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1. Abstract

Muslims strive to accurately learn and recite the Holy Quran. Traditional methods of recitation verification, however, rely on human verification, which may not be possible. Conversely, the development of intelligent recitation verification technologies based on Natural Language Processing and speech recognition is made possible by the capabilities of Artificial Intelligence (AI).

Al-Maqraa was created to help Muslims with two critical areas of learning and reciting the Quran: pronunciation and memorizing accuracy. As the sacred book of Islam, the Quran is extremely important to millions of people all over the world. It is a religious obligation to memorize and precisely recite the whole Quran.

Al-Maqraa will offer a knowledgeable Quran instructor who will be available 24/7. This will be especially beneficial for employees who work long hours because it will allow them to read for the memorization and pronunciation test during their free time rather than being forced to visit the sheikh at set times that might not be feasible for them. In nations like the USA, Canada, and the EU where there is a majority of non-Muslims, it will be more advantageous for newly converted Muslims. It is difficult to get in touch with sheikhs who are knowledgeable about the Qur'an in these nations, and because of the time differences between them, talking to sheikhs in Muslim countries might occasionally be unsuitable.

Al-Maqraa, that point, seeks to close this gap by offering a highly technological solution that uses speech recognition and analysis to evaluate Quranic recitations objectively.

2. Background

For Muslims, the Quran is a holy book that explores many facets of life and religion and serves as a guidance for daily life. The Quran is divided into 114 chapters, or "Surah سورة," with several verses known as "Ayah آية" in each chapter. There are 6236 verses in the Quran.

The Arabic text of the Quran was revealed, and it has been translated into several languages. The holy Quran should be memorized and recited by every Muslim. Nonetheless, while reciting verses from the Quran, one should pronounce the letters and diacritical marks correctly, such as "Tashkeel التشكيل." It is improper to alter a word's meaning during the recitation of the Quran by changing a diacritical mark or a letter.

2.1. Main Area:

Al-Maqraa project's focus is on the nexus of voice recognition, NLP, and Quranic recitation technologies. Al-Maqraa hopes to offer a virtual Quran

instructor that can assess and help users with their memorizing and pronunciation of the Quran by utilizing these technologies.

Al-Maqraa objective is to empower Muslims in two crucial aspects of Quranic learning: pronunciation and memorization accuracy. Given the Quran's significance to millions globally, the platform strives to create a modern solution that is both accessible and flexible. Al-Maqraa introduces a knowledgeable Quran instructor available 24/7, eliminating the constraints of fixed scheduling for recitation and memorization tests.

2.2. Motivation:

The goal of Al-Maqraa is to help Muslims overcome two significant obstacles: pronouncing the Quran correctly and memorizing it. Because of scheduling conflicts and distance limitations, traditional techniques, which sometimes require a human instructor, are not as accessible. By providing a technical solution that is accessible around-the-clock, Al-Maqraa seeks to close this gap by enabling users to practice and get feedback whenever it is convenient for them.

commitment to making Quranic learning accessible to Muslims globally. In a world marked by diverse time zones, cultural contexts, and accessibility challenges, the platform seeks to break down barriers and provide a universally available solution.

The EU, Canada, and the USA all have sizable and diversified Muslim communities, which is the driving force behind Al-Maqraa. Only 1400 mosques are accessible for the 25,770,000 Muslims in the EU, which restricts access to Quranic education. There are just 200 mosques in Canada, although there are 33,000,000 Muslims, and 2481 mosques in the USA, where there are 3.45 million Muslims. The lack of mosques, which are sometimes not dispersed equally throughout towns, is a major obstacle for Muslims looking for guidance and teaching from the Quran.

Introducing new technology using Artificial Intelligence in the field of the Arabic language and the Holy Quran.

2.3. Main Techniques, Technologies, and Application

2.3.1 Frontend Technology

2.3.1.1. Flutter:

an open-source framework that Google developed. Utilizing the same code, it is used to create apps for several platforms. Consequently, we could utilize it to create an application with the same code that runs on both iOS and Android. It may also be applied to the construction of user interfaces for websites.

Application: Mobile frontend.

2.3.2 Backend Technology

2.3.2.1. Microsoft .NET Framework:

.NET Framework is a robust and versatile software development framework developed by Microsoft. It provides a comprehensive programming model, a vast class library, and runtime support for building and deploying various types of applications. Originally released in the early 2000s, .NET Framework has since evolved into a family of frameworks and technologies that cater to different application scenarios.

Application: Backend of the system

2.3.2.2. PostgreSQL

It's an object-relational database management system that's available for free. It supports user-defined types and application features like XML and JSON. It is safe, dependable, and quick for both read and write operations, making it appropriate for big systems or systems with big datasets.

Application: querying and managing databases

2.3.3 Machine Learning Architecture & Technology

2.3.3.1. Deep Learning

It is a multi-layered kind of neural network and machine learning. It may operate under supervision or independently and mimics the functioning of the human brain. But instead, we'll employ a supervised method with a labeled dataset.

Application: Virtual teacher for the Quran

2.3.3.2. PyTorch

PyTorch is an open-source machine learning framework developed by Facebook. It provides a flexible and dynamic computational graph, making it well-suited for deep learning tasks. PyTorch is widely used for building and training neural networks, and it has gained popularity in the research community due to its intuitive and Pythonic syntax. The framework supports dynamic computation, allowing for easy experimentation and model development.

Application: development of Deep Learning Model.

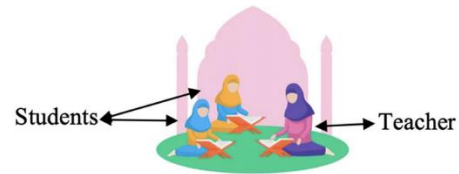
3. Problem definition

Fixed timings for sheik instruction are a common feature of traditional Quranic learning approaches. The lack of a resource that is accessible around-the-clock makes it difficult for people to study the Quran at their convenience.

The absence of immediate feedback on individual Quranic recitation impedes the learning process. Without timely and constructive feedback, individuals may struggle to identify and rectify errors in their pronunciation and memorization.

Regretfully, all the systems available for memorizing the Qur'an simply check if the text has been committed to memory; they do not check to see if the pronunciation is correct.

Traditional Quran Recitation and Memorization Approach:



Online Quran Recitation and Memorization Approach:



Al-Maqraa Approach:



Fig. 1 Traditional and Al-Maqraa Quran recitation Approach

4. Related Work

4.1. Commercial applications

1. **Tarteel.ai**^[1]: Using deep neural networks, this speech recognition-based Quran application facilitates reading and memorization of the Holy Quran. The program offers a memorizing mode where the user may record his memory of the Quran while the verses are concealed. Words will emerge when they are correctly spoken by the user. On the other hand, if a word is mispronounced by the user, it will be highlighted in red. Additionally, the program has audio search features for both verses and chapters. You must purchase the Premium edition of the program to access all its features. The application concentrates on accurately spoken words without considering Tajweed rules and word diacritical. This edition has a monthly fee of \$7.50.

2. **Tamkeen**^[2]: A Quran application that uses speech recognition technology to facilitate reading and memorization of the Holy Quran. In the memorizing mode, the verses are buried until the user successfully recites them. Until the user corrects his recital, a mispronounced verse will remain hidden. The program prioritizes accurately spoken words above Tajweed rules and word diacritical marks.

3. **Tasmee**^[3]: A Quran application that uses speech recognition technology to facilitate reading and memorization of the Holy Quran. AI-based personal

recitation is one of the services it offers. Additionally, the program offers a memorizing mode in which all of the verses disappear unless they are said properly by the user. Sharing one's recitation with others is another feature that it offers. Because the program takes into account Tajweed restrictions, it might not be appropriate for novice users.

Features	Al-Magraa	Tarteel.ai	Tamkeen	Tasmee
Supported platform	Android and IOS	Android and IOS	Android	Android and IOS
Price	Free	\$7.50 per Month	Free	Free
Support diacritics?	Yes	No	No	No
Connect the verse with the next?	Yes	No	Yes	Yes
Type of error the app focuses on	Obvious errors and Hidden errors	-	Obvious errors	Hidden errors
Streaks	Yes	Yes	No	No
Session history	Yes	Yes	No	No
Memorization progress	Yes	Yes	No	No
Limitations	Don't Support Offline	Does not consider obvious errors, such as missing the first letter of a verse Does not ensure that the learner reads the verses in the correct order Don't Support Offline	Encounters some speech recognition errors	Encounters some speech recognition errors Sometime doesn't Recognize the correct word

Table 1 Comparison between Al-Magraa and the Other applications

❖ Main difference between Al-Maqraa and the other application:

Al-Maqraa offers free access to its extensive Quranic learning platform, in contrast to many of its rivals who charge a monthly fee.

Al-Maqraa does an excellent job of supporting Arabic diacritical marks, which helps students pronounce and recite words correctly. This feature improves the learning process overall and distinguishes it from rivals.

Al-Maqraa goes beyond simple error identification to focus on both obvious and concealed faults. this ensures that the student Pronounced correctly.

Al-Maqraa facilitates the seamless connecting of verses, hence enhancing the accuracy and fluidity of recitation. With a correct comprehension of the verse sequence, this function improves the user's capacity to memorize and recite the Quran.

Memorization progress monitoring, session history, and streaks are all available in Al-Maqraa. These tools provide students the ability to track their progress over time, encouraging continuous involvement and development.

4.2. Existing Literature Reviews

Table 2 Topics covered in previous review papers.

Subject	Basic Information		Recitation recognition	Recitation verification	Traditional speech recognition methods	End-to-end speech recognition methods	Audio feature extraction techniques	Datasets	Mobile applications	Traditional Models	End-to-end Models
	Authors	Year									
Quranic Verse Recitation Recognition Module for Support in j-QAF Learning: A Review [4]	Zaidi Razak.et al	2008	✓	✗	✓	✗	✓	✗	✗	ANN HMM VQ	
Improve design for automated Tajweed checking rules engine of qur'anic verse recitation [5]	Noor Jamaliah & M. Y. Zulkifli &Zaidi Razak	2011	✓	✓	✓	✗	✓	✓	✗	HMM MLLR	
Quranic Verses Verification using Speech Recognition Techniques [6]	Mohammed.et al	2015	✓	✓	✓	✗	✓	✗	✗	ANN HMM VQ	
Automatic speech recognition for the holy Qur'an, a review [7]	Bilal Yousfi1 & Akram M Zeki	2016	✓	✓	✓	✗	✓	✗	✗	MFCC HMM	
Verification system for Quran recitation recordings [8]	Sherif Mahdi Abdo & Ayat Hafzalla	2017	✓	✓	✓	✗	✓	✗	✗	ANN HMM VQ	
Deep Diacritics-Based Recognition Model for Arabic Speech[9]	Sarah S. Alrumiah	2023	✓	✗	✓	✓	✓	✓	✗		TDNN-CTC RNN – CTC Transformers
Intelligent Quran Recitation Recognition and Verification: Research Trends and Open Issues [10]	Sarah S. Alrumiah	2023	✓	✓	✓	✓	✓	✓	✓	HMM GMM VQ K-Means SVM TDNN	LSTM MaLSTM HMM+BLSTM

As shown in Table 3, work from the review articles that have already been published on Quran recitation voice recognition and verification. The specifics of conventional voice recognition techniques, which rely on linguistic and acoustic models as well as pronunciation dictionaries, were covered in the brief review studies that are now available [4–10]. The preprocessing and feature extraction approaches were also covered in those works. The first review paper on Quran recitation recognition was released in 2008 and included the first attempts at recitation recognition using the Sphinx toolkit [4]. Furthermore, a revised version of [5] including Quran recitation verification efforts was published in 2011. Moreover, other review articles addressing voice recognition and verification efforts for traditional Quran recitation were released in 2015 [6], 2016 [7], and 2017 [8]. Verification methods have also been proposed in [6, 8].

The authors of [8] suggested a verification method to recognize the user and fix them when a recitation error happens. However, a verification method based on matching steps—that is, matching the uttered words with the target words until the recitation stops—was presented by the authors in [6].

Consequently, the current review papers have just covered the conventional speech recognition technique. On the other hand, this work addresses both end-to-end and conventional voice recognition techniques used for Quran verification and recitation. Additionally, while Quran learning mobile applications were covered in [9], the instructor's real-time audio-based recitation recognition and verification applications were not included. In order to highlight the existing shortcomings and restrictions in practical applications, these kinds of applications are demonstrated in this study. Therefore, this study's distinctive contributions are as follows: • It covers all voice recognition and verification work related to Quran recitation from 2006 to 2021.

- Taking into account efforts relevant to both conventional and end-to-end voice recognition.
- Talking about the limits of the real-time, instructor-free mobile applications for recitation identification and verification that are now available.

5. Project Specifications

5.1. System Architecture

We'll employ a tiered architecture in which every layer communicates with every other layer.

❖ Presentation layer:

In charge of overseeing user engagement with the system.

❖ Business Layer:

Responds to requests from the display layer, applies logic to them, and retrieves data from the data layer.

❖ Data Layer:

In charge of keeping track of the data and establishing a connection to retrieve it from the back end.

consists of a Redis database that handles caching and a local database.

5.2. Stockholders

Developers: The team responsible for designing, developing, and maintaining the mobile application are key stakeholders. They need to ensure that the application meets technical requirements, is user-friendly, and functions smoothly.

Users (Muslims): The primary stakeholders are the users who will be using the Quran recitation mobile application.

Experts: Inclusion of experts in Quranic studies can provide valuable insights into the accuracy of the recitations, and the overall educational value of the application.

Testers: Responsible for quality assurance and testing play a role in identifying and fixing bugs, ensuring the application's reliability, and providing a smooth user experience.

AI engineer: crucial component of our creative team since they help create and use state-of-the-art AI solutions. These experts are focused on creating, refining, and

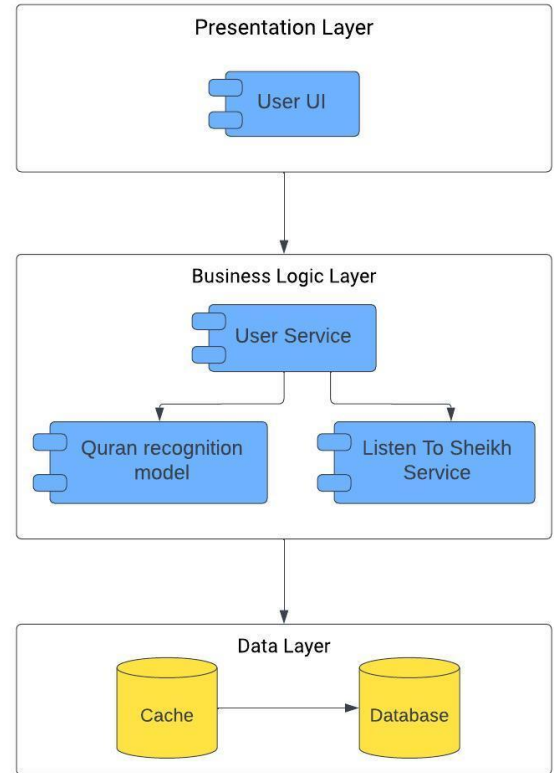


Fig. 2 System Architecture

using AI models to improve our goods and services. To smoothly incorporate AI technology, they collaborate closely with software engineers, data scientists, and other cross-functional teams.

5.3. Functional requirement

User Authentication: Users will be able to create accounts and log in securely.

Quran Recitation: Users can recite a specific (Surahs) and (Ayahs).

Quran Memorization:

Users can access a dedicated section for Quran memorization.

Include audio prompts for users to repeat and practice memorized verses.

Listening for Imam:

Provide a feature for users to listen to recorded Quranic recitations by renowned Imams.

Allow users to choose their preferred Imam for recitations.

Bookmarking and Favorites: Users will be able to bookmark specific (Surahs) or (Ayahs).

Daily Tracker:

Implement a daily tracker to record and display the user's Quranic activities.

Provide visual representations of daily progress and achievements.

5.4. Non-functional Requirements:

Performance: Response time for user actions will be within acceptable limits.

Scalability:

The system will handle a growing number of users and content without affecting performance.

Reliability: The application will be available 24/7 with minimal downtime.

Security: Protect user data from unauthorized access.

Compatibility:

The application will be compatible with different versions of mobile operating systems and with various mobile devices and screen sizes.

Usability:

The user interface will be intuitive and easy to navigate.

Provide accessibility features for users with disabilities.

Maintainability:

Implement a maintainable code structure for easy updates and future enhancements.

5.5. Machine Learning Architecture

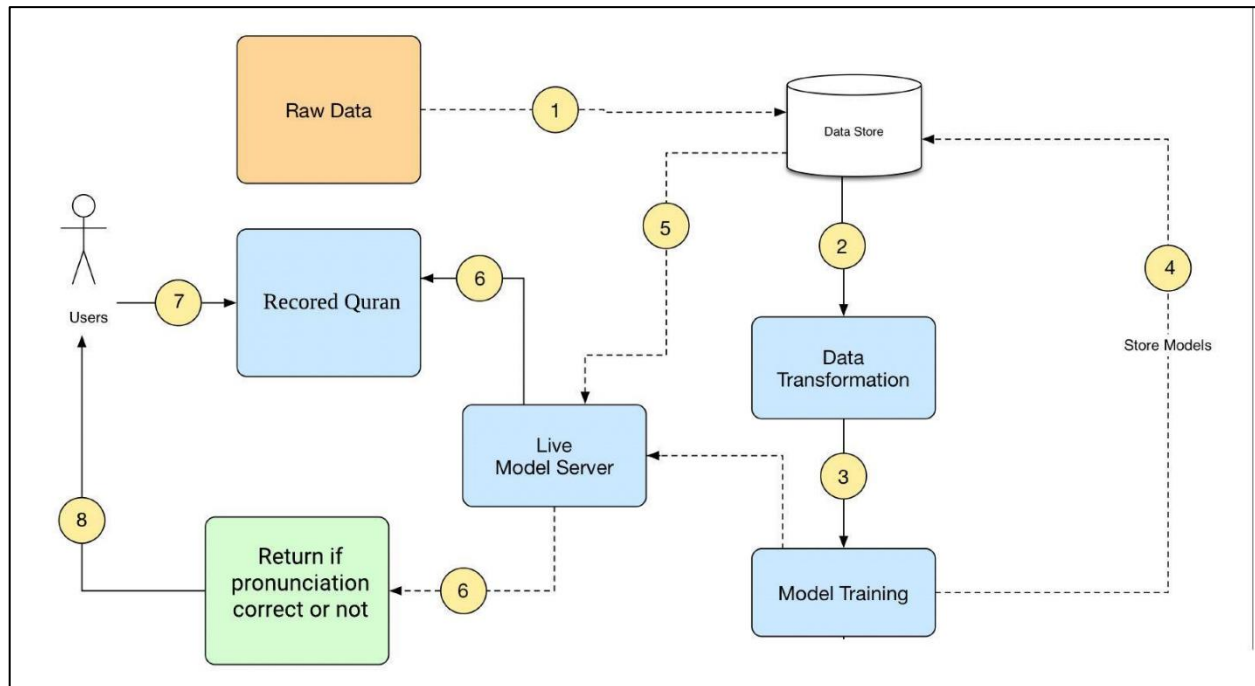


Fig. 3 Machine Learning Architecture

5.6. Data Collection

Table 3 Dataset Collection

References	Dataset size	Covered chapters	Number and type of reciters
[¹¹]	7*6236 wav file	The whole Quran	7 expert male reciters
[¹²]	1509 Wav File	قَالُوا لَا عِلْمَ لَنَا بِإِنَّكَ أَنْتَ عَلَّامُ الْغُيُوبِ	1159 Female, 350 Male
[¹³]	232365 Wav File,43GB	The whole Quran	38 expert male reciters
[¹⁴]	7.5 hours of recorded recitations	Different Quran verses	68 men and 100 women

5.7. Use Case Diagram

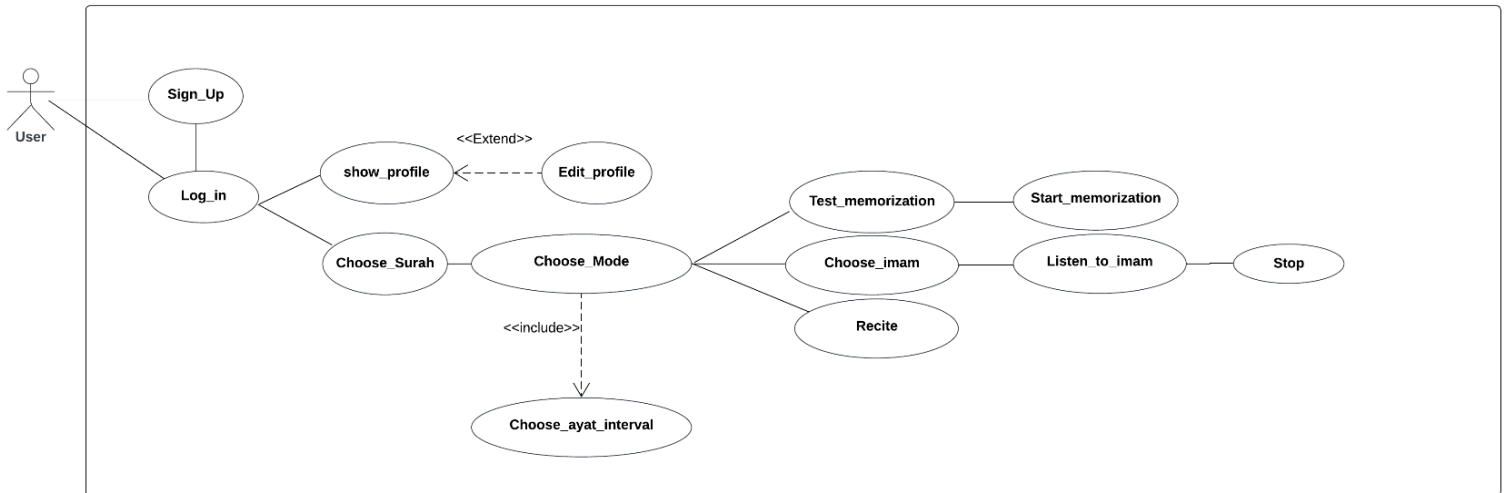


Fig. 4 Use Case Diagram

5.8. Class Diagram

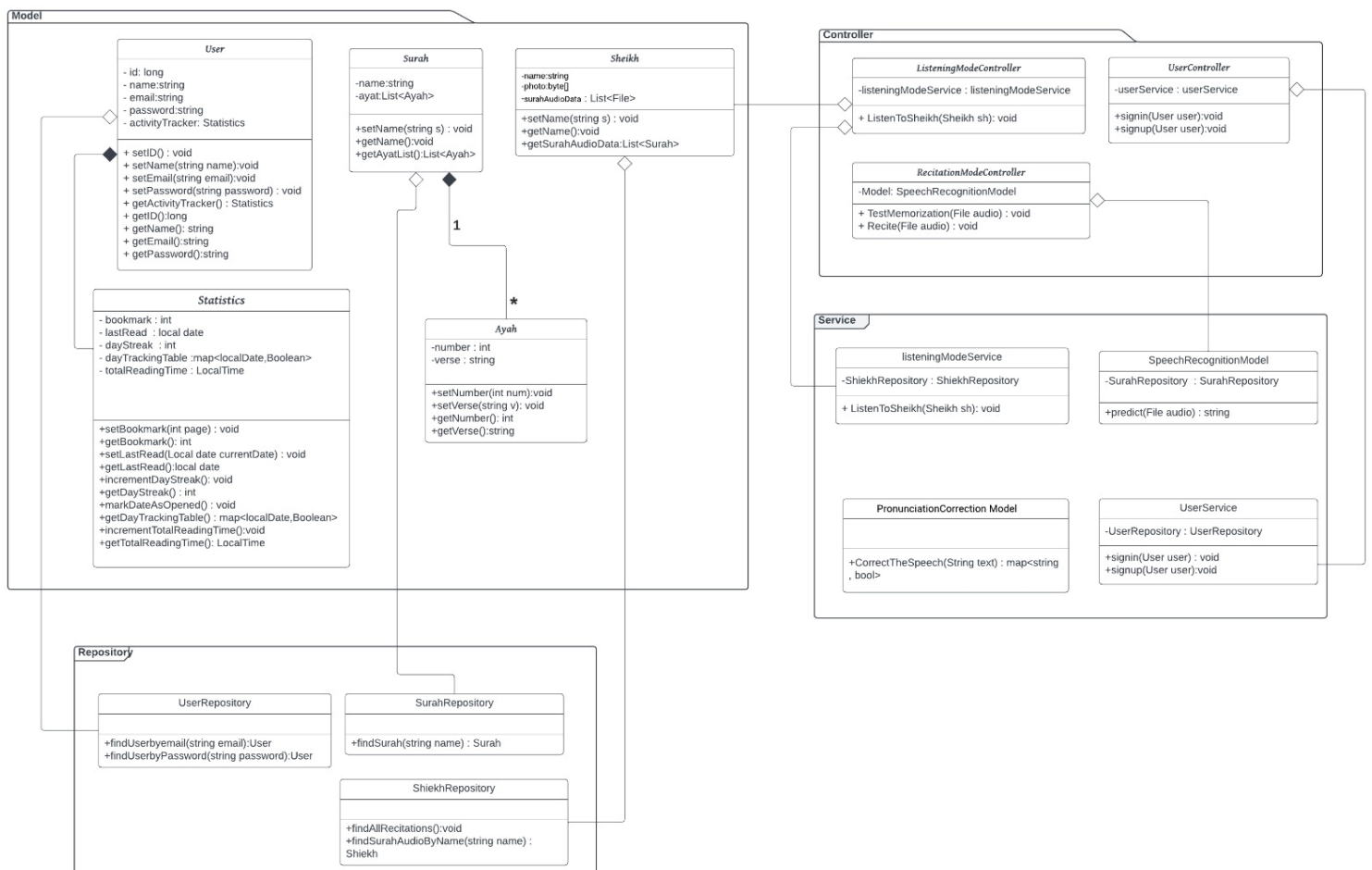


Fig. 5 Class Diagram

5.9. Entity Relationship Diagram (ERD)

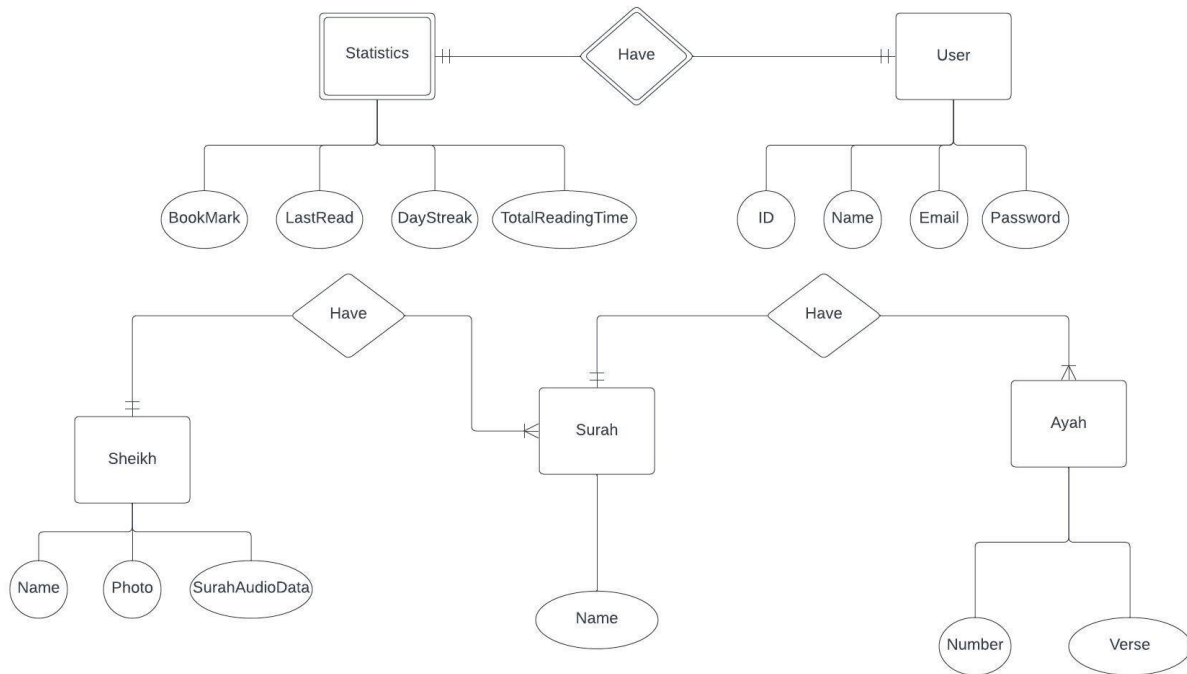


Fig. 6 ERD

5.10. Sequence Diagram

5.10.1. User Choose to listen to Quran.

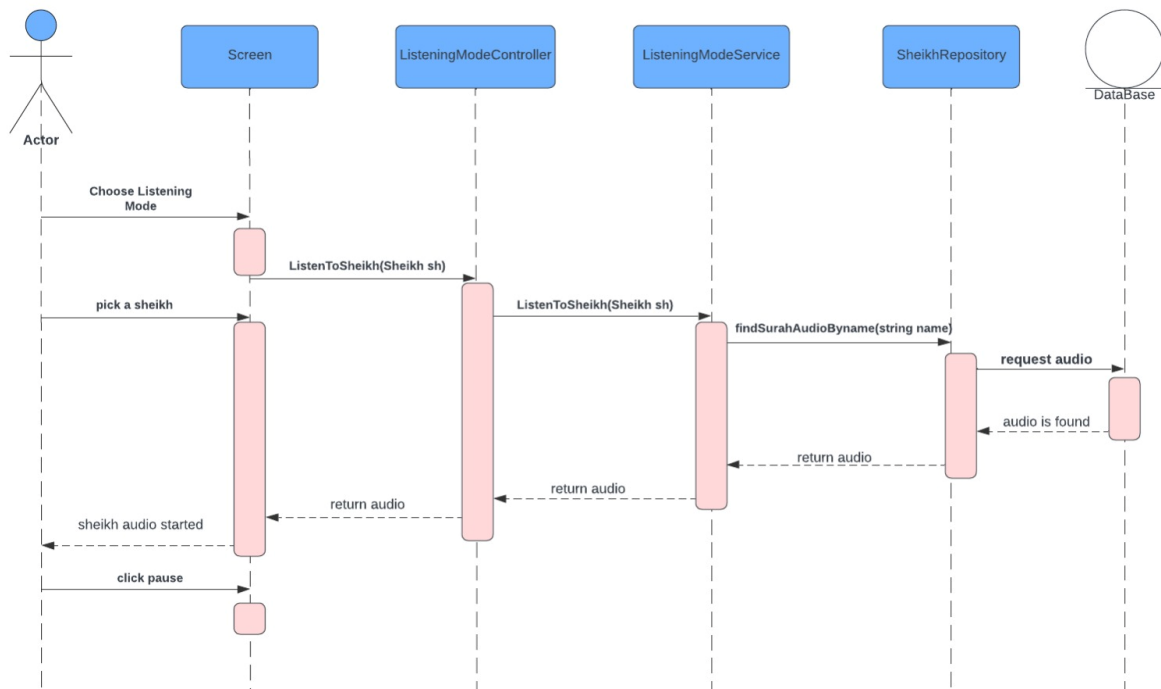


Fig. 7 User Chooses to listen to sheikh

5.10.2. User Choose to Recite to Quran.

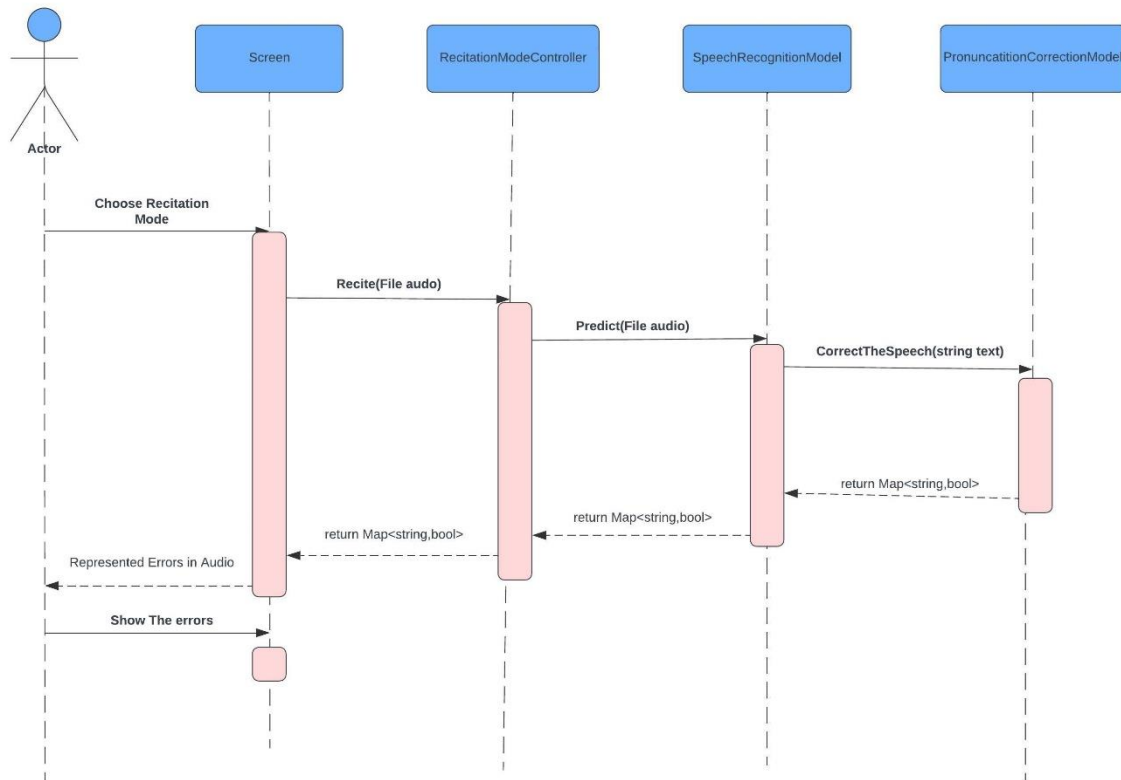


Fig. 8 - User Choose to Recite Quran

5.10.3. The user chooses the Quran memorization test.

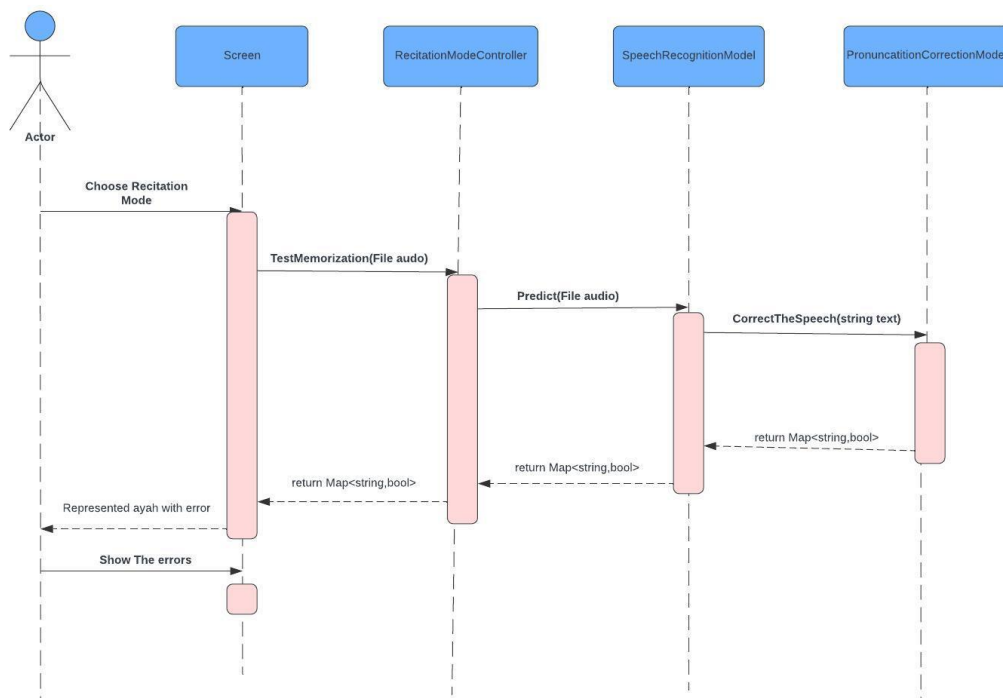


Fig. 9 - Quran memorization test

5.11. User Experience

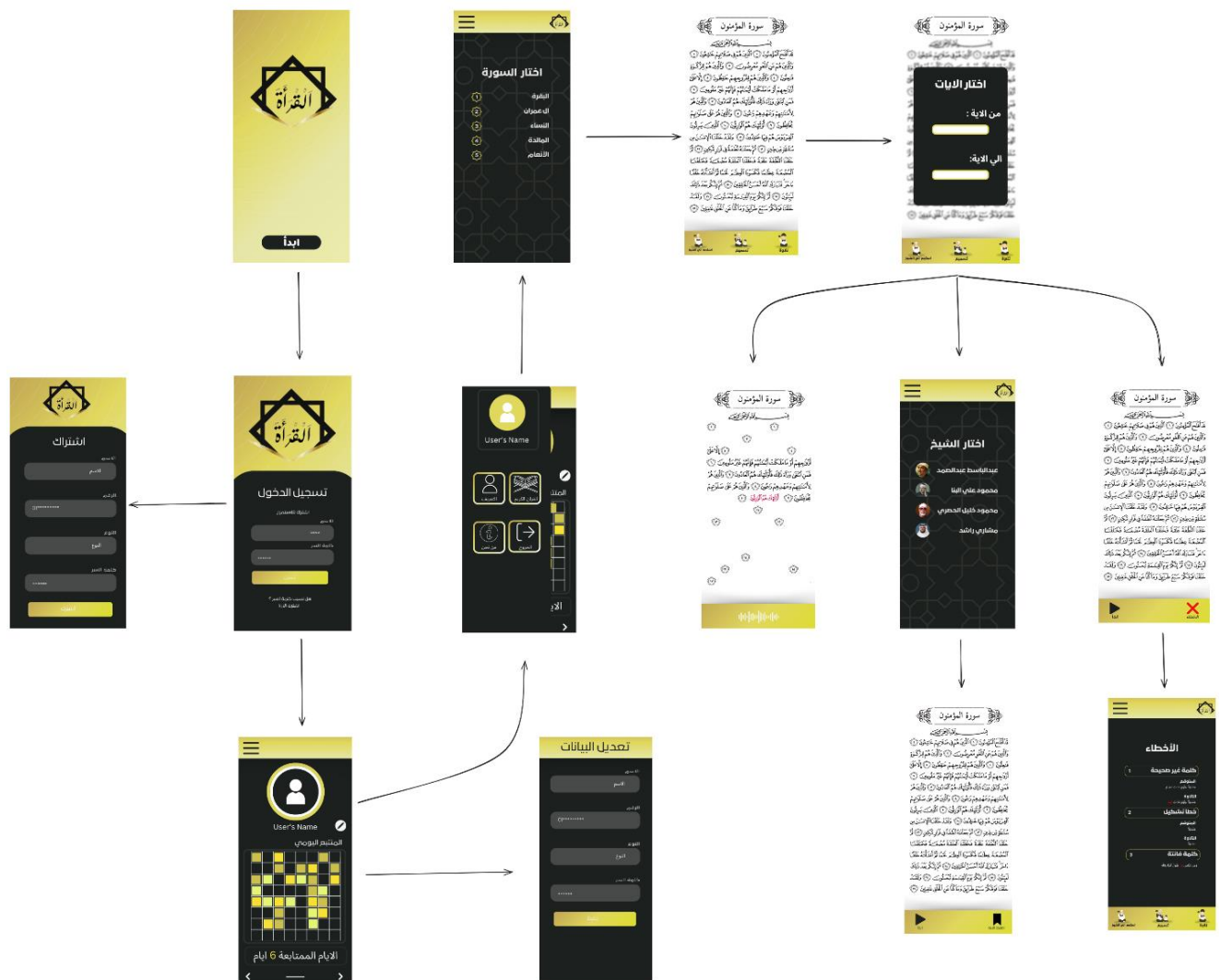


Fig. 10 User Experience

6. Work Plan & Gantt Chart

No.	Task Title	Description	Status
1	Searching for related work	Search on the internet for some research like our project Studying and understanding our collected similar research to our project.	Completed
2	Collecting Datasets	Searching for different useful datasets to help us in our project.	Completed
3	Project Analysis	Making System Analysis.	Completed
4	Study the needed Technologies	Studying deep learning algorithms such as LSTM and Transformers	Working on
5	Study the needed Technologies	Studying Flutter and Fast API and ASP .Net	Working on
6	Page views	Implement the different pages of the application.	Completed
7	Mid-year Document	Writing the Mid-year Document to describe our project.	Completed
8	Project Design	Making design for the project.	Completed
9	Data Preprocessing	changing the raw data into a clean data se	Planned
10	Experiment different models on Dataset	Try different classifier on the dataset and compare results	Planned
11	Build our ML Model	Start writing our own code.	Planned
12	Requirements for the final discussion	Write the final documentation and recap the requirements.	Planned
13	Build Backend	Build authentication, Database.	Planned
14	Integration	Integrate the application with backend and ML model.	Planned
15	Testing	Evaluating and verifying that a software application does what it is supposed to do	Planned

Table 4 Work Plan

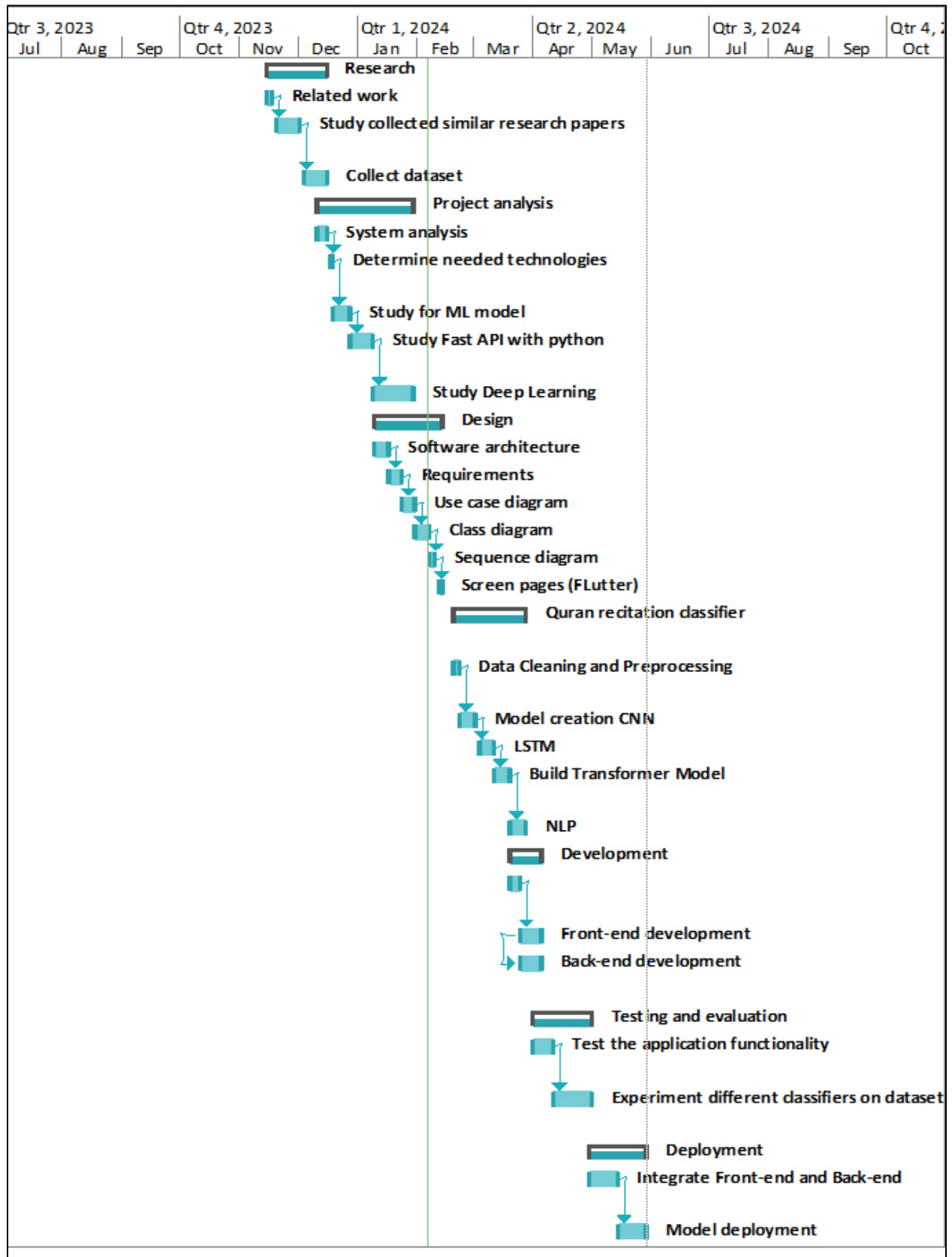


Fig. 11 Gantt Chart

7. References

- [1] *Tarteel - Recite the Quran confidently*. (n.d.). <https://www.tarteel.ai/> Accessed 10 February 2022
- [2] Tamkeen [Mobile App]. Available : https://play.google.com/store/apps/details?id=com.mighty.tamkeen&hl=en_US Accessed 10 February 2022
- [3] Tech, E.: Tasmee. (10.01) [Mobile App]. <https://play.google.com/store/apps/details?id=com.eqra.android.tasmee>. Accessed 10 February 2022
- [4] Razak, Z.; Ibrahim, N.J.; Idris, M.Y.I.; Tamil, E.M.; Yakub, M.Yusoff, Z.M.Abdulrahman, N.N.: Quranic verse recitation recognition module for support in j-QAF learning: a review. *Int. J. Comput. Sci. Netw. Secur.* 8, 207–216 (2008)
- [5] Ibrahim, N.J.; Yakub, M.; Yusoff, Z.B.M.; Razak, Z.; Salleh, R.: Improve design for automated Tajweed checking rules engine of quranic verse recitation: a review. *Int. J. Quranic Res* 1, 39–50 (2011)
- [6] Mohammed, A., Sunar, M. S., & Hj Salam, M. S. (2015). Quranic Verses Verification using Speech Recognition Techniques. *Jurnal Teknologi*, 73(2). <https://doi.org/10.11113/jt.v73.4200>
- [7] Yousfi, B.; Zeki, A.M.: Automatic speech recognition for the holy qur'an, a review. In: *Proceedings of the International Conference on Data Mining, Multimedia, Image Processing and Their Applications (ICDMMIPA)*, Kuala Lumpur, Malaysia, pp. 23–29 (2016)
- [8] Ahmed, A.H.; Abdo, S.M.: Verification system for Quran recitation recordings. *Int. J. Comput. Appl.* 163(4), 6–11 (2017). <https://doi.org/10.5120/ijca2017913493>
- [9] S. S. Alrumiah and A. A. Al-Shargabi, "A Deep Diacritics-Based Recognition Model for Arabic Speech: Quranic Verses as Case Study," in *IEEE Access*
- [10] Alrumiah, S.S., Al-Shargabi, A.A. Intelligent Quran Recitation Recognition and Verification: Research Trends and Open Issues. *Arab J Sci Eng* 48, 9859–9885 (2023). <https://doi.org/10.1007/s13369-022-07273-8>
- [11] Quran Ayat Speech to text. (2022b, September 18). Kaggle. Accessed 10 February 2024 <https://www.kaggle.com/datasets/bigguyubuntu/quran-ayat-speech-to-text>
- [12] Osman, Hanaa & Mustafa, Sharief & Mohammad, Yusra. (2021). QDAT: A data set for Reciting the Quran.
- [13] Quran.com: EveryAyah Dataset. <https://everyayah.com/> (2009). Accessed 10 February 2024
- [14] Yousfi, B.; Zeki, A.M.: Holy Qur'an speech recognition system Imaalah checking rule for warsh recitation. In: *2017 IEEE 13th International Colloquium on Signal Processing & Its Applications (CSPA)*, pp. 258–263. IEEE, Penang, Malaysia (2017)
