A Kenyan Indigenous Language – Based Communication Mobile Application

Kitali, Gloria Mutheu

098608

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Declaration

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the project documentation contains no material previously published or written by another person except where due reference is made in the project documentation itself.

Abstract

Indigenous languages, commonly known as mother tongue are an important part of a person's identity. These are the languages in which we first interact with the world and which shape our identity based on the culture attached to them. Many Kenyans who were raised in urban areas have little knowledge of their mother tongue. This lack of knowledge deprives them of the ability to experience their culture and interact with their elders and other relatives who speak only mother tongue. In contrast, those raised in rural areas mainly spoke mother tongue while learning some English and Kiswahili in school. Therefore, mother tongue was their fluent language while their skills in the other two languages were not sharpened. Facing this problem, there is an opportunity that presents itself. These two groups of people can learn from each other and improve their knowledge of these languages together. This can be done through a language exchange application. As most people have smartphones in these times, these parties are able to find each other and interact. The project has proposed a mobile application through which interested learners would be able to discover each other and communicate through chat. An object-oriented approach will be taken in the development of the solution that will solve the above stated problem. The tools that will be used in project development will include Dart programming language which is utilized through the flutter framework, along with Firebase database tools. In conclusion, the project benefits Kenyan adults by providing an application for them to learn more about their culture, mother tongue and for the other side to learn more about the world and communicate effectively in English and Kiswahili.

Key words: mother tongue, language exchange, android, Kenya

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List of Abbreviations

CASE	Computer-Aided Software Engineering
ECD	Early Childhood Development
IDE	Integrated Development Environment
ITM	Indigenous/ Tribal/ Minority
KICD	Kenya Institute of Curriculum Development
MT	Mother Tongue
UNESCO	United Nations Educational, Scientific and Cultural Organization
XML	Extensible Markup Language

Chapter 1: Introduction

1.1: Background

The increased move of the Kenyan education system towards digital literacy has widened the horizons of many Kenyans. Language is a natural resource to be used for socio-economic development (Skutnabb-Kangas, 2000). The multilingual environment which many Kenyans are exposed to causes them to pick and choose a language of fluency, mainly focusing on English as it is the language taught through in schools. According to Obondo (1997), the practices in use currently of bilingual education have been influenced by history, specifically, the colonial authorities' history in Africa. That occurrence crafted the attitude that many Africans have towards their mother tongues as it is associated with poverty and illiteracy.

This perception will shift when more people are able to communicate with the native speakers of these indigenous languages. Some countries such as Angola and Mozambique were forbidden to teach other foreign languages or their native languages while the other colonial authorities allowed the retention of the native languages. These colonial authorities can be divided into the 'pro-users' and 'anti-users', depending on their model of colonialism, whether assimilation or 'decrees' (Ansre, 1978). The Portuguese High Commissioner Senhor Norton De Natos issued the Decree 77 in Angola in the year 1921 allowing only the use and teaching of Portuguese. Training the indigenous Kenyan people to reach a high level of English proficiency did not mesh well with the British policy of divide, conquer and rule (Awoniyi, Bamgbose, 1976).

In previous years, indigenous languages were the language of teaching for the lower primary years mostly in rural areas. The indigenous languages were associated with "backwardness" but the perception has shifted to a more positive light. Currently, the guidelines for upper primary school in accordance with the new curriculum as stated by the Kenya Institute of Curriculum Development (2017) "Learners will be expected to advance their learning in the mother tongue in order to become linguists and specialize in such areas as the development of orthographies." This shows a positive move towards fluency in the indigenous languages in Kenya as a way to enrich our culture and live fully as Kenyans.

1.2: Problem Statement

Having competency in one's mother tongue enables for the development of other languages to proceed with more ease. Indigenous languages provide a cultural heritage for the speakers, along with identity and clear purpose. The current means of learning one's native tongue is greatly informal, making it difficult for those trying to learn the language in adulthood. This leads to individuals lacking the necessary language skill that is assumed to have been imparted in early childhood. The language ability already owned by individuals fluent in indigenous languages is denied for the sake of English fluency which may not be as accessible to these individuals.

Most city born people haven't had the opportunity to learn their mother tongue, this shuts them out from enrichment from a large part of their heritage. These individuals are able to briefly understand what others say in mother tongue but rarely or never use it. There is a lot of judgement received from elders and peers when trying to learn the language from them, reducing one's eagerness. These individuals would be willing to put in the necessary time and effort to learn if given the opportunity, which the system would provide. The problem would be solved by clear communication between those seeking to learn each other's language through the system to be developed. In this way, the language exchange system would increase the competency of Kenyans in both the indigenous languages and English.

This work seeks to develop a mobile application to solve the problem of lack of mother tongue, English and Kiswahili knowledge among Kenyan adults by providing a medium through which they can collaborate and learn from each other.

1.3: Aim

The aim was to develop a system on the mobile platform to solve the problem identified in the section 1.2 above. The system would solve the problem by allowing greater interaction with fluent native and non-native speakers of the tongue through an app that creates a means for communication.

1.4: Specific Objectives

i. To investigate the current means of learning individual indigenous languages.
ii. To investigate the current systems and apps used to help people learn indigenous languages
iii. To develop a mobile application that will facilitate interaction with fluent speakers of the interested parties' tongue.

iv. To test and evaluate the developed application.

1.5: Justification

This project's importance is that it will help increase communication among the people who speak the same native tongue, allowing for better interaction with the elderly and young children who speak the tongue. The Constitution of Kenya commits for the promotion and protection of the diversity of languages to the people of Kenya and to promote the development and use of these indigenous languages (Basic Education Curriculum Framework, 2017). The system will also be able to assist in literacy of both parties, one improves their knowledge of the indigenous language while the other improves their knowledge of English or Kiswahili.

1.6: Scope and Limitations

1.6.1: Scope

The scope of this project is that it will be limited to Kenyan indigenous languages. The application will be available only on the Android platform.

1.6.2: Limitation

The limitation of this project is that the time for development of the application is limited therefore testing may be hindered.

Chapter 2: Literature Review

2.1: Introduction

This chapter presents a review of the existing literature on the current indigenous language learning means in urban areas in Kenya. It also discusses the cases of indigenous language learning in other countries having a similar variety of tongues as Kenya.

2.2: Current Means of Learning Mother Tongue

Currently, the means by which majority of Kenyans learn their mother tongue is from their relatives and other members of their community who speak the same tongue. This normally occurs during childhood, where an individual becomes familiar with the world through the language. In rural areas, this means of learning is used up to the end of Class 3 under the former 8-4-4 system of education. The same means of education is present in other countries with a large number of mother tongues, namely the Philippines having 120 to 175 different languages with native speakers (Racoma, 2014) and Nepal having over 122 major languages (Translators without Borders, n.d.).

2.2.1: Challenges Experienced Using the Current Means of Learning Mother Tongue

Kenya has a large linguistic diversity consisting of over 40 different mother tongues and ethnic groups. There are three main language groups: Bantu-speaking tribes, Nilotic-speaking tribes and Cushitic-speaking tribes. In urban areas, young children begin their nursery school education by learning in either English or Kiswahili, leaving their mother tongue reading, writing and comprehension skills almost non-existent. The opposite is true for children in catchment areas where a mother tongue is the language of instruction until class 3.

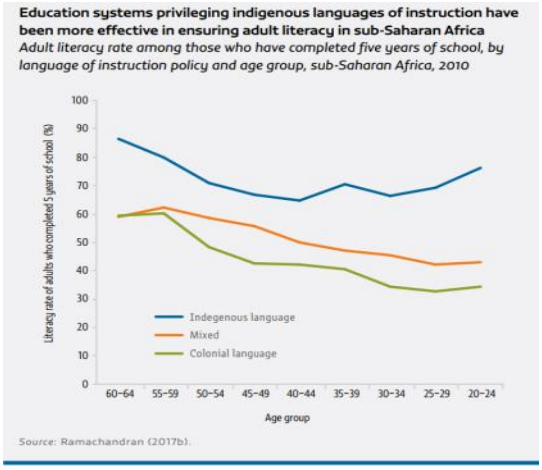

Figure 1 : Literacy among age groups by language of teaching instruction

(Accountability in Education, 2017)

A similar challenge is experienced in Nepal where according to Tove Skutnabb-Kangas (2011), many ITM children who are not taught in their mother tongue leave school early, without having learned much Nepali, not having learned properly how to read and write, without having developed their mother tongue and almost without any school knowledge. Nepali is one of the national languages of Nepal along with English, much like Kiswahili to Kenya. “If the child has the MT as the teaching language, they understand the teaching, learn the subjects … and has very good chances of becoming a thinking, knowledgeable person who can continue the education.” (Tove Skutnabb-Kangas, 2011).

2.3: Systems and Apps Used to Learn or Re-Learn Languages

There are a number of applications currently used to learn languages. The majority of them focus on learning Asian and European origin languages where the focus is on teaching the language on the app rather than having a real person to interact with through the app.

2.3.1: Language Teaching Apps

Language teaching applications provide learning materials through which the user interacts and seeks to learn a language. Pictures are used to communicate words and give impressions of words. This means of imparting knowledge is flawed as the methods through which adults learn vary. Also, this is a method commonly used to teach children language which is highly effective due to the fact that children have little to no knowledge of language therefore the means by which they may comprehend attachment of a word or concept to an object is through direct representation. Some language teaching apps are commonly known such as: Duolingo and Rosetta Stone. Duolingo being a free app while Rosetta Stone is a paid app.

Challenges

Adults already have knowledge of objects and concepts, making this method of teaching irrelevant. Also, it proves difficult to achieve a reliable understanding of the unique grammar rules depending on context. These apps are also difficult to use for an absolute beginner as at the very least, a user requires knowledge on the phonology of the desired language, phonetics being the sounds present in a language while phonology studies the contextual variations of sound in a language (Gussmann, 2002). These apps also lack the capability for a learner to ask any questions and clarify.

2.3.2: Language Exchange Apps

Language exchange applications link learners of a language to native speakers. These applications differ from getting a tutor for the language since having a tutor is a one-way

learning situation while having a language exchange partner is a two-way learning situation. Websites such as conversionexchange.com and mylanguageexchange.com allow individuals to practice interaction in the language. They allow individuals to interact via chat, email or even as a pen pal. Some popularly used language exchange applications are: HelloTalk, Bilingua, HiNative and Tandem. The stated applications allow for language exchange in first and second world languages.

Challenges

In order to effectively use language exchange applications or websites, the user must have a working knowledge of the language. They must know how to communicate in it on a basic level therefore these applications cannot be the first means of interaction with the language. They may be used in the case of full immersion in the language where someone can interact with other native speakers.

2.3.4: Learning Apps Using Mother Tongue in Kenya

Currently, there is a learning app available in Kenya focusing on a number of mother tongues. M-lugha is a Kenyan mother tongue based educational app that is focused on teaching rural ECD level children. The app has different versions which facilitate learning of English, Kiswahili and Mathematics in their mother tongue. Currently, the app has versions in 19 Kenyan vernaculars. There is no app currently available that deals with the issue this system aims to solve except for a few teaching apps for Kiswahili.

2.4: Gaps in the Existing Systems

The existing technological systems do not connect Kenyans on a local scale to learn their mother tongue. The applications lack the option of learning their vernacular while some provide the option of learning Swahili as a language.

2.5: Conceptual Framework

Below is a conceptual diagram showing how the system functions. The learner logs into the system and authenticates their email and password. If the credentials are accepted, the user selects the language which they are proficient in and the language which they want to meet an exchange partner. From the home page, the user will then be able to interact with other users who would like to do a language exchange. The other learners and teachers will be able to choose to interact with the learner or not. From their interaction, the users will be able to chat and even share pictures.

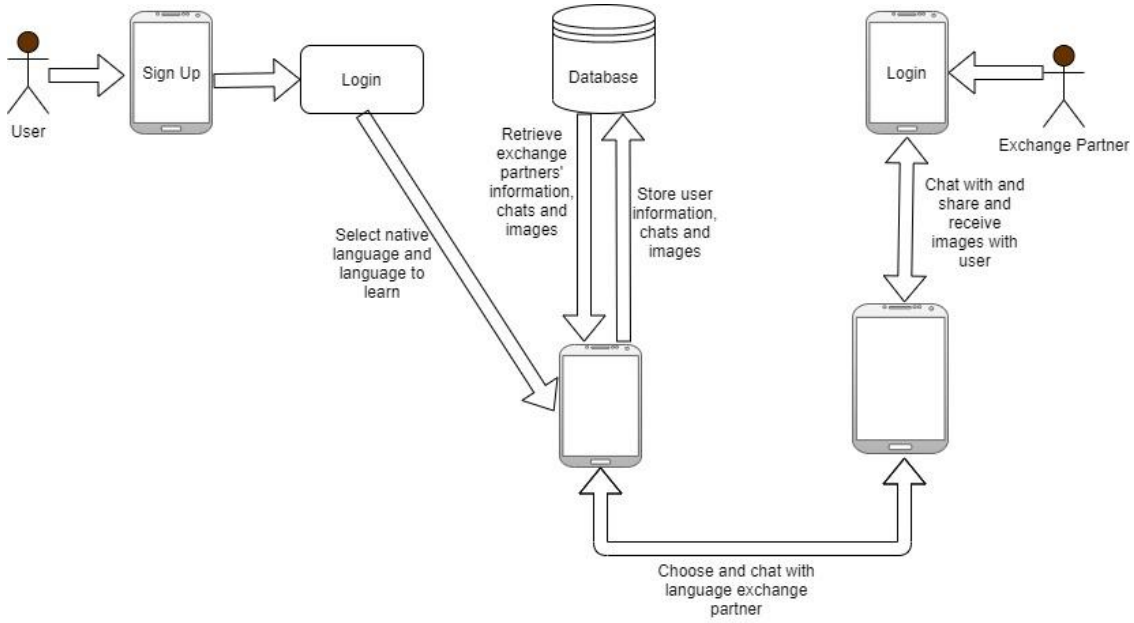

Figure 2: Conceptual Framework

Chapter 3: System Development Methodology

3.1: Introduction

This chapter provides a basic summary of the methodology that will be used to develop the proposed system. The system development methodology will show the methods to be used to create, plan and supervise the development of the system. For the proposed system, the agile software development methodology is most suitable.

3.2: Agile Software Development Methodology

The agile software development methodology uses an iterative approach to software design and development. According to Highsmith (2002), agile development focuses more on the people rather than the processes. This methodology adapts to the system's situation rather than predicts it, allowing for the processes to adapt. According to Denis, Wixom and Roth (2012), agile development is excellent at developing a system with unclear requirements and a short time schedule as in the case of the proposed system.

Figure 3: Agile Methodology (Pisuwala, n.d)

3.2.1: Requirements

This is where the needs of the system are identified along with what the system must do. During this phase, the functionality that is required in the system is defined, determined and specified. These requirements are business requirements, user requirements, functional requirements, system requirements and non-functional requirements. This is all specified to avoid ambiguity in the other phases of software development and in order to meet these requirements to avoid failure.

3.2.2: Design

This is providing the concepts that will be used in defining the system's appearance and functions. The modelling diagrams that will be used are use case diagrams to summarize the expected relationships between actors and the system. Sequence diagrams will be used to display the interaction between active objects in the system.

3.2.3: Implementation

In this phase, the development and coding for the system is done using the tools that will be defined later on in this chapter.

3.2.4: Testing

The system is tested against its requirements to ensure that it functions accordingly and it is tested in other ways to ensure that it has as few problems as possible.

3.2.5: Maintenance

This is the phase where the system is ensured to work accordingly and any changes that need to be made are made. This phase is repeated.

3.3: Analysis

Software requirements analysis entails system requirement determination and specification along with structuring of system requirements. The system applied the object-oriented analysis and design as it focused on data structure rather than procedural structure of the system, allowing for the real-world objects to be captured in a way that is important to the system. In order for effective analysis to be done, the functional and non-functional requirements are defined in the next chapter of this work.

3.4: Tools and Techniques

This section refers to the tools that were used to develop the system.

3.4.1: Android Studio

This is the IDE to be used to develop the application. Since the app will be available on the android platform, this is the best program for use.

3.4.2: Firebase Storage

This is the database used to store the system's image data. It is a lightweight development platform that provides a database.

3.4.3: Flutter

This is a framework used to natively develop mobile and web applications. It allows for fast development while using the dart language, which is an 'open source language developed in Google with the aim of allowing developers to use an object-oriented language with static type analysis.' (Divi, n.d.).

3.4.4: Visual Paradigm

This is a CASE diagramming tool that was used to create diagrams to represent data and system processes.

3.4.5: Cloud Firestore

Cloud firestore is an online database which was used to store the major data for the system as it provides a greater read/write capacity in comparison to firebase storage.

3.4.6: Firebase Authorization

Firebase Authorization allows for simple and secure management of user information, along with allowing an administrator to enable or disable access according to user.

3.5: Methods to be used for Testing

These are the tests that were performed on the system, they are further explained in section 5.2 of this document.

3.5.1: Black Box Test

This test was done without knowledge of the internal structure of the application and is therefore focused on the internal operation of the system.

3.5.2: Compatibility Test

The system was tested on its ability to run well in a different environment. In this case, the different environment was an alternative android device.

3.5.3: Functional Test

This test focuses on the output of the app ignoring the internal components for the tester to view it from a user's perspective.

3.6: Domain of Execution

The application is mobile-based, specifically on Android mobile devices. The android devices shall be the focus of the application because they are numerous in Kenya due to their cost and

most Kenyans are familiar with their use. The application is therefore easily available to the target demographic (Kenyan adults).

3.7: Modules and System Architecture

The modules included in the system are:

a. Account – this module displays the users' information where the user may configure their app and edit information about themselves.
b. Chats – this module displays the conversations that the user has had.
c. Learn – this module allows for the users to add and edit any words that they have learnt during their conversations.
d. Meet – this module allows for users to find each other and view another user's information.

Chapter 4: System Analysis and Design

4.1: Introduction

This chapter purposes to provide the identified system requirements and highlight the approach taken in gathering the requirements, both functional and non-functional during the system analysis stage. The design methodology employed was object – oriented analysis and design.

4.2: Requirements Gathering

The requirements for the system were gathered using the qualitative method. Individuals within the target population were interviewed to analyze the problems faced when attempting to communicate in and learn their mother-tongue. A major problem faced in learning mother tongue is the lack of varied written material in mother tongue, lack of vocabulary and lack of desire to learn the language.

4.3: System Requirements

The system requirements are the needs of the system in order to function on a device. For a mobile device, it must be an Android device with at least 2GB RAM (Random Access Memory). The device must also be using a language-compliant keyboard such as Microsoft SwiftKey Keyboard which provides the special characters for Kenyan indigenous languages to be used.

4.3.1: Functional Requirements

The functional requirements for the system are:

a. Authentication – the users are able to use valid credentials to enter the system.
b. User communication – the users are able to use the application to interact with other users.
c. Data storage – the system is able to store the conversations between users and the sent data.
d. Sharing images – the users are able to send and receive images.

4.3.2: Non-Functional Requirements

The non-functional requirements for the system are:

a. User – friendly interface – the interface is easy to use without too much complexity.
b. Performance – the system can be accessed easily with quick response times since its core is communication.

c. Flexibility – for future versions the same code base may be used for both Android and iOS devices.
d. Non – repudiation – the implementation of the database allows for tracking of messages between users.
e. Reliability – the user data in the system is kept secure from outside tampering.

4.4: System Architecture

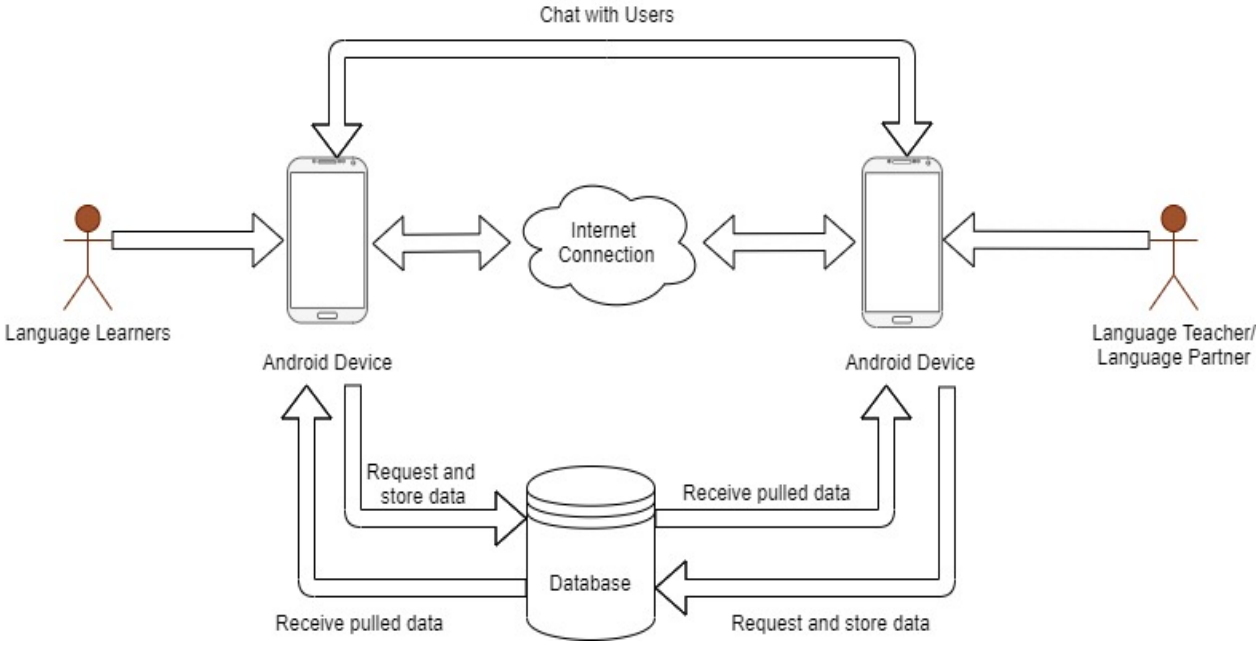

Figure 4: System Architecture Diagram

The system architecture composes of the application which functions through the use of android devices, an internet connection and the presence of the database, which stores the system's data. The application can be accessed by users who can add and edit their own information.

4.5: Analysis

This section contains a diagram that may be used to clearly display the interaction between users and the operations that may be undertaken.

4.5.1: Use Case

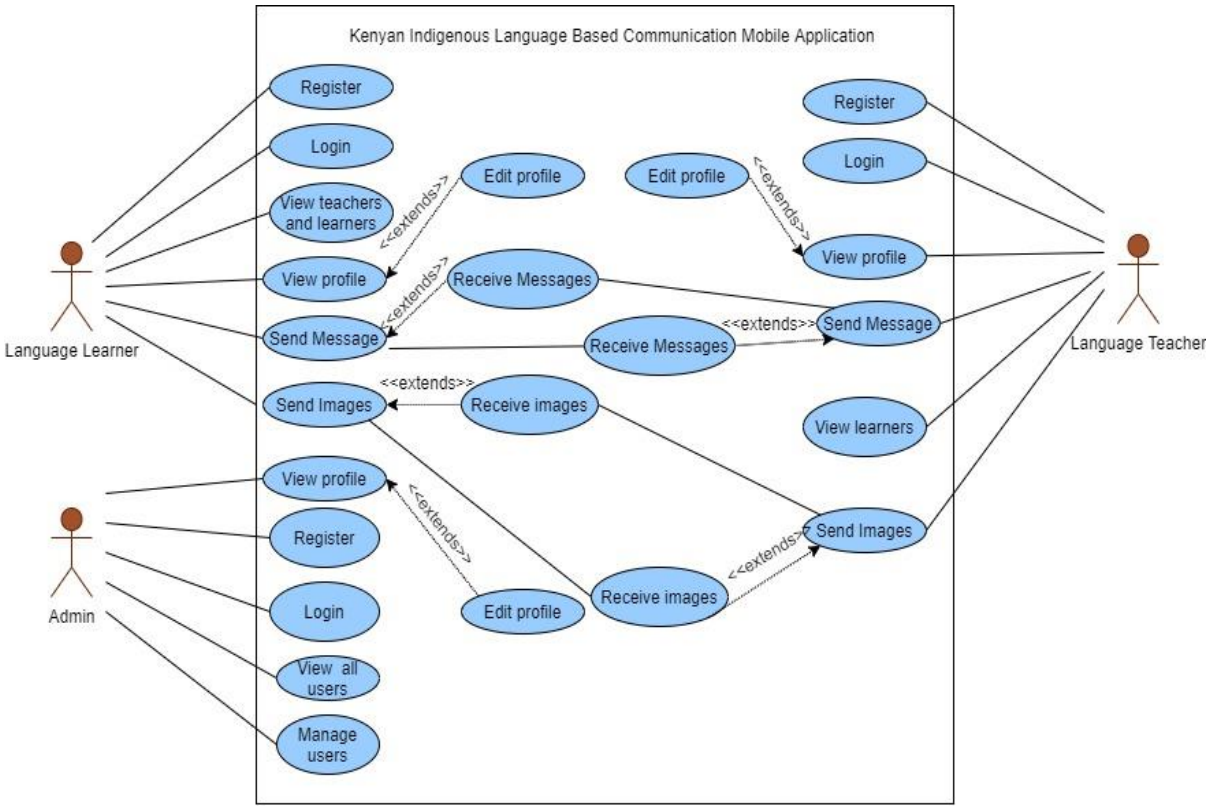

Figure 5: Use Case Diagram

The above use case diagram displays the users of the system while the requirements for use are represented by the use cases.

4.5.1: Sequence Diagram

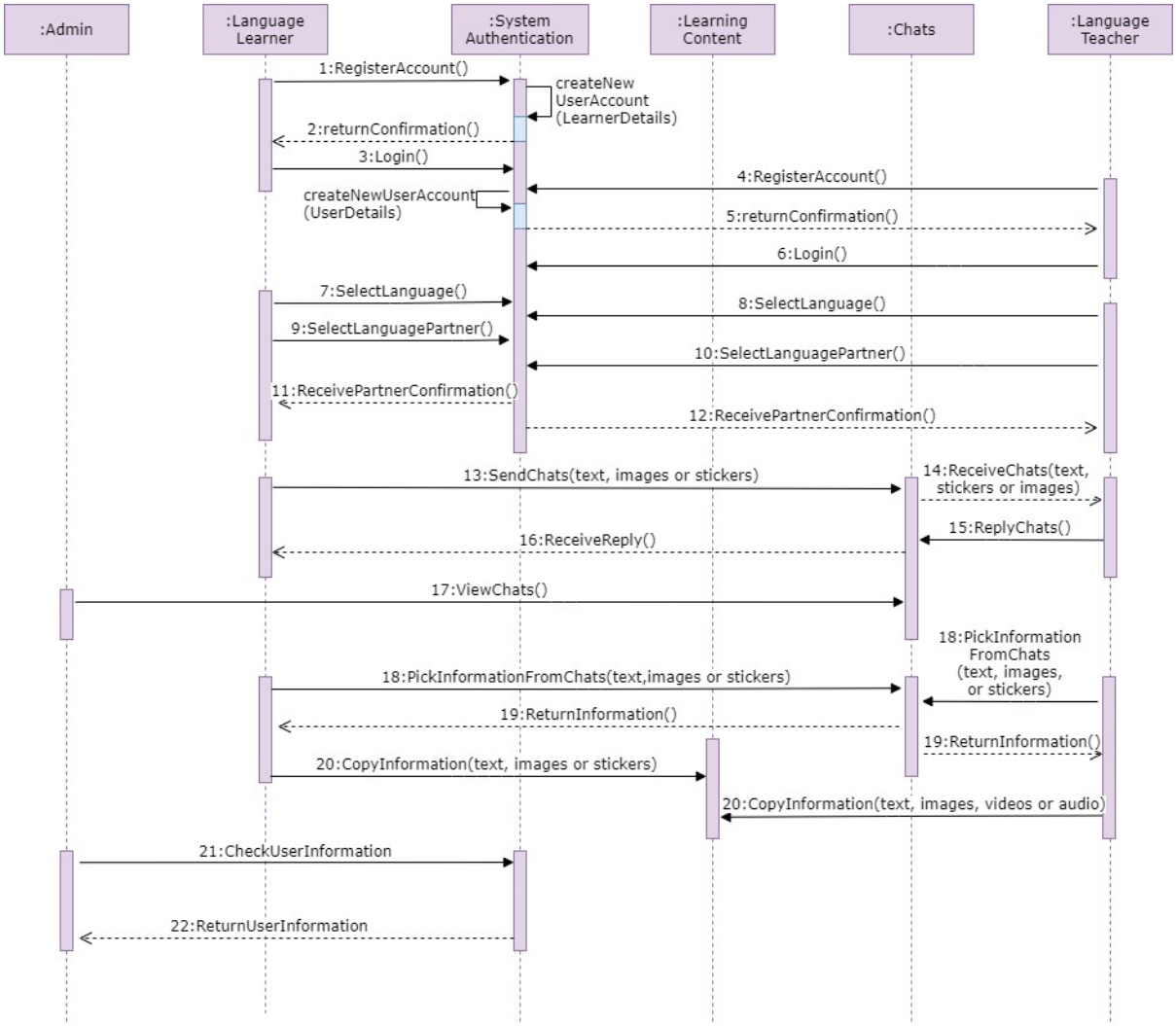

Figure 6: Sequence Diagram

4.6: Designs

This section contains the diagrams depicting the design of the system.

4.6.1: Database Schema

Due to the use of firestore which is a noSQL database, the below database schema is a representation of the database in terms of the relationships between collections with documents and the data stored in fields within the database. Firebase Storage is used in order to store images due to a larger capacity provided. The data in firestore is arranged hierarchically in a JSON tree, thus an accurate representation would be as in Appendix B. The database schema in mySQL would be as below.

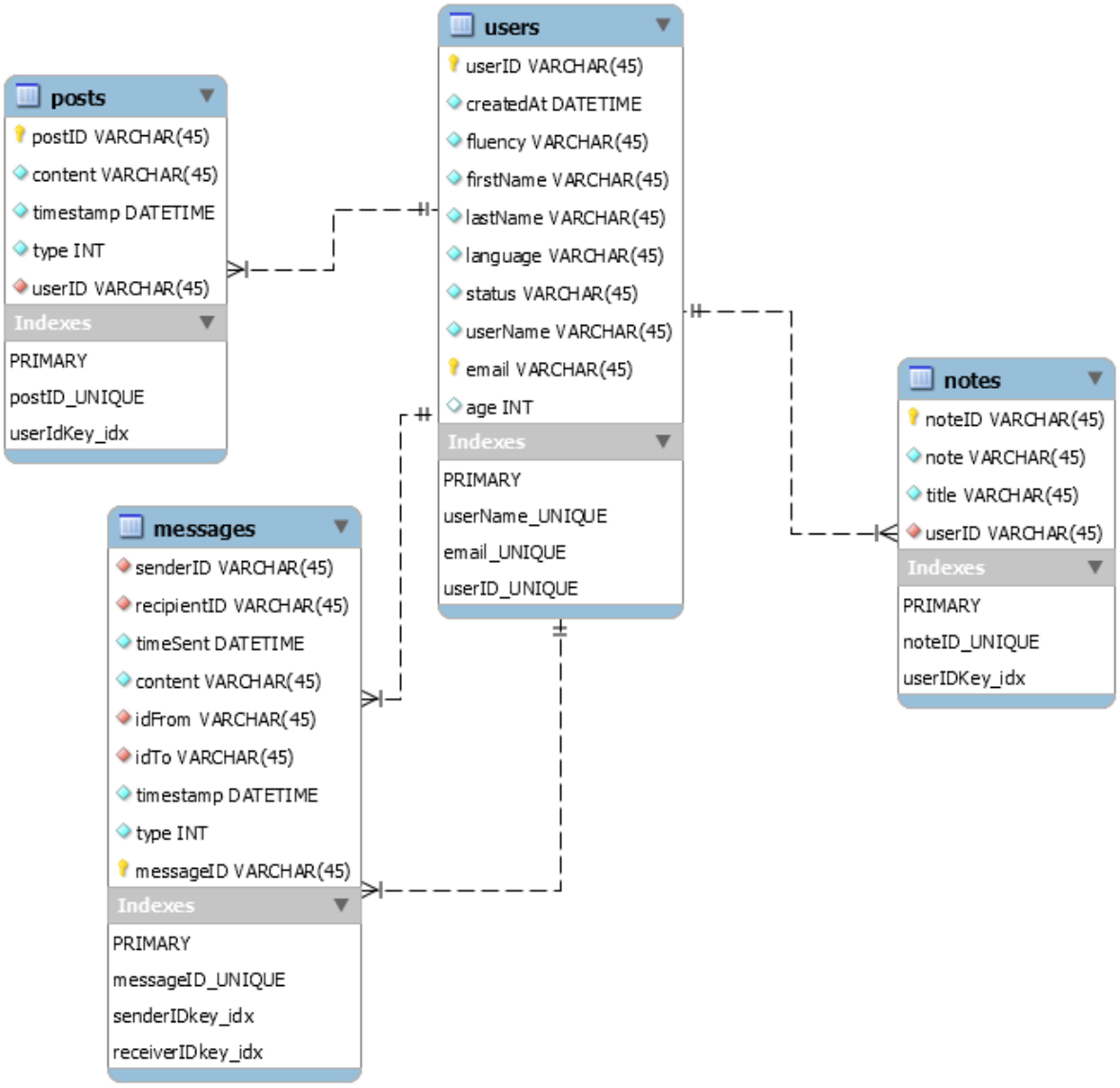

Figure 7: Database Schema

4.6.2: Class Diagram

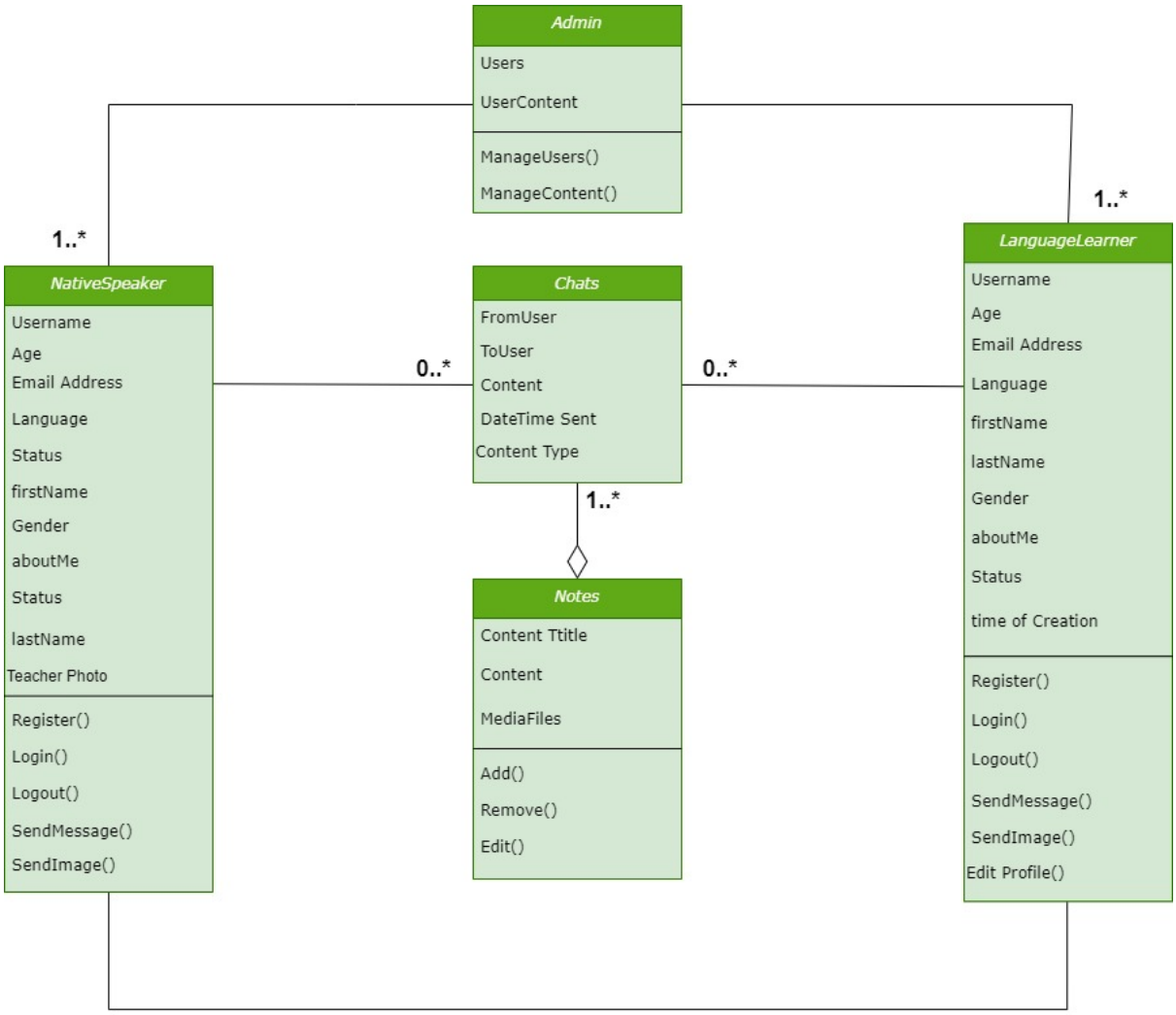

Figure 8: Class Diagram

4.6.3: Entity Relationship Model

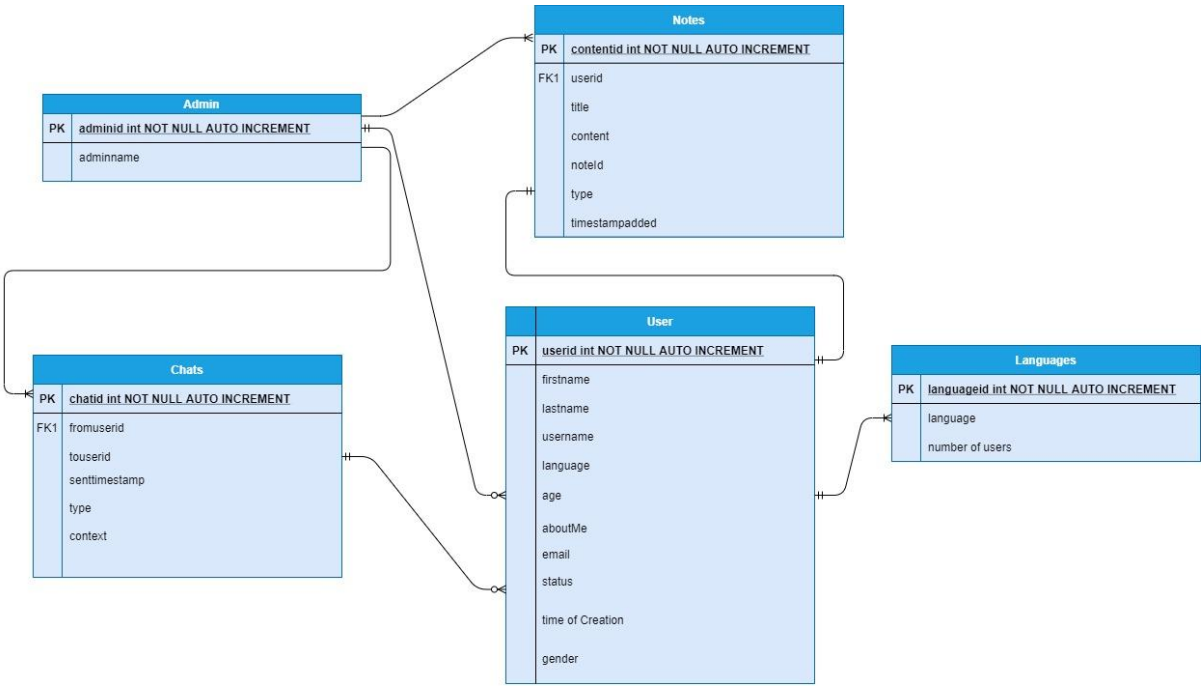

Figure 9: Entity Relationship Diagram

Chapter 5: System Implementation and Testing

This chapter purposes to describe the manner in which the system was developed along with the tests done on it.

5.1: Testing

This section focuses on the system, what it does and whether the requirements of the system have been met. The testing assists in the detection of system failures and defects which allowed for their rectification.

5.1.1: Black Box Testing

This method of testing was used on the system in order to check on the usability of the system from the perspective of the end user. An interactive user interface was implemented using colorful flutter widgets. The interface is low in complexity with clear labeling of pages. The reports were numerous in classification thus a pie chart was utilized to clearly represent all user groups registered in the system.

5.1.2: Compatibility Testing

The application was tested for compatibility using a 1GB RAM Android device, named device A and with a 3GB RAM Android device, named device B. Both devices are of the same relative age, with device A running Android 8.1 Oreo. It is a light version of Android thus does not provide the full features of the operating system while device B runs on Android 8.0.0, which is a regular Android version. The application ran slightly slower on device A and failed the performance requirement on this device. The unused dependencies in the application were dropped, after which, performance improved significantly in terms of loading, read and write time.

Having been developed using the flutter framework, the application is flexible as it can be used on the Android operating system and the iOS operating system thus it is compatible with a majority of smart phones.

5.1.3: Functionality Testing

The application satisfied all of the functional requirements by allowing users to register and login with email validation. The application also allows user to sign out successfully. The application allows users to communicate between each other in chats and with many users at once in posts. The application is able to store the information sent between users locally on the device and in the firestore firebase, satisfying the data storage requirement. The application has

a user – friendly interface as seen in the section 5.3 below. The use of Firebase Authentication keeps user passwords safe, even from administrators, thus satisfying reliable information to be loaded. Users are not able to delete messages they send, thus satisfying the non-repudiation requirement for the application.

5.2: System Implementation

The system was implemented using Android studio using the dart language in the flutter framework. Cloud firestore and firebase storage were used to store text and image data from the system respectively. The register and login pages were developed first for authentication of email and password, after which the bulk of the system was created.

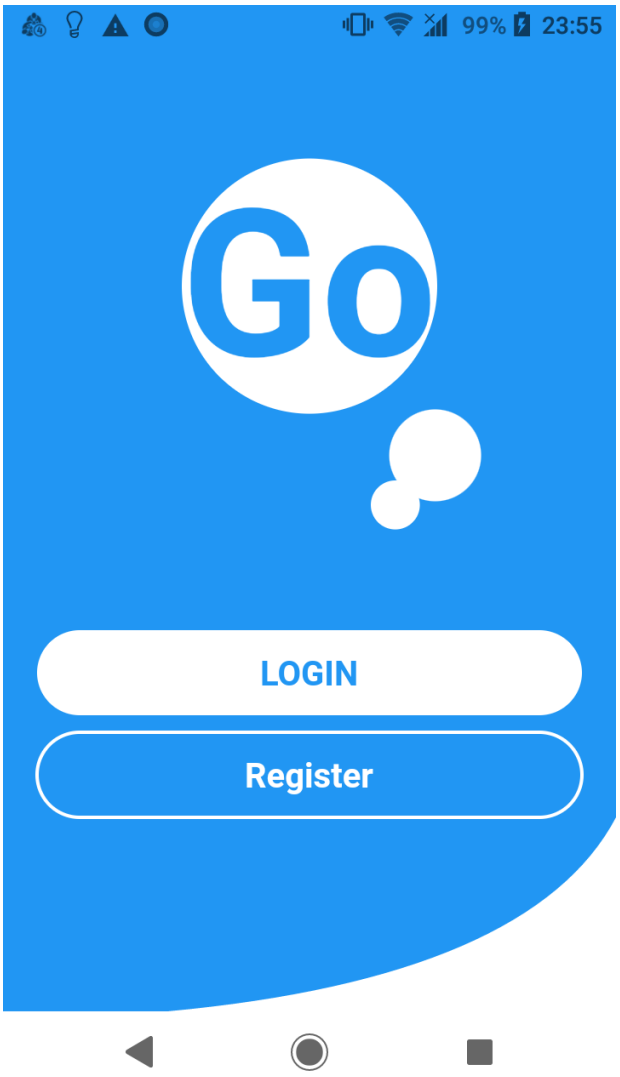

Figure 9: Landing page

Chapter 6: Conclusions, Recommendations and Future Works

6.1: Conclusions

The increased focus of mother- tongue based education in Kenya today may lead to a younger generation having fluency in their mother tongue. While the young adults in urban areas today have little understanding of it may lead to a gap in communication between these closely related individuals. The observation of events such as 'International Mother Language Day' to promote multilingualism and cultural diversity impresses the need to know more about mother tongue and the culture associated with it (IAFOR, 2017).

6.2: Recommendations

In order for the Kenyan indigenous language communication system to function accordingly, the Android mobile devices used must be connected to the internet during use. The user must also register using an accessible email address due to the email verification implemented.

6.3: Future Works

The application is a functional system according to communication among users. Some functionalities may be added into the system by future developers to further improve upon it. The system may be improved by the implementation of a quiz maker in order to increase interaction between the learners and teachers while providing a semi-formal means of interaction between the two. To increase the association among the users, the locations of the various users may be added to allow for meetings

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Appendix A – Time Schedule

Below is a representation of the project duration.

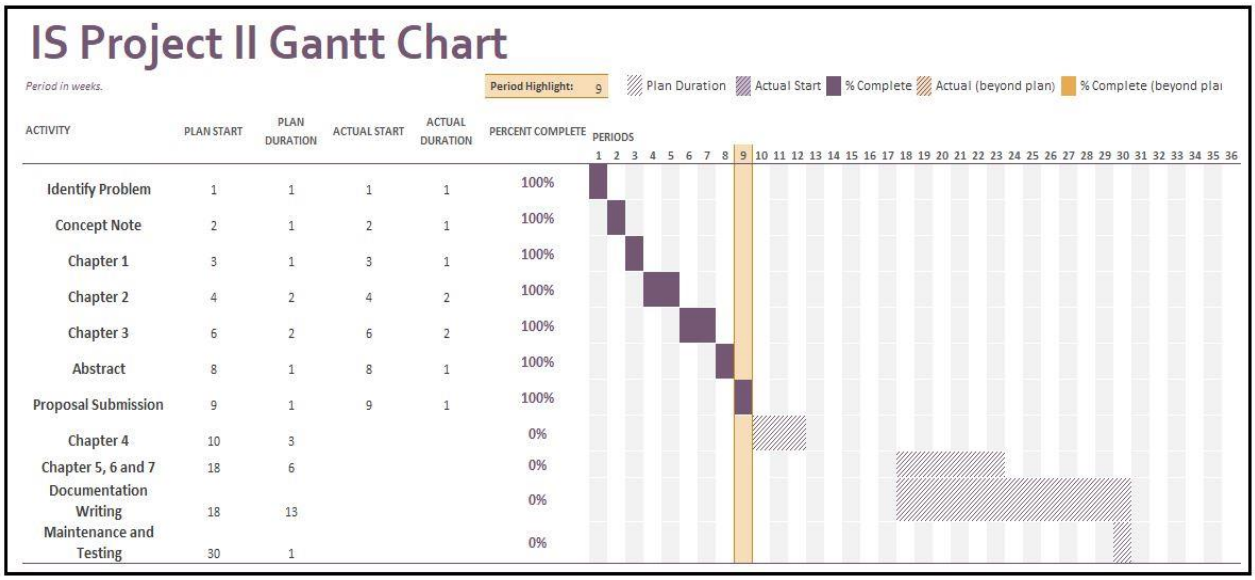

Figure A. 1: Gantt Chart

Appendix B JSON Tree for Cloud Firestore

```
{
  'users': {
     'userID' : {
        'createdAt' : 'data',
        'fluency' : 'data',
        'firstName' : 'data',
        'lastName' : 'data',
        'language' : 'data',
        'status' : 'data',
        'userName' : 'data',
        'email' : 'data',
```

```
        'age' : 'data',
        'aboutMe' : 'data'
        'photoUrl' : 'data'
              }
  'posts' : {
     'postID' : {
        'content' : 'data',
        'postID' : 'data',
        'timestamp' : 'data',
        'type' : 'data',
        'userID' : 'data'
              }
  'notes' : {
      'noteID' : {
        'note' : 'data',
        'title' : 'data'
         }
   'messages' : {
      'senderID' : {
        'recipientID' : {
            'timeSent' : {
                'content' : 'data',
                'idFrom' : 'data',
                'idTo' : 'data',
                'timestamp' : 'data',
                'type' : 'data'
                      }
                    }
                }
             }
}
```