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Development of a Web-Based Kasem Language Learning System

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The concept of language involves using words in an organized and traditional way, be it through speaking, writing, or gesturing, as a means of human communication. The inability to communicate efficiently in a specific language is known as language barrier. Such limitation can result in difficulties performing everyday tasks and create challenges on a global levels, such as when businesses move to other nations or on a local level, like when a family or student moves to a region where English is not the primary language. The effects of linguistic barriers can negatively impact the quality of life for everyone involved, regardless of the context. In this paper, the researchers have designed and implemented a web-based Kasem language learning system (KLLS). The technology provides audio output, with corresponding text in the Kasem language to the end user, allowing them to study and become fluent in it. High-level Python web framework, Django, was used to develop and implement the system. Finally, a series of tests were conducted by different levels of users. Each end user reported a high level of satisfaction with the system after navigating through and receiving a clear audio output.

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1. INTRODUCTION

"Human language is the most complex behavior on the planet and, at least as far as humans know, in the universe. Language involves both the ability to comprehend spoken and written words and to create communication in real-time when individuals speak or write. Most languages are oral and generated through speaking. Speaking involves a variety of complex cognitive, social, and biological processes, including the operation of the vocal cords, and the coordination of breath with movements of the throat, mouth, and tongue" [1]. "*Speaking* is one of the most important skills to be developed and enhanced as means of effective communication. *Speaking* skill is regarded one of the most difficult aspects of language learning. Many language learners find it difficult to express themselves in spoken language. They are generally facing *problems* to use the foreign language to express their thoughts effectively. They stop talking because they face psychological obstacles or cannot find the suitable words and expressions" [2]. "Human communication is a social interaction process. It is an essential part of human daily life. It is a process of creating, exchanging, and sharing ideas, information, opinions, facts, feelings, and experiences between a sender and a receiver. Communication is fundamental to the existence and survival of individuals, groups, societies, and nations. Language is the most common tool of communication. It plays a vital role in helping people build a bridge of relationships. At the same time, language acts as a destroyer of bridges of human relations because it separates people from each other. Language remains a barrier to conveying messages to people in the globalization and communication era. Language barriers are a common challenge in international business, aviation, and social settings. They affect human daily life" [3]. "Obtain a second language is a valuable asset that goes beyond communication. It enables individuals to make new friends by bridging linguistic and cultural gaps, while also facilitating their adaptation and integration into new communities. By embracing a second language, individuals and enrich their social interactions, broaden their perspectives, and create lasting connections in their new environment. A good level of interaction or communication between individuals in a society is not only important but also critical to ensure the high quality of relationships and successful business transactions. Effective interaction and communication play vital roles in fostering understanding, trust, and cooperation among people, leading to a harmonious and thriving social fabric. When individuals interacts and communicate well with each other, they create a foundation of mutual respect and empathy. It allows them to exchange ideas, thought, and perspectives, promoting a sense of inclusivity and openness within the society, this exchange of information and understanding enables people to build meaningful connections, bridge cultural differences, and appreciate diverse viewpoints. Human communicate through language. It is well known that our new life is highly affected by the era of information technology, and technology plays an important role in today's human society development" [4]. "Given this reality, it is crucial to leverage modern technology to assist in the process of learning the Kasem Language. The term New Technology includes communication techniques for language teaching in which the personal computer plays a central role" [5]. "The effect of technology has become huge in teaching and learning the language in addition to the instructor's role. In other words, the role of the instructor together with the role of the technology can lead to advanced learning results" [6]. The rest of the paper is organized as follows; Section 2 presents a review of related works, the methods, and tools deployed to develop the system in Section 3, and test implementation results of the system are presented in Section 4, whiles Section 5 concludes the paper.

2. LITERATURE REVIEW

"Kasem is a Central Gur language belonging to the Northern Grusi group, the only representative of this group to be found in Ghana. The language homeland is in the Kassena-Nankani district of the Upper East Region, in the recently established Paga district, and across the northern Ghana border in Burkina Faso. The main towns are Navrongo, Paga, and Chiana in Ghana; Pô, Tiébélé, and Guiaro in Burkina Faso" [7]. "The Kassena people are a subset of the Gurunsi Meta ethnicity, a term used to describe a set of ethnic groups inhabiting northern Ghana and southern Burkina Faso, as well as Togo." The Gurunsi people are not closely related to each other, and their classification as Gurunsi comes from a term used

by a Djerma jihadist leader by the name of Baba Ato Zato to describe a group of soldiers recruited from multiple different ethnic groups within the same region. According to Doctor Salif Titamba Lankoande, in *Noms de famille (patroniemes) in Burkina Faso*, the name Gurunsi comes from the Djerma language of Niger, "Guru-si," which means "iron does not penetrate." It is said that during the Djerma invasions of Gurunsi lands in the late 19th century, Baba Ato Zato (better known by the Hausa corruption of his name: Babatu) recruited a battalion of indigenous men for his army who, after having consumed traditional medicines, was said to be invulnerable to iron. Since then, the term has been used to refer to these people, but they are culturally and linguistically distinct ethnic groups. The Kassena people form an arc of towns, mostly organized as defensive strongholds, from Ouagadougou to northeast Ghana. Historically, these towns were subjects of the Mossi Empire. This area became part of a three-way competition in the late 1890s between French, British, and German colonial forces attempting to subdue Djerma warlords while also fighting the warlike local population, which resisted fiercely to maintain its autonomy while vying to occupy as much territory as possible at the expense of rival colonial powers. Each of the three claimed part of the territory occupied by the Kassena, but the competition between the colonial powers was not resolved until the last year of the 19th century. After establishing the protectorates of Yatenga (1895) and Ouagadougou (1896), the French annexed the Kassena lands in 1897. Eventually, the Germans withdrew to Togoland (modern Ghana and Togo), and an 1898 Anglo-French agreement officially established the boundary with the Gold Coast (now Ghana). This partition divided the Kassena peoples among French and British administrative systems, with some Kassenas living in southern Burkina Faso, notably in the Naouhri province and the cities of Tiebele and Pô, and some living in Ghana, notably in the Kassena-Nankana administrative district, Navrongo, and in the cities of Paga [8]. Currently, the market for language learning programs is vast and varied. Many languages, including widely spoken ones like English, French, and German, have numerous resources available to learners, such as textbooks, online courses, mobile apps, and software. However, there is a noticeable absence of fit-for-purpose Kasem language software. This means that non-native speakers who want to learn the Kasem language are left with very few options, and the ones that do exist may not be optimized for efficient and effective learning. The lack of dedicated Kasem language software can create a significant barrier for people who want to learn the language. They may have to rely on generic language learning tools that do not take into account the unique characteristics and nuances of Kasem. This can slow down the learning process and make it harder to achieve fluency in the language. Moreover, this gap in the market represents an opportunity for researchers and developers to create an innovative, tailored solution for Kasem language learners. By designing and implementing a web-based Kasem Language Learning System (KLLS), the researchers are filling this gap and providing much-needed resources for those who wish to learn the language.

3. METHODOLOGY

The waterfall model is also known as a linear sequential life cycle model. It boasts a straightforward approach, making it easy to comprehend and apply [9]. The model stipulates that each phase must conclude before initiating the next, with no overlap between phases. There are many types of SDLC; however, for this project, the researchers adopted the waterfall SDLC. With this, every module went through requirements gathering, design, implementation, testing, and maintenance. All system development methodologies lead to a portrayal of the system idea as far as processes and data are concerned. They differ as far as whether the methodology places essential accentuation on the business or on the data that supports the business.

3.1 Phases of the Waterfall Methodology

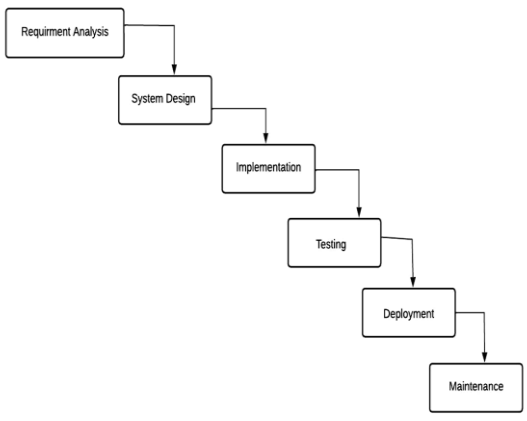

Fig. 1. Structure of the waterfall model

Activities Carried Out Through Each Stage:

The activities carried out through each phase of the waterfall methodology are practically clarified below in sequential order:

3.1.1 Requirements gathering and analysis

The researchers began with a systematic query highlighting the issue of how non-speaker (s) struggle to adapt and relate to native Kasem language speakers. A preliminary examination is then conducted to describe issues related to the language barrier. This evaluation reviewed the anticipated costs and recommended actions based on several factors. The following were considered before moving on to the next step:

1. How effective will the system be after its development?
2. The technical resources needed to develop the system.
3. Maintenance costs.

3.1.2 Analysis

Audio and text are outputs that the system produces. An analysis of the data required to enter the system was carried out. A study of why the system must be made free to access to gain a larger audience for advertisement purposes was also conducted.

3.1.3 System design

At this stage, the technical design requirements were implemented. i.e., data flow and access control by the user. Microsoft Visio software was used to design the following diagrams:

1. Data flow diagram of the system
2. Entity-relationship diagram
3. Use case diagram
4. Implementation

In this phase, the real source code and commands were written, and all the business logic described in the previous steps was implemented. A tool like the Microsoft Visual Studio Code was leveraged. The research considered the Python programming language with the Django web framework the best fit to develop the interface and models.

3.1.4 Testing

The system was taken through some levels of tests, such as

1. Unit testing: where each component of the system was tested.
2. System testing: where some end users and the researcher tested the entire operation of the system.
3. Acceptance testing: This was the final testing phase where the users approved that the system was reliable and can be deployed.

3.1.5 Deployment

Currently, the system is running locally but will soon be developed online.

3.1.6 Maintenance

Here, the recommendations of testers and users were implemented.

3.2 System Database

Database performance is a very important factor in the development of any application. Some applications need very fast feedback, others process a large amount of data and without the support of modern database management systems, and this is almost impossible [10].

The design of the database of this KLLS uses the Django model feature (SQLite3). The system comprises three tables (Admin, Word, and Users); the "Admin" and the "Users" tables are used for storing usernames, passwords, and other credentials that allow the right user to enter the system using a password and username that matches those stored in the system's database. The "Word" table stores text and audio of English words translated into the Kasem language.

Figs. 2, 3, and 4 show the schematic and diagrammatic representations, respectively.

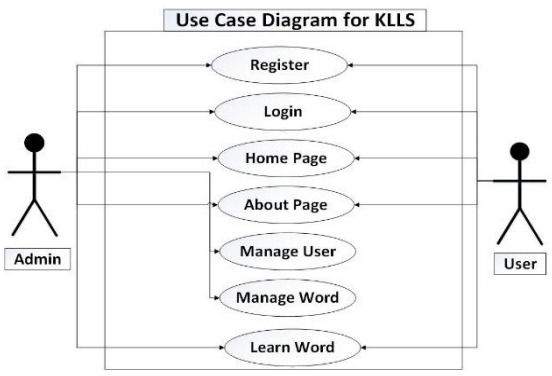

Fig. 2. System's use case diagram

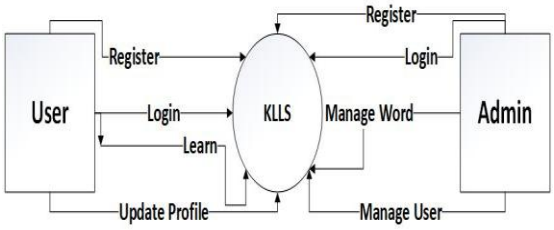

Fig. 3. System's data flow diagram

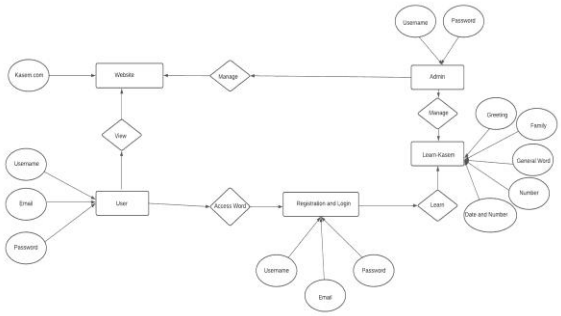

Fig. 4. Systems of ER diagram

3.3 System Development Tools

The software tools that were used to implement this project include:

1. Microsoft Visual Studio Code; this tool enabled the researchers to develop the entire system.
2. Django models were employed to create tables for data storage.
3. Python programming language.

4. IMPLEMENTATION

This is a very crucial stage in system development. This is the very stage where the researchers ensure the information system is operational and that, in its formation, the system quality standard is met. Users of the system are trained on how to handle it and what it will or will not do at this stage.

4.1 System Description

Being web-based, this system would be hosted online. The following are basic system requirements that must be met to access this system:

1. Any Web Browser
2. Hard disk: 100 GB
3. RAM: 2.00 GB
4. Processor speed: 1.1 GHz
5. Any type of operating system

Figs. 5 to 12 show some interfaces of the system after development.

4.1.1 Registration form

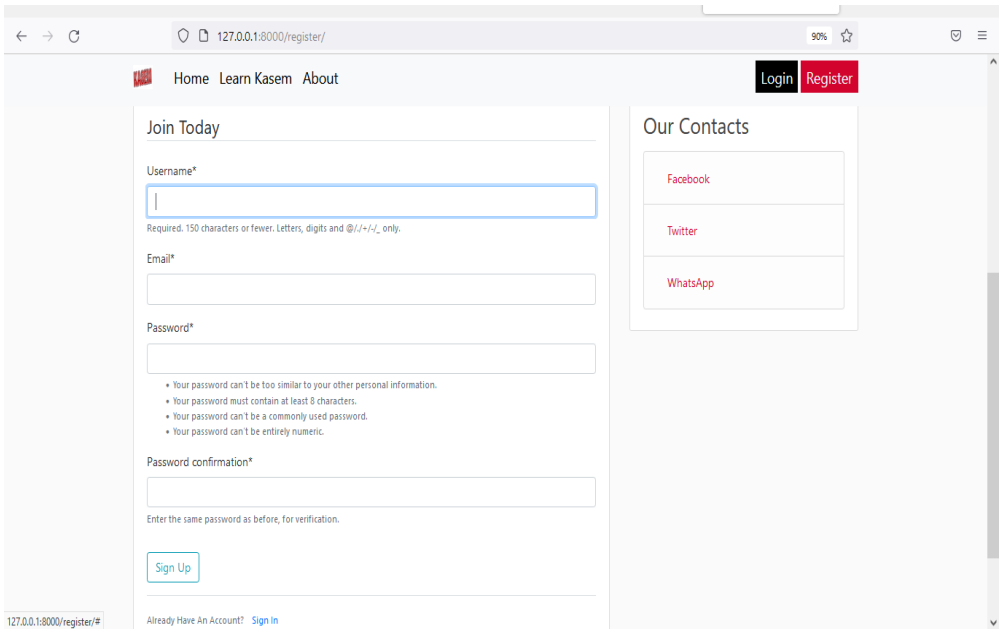

Fig. 5. KLLS registration form

4.1.2 Login form

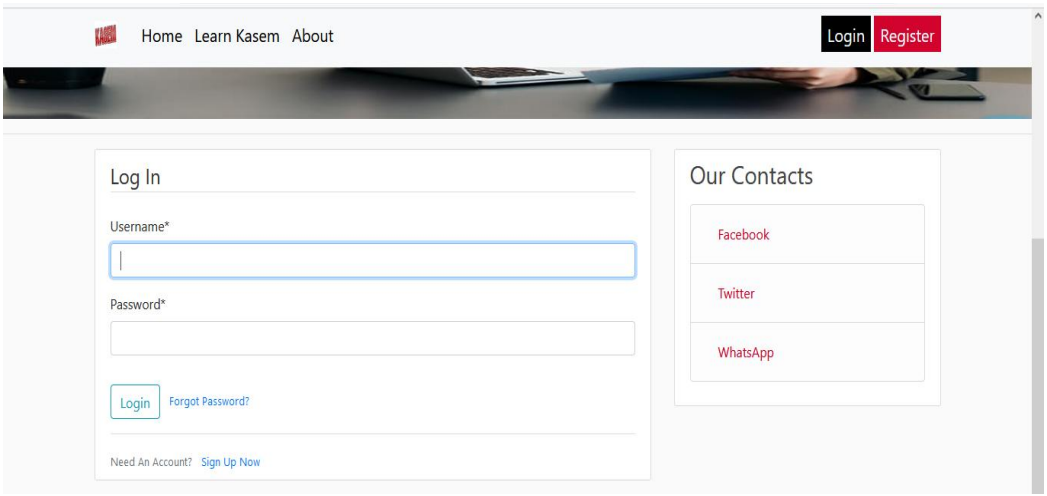

Fig. 6. KLLS Login form

4.1.3 Home page

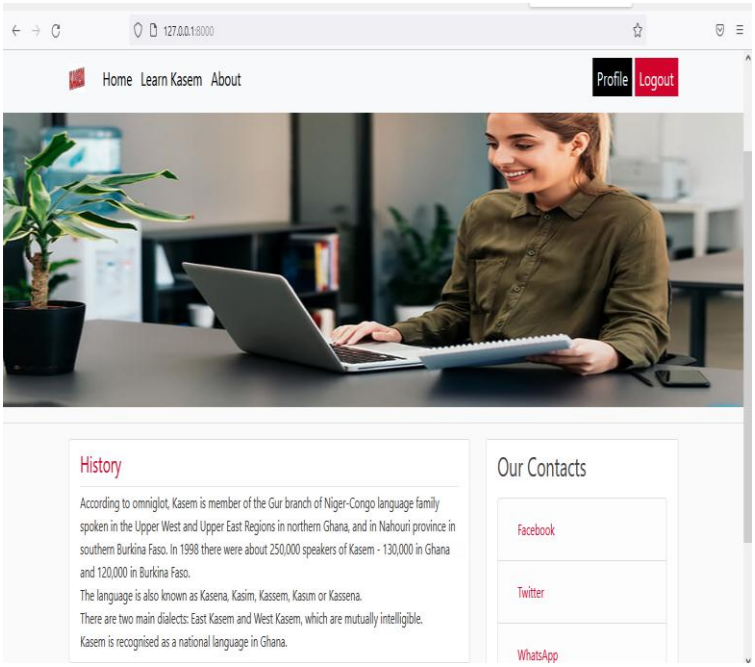

Fig. 7. KLLS homepage

4.1.4 Learn page

The Kasem Language Learning System feature is structured into five (5) categories: Greeting, General Page, Date and Time, Numbers, and Family Tree. Each category consists of a web page with specific contents. The web pages feature multiple audio buttons, each accompanied by an English text. Users can click on these buttons to listen to the Kasem translation of the corresponding English word or sentence.

The General Page includes commonly used Kasem words, while the Greeting Page focuses on words used during the exchange of pleasantries in the Kasem language. The Date and Time category contains information related

to dates and times. The Numbers page is dedicated to counting numbers, and the Family Tree page contains names. Below are categories:

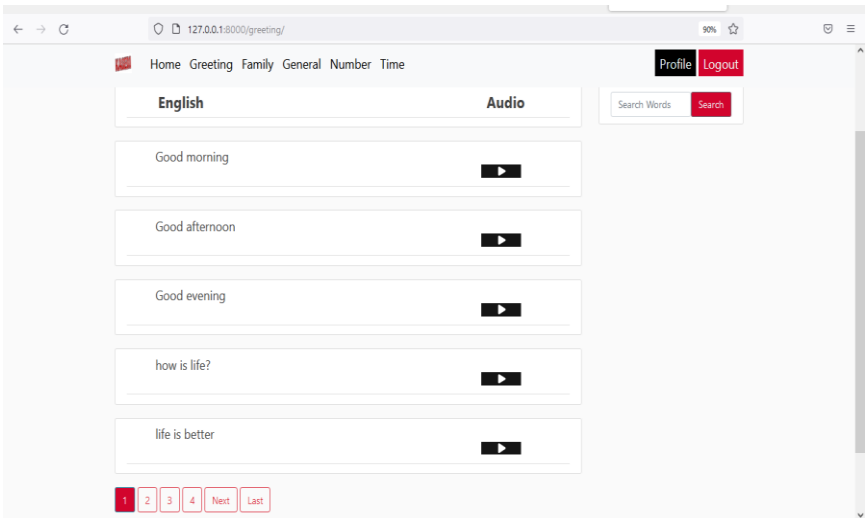

Fig. 8. Greeting page

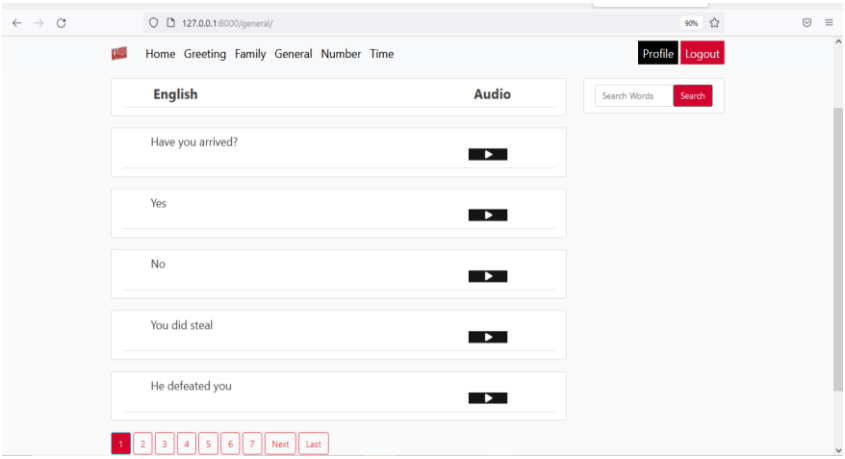

Fig. 9. General page

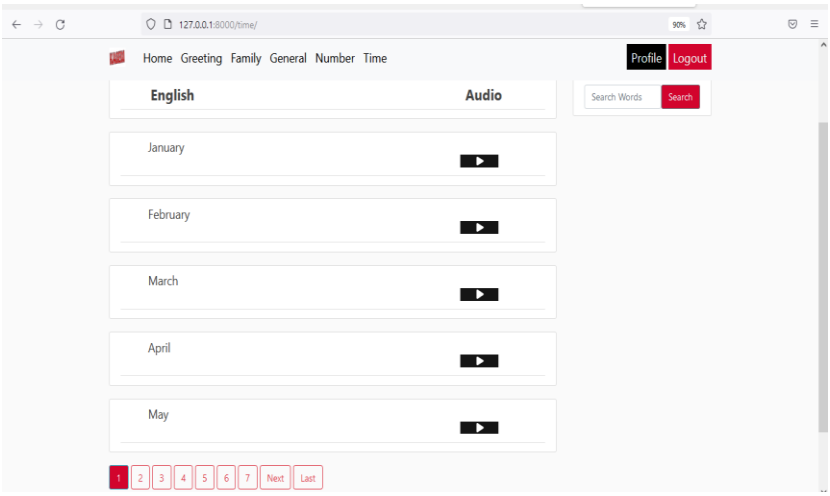

Fig. 10. Date and Time page

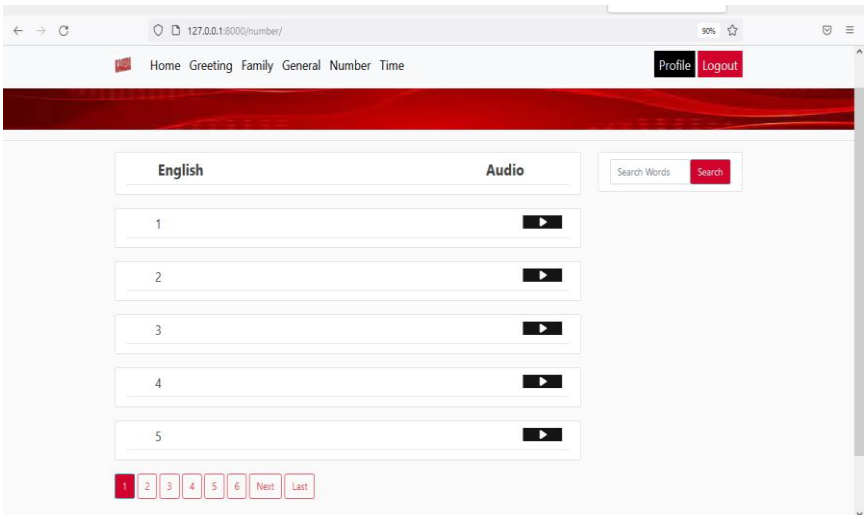

Fig. 11. Number count page

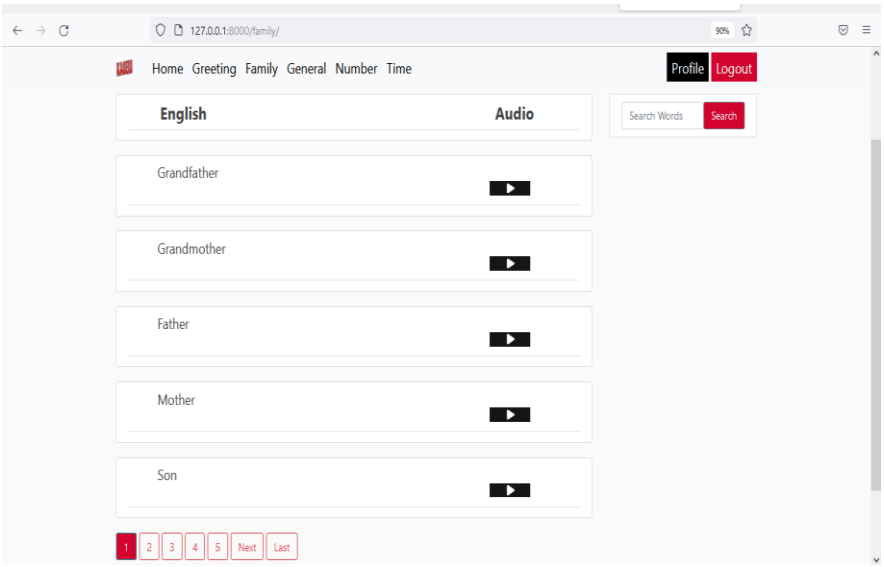

Fig. 12. Family tree page

5. LIMITATION

The Kasem Language Learning System, while beneficial in various aspects, does have certain limitations that need to be taken into account. These limitations primarily revolve around the system's reliance on internet connectivity and the storage capacity required for audio recordings.

Firstly, due to its dependence on internet connectivity, the system's accessibility is restricted in areas with poor or no internet access. This can hinder users in such regions from fully utilizing the language learning resources provided by the system. Secondly, the system's usage of recorded audio and stored text imposes a restriction on the number of words and sentences that can be accessed. Only the words and audio recordings that have been stored within the system's database can be accessed by users. This limitation implies that the available vocabulary and language content may be limited in comparison to the entirety of the Kasem language. Lastly, one potential issue that may arise is the requirement of substantial memory capacity to store the recorded audio files. As the system grows and more audio recordings are added to the database, the need for larger memory resources becomes evident. This can pose a challenge in terms of managing and maintaining a vast collection of audio data while ensuring smooth functionality of the system.

6. CONCLUSION

The web-based system developed for learning the Kasem language has generated significant interest among non-speakers and students. However, the system currently requires internet connectivity, which limits its accessibility in areas with poor or no internet connectivity. To address this issue, future Android application developers should prioritize creating an offline mobile application of the system to increase its reach.

Additionally, further studies should explore the use of AL models, such as Natural Language Processing, speech-to-text, and text-to-speech machine learning algorithms to enhance the user experience. The speech-to-text technology can enable the system to capture and transcribe the user's spoken audio into text that is close to verbatim. The Natural language Processing model can then translate this text into the intended language. Finally, text-to-speech technology can be used to convert the translated text into spoken words, making the system more user-friendly for those who may have difficulty writing or typing.

Overall, the development of an offline mobile application and the incorporation of AI models can significantly improve the accessibility and user experience of the system for learners of the Kasem language.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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