fills the account information and clicks on login.
6. The user click on view comment.

Post Condition: Comment information displayed.

Use Case Name: View wordlist Appendix
Purpose: To View Appendix for wordlist

Actor: Administrator, Data Encoder, Dictionary user

Precondition: The Dictionary Appendix Page is displayed and the wordlist is already found in the dictionary database.

Flow of event:

1. User opens the system.
2. The system displays the home Page.
3. user clicks on appendix page link.

4. The system displays Appendix dictionary page.
5. The user clicks on the word whose information is to be displayed.

Post Condition: word information detail displayed.

Use Case Name: Generate and print dictionary wordlist

Purpose: To generate a Dictionary wordlists.

Actor: Administrator, Data Encoder

Precondition: The user must be a registered user and there is Dictionary wordlist information in the database.

Flow of event:

1. User opens the system.
2. User login by entering password and user name.
3. The system displays the admin Page.
4. User clicks on Generate Dictionary wordlist report.
5. The system searches for all information and display list.
6. The user clicks on print button to print the report.
7. The system displays print preview.
8. The user clicks on ok.

Post Condition: List is generated and printed.

Include: Login

Use Case Name: Suggest new wordlist

Purpose: To suggest new wordlist that must be verified or deleted by the administrator

Actor: Dictionary User.

Trigger: When the user wants to suggest dictionary wordlist.

Precondition: The Dictionary Suggest new wordlis Page is displayed.

Flow of Event:

1. The user enters the wordlist information he wants to suggest.
2. The user clicks on Suggest button.
3. The system validates the data and displays confirmation message.

Post Condition: Suggested wordlist information is inserted to the database.

Use Case Name: **Create user**

Actors: Administrator

Purpose: This use case is used to add, edit, authorize (Activate/Deactivate) or delete user accounts.

Trigger: When the Administrator wants to manage user accounts.

Preconditions:

1. The user is successfully logged in
2. The Dictionary Admin Main Page is displayed

Flow of Event: To create new user

1. The user clicks on create User Link item from Main Page.
2. The system displays Create new user page.
3. The user enters account information such as username, password, confirm password, status and presses the Save button.
4. The system validates the data and displays confirmation message.

Post Condition: user Account is created.

Use Case Name: Add new wordlist

Purpose: This use case is used to add new dictionary wordlist.

Actor: Data Encoder

Trigger: When the Data Encoder wants to add new dictionary list.

Precondition:

1. The user is successfully logged in.
2. The Dictionary Data encoding Page is displayed.

Flow of Event:

2.1 To add new wordlist

1. The user clicks on Add New word List link.
2. The system displays Add New word List page.
3. The user enters all the required information and presses the Save button.
4. The system validates the input data and displays confirmation message.

Post condition: New Dictionary wordlist information is saved.

4.3.4 Class Diagram

A class diagram provides an overview of the target system by describing the objects and classes inside the system and the relationships between them. It provides a wide variety of usages, from modeling the domain-specific data structure to detailed design of the target system. Figure 4.2-4.10 describes the structure of the classes of the dictionary system (class diagram).

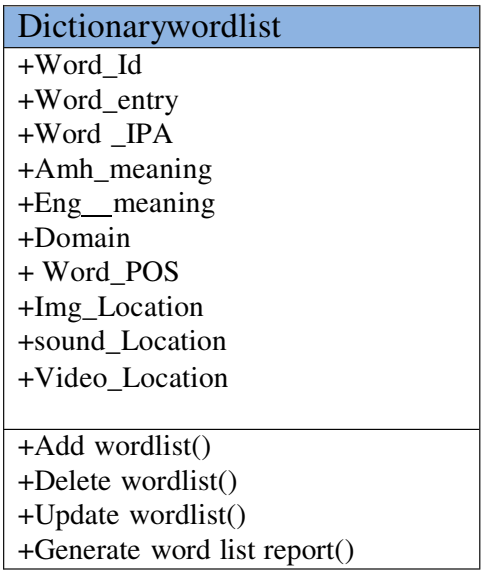


Figure 4.2: Dictionary wordlist class

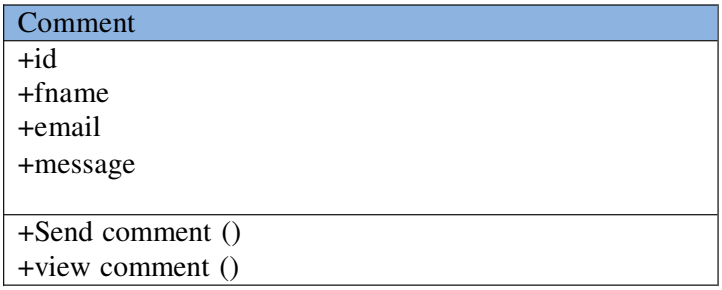


Figure 4.3: Comment class

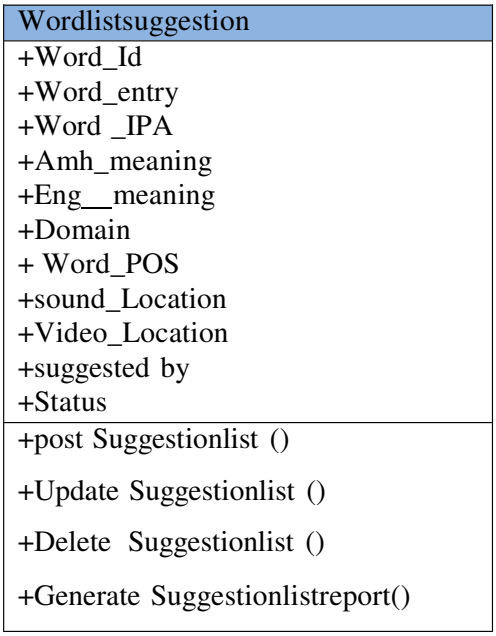


Figure 4.4: Suggest wordlist Class

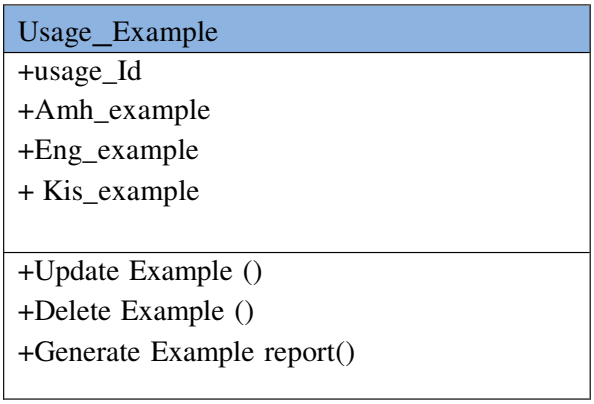


Figure 4.5: Usage Example Class

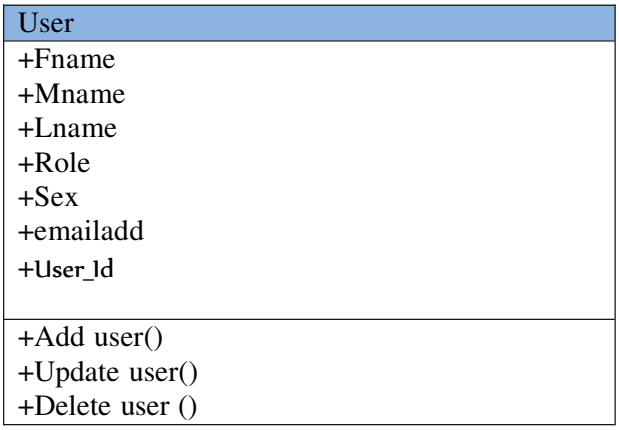


Figure 4.6: Class Diagram for User Class

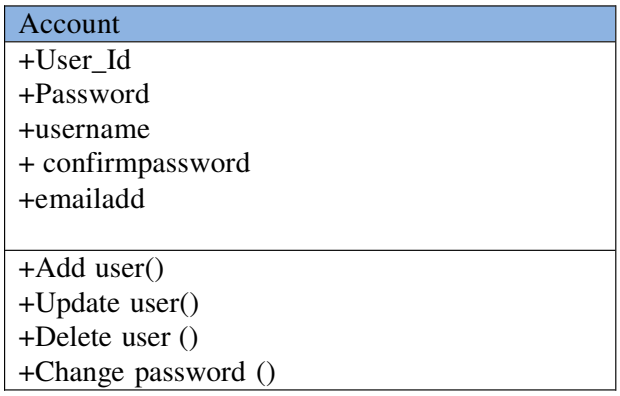


Figure 4.7: Account Class

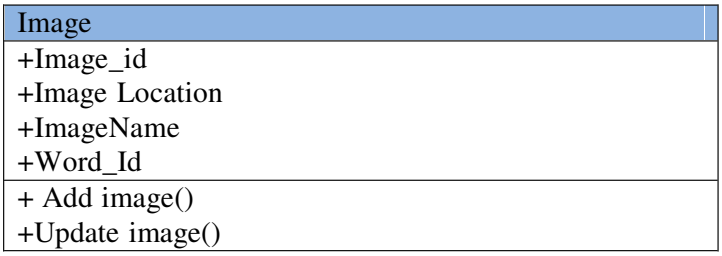
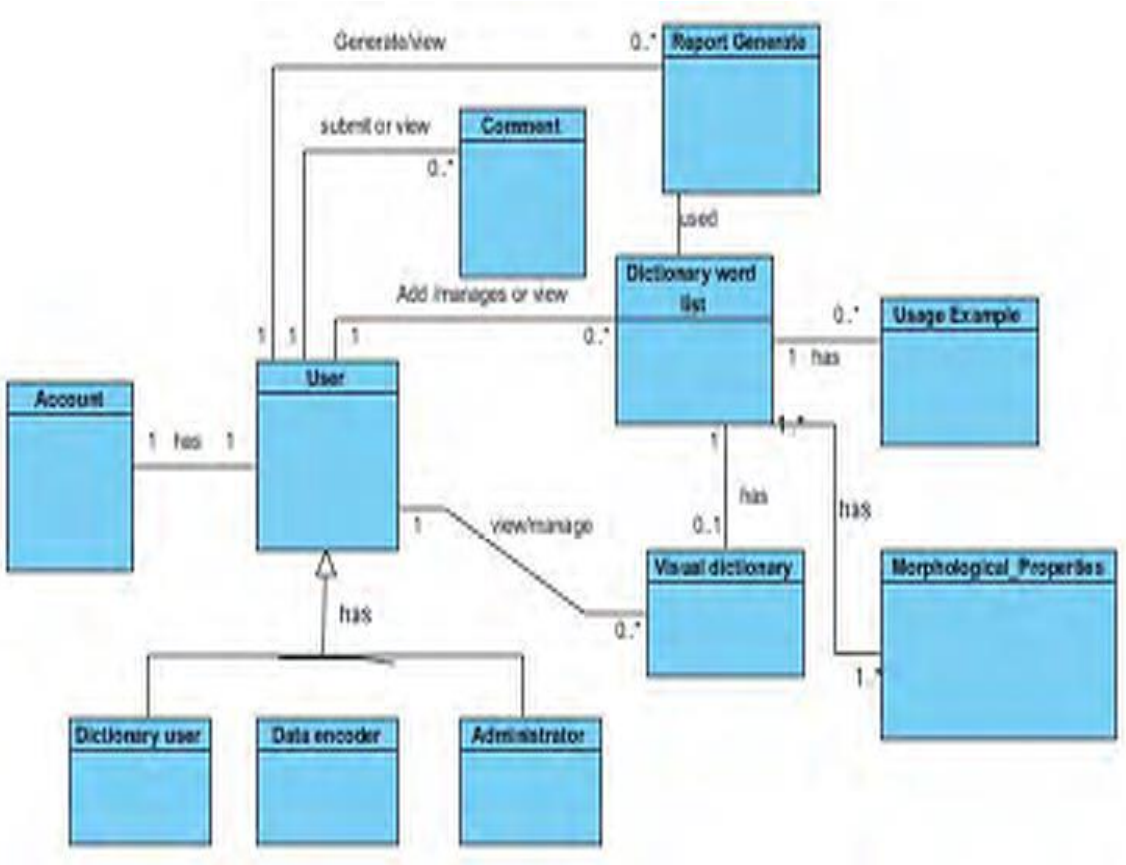
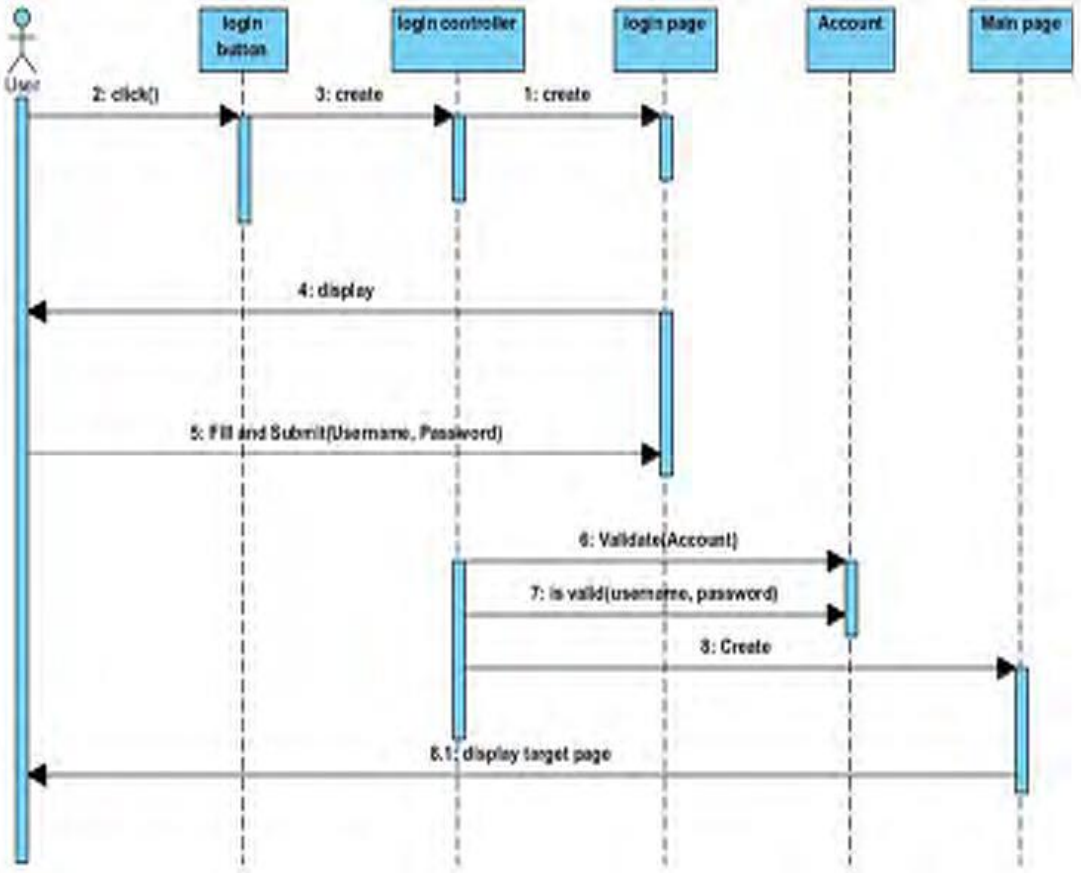
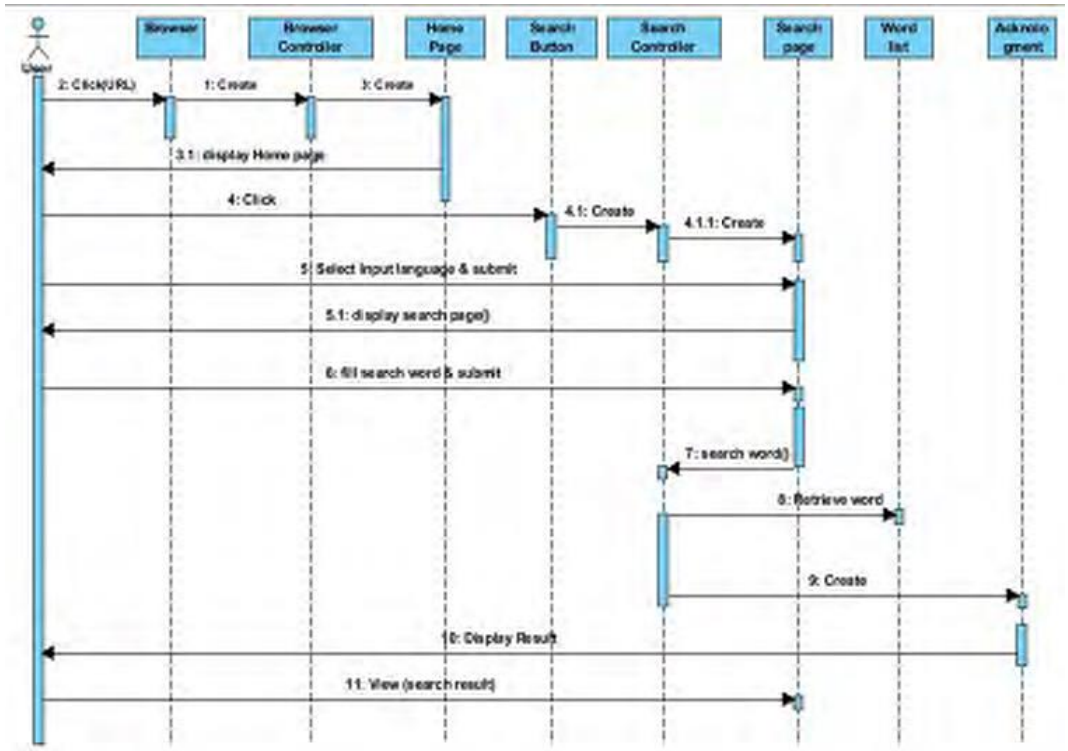


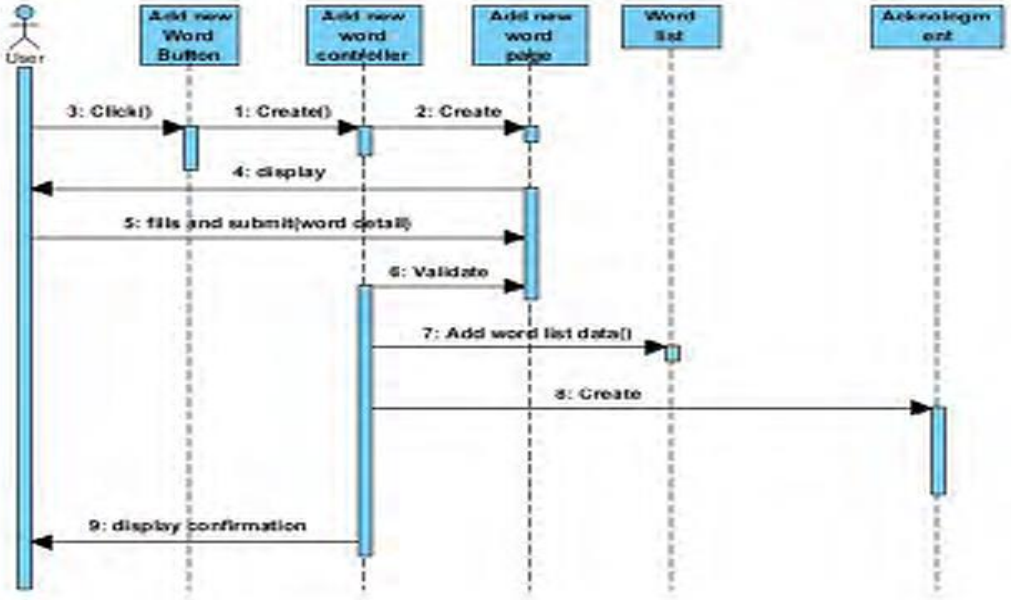
Figure 4.8: image class

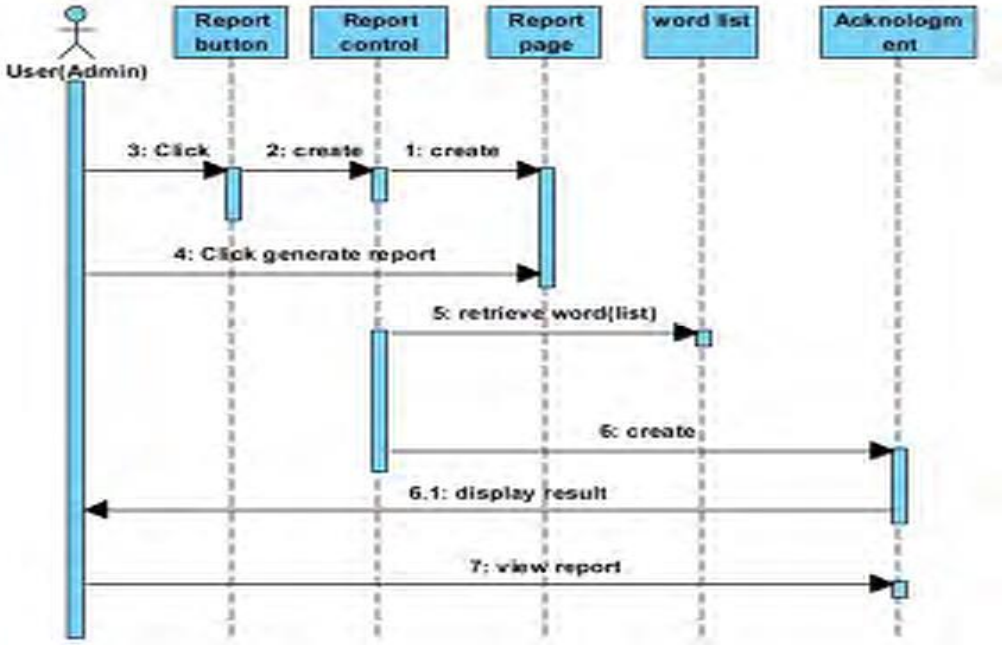
Morphological_Properties
+ Morpheme +SubjectMarker + ObjectMarker +Word_Id +Possesstion +Preposition +Negation +Plural +Singular +Accusation +Definitenes +Gender +Example
+ Add properties() +Update properties()

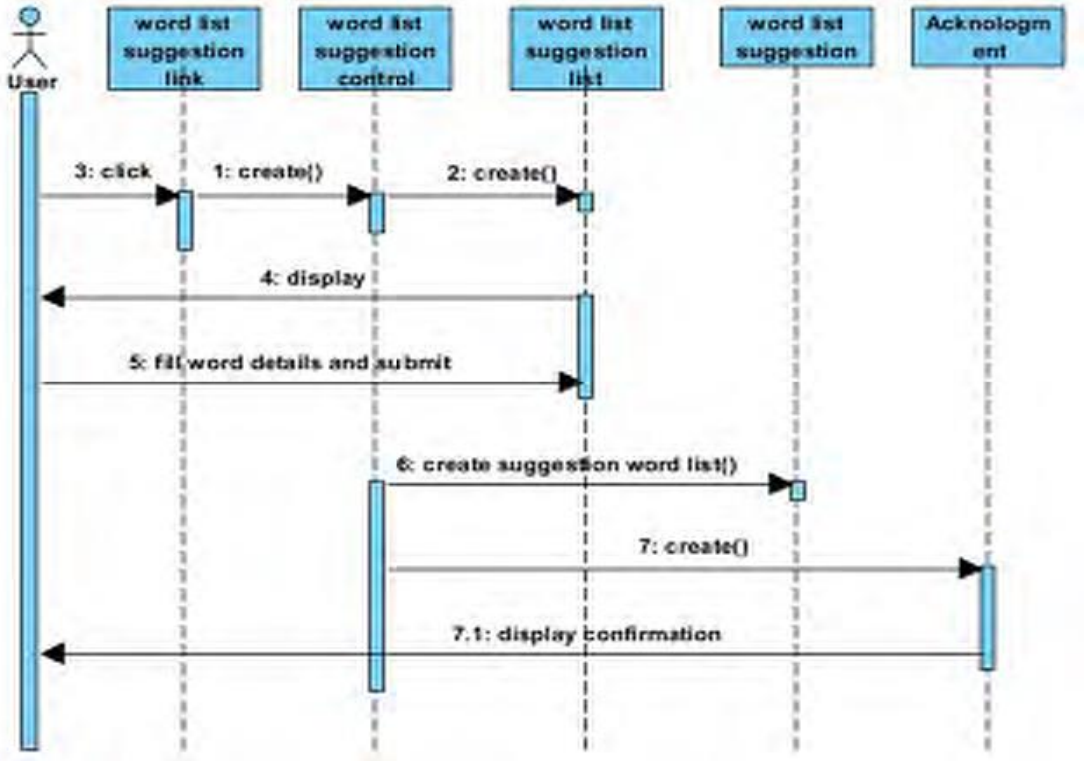


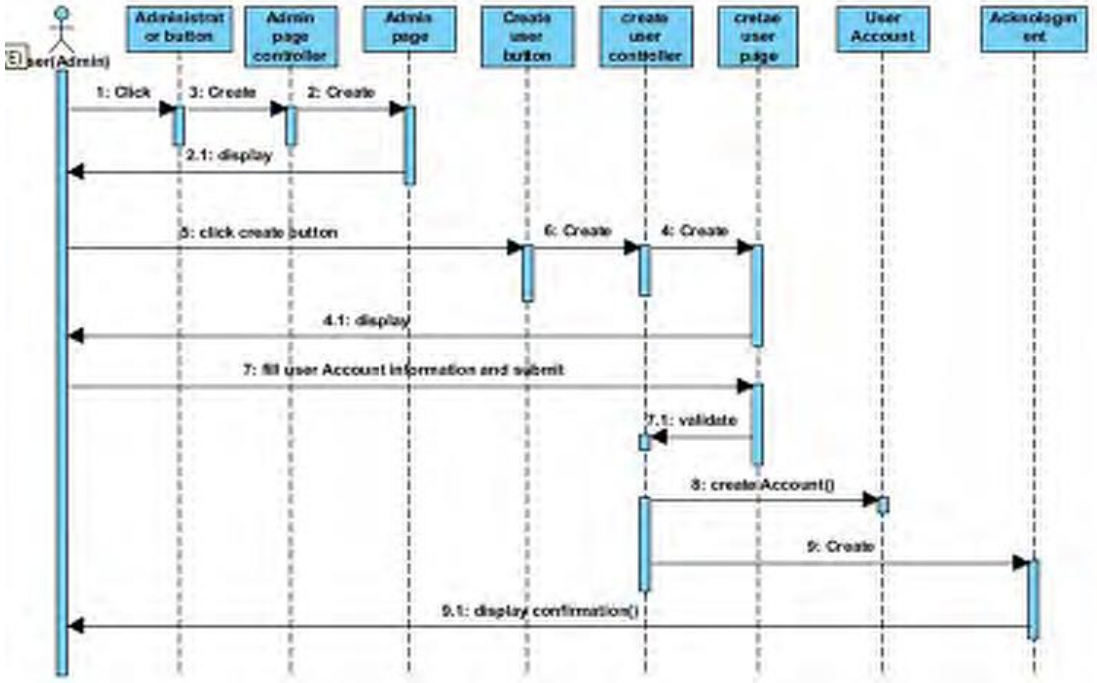

User
login button
login controller
login page
Account
Main page
2: click()
3: create
1: create
4: display
5: Fill and Submit(Username, Password)
6: Validate(Account)
7: is valid(username, password)
8: Create
8.1: display target page


User
Browser
Browser Controller
Home Page
Search Button
Search Controller
Search page
Word list
Acknowledgment
2: Click(URL)
1: Create
3: Create
3.1: display Home page
4: Click
4.1: Create
4.1.1: Create
5: Select input language & submit
5.1: display search page)
6: fill search word & submit
7: search word)
8: Retrieve word
9: Create
10: Display Result
11: View (search result)


User
Add new Word Button
Add new word controller
Add new word page
Word list
Acknowledgment
3: Click()
1: Create()
2: Create
4: display
5: fills and submit(word detail)
6: Validate
7: Add word list data()
8: Create
9: display confirmation


User(Admin)
Report button
Report control
Report page
word list
Acknologm ent
3: Click
2: create
1: create
4: Click generate report
5: retrieve word(list)
6: create
6.1: display result
7: view report


User
word list suggestion link
word list suggestion control
word list suggestion list
word list suggestion
Acknologm ent
3: click
1: create()
2: create()
4: display
5: fill word details and submit
6: create suggestion word list()
7: create()
7.1: display confirmation


User(Admin)
Administrat or button
Admin page controller
Admin page
Create user button
create user controller
cretae user page
User Account
Actinologen ent
1: Click
3: Create
2: Create
2.1: display
5: click create button
6: Create
4: Create
4.1: display
7: fill user Account information and submit
7.1: validate
8: create Account()
9: Create
9.1: display confirmation()

CHAPTER 5: SYSTEM DESIGN

5.1 Introduction

The purpose of this software design section is to describe the architecture and system design activities of online dictionary system in detail. It is a system development blueprint that describes the system in detail technical description about how we will implement the requirements, which provides a high-level overview of the system and includes additional information that may be appropriate.

The software design addresses architectural overview of the system, system functionality, user interfaces, design constraint, and detail design. It is intended to capture and convey the significant architectural decisions which have been made on the online dictionary system.

It consists of list of design goals, describing the qualities of the system that developers should optimize and software architecture, describing the subsystem decomposition in terms of subsystem responsibilities, dependencies among subsystems, subsystem mapping to hardware, and major policy decisions such as access control and data storage and the object design part that specifies service specification like type, visibility, and constraints of the attributes and operations for each object found in the system to restructure the requirement elicitation and the system design.

The system design establishes a foundation for the system functional components, code development, system testing and deployment. The description of these functions will assist the implementation strategy to ensure that the system meets the defined requirements. The system design is also one part of the process of software development life cycle and is used in implementation, project monitoring, verification, validation and in training.

5.2 Design Goals

Design goals describe the qualities of the system that the developers should consider and also guide the decisions to be made by the developers especially when trade-offs are needed. These goals are inferred from the non functional requirements section of Chapter Four, requirement analysis section, that are the things that should be considered during the development of the software design such as, minimizing the time needed for processing and report generating, protecting unauthorized access to the

system, friendly user interfaces for searching, entering data and using visual dictionary easily by end user. The design goals are grouped into the following categories.

- Performance
- Dependability
- Error handling
- Maintenance
- User Interface
- Documentation

Performance: The system should respond as fast as possible with high throughput so that it responds within a minimal time while performing the operations on the system. The information processed contains multimedia data. Thus it will need more performance of the system which can be achieved through upgrading hardware components. In addition to that the system will require enough memory size to run and store its data; therefore, it will be more interactive.

Dependability: The system will be dependable, highly reliable, available, have fault tolerance, security and robust features. It should be available 24hrs on a web server when the user wants to use the system. It also controls and handles any user's activity and protects itself from any failure as user enters invalid data, and it should tolerate any fault done by the user. It should also provide some sort of support for the user at the time of data entry and other activities. The system also protects itself and the data stored from being accessed by unauthorized person and loss of data. From security point of view, the system gives a serious attention for protecting itself and data stored to be secured and safe. The system shall be well protected and secured through encrypted password and controlled by a session variables so that a secured page will expire if not used for a longer period of time so that it will prevent unauthorized access to a secured page.

Error handling: The system handles invalid inputs and exceptions by validating user input and catching the exception, displays a message for the user to enter a correct data.

Maintenance: As the system is designed on object oriented approach it will be easy for future maintenance and enhancement if any malfunction of subsystems occurs, it should be easily extensible to add new functionality and flexible when there is a need to modify the system, and it should be readable and adaptable by incorporating significant and clear comments describing each part of the code.

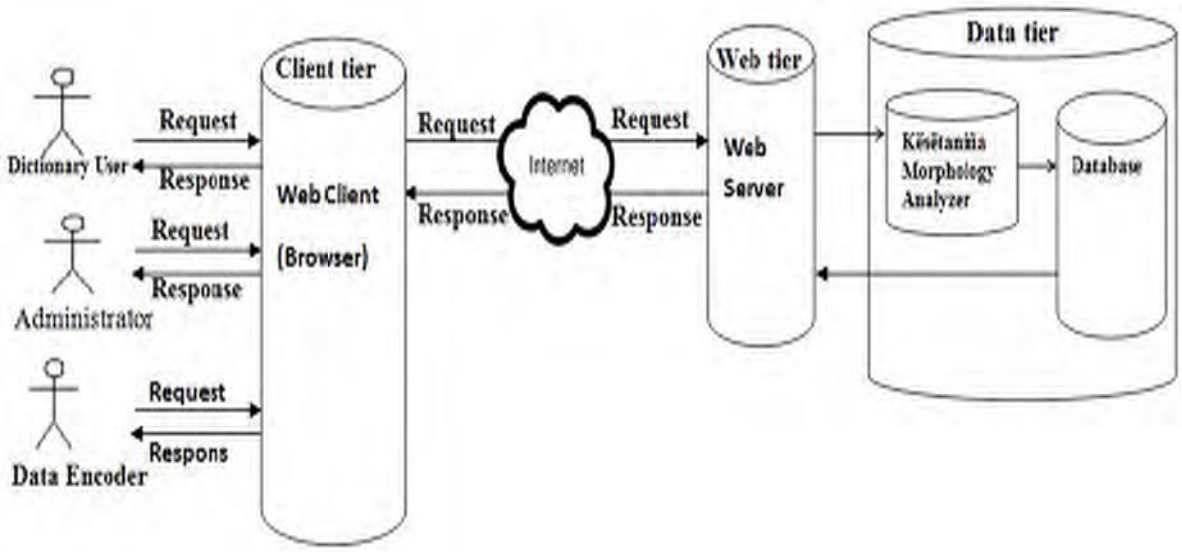
User Interface: The user interface of the system should be designed simply to make it more useable and user friendly, thus the users can easily adapt to the system.

Documentation: User manual or help page should be designed to help the user to easily understand the system.

5.3 Proposed System Architecture and its Services

The dictionary system is an online system that gives dictionary searching facilities and maintains requests from dictionary users. The services are accessible from different locations through the Internet with web client. The system Architecture of the online KAEMD system is composed of searching for dictionary meaning and extracting morphological properties of input words with related wordlists. A user's input is accepted and checked for existance in the dictionary database. Subsequently, the morphological properties of the word are extracted so that the different lexical forms of the word can be extracted and displayed.

The Kësëtaniña language creates inflectional and derivational word forms through prefixing, suffixing, infixing, reduplication, and with tense, case, gender, number, person and other relevant information shown in Appendix B. Morphological properties is crucial for morphologically complex languages since it is difficult to store all possible wordlist in the dictionary. The problem of recognizing different wordlist forms in a dictionary is difficult that is why we need morphological processing. Therefore, it is required to handle different word forms in the dictionary using the morphological analysis. In our study we used manually prepared morphological analysis since there is no morphological analyzer developed for Kësëtaniña. Figure 5.1 depicts system architecture and services of the online web based dictionary system.


Client tier
Web tier
Data tier
Dictionary User
Request
Response
Web Client
(Browser)
Request
Response
Internet
Request
Response
Web
Server
Kèsètanìla
Morphology
Analyzer
Database
Administrator
Request
Response
Data Encoder
Request
Respons

5.3.1 Subsystem Decomposition

Subsystems are part of the overall system that kperforms specialized tasks of the system. These subsystems are in the framework of the general system to contribute in the achievement of the system goal of the total system. We define the subsystems in terms of the services they provide.

The whole system is decomposed into manageable subsystems to reduce system complexity and to enable the system to be capable of separating modification of the subsystem. This allows us to minimize the impact of change when we need to modify the implementation of a subsystem.

From the functional requirement, we identified in the requirement analysis in Chapter Four, keeping functionally related objects with their cohesiveness and coupling properties into one subsystem, we have the following major subsystems:

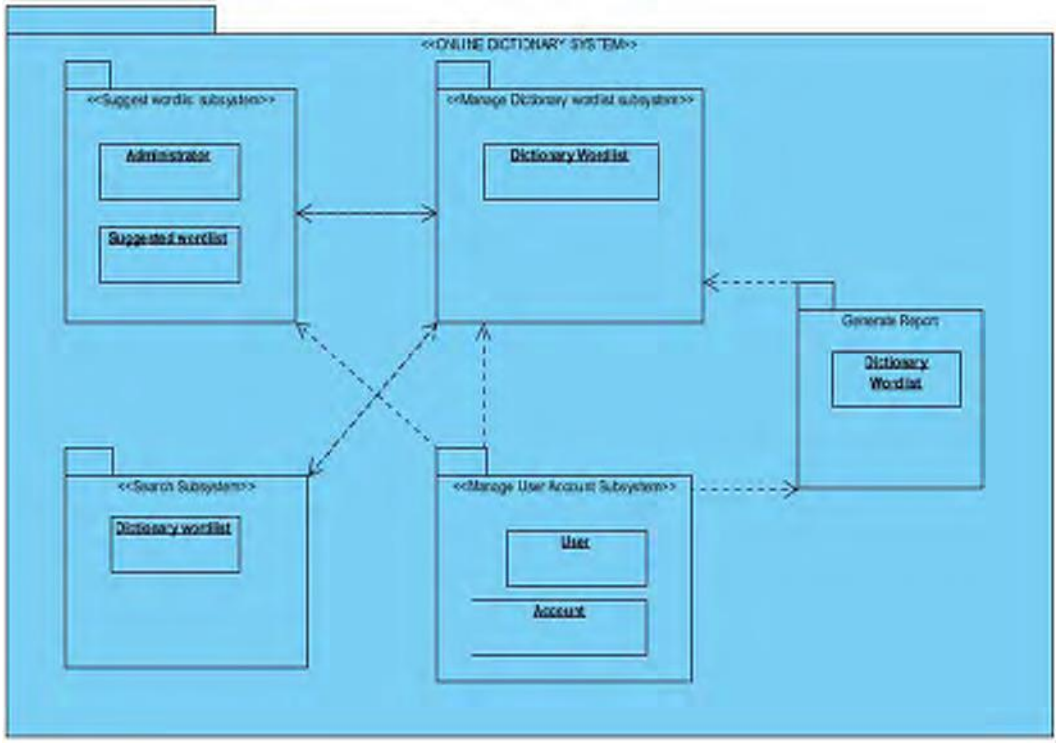
- Manage User Account Subsystem
- Manage Dictionary Wordlist Subsystem
- Suggest wordlist Subsystem
- Search Subsystem
- Generate Report Subsystem

The system decomposition for the dictionary system is shown in Table 5.1 as follows

Table 5.1: Subsystem Decomposition

S. No	Subsystem	Description
1.	Manage User Account Subsystem	This subsystem manages and maintains different user accounts information according to the registered user's login information. It provides methods for creating user accounts, changes password, editing user account detail to modify and Activate/ deactivate login accounts and it manages usernames, passwords and authorization level of users.
2.	Manage Dictionary Wordlist Subsystem	A subsystem that enables to keep information about dictionary wordlist that is to perform add, edit, delete, and view wordlist detail and it also manages and maintains information about word category to view, add, edit and delete word category /POS for the wordlist. In addition it displays visual dictionary for available word list in the system and display the images with their Këwhile, Amharic and English meaning as a caption with Këtaniña sound within a

S. No	Subsystem	Description
		domain or with searching the word.
3.	Suggest wordlist Subsystem	A subsystem that handles posted users Suggestion to add new word with its detail information, and to edit, verifies and adds it to the dictionary wordlist in the database.
4.	Search Subsystem	A subsystem that handles users search queries/ look up dictionary word to use online search facilities of the system for Amharic/ English or Këšëtaniña language input entry and display result of the search query.
5.	Generate Report Subsystem	A subsystem engaged in generating various types of reports based on user preference.



the client side web browsers interprets and display the system. The communication between the application and the database will be through client request so that the server will process the server script implemented in PHP script through the connection with MYSQL database to provide response to the client/user request. Figure 5.3 shows the deployment diagram of the KAEMD system.

5.3.3 Persistent Data Management

Persistent data outlive a single execution of the system. Information related to dictionary wordlist details, post suggestion details, verification of suggestion word information, user account information, and other related information are persistent data and hence stored on a database management system. This allows all the programs that operate on the dictionary system database to do consistently.

Moreover, storing data in a database enables the system to perform complex queries on a large dataset. For complex queries over attributes and large dataset a relational database management system (MYSQL) is used.

I. Mapping Classes to Tables

In order to store data persistently we map class names into table names and attributes into fields to the specific table based on the classes identified.

II. Relationship among Tables

The relationship among those identified tables is shown in Figure 5.3.

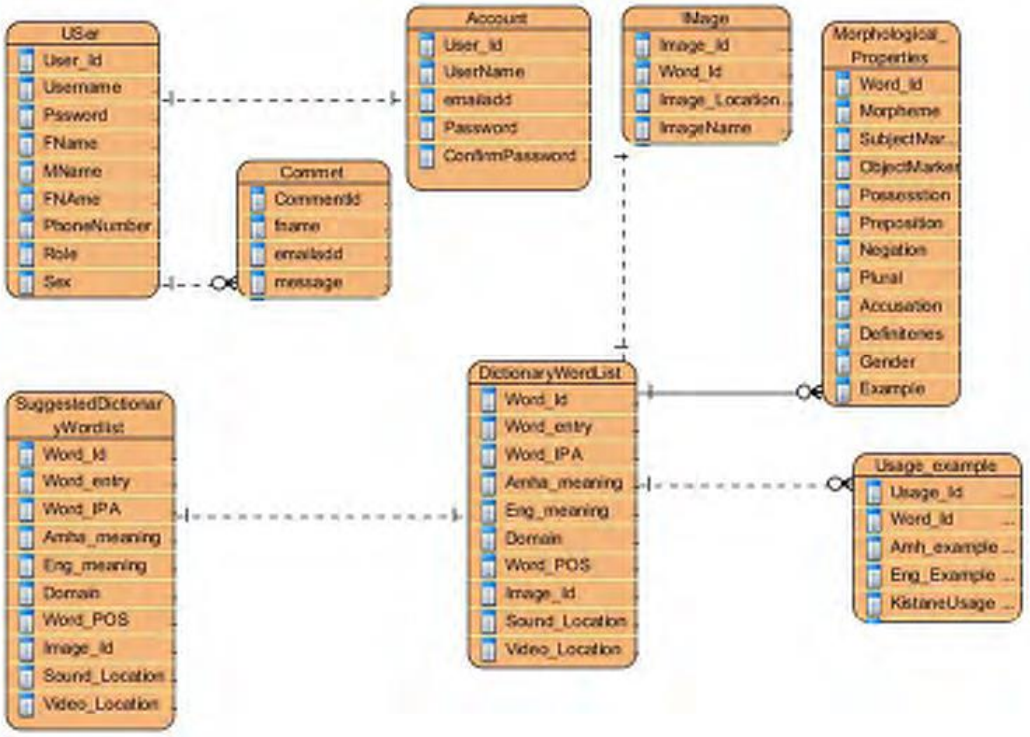

USer
User_Id
Username
Pssword
FName
MName
FNAme
PhoneNumber
Role
Sex
Account
User_Id
UserName
emailadd
Password
ConfirmPassword
Commet
Commentid
fname
emailadd
message
IMage
Image_Id
Word_Id
Image_Location
ImageName
Morphological_
Properties
Word_Id
Morpheme
SubjectMar...
ObjectMarker
Possession
Preposition
Negation
Plural
Accusation
Definitones
Gender
Example
SuggestedDictionar
yWordlist
Word_Id
Word_entry
Word_IPA
Amha_meaning
Eng_meaning
Domain
Word_POS
Image_Id
Sound_Location
Video_Location
DictionaryWordList
Word_Id
Word_entry
Word_IPA
Amha_meaning
Eng_meaning
Domain
Word_POS
Image_Id
Sound_Location
Video_Location
Usage_example
Usage_Id
Word_Id
Amh_example
Eng_Example
KistaneUsage

Table 5.2: Users and their privilege to access specific operations

Class	Actor, Operation
Dictionary wordlist	(Administrator ,Add wordlist Info) (Administrator, Delete wordlist Info) (Administrator,Edit wordlist Info) (DataEncoder, Add wordlist Info) (DataEncoder,Delete wordlist Info) (DataEncoder,Edit wordlist Info) (DataEncoder ,Search wordlist Info)
Add Suggestion wordlist	(DictionaryUser ,Add Suggestion wordlist) (Administrator, view Suggested wordlist) (Administrator ,verify Suggested wordlist)
User Account	(Administrator ,create new user) (Administrator ,Activate user) (Administrator ,Deactivate user) (Dataencoder ,change password)
Report Generation and print	(Administrator, Generate report) (Administrator , print report)

CHAPTER 6: IMPLEMENTATION OF THE SYSTEM

6.1 Tools used during the development of the system

In this chapter we will provide the implementation details and overview of different tools used while developing the system starting from the documentation to the implementation.

Based on appropriateness of the tools we used php-mysql and other web development tools to develop the system. Audio, video, and picture editing tools such as Adobe audition, Adobe photoshop and Adobe premier are also used. Table 6.1 shows tools used during the development of the system.

Table 6.1: Tools used in developing the system

Tasks	**Tools used**
Documentation	MS word 2007
Design	Microsoft Visio 2013,Visual paradigm for UML standard design, Macromedia Dreamweaver 8
Editing	Ms Paint, Macro media flash 8, Adobe Photoshop CS6
Script languages	PHP, JavaScript, CSS, HTML,JQuery
Web server	Wamp server
Web layout and Presentation	Cascading style sheet (CSS)
Data base Server	MYSQL database server

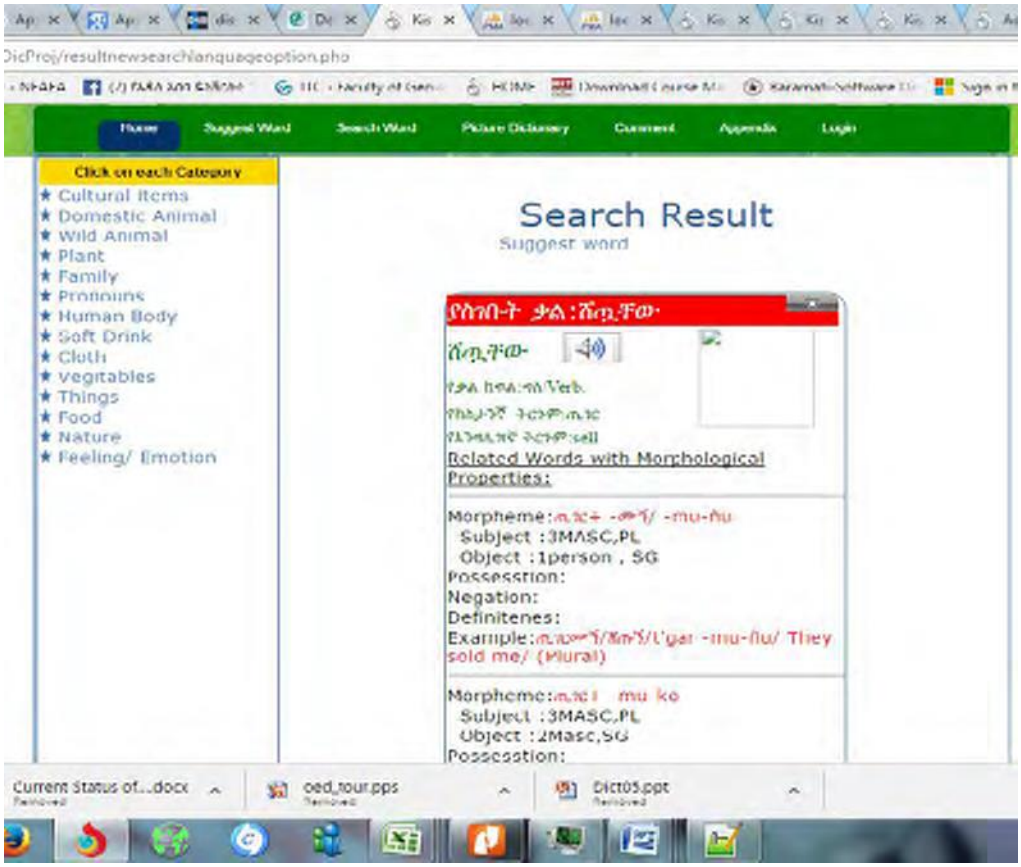
6.2 System Implementation and prototype

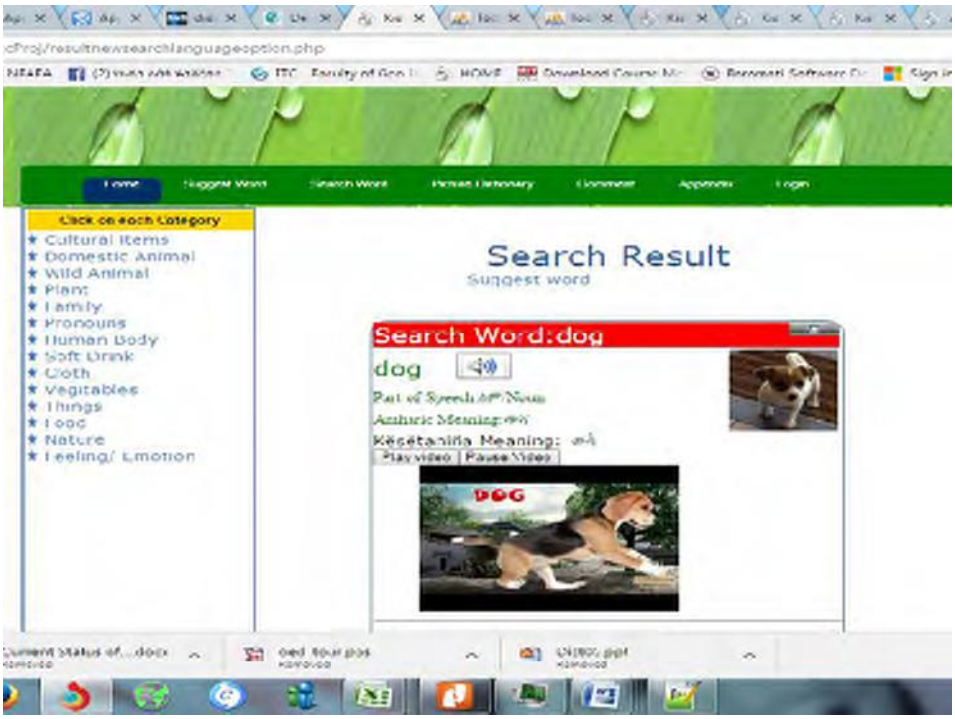
The system is decomposed into five main subsystems as shown in the system decomposition section of Chapter 5. In this section, the detailed service of the system and its preliminary interface is presented.

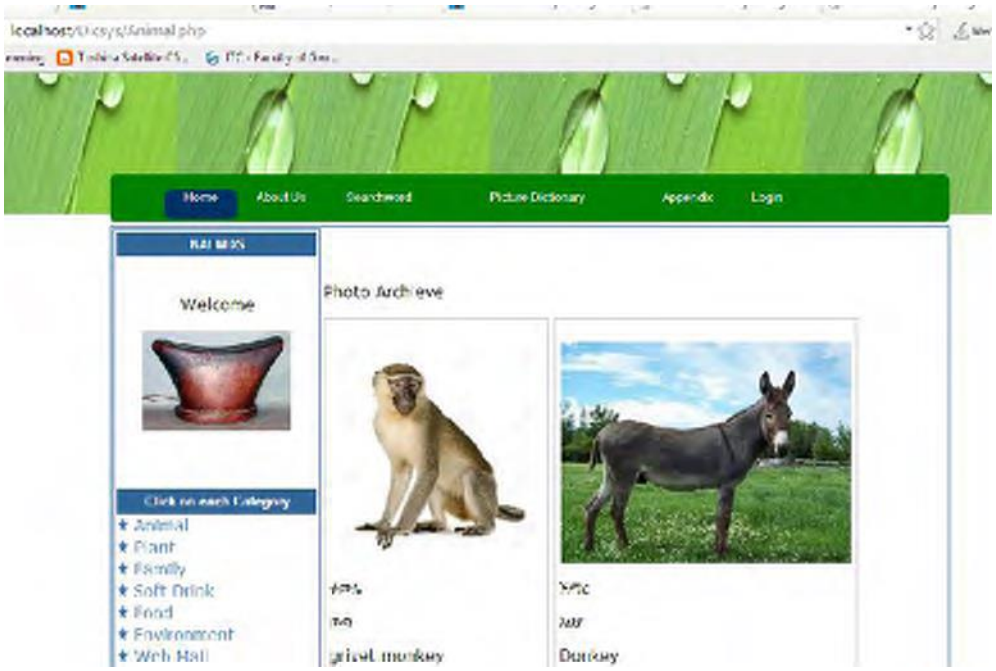
Figure 6.1 is displayed when we open URL of the dictionary system home page/ Search page. If user wants to search meaning with Amharic, English or Këtaniña language search word input, he/she can select the target language and enter the search word and click on Search.

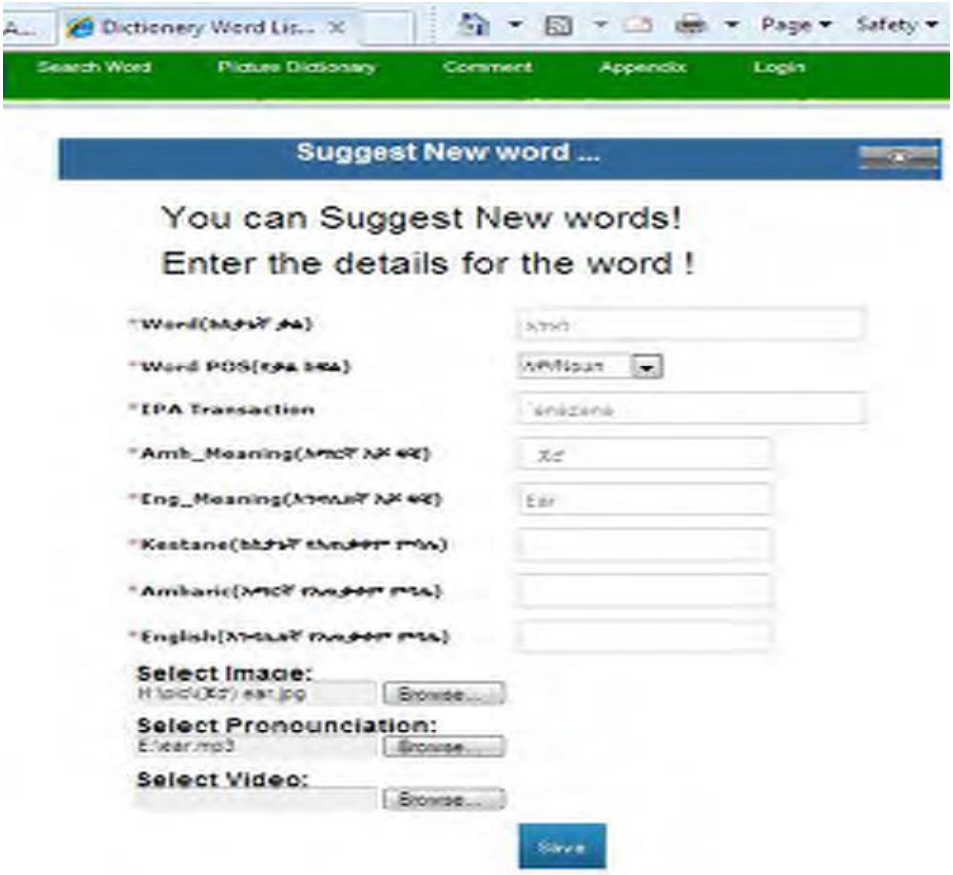

Home
Search Word
Click on word to Category
Domestic Animal
Wild Animal
Pronouns
Human Body
Vegetables
Things
Food
በለለዲይንጣ
Kĕsĕtaniña-Amharic -English Online Multimedia Dictionary system
እንኳን ደህና መጡ
የከስታንኛ-አማርኛ-እንግሊዝኛ መዝገበ ቃላት Welcome to Dictionary Home Page
Search Word
Search


Photo Five
ቃል:ሽማር (ስ/ተ.)
አማ:ኛ አ/ ቁ:ቁ:አህያ
እንግሊዘኛ አ/ ቁ:ቁ:donkey,
Click to listen:
የሽማር (አህያ)donkey.ምስል/ image
የአጠቃቀም ምሳሌ:
ከሰታቱኛ የአጠቃቀም ምሳሌ ሽማር ሊጫንዖይ ያማሰቅል አንሰሳ።
አማርኛ የአጠቃቀም ምሳሌ አህያ ጠቃሚ የጭነት እንሰሳ ነው።
እንግሊዘኛ የአጠቃቀም ምሳሌ: A donkey is a useful animal of burden


Click on each Category
Cultural Items
Domestic Animal
Wild Animal
Plant
Family
Pronouns
Human Body
Soft Drink
Cloth
vegitables
Things
Food
Nature
Feeling/ Emotion
Search Result
Suggest word
Related Words with Morphological Properties:
Morpheme:
Subject :3MASC,PL
Object :1person , SG
Possession:
Negation:
Definitenes:
Example:
Morpheme:
Subject :3MASC,PL
Object :2Masc,SG
Possession:


Home
Suggest Word
Search Word
Click on each Category
Cultural Items
Domestic Animal
Wild Animal
Plant
Family
Pronouns
Human Body
Soft Drink
Cloth
Vegitables
Things
Food
Nature
Feeling/ Emotion
Search Result
Suggest word
Search Word:dog
dog
Play video
Pause Video
DOG


Home
About Us
Searchword
Picture Dictionary
Appendix
Login
Welcome
Photo Archieve
Click on each Category
Animal
Plant
Family
Soft Drink
Food
Environment
Web Hall
Donkey


Dictionary Word Lis...
Page
Safety
Search Word
Picture Dictionary
Comment
Appendix
Login
Suggest New word ...
You can Suggest New words!
Enter the details for the word !
*Word(
*Word POS(
*EPA Transaction
*Amh_Meaning(
*Eng_Meaning(
*Kestane(
*Amharic(
*English(
Select Image:
Browse...
Select Pronounciation:
Browse...
Select Video:
Browse...
Save

Click on each word to view its dictionary meaning.

ቪገፈ	ሚጅ	ቱሙሴ	ኧማር	ሙ	ሙሃለት	ሙሃጎ	መሞሪድ	መሃሪም
መሃይም2	መሀራ	መሰሳ	መሰሎ	መሰሎ	ማሳንቬ	መሰመሳ1	መሰመሳ2	መሰመል
መልኘ	መለኪያ1	መለኪያ2	መለኩት	መለኩታዊ	መሰቦ1	መሰቦ2	መሰቦ3	መሰጉ1
መሰጉ3	መሰጨለት	መልማን	መሰጠ1	መሰጉ2	መሰጉ3	መሰጠለት	መለማን	መሰጠ1
መጣ	መሳስ	መሳሰኘ	መሳቅደስት	መሳቢስ	መሳን	መጎከት	መሳከተኘ	መፍ
መረመር	ነ	ነሰሬ	ነሰጎ	ነዘልነታ ባሎ	ነሻራ	ነገ	ነገር	ነገር1
ኘክነኘክ ባሎ1	ሰዘን	ሰሚን	ሰዘና	ሰዘና	ሰለለል	ሰዘሳ	ሰለሌታ	ሰለሎ
ሰባቢ	ሰሰቶ1	ሰሰቶ2	ሰሰቶ3	ሰሰክሰክ	ሰሊተ	ሰብም1	ሰብም2	ሰብማዊ
ሰሳው1	ሰሳው2	ሰባት	ሰባጣ	ሰሌል	ሰሌን	ሰሌዳ	ሰልፍ	ሰልፈኘ
ሰማሮ	ሰማንያ1	ሰማንያ2	ሰማንያ3	ሰማያዊ	ሰማይ	ሰሚን	ሰም	ሰምሰሞ
ሰሞት2	ሰሞን1	ሰሞን2	ሰሞናኘ	ሰሞነሙ	ሰረሰር	ሰረር	ሰረቆ	ሰረባ
ሰረጌ	ሰራት1	ሰራት2	ሰራዊት1	ሰራዊት2	ሰርጫን	ሰርጾ	ሰሰ	ሰቃባ
ሰበባ	ሰበከት	ሰበክ1	ሰበክ2	ሰባኪ1	ሰባኪ2	ሰባ1	ሰባ2	ሰባ
ሰባት1	ሰባው	ሰባጫራ	ሰብ	ሰቢ	ሰብል	ሰብሰብ1	ሰብሰብ2	ሰብሰብ3
ሰብሳቢ2	ሰብሳቢ3	ሰብራዳ	ሰቶት1	ሰቶት2	ሰቶት	ሰታቴ	ሰቸ1	ሰቸ2
ሰነቁሎ	ሰንሮ	ሰኔበ	ሰናጠት	ሰናታ	ሰናፉሚ	ሰኔ	ሰንሰለት	ሰንቀሉ
ሰንበት	ሰንበትበት	ሰንካሳ	ሰንጸለት	ሰንጸል	ሰንጸቅአላማ	ሰንሱት	ሰንዳ	ሰንጋ
ሰአት1	ሰአት2	ሰከር	ሰከባ1	ሰከበቶኘ	ሰከባ2	ሰከን	ሰከኖ	ሰኮሌ
ሰውሰው ባሎ	ሰውሳዋ	ሰውሳውንት	ሰደረዩ	ሰደበ	ሰደዳ (ን)	ሰደዲ	ሰደፍ	ሰዳቃ
ሰዳዳ	ሰጀ	ሰገራ	ሰገር	ሰጎጾ	ሰጉን	ሰጠቶ	ሰጠቶ	ሰጽ
ሰፈር1	ሰፈር2	ሰፈጥ	ሰፉ	ሰፌ	ሰፌ	ሰፋፌ		

6.3 Evaluation and Test

Even if the system functions as expected, there may still be some issues that are not clear to other users. Since we have designed and developed the system, then it is noticeable to the developer where the links are and how they work. Therefore, to assure usability test we perform testing with other users.

6.3.1 Internal test

Stand alone test

The basic test we performed is testing the system functionality on the developer local machine then open it in the web server and compare it with the functional requirements. We also performed tests for user interface on different browser to prove the page is actually displayed as per the requirement.

Online test

In the subsequent test, the files and pages are hosted on the web server temporarily and tested for its functionality using the Internet.

6.3.2 Usability Testing

In evaluating the prototype useability testing, 30 different users were selected using random sampling technique to select representative participants. The participants were chosen considering their experience on using online systems, 15 of them are ICT professionals and 15 different users who have computer literacy and experience on using web based systems Before starting the testing process, detailed description about the prototype has been given to the respective participants to help them understand function of the system. The questionnaires were prepared (see APPENDIX B), which can help to see the reflection of the users and conduct the usability testing. Following the description of the prototype, participants were provided with questionnaires used for the testing, which are a five level likert scale analysis.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Table 6.2 shows summary of questionnaire test result for useability test of the system

Table 6.2: Summary of Questionnaire Test Result

Question Number	Response	likert Scales					Total
		Strongly Agree	Agree	Neutral	Disagree	StronglyDisagree	
1	Frequency	15	9	3	3	0	30
	Percent	50%	30%	10%	10%	0	100%
2	Frequency	15	4	6	0	0	30
	Percent	50%	30%	20%	0	0	100%
3	Frequency	17	5	3	5	0	30
	Percent	56.67	16.67%	16.67%	10%	0	100%
4	Frequency	22	3	5	0	0	30
	Percent	73.33%	10%	16.67%	0	0	100%
5	Frequency	28	2	0	0	0	30
	Percent	93.33%	6.67%	0	0	0	100%
6	Frequency	17	3	7	3	0	30
	Percent	56.67%	10%	23.33%	10%	0	100%
7	Frequency	15	10	5	0	0	30
	Percent	50%	33.33%	16.67%	0	0	100%
8	Frequency	20	6	4	0	0	30
	Percent	66.67%	20%	13.33%	0	0	100%
9	Frequency	15	12	3	0	0	30
	Percent	50%	40%	10%	0	0	100%
10	Frequency	13	10	5	2	0	30
	Percent	43.33%	33.33%	16.67%	6.67%	0	100%
11	Frequency	20	8	2	0	0	30
	Percent	66.67%	26.67%	6.67%	0	0	100%
12	Frequency	19	7	4	0	0	30
	Percent	63.33%	23.33%	13.33%	0	0	100%
13	Frequency	17	10	3	0	0	30
	Percent	56.67%	33.33%	10%	0	0	100%
14	Frequency	18	8	4	0	0	30
	Percent	60%	26.67%	13.33%	0	0	100%
15	Frequency	15	10	5	0	0	30
	Percent	50%	33.33%	16.67	0	0	100%

Source: Usability Questionair 2016

Percentage of Strongly Agree and Agree =59.11%+24.89%

=84%

Among the respondants 84% of the participant have strongly agree and agree for the questions for the usability test which shows that the system satisfies useability test and the system the system achieves the functional and non-functional requirement.

Table 6.3: Summary of Background of respondant

Demography /Background	Category	Frequency	Percentage
Sex	Male	15	50%
	Female	15	50%
Language	Amharic	30	100%
	English	30	100%
	Kësëtaniña	10	33.33%
Experience	Yes	20	66.67%
	No	10	33.33%

Source: Usability Questionair 2016

From the respondents 50% were female and the remaining 50% were male. concerning language profestiency 100% of the participant can write, speak, and read Amharic,and English and around 33% can read, write , and speak Kësëtaniña, Amharic and English.Among the respondants most of the participant has experience on using online dictionary and only 33.33% don't have experience on using online dictionary, which shows that the experience for the participant helps to give a better response comparing with the existing online dictionary for other languages to provide appropriate answer for the useability test.

Data obtained from the respondants comment revails that the overall system is relevant and more than 85% of the respondent provide posetive aspects of the system as a comment which supports the useability questions and shows that the overall system is useable and important.

CHAPTER 7: CONCLUSION, RECOMMENDATIONS AND FUTURE WORK

7.1 Conclusion

Nowadays the ways people communicate, work, learn and live is changing from paper to electronic form and migrate to multimedia digital information communication system and portable form. Therefore, in order to reach large group of people the development and implementation of an online system is the right solution. Hence, due to this opportunity we propose, design and implement a web based online dictionary system which can solve the need to develop the first KAEMD that addresses the problem of the language revitalization and lack of attention for Kësëtaniña language. Since to the best of our knowledge there are no dictionaries available for Kësëtaniña language both printed and electronic version to date. Therefore, the development of this system is important to document and learn the language.

In this study we develop prototype with a sample wordlists of 2000 Kësëtaniña and illustrations when possible. The use of multimedia for the system is one of the most important features that can help to document original resources of the language, culture, and history through documents such as native speaker pronunciation and pictorial illustration.

This system has searching service, visual dictionary, suggestion service to add new wordlist to the dictionary, generate wordlist report, and it is developed with PHP and MYSQL database management software. In order to address the problem of recognizing different wordlist forms in a dictionary we use manually prepared Kësëtaniña Morphological Analyzer.

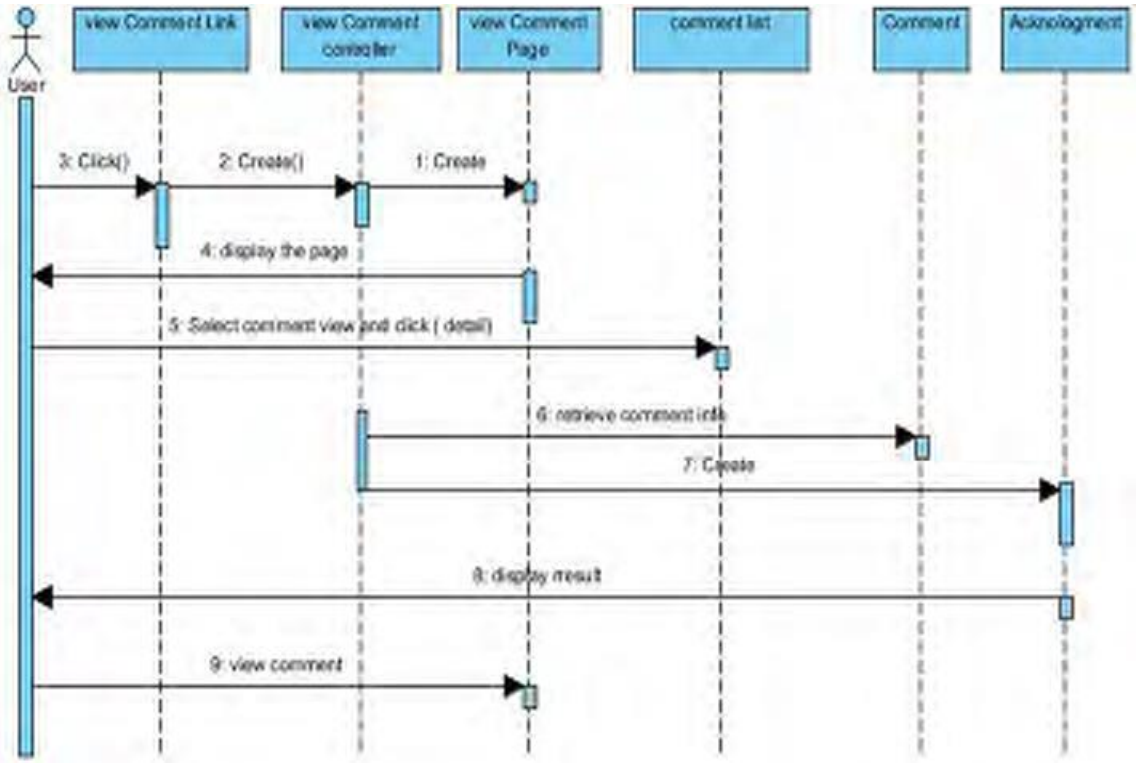
Finally, the system is tested with different data and is important to bring change on current state of the language. We have tested the system for its usability through questionnaire distributed to different group of people who are native speakers and who are not speakers of the language. In the prototype evaluation, 30 users participated. The respondents participated as users on the system using laptop and desktop computers. The results of the evaluation have shown that the dictionary system is easy to use and it is functional and better than paper based dictionary systems.

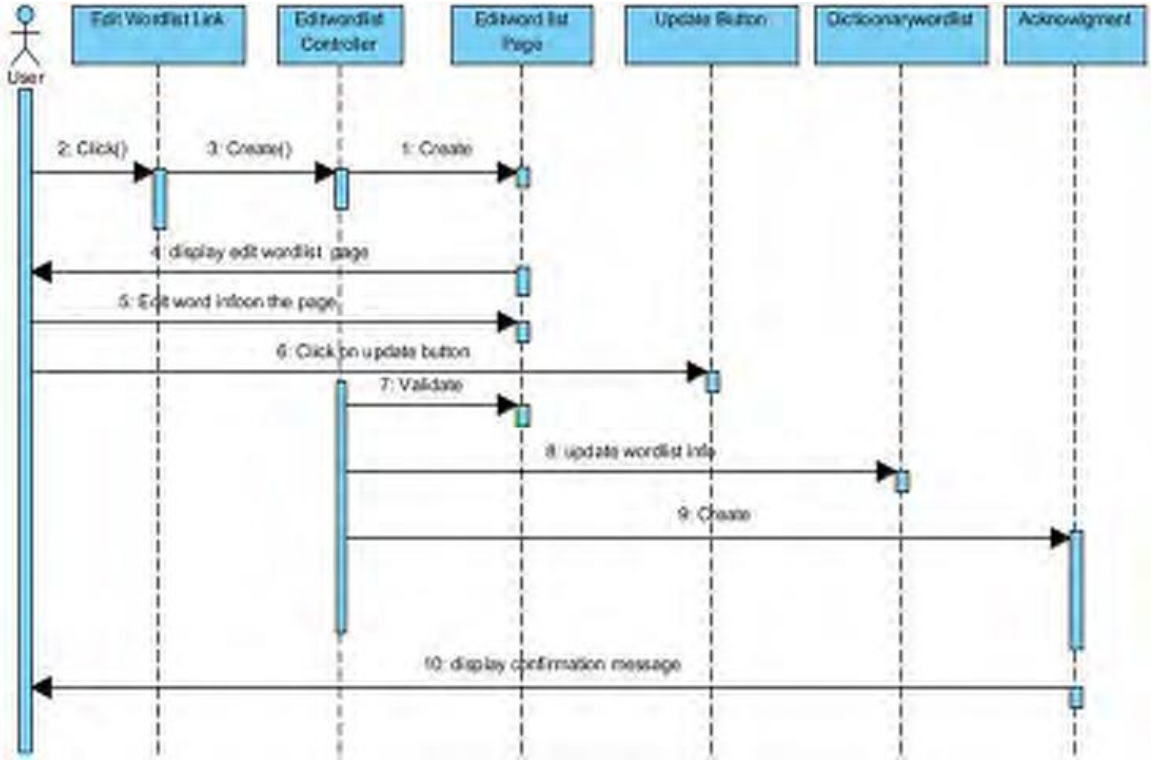
7.2 Recommendations and Future Work

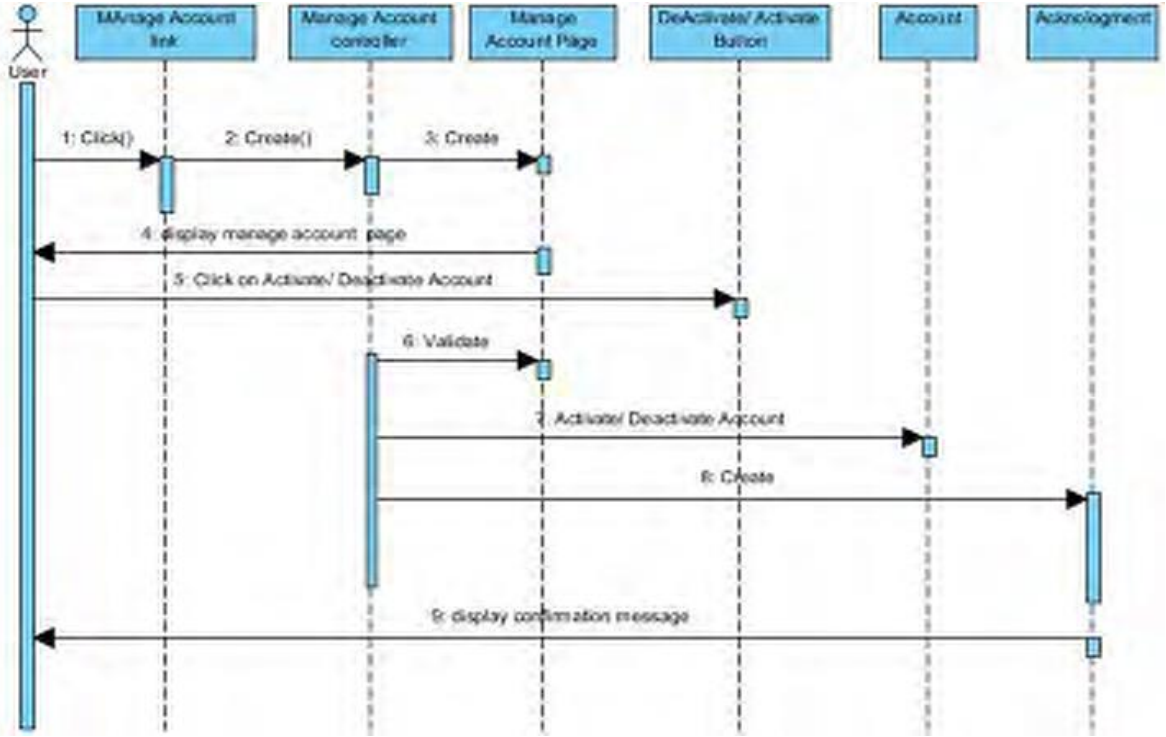
To make the dictionary complete and provide a better and enhanced service to users, an extended work and entering more data and multimedia content into the dictionary database is important. In addition, Since the Kësëtaniña language lacks linguistic resources such as Automatic Morphological Analyzer, Part of speech tager and Morphology syntesizer which are crucial for the study to have a more significant contribution in the computitional linguistic, we forward the following recommendations

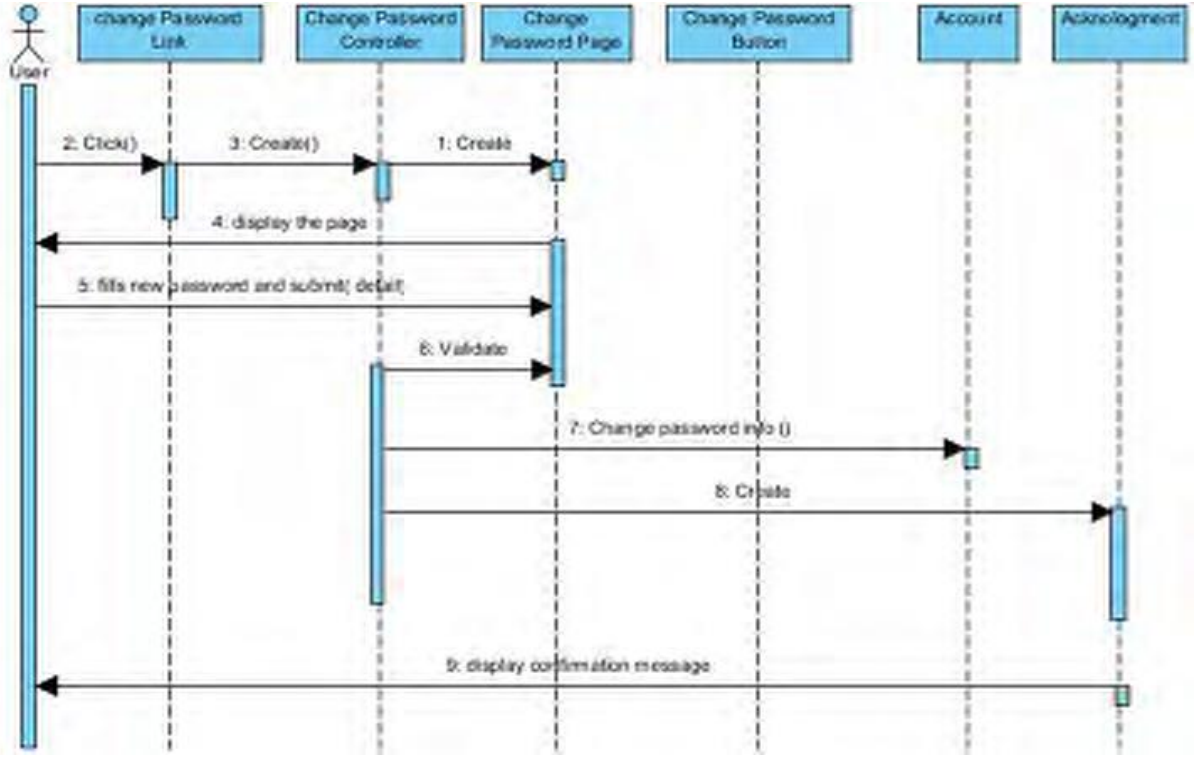
- Since there is no Kësëtaniña Morphology Analyzer available, we have used manually developed Kësëtaniña Morphology Analyzer for the study which is tedious to prepare. Hence we recommend the development of complete Kësëtaniña Morphology Analyzer for the future that can make the system more important and efficient.
- To satisfy every user we also recommend to include Amharic Morphology synthesizer (AMS) and English Morphology Synthesizer (EMS) to the data tier as a component to syntesize the equivalent word forms for the input Kësëtaniña word with Amharic and English languages.

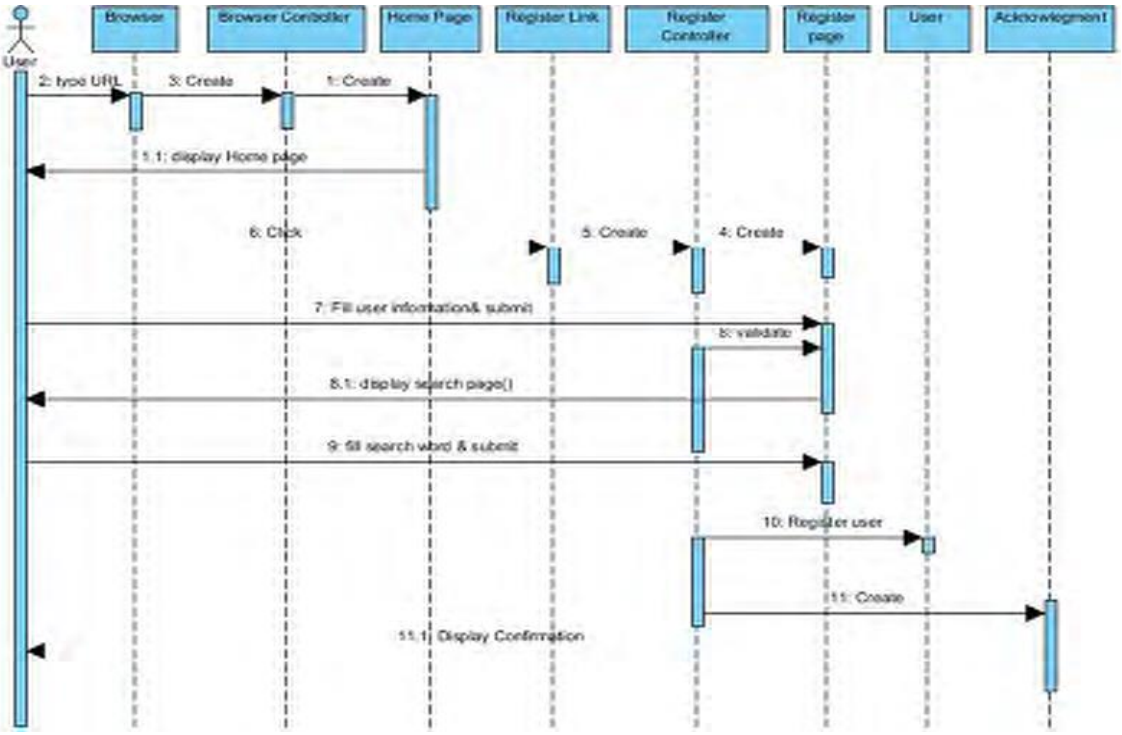
To complete the dictionary system and make it more relevant by improving its service we need to add additional wordlists with more multimedia illustration. Through the testing, commenting and suggesting new wordlist we will also have the option to enhance and extend the functionality of the system. Therefore, as part of future work to make this system complete and provide input to the NLP tool for Kësëtaniña language, we would like to add more wordlists and multimedia illustration.

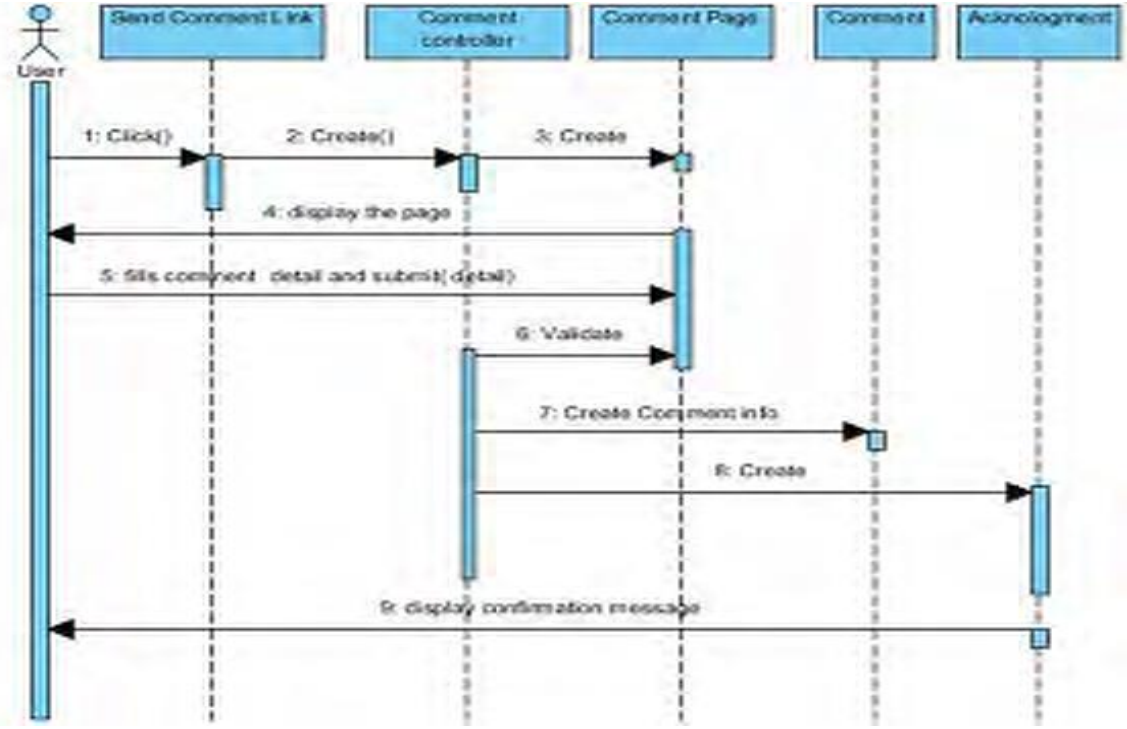

User
view Comment Link
view Comment controller
view Comment Page
comment list
Comment
Acknolagment
3: Click()
2: Create()
1: Create
4: display the page
5: Select comment view and click (detail)
6: retrieve comment info
7: Create
8: display result
9: view comment


User
Edit Wordlist Link
Editwordlist Controller
Editword list Page
Update Button
Dictionarywordlist
Acknowlgment
2: Click()
3: Create()
1: Create
4: display edit wordlist page
5: Edit word infoon the page
6: Click on update button
7: Validate
8: update wordlist info
9: Create
10: display confirmation message


User
IMnage Account link
Manage Account controller
Manage Account Page
DeActivate/ Activate Button
Account
Acknolegment
1: Click()
2: Create()
3: Create
4: display manage account page
5: Click on Activate/ Deactivate Account
6: Validate
7: Activate/ Deactivate Account
8: Create
9: display confirmation message


User
change Password Link
Change Password Controller
Change Password Page
Change Password Button
Account
Acknolegment
2: Click()
3: Create()
1: Create
4: display the page
5: fills new password and submit(default)
6: Validate
7: Change password info ()
8: Create
9: display confirmation message


User
Browser
Browser Controller
Home Page
Register Link
Register Controller
Register page
User
Acknowlegment
2: type URL
3: Create
1: Create
1.1: display Home page
6: Click
5: Create
4: Create
7: Fill user information& submit
8: validate
8.1: display search page()
9: fill search word & submit
10: Register user
11: Create
11.1: Display Confirmation


User
Send Comment Link
Comment controller
Comment Page
Comment
Acknowlegment
1: Click()
2: Create()
3: Create
4: display the page
5: fills comment detail and submit(detail)
6: Validate
7: Create Comment info
8: Create
9: display confirmation message

APPENDIX B: MORPHOLOGICAL PROPERTIES OF WORDS

Below are examples of grammatical properties of individual words which are used in the study to show the morphological properties of words used in the dictionary.

t'gar -mu-ñ/ጢገርሙኝ/ They sold me/ሸጡኝ

morpheme	Subject	Object
-mu-ñ	3MASC,PL	1person , SG

al-t'gar -mu-ň negation: al

t'gar -mu-ko /ጢገርሙኮ/ሸጡክ/They sold You

morpheme	Subject	Object
-mu-ko	3MASC,PL	2Masc,SG

t'gar -mu-čin/ ጢገርሙችን/ሸጡሽ/They sold you/

morpheme	Subject	Object
-mu-čin	3MASC,PL	2FEM,SG

t'gar -mu-ut/ጢገርሙት/ሸጡት/They Sold Him

morpheme	Subject	Object
-mu-ut	3MASC,PL	3MASC,SG

t'gar -mu-wat/ጢገርሙዋት/ሸጡዋት/They sold her

morpheme	Subject	Object
-mu-wat	3MASC,PL	3FEM,SG

t'gar -mu-no/ጢገርሙኖ/ሸጡን/They sold us

morpheme	Subject	Object
-mu-no	3MASC,PL	1, PL

t'gar -mu-kimun/ጢገርሙክሙን/ሸጧቹ/They sold you

morpheme	Subject	Object
-mu-kimun	3MASC,PL	2Masc,PL

t'gar -mu-kiman/ጢገርሙክማን/ሸጧቹ/They sold you

morpheme	Subject	Object
-mu-kiman	3MASC,PL	2FEM,PL

t'gar -mu-nu/ጢገርሙኑ/ሸጧቸው/They sold them

morpheme	Subject	Object
-mu-mnu	3MASC,PL	3MASC,PL

t'gar -mu-man/ሸጧቸው/They sold Them

morpheme	Subject	Object
-mu-man	3MASC,PL	3FEM,PL

t'gar -u/He was sold/እሱ ተሸጠ

morpheme	Subject	Object
-u	3MASC,SG	Impersonals

t'gar -wa/ተሸጠች/She was sold

morpheme	Subject	Object
-wa	3FEM,SG	Impersonals

t'gar -ika/ሸጡህ/you were sold

morpheme	Subject	Object
-ika	2MASC,SG	Impersonals

t'gar -ič/ሸጡሽ/you were sold

morpheme	Subject	Object
-ič	2FEM,SG	Impersonals

t'gar -iñ/ሸጡኝ/I was sold

morpheme	Subject	Object
-iñ	1Person,SG	Impersonals

t'gar -wam/ሸጧቸው/They were sold

morpheme	Subject	Object
-wam	3MASC,PL	Impersonals

t'gar -wama/ሸጧቸው/They were sold

morpheme	Subject	Object
-wama	3FEM,PL	Impersonals

t'gar -ikim/ተሸጣቹ/you were sold

morpheme	Subject	Object
-ikim	2MASC,PL	Impersonals

t'gar -ikima/ሸጧቹ/They were sold

morpheme	Subject	Object
-ikima	2FEM,PL	Impersonals

t'gar -ina/ሸጡን/we were sold

morpheme	Subject	Object
-ina	1Person,PL	Impersonals

al-t'igaru/አልተሸጠም/not sold ፣ ti -t'igar/ቲጠገር/አይሸጥም/

negation :al-/ ti-

sab-očč-ña/ሰዎቻችን/Our people

morpheme	Plural
-očč-ña	**-očč**

sab-di/my person

Possession

-di

sab-očč/ሰዎች/People

Plural : -očč

ya-sab/የሰብ/የሰው

Accus: ya-

ya-sab-očč/የሰቦቿች/የሰዎች

Morpheme: ya-očč

sab-ña/ሰብኛ/ሰዋችን፡ Plural: -ña

sab-očč-i/ሰቦቿ/ሰዎቹ/The people

Possesstion: -i

ge-di/my house/የእኔ ቤት

Possesstion: -di

ge-dašh/ጌደሽ/ የአንቺ ቤት/ your house/ morpheme Subject -dašh 2Fem ,Sg
ge-da/ጌደ/your house/ቤትህ/የአንተ ቤት morpheme Subject Object -da 2Masc,Sg
ge-hi/her house/ቤትሽ/የአንቺ ቤት morpheme Subject Object
ge-ña/ጌኛ/our house/የእኛ ቤት/ቤታችን morpheme Subject **--ña 1Plural**
ge-aw /ጌው/His house/የእሱ ቤት morpheme Subject **-aw 3 Masc,PL**
ge-dahm/ጌደህም/your house/የእናንተ ቤት morpheme Subject Object
ge-dahma/ጌደህማ/your house/የእናንተ ቤት morpheme Subject Object
ge-hinam/ጌህነም/Their house/የእነሱ ቤት/ morpheme Subject **- hinam 3MASC ,PL**
ge-hinama/ጌህነማ/Their house/የእነሱ ቤት/ጌ morpheme Subject **-hinama 3Fem, Pl**
ge-i/ጌኢ/The house/ቤቱ morpheme Definiteness **-i -i**
zam-ačč-i/ዘማቺ/brothers/ወንድማማቾቹ Morpheme Def Plural marker for kinship **-ačč-i -i -ačč**
amar-i/አማሪ/The donkey/አህያው morpheme Def **-i -i**
amarara/አማረረ/donkeys/አህያዎች morpheme Plural by reduplication (for animals) **-rara -rara**
ganit-amar/ጎኒት አማር /Female donkey/ሴት አህያ/ጎኒት አማር morpheme Gender (female)marker for animal **ganit- ganit-**
amar-di/አማርዲ/my donkey/አህያዬ morpheme Subject **-di 1person**
ya-amar-i/የአማሪ/የአህያው/ the donkey morpheme Definitenes

Ya- -I -i
amar-daš/ኧማርደሽ/አህያሽ/ your donkey
ge-da/your house/ቤትህ
amar-ki/ኧማርኪ/የእሷ አህያ/አህያዋ/ her donkey
amar-ña/ኧማርኛ/አህያችን/our donkey
amar-han/ኧማረሀን/His donkey/አህያው
amar-dahm/ኧማርደህም/your donkey/አህያቹ/የእናንተ አህያ
amar-dahma/ኧማርደህማ/your donkey/አህዮቹ
amar-kinam/Their donkey/አህያቸው
amar-kinama/ኧማርክነማ/Their donkey/አህያቸው
amar-da/ኧማርደ/your donkey/አህያህ/
These are some words for which we prepare morphological properties of the words in the dictionary:ጀረ ፣ሲፎ፣ቀመሌ፣አንቆ፣፣ማለቅ፣ኧጣይ፣መሌ፣ ጠበል፣ሰላ፣ተን፣ወለሆ፣ሜትየ፣ስብር፣አበም…ተቸ

APPENDIX C: USABILITY TESTING QUESTIONNAIRE

ONLINE Dictionary System

Please provide your response and satisfaction with the system.

- Try to respond to all the items.
- Add a comment about an item by clicking on comment link during using the system.
- For Additional comment or suggestion you can write the positive or negative aspects of the system.
- This questionnaire is intended to know user satisfaction related to usability test.

I. Demographic and Background Information about Dictionary user

1. Your Profession _____.
2. Do you have experience on using online dictionary? ☐Yes ☐No
3. Which language do you speak write read and listen?

   ☐Amharic ☐English ☐Këwhile taniña

II. Prototype Usability Testing Question

The following questions are related to the main functionalities of the Online dictionary System which can be used to measure usability of the system. Please indicate your agreement by making (✓) in the boxes

No.	Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	NA
1	**Do you think that the system is simple to use.**	☐	☐	☐	☐	☐	☐
2	**It was easy to find the information you need.**	☐	☐	☐	☐	☐	☐
3	**Organization of information on the system screen was clear.**	☐	☐	☐	☐	☐	☐
4	**Does the system have all the functions and capability you expect?**	☐	☐	☐	☐	☐	☐
5	**Do you think the text which appears on the pages is clearly readable?**	☐	☐	☐	☐	☐	☐

6	**Whenever I made a mistake using the system. I could recover easily and quickly.**	☐	☐	☐	☐	☐	☐
7	**Do you think the system can be used by any user with basic knowledge of using computers?**	☐	☐	☐	☐	☐	☐
8	**Are the searching page and other pages functions as it should be?**	☐	☐	☐	☐	☐	☐
9	**Are all links consistent and worked well?**	☐	☐	☐	☐	☐	☐
10	**Do you think the response time for most operations is fast enough?**	☐	☐	☐	☐	☐	☐
11	**Is the system easy to read and write**	☐	☐	☐	☐	☐	☐
12	**Does the system give enough information when an error occurs?**	☐	☐	☐	☐	☐	☐
13	**Do you think that the system is appropriate for all levels of users?**	☐	☐	☐	☐	☐	☐
14	**Do you think the system is reliable and user friendly?**	☐	☐	☐	☐	☐	☐
15	**Overall, are you satisfied with this system?**	☐	☐	☐	☐	☐	☐

Please write any other comment if you have about the system

List the most negative aspect(s):_____.

List the most positive aspect(s): _____

_____

Reflection on the overall system_____

_____.

APPENDIX D: PARTS OF THE KËSËTANIÑA FIDELS

Below are presented the remaining parts of the Kësëtaniña fidels together with their forms , sounds and Numerals and numbers used in the document.

k«	ku	ki	ka	ke	kë	ko
ወ	ዉ	ዊ	ዋ	ዌ	ው	ዎ
ሀ	ሁ	ሂ	ሃ	ሄ	ህ	ሆ
Ha	hu	hi	ha	he	hë	ho
ለ	ሉ	ሊ	ላ	ሌ	ል	ሎ
l«	lu	li	la	le	lë	lo
መ	ሙ	ሚ	ማ	ሜ	ም	ሞ
m«	mu	mi	ma	me	më	mo
ረ	ሩ	ሪ	ራ	ሬ	ር	ሮ
r«	ru	ri	ra	re	rë	ro
ሰ	ሱ	ሲ	ሳ	ሴ	ስ	ሶ
s«	su	si	sa	se	së	so
ሸ	ሹ	ሺ	ሻ	ሼ	ሽ	ሾ
š«	šu	ši	ša	še	šë	šo
ቀ	ቁ	ቂ	ቃ	ቄ	ቅ	ቆ
k'«	k'u	k'i	k'a	k'e	k'ë	k'o
በ	ቡ	ቢ	ባ	ቤ	ብ	ቦ
b«	bu	bi	ba	be	bë	bo
ተ	ቱ	ቲ	ታ	ቴ	ት	ቶ
t«	tu	ti	ta	te	të	to
ቸ	ቹ	ቺ	ቻ	ቼ	ች	ቾ
č«	ču	či	ča	če	čë	čo
ነ	ኑ	ኒ	ና	ኔ	ን	ኖ
n«	nu	ni	na	ne	në	no
ኘ	ኙ	ኚ	ኛ	ኜ	ኝ	ኞ
ñ«	ñu	ñi	ña	ñe	ñë	ño
አ	ኡ	ኢ	ኣ	ኤ	እ	ኦ
a	u	i	a	e	ë	o
ከ	ኩ	ኪ	ካ	ኬ	ክ	ኮ

k«	ku	ki	ka	ke	kë	ko
ወ	ዉ	ዊ	ዋ	ዌ	ው	ዎ
w«	wu	wi	wa	we	wë	wo
ዘ	ዙ	ዚ	ዛ	ዜ	ዝ	ዞ
z«	zu	zi	za	ze	zë	zo
ዠ	ዠ	ዢ	ዣ	ዤ	ዥ	ዦ
ž«	žu	ži	ža	že	žë	žo
የ	ዩ	ዪ	ያ	ዬ	ይ	ዮ
y«	yu	yi	ya	ye	yë	yo
ደ	ዱ	ዲ	ዳ	ዴ	ድ	ዶ
d«	du	di	da	de	dë	do
ጀ	ጁ	ጂ	ጃ	ጄ	ጅ	ጆ
ǧ«	ǧu	ǧi	ǧa	ǧe	ǧë	ǧo
ገ	ጉ	ጊ	ጋ	ጌ	ግ	ጎ
g«	gu	gi	ga	ge	gë	go
ጠ	ጡ	ጢ	ጣ	ጤ	ጥ	ጦ
t'«	t'u	t'i	t'a	t'e	t'ë	t'o
ጨ	ጩ	ጪ	ጫ	ጬ	ጭ	ጮ
č'«	č'u	č'i	č'a	č'e	č'ë	č'o
ጸ	ጹ	ጺ	ጻ	ጼ	ጽ	ጾ
p'«	p'u	p'i	p'a	p'e	p'ë	p'o
ጸ	ጹ	ጺ	ጻ	ጼ	ጽ	ጾ
s'«	s'u	s'i	s'a	s'e	s'ë	s'o
ፈ	ፉ	ፊ	ፋ	ፌ	ፍ	ፎ
f«	fu	fi	fa	fe	fë	fo
ፐ	ፑ	ፒ	ፓ	ፔ	ፕ	ፖ
p«	pu	pi	pa	pe	pë	po
◌ « ኸ h«						
ቨ	ቩ	ቪ	ቫ	ቬ	ቭ	ቮ

v« vu vi va ve vë vo

ቀኡ	ቋ	ቌ	ቀኡ	ኈኡ	ኋ	ኌ	ኈኡ	ኩኡ	ካ	ኬ	ኮ	ጉ
k’ʷi	k’ʷa	k’ʷe	k’ʷi	hʷi	hʷa	hʷe	hʷi	kʷi	kʷa	kʷe	kʷi	gʷi
ጓ	ጔ	ጕ	ኗ	ቧ	ዟ	ጧ	ሟ	ቷ	ኟ	ቈ	ሯ	ቿ
gʷa	gʷe	gʷi	lʷa	bʷa	zʷa	t’ʷa	mʷa	tʷa	ʒʷa	ɸ’ʷa	rʷa	ɸʷa
ጀ	ጃ	ኃ	ኗ	ዷ	ፏ	ሿ	ኟ	ሯ	ሻ	ሬ	ኧ	
ʤʷa	ts’ʷa	sʷa	nʷa	dʷa	fʷa	ʃʷa	ɲʷa	rʲa	nʲa	fʲa	e	

፩	፪	፫	፬	፭	፮	፯	፰	፱	፲
ቁና/አት፡	ኪት	ሰስት	አረት፡	አምስት፡	ስድስት	ሰባት	ስምት፡	ዘጠኝ	አስር
One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten
1	2	3	4	5	6	7	8	9	10

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Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all source of materials used for the thesis have been duly acknowledged.

Declared by:

Name: _____

Signature: _____

Date: _____

Confirmed by advisor:

Name: _____

Signature: _____

Date: _____