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NotaryNow

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Final Year Project

March 27, 2024

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Abstract

The process of ensuring the authenticity and legal validity of documents through notarization holds immense importance. Notarization, carried out by the notary public, involves verifying the signer's identity and witnessing their signature. However, conventional notarization can be time-intensive and demanding, necessitating an innovative solution. E-Notarization emerges as a contemporary remedy, enabling remote and efficient notarization through electronic means. By obviating the need for physical presence, reducing paperwork, and employing secure electronic signatures, E-Notarization enhances accessibility, security, and accuracy. Our project aims to achieve several goals, including the creation of an intuitive online platform for E-Notarization, ensuring platform security, and expanding notary services reach. The application, built on the SERN Stack, provides seamless experiences for both notaries and clients. Through real-time interactions, meticulous identity verification, and digital seals, the platform ensures user authenticity and ease of use.

Executive Summary

Notarization is a crucial process for ensuring document authenticity and legal validity. Our project is dedicated to enhancing Remote Online Notarization (RON) services by providing Electronic Notarization services to both Notaries Public and Clients. Remote online notarization (RON) enables the notarization of electronic documents using electronic signatures and live online appearances by signers before commissioned notaries. This approach grants internet accessibility for signing and notarizing documents.

Our objective is to develop a web application that highlights the primary features of our project. This application will consist of two dedicated portals for Notary Public and Clients, seamlessly integrated to facilitate the notarization process. Notaries will specify their availability, and Clients can schedule appointments with their preferred Notary. A video call session will be initiated between the Client and Notary to execute the E-notarization. The Notary will verify the Client's identity by asking a series of questions and requiring two government-issued IDs. A successful session will result in a notarized document. These documents will be securely stored in the tamper-proof ImmuDB to monitor changes in sensitive data and record them immutably in the database.

We have explored quite a few applications to understand the current landscape, progress, and challenges in the realm of RON. This guided and informed the development of our E-notarization platform by outlining the Strengths and Weaknesses of existing applications.

Chapter 4 outlines a comprehensive list of features for our project. Functional requirements for the System, Notary, and Client are detailed separately. Additionally, we've specified quality attributes and non-functional requirements such as reliability, security, compliance, and data management.

The following sections contain an extensive list of use cases that describe interactions between the system and users (Notaries and Clients). The application encompasses 19 use cases, including document uploads, appointment bookings, appointment creation, appointment cancellations, video call sessions, document notarization, viewing and sharing notarized documents, and Notary's Seal and stamp creation. These use cases are thoroughly described in the report.

In addition to this, we've included front-end designs for various screens. We have focused on making an interactive interface while keeping it user-friendly and easy to understand. Lastly, we've discussed the risks that can impede workflow including security breaches, legal barriers in E-notarization, and electronic signature forgery.

The High and Low-Level System Design is explained with the help of diagrams. Design considerations and strategies are detailed extensively. Architectural Diagrams, Class Diagrams, and Sequence Diagrams for various scenarios have been included to depict major structural aspects of the application.

In the prototype phase, we have completed authentication, CNIC integrity verification, digital signatures module, Notary and Client Side's Frontend, and video conferencing module. We hope to implement all the features and functionalities necessary for a streamlined E-Notarization process.

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Chapter 1 Introduction

It is very important to ensure that the documents are authentic and legally bound under the law. For such purposes, Notarization is helpful. A notary public verifies the signer's identity and also witnesses the signing procedure during this notarization procedure. After confirming the identity and witnessing the signing procedure, the notary adds their signatures and seal on the document. In this way, the Notarization makes the document secure preventing the probabilities of fraud and tempering.

In the present digital era, many challenges are being faced by the traditional notarization system. Paper-based processes create many difficulties and time consumption, making it very difficult for the people who are looking for document notarization. Also, mistakes and corrections make traditional notarization more complex. To deal with these problems, it is essential to find efficient and secure ways of document notarization.

The possible solution to make the notarization more efficient is E-notarization. E-notarization is a cutting-edge and practical approach to document notarization as it removes the need to travel, huge time consumption, and paperwork resulting in time and cost savings. Also, it offers high security because it uses tamper-proof electronic signatures and digital seals. E-notarization makes it available to everyone, anytime, anywhere while preserving time, cost, and legal standing.

1.1 Purpose of this Document

The purpose of this Final Year Project (FYP) is to modernize and streamline the notarization process by implementing Electronic Notarization (E-notarization) through the development of a user-friendly online platform.

This project aims to increase the efficiency of the notarization procedure by introducing an online notarization system. By doing so, we are aiming to eliminate the constraints of physical availability, extensive paperwork, and time consumption. This efficiency improvement is intended to save time, effort, and resources for both the notary public and individuals seeking notarization services.

1.2 Intended Audience

The project is intended for mainly two primary user groups. First are the notary public who are assigned by the government to supervise the notarization procedures. They will use our online platform to officially validate and electronically sign the document.

The second group is the citizens and organizations who want to get their documents notarized. whether

it is a legal document, power of attorney, or any other paper that needs to be notarized, they can rely on an online notarization platform. It is a secure and reliable way to get the documents legally stamped and notarized.

1.3 Definitions, Acronyms, and Abbreviations

FYP: Final Year Project

Notarization: Formal process aimed at deterring fraud and providing assurance to the parties involved in a transaction that a document is genuine and reliable.

E-Notarization: Electronic Notarization

UI: User Interface

E-Meeting: Electronic meeting e.g. Video Calls

OTP: One-time Password

Electronic Notarization: The use of a secure online platform to digitally notarize the documents by verifying the parties involved in the transaction.

Notary Public: A person appointed by the government who holds the authority of notarizing the documents by verifying the parties involved in the transaction.

SERN: SQL, ExpressJS, ReactJS, NodeJS

ID: Identity Document

CNIC: Computerized National Identity Card

NADRA: National Database and Registration Authority

ImmuDB: Immutable database

API: Application Programming Interface

1.4 Conclusion

Chapter 1 introduced the importance of notarization and the need to introduce electronic notarization in the modern era. The project aims to create a user-friendly digital environment to modernize the notarization system, benefiting both the notary public and individuals and companies. Our targeted audience includes these two key stakeholders.

Chapter 2 Project Vision

The goal of this project is to make a system where we provide an online platform for the notarization of documents that are available to people and organizations throughout the country. We aim to make the online notarization process more secure by incorporating digital signatures and cryptographic techniques and also ensure availability.

2.1 Problem Domain Overview

The notarization process includes a notary public who verifies and authenticates the documents and contracts. Moreover, it also involves the verification of the user, witnessing the process of signing, and then adding seal and signature both by notary and users respectively to document who is involved in this process.

E-notarization eliminates the need for physical presence which is a key advancement in this modern world. This approach enhances the security of documents by incorporating digital signing.

Digital signatures are the most important feature of our E-notarization process which works on Public key infrastructure by using cryptographic techniques like using public and private keys for signing the document. Private key is used for signing the document and public key used for verifying the authenticity of the person who signed the document is the one who claims to be.

2.2 Problem Statement

The traditional notarization procedures involve a physical presence in a notary public office for verification of documents and persons, this process takes a long time. Considering those people who are living in backward areas, this process seems difficult to obtain. Furthermore, the traditional system involves security and transparency issues. Moreover, the process involving the use of paper causes environmental problems.

2.3 Problem Elaboration

The traditional notarization process involves several loopholes. To overcome these loopholes we need an advanced approach while ensuring the security of the process. Following are the few problems associated with the traditional notarization:

2.3.1 Inefficiency

Traditional and old notarization process takes a lot of time, waiting time, and money.

2.3.2 Inaccessibility

Backward and rural people may find it difficult to get these services. They have to travel long, waste time, and spend a lot of money to get their document notarized.

2.3.3 Excessive Paperwork

The conventional notarization method involves an excessive amount of paperwork. In this way, it adds a burden to the administrative expenses.

2.3.4 Limited Hours of Operation

Notary Officers are usually available during regular working hours, making it difficult for someone who is committed to other work. So if someone wants to get their document notarized one has to make itself available for that may be by compromising or getting leave from work.

2.4 Goals and Objectives

The main goal is to create a user-friendly online platform for a smooth, secure, and reliable notarization system. Our main objectives are to:

- Creating an online application for electronic notarization to streamline the notarization process.
- Making sure that the platform for document authentication and verification is safe.
- Expanding access to notary services across the nation, especially in rural locations.
- Increase transparency and accountability in the notarization process by maintaining track of all notarized documents.
- Enhancing customer experience by speeding up the notarization procedure and decreasing wait times.
- Creating a user-friendly design that is simple to use and understand, especially for non-technical people.
- Promoting the use of digital signatures and minimizing the necessity for printed documents.

2.5 Project Scope

The SERN Stack serves as the foundation for our innovative application, strategically catering to both notaries and clients. Dedicated portals will streamline the account creation and notarization process, ensuring seamless experiences.

Notaries will highlight their availability and service fees, while clients will conveniently schedule appointments post-secure payments. Document uploads precede real-time video interactions, facilitating meticulous identity verification via government ID photo and signature comparison. Clients must present at least two photo IDs, with subsequent mental state assessment and testimony confirming their willful participation.

This comprehensive approach takes around 5 minutes subject to provision of all required forms of identification and answers. The notary will bring up the document (already accessible to the notary) and attach his digital seal to it, authenticating the signer's identity and witnessing the document signing. Stored in ImmuDB, which offers cryptographic verification for tamper-proof storage, our solution ensures document authenticity.

Clients effortlessly access and export notarized documents for external use, cementing our commitment to convenience and security.

Excluded from our project scope are the integration of payment gateways, responsible for managing financial transactions, and the verification of the authenticity of notaries' licenses. These aspects, though essential in the broader context of notarization services, lie beyond the immediate focus of our project. Our project's primary goal is to establish an efficient and secure E-Notarization platform, emphasizing accessibility and reliability for notary users.

2.6 Sustainable Development Goal (SDG)

Our project aims to create an online platform for efficient E-Notarization which has the potential to contribute to some of the Sustainable Development Goals set forth by the United Nations. These goals provide a comprehensive framework for addressing some of the world's most pressing challenges while fostering global sustainability. A brief detail of how our project aligns with those Sustainable Development Goals is given below.

2.6.1 SDG 12 - Responsible Consumption and Production

Our project promotes responsible consumption by reducing the need for physical paperwork and printed documents. This contributes to a more sustainable and eco-friendly approach to notarization.

Figure 2.1: Responsible Consumption and Production

The target SDG is SDG 12 Responsible Consumption and Production

2.6.2 SDG 16 - Peace, Justice, and Strong Institution

By ensuring the authenticity of the notary users and preventing fraud through E-Notarization, we are trying to contribute to the overall stability and trust in the legal systems.

Figure 2.2: Peace, Justice and Strong Institution

The target SDG is SDG 16 Peace, Justice, and Strong Institution

2.7 Constraints

The following constraints are so far out of the scope of our project:

2.7.1 Inability to Verify Notary License Validity

One important constraint includes the inability to check the validity of a notary's license. We won't be able to confirm whether the license of a notary public is up-to-date and legitimate. This module is for now out of the scope of our project.

2.7.2 Exclusion of Payment Method Integration

The payment method is also not part of our project for now. By payment methods, we mean to say that the payment processes for notarization services will not be handled directly by our system. The user will upload the receipt with the document to be notarized and the notary will confirm the payment.

2.8 Business Opportunity

The E-notarization project provides a great business and financial opportunity. Firstly, this platform is quite simple and easy to operate for people and organizations. Secondly, the Notary public will charge the users for the services they provide. Thirdly, investors who invest in the project also get a return on the investment they make. Developers who build and maintain the website also get their margin.

2.9 Users and Stakeholders

The following are the main users and stakeholders involved in our system:

2.9.1 Users

The users of a system include:

- Clients: These are the individuals or organizations who want to get their documents notarized. Clients use the system to upload documents for notarization and schedule appointments with notary officers.
- Notary Officers: These are the government-appointed notary public to verify the parties involved in a transaction. They use the online platform to digitally sign documents. They can accept and reject the notarization appointments according to their schedule. Once the appointment is confirmed, the notary officer will conduct the notarization session in a video meeting.

2.9.2 Stakeholders Summary

Clients, notary officers, developers, regulatory authorities, and potential investors are the stakeholders involved in the electronic notarization system. The platform is used by notary officers to authenticate and notarize documents, while clients depend on it for efficient notarization. System development and maintenance are developers' responsibilities. Regulatory organizations guarantee respect for laws and regulations. Investors support the platform's growth and success financially and strategically by offering advice. Together, these parties play a part in improving the effectiveness and reliability of the notarization procedure and creating a safe and convenient setting for electronic notarization services.

2.10 Conclusion

To conclude Chapter 2, the NotaryNow project aims to make getting documents notarized easier and faster by creating an online platform. We want to use modern technology to improve how documents are

verified, promote digital signatures, and simplify the notarization process for people and businesses all over the country. Our main goals are to make notarization more accessible, clear, and environmentally friendly while supporting important development goals. Although we have some limitations, this project offers a good business opportunity for everyone involved and the chance to change how we make sure documents are real and legal. By understanding our users and partners well, we can create a safe and easy online system for notarizing documents, making them simpler and more trustworthy.

Chapter 3 Literature Review / Related Work

The realm of electronic notarization (E-Notarization) has experienced a significant evolution, driven by technological advancements and the growing demand for efficient and secure notarization processes. In our comprehensive literature review, we embark on a journey through the past and present of E-Notarization solutions with a clear purpose: to explore related work in this field.
Our review critically examines the contributions, methodologies, and innovations within the realm of E-Notarization, drawing insights from various sources. By analyzing the successes and challenges of existing E-Notarization platforms, we aim to uncover emerging trends, pinpoint gaps in current knowledge, and identify opportunities for further advancement. This exploration serves as a foundational step in our larger goal of developing and enhancing ”NotaryNow,” an innovative project dedicated to redefining the notarization experience.

3.1 Definitions, Acronyms, and Abbreviations

E-Notarization: Electronic Notarization
RON: Remote Only Notarization

3.2 Detailed Literature Review

This section will include a detailed literature review of your problem area. Make different categories for different types of work done in the past. In addition to textual descriptions, make a summary table that describes each paper that you have read, along with references.

3.2.1 DocuSign

DocuSign is one of the most known digital transaction management platforms. It changed approaches to making contracts, agreements, and other paper-based records. It was founded in 2003 and since its inception has become a renowned name in Electronic Signatures [1].

3.2.1.1 Summary of the research item

DocuSign has revolutionised online document sharing, management, and signing. The way individuals and organisations conducted online transactions experienced a radical shift when applications like DocuSign were launched. I eliminated the need for paper and streamlined the documentation process. DocuSign offers many features and functionalities other than electronic signatures, such as E-Notarization, document storage, workflow automation, and authentication methods.

3.2.1.2 Critical analysis of the research item

Strengths are:

- DocuSign is renowned for its popularity in the e-notary industry, largely due to how simple it is to use.
- Among the security features that DocuSign guarantees are the confidentiality and integrity of notary papers, authentication procedures and data encryption.
- DocuSign is made simpler and more easy to use for both consumers and businesses through integration with other business softwares.
- Its support for live notarization via an online link and compliance with legal standards in many districts are some of its advantages.

Weaknesses are:

- Some users have expressed dissatisfaction with the complex pricing schemes that make some use cases quite costly.
- All information is linked to centralised servers for document administration and storage. Users who prefer decentralised alternatives may be concerned about information security.
- There's a chance that some changes to the UI won't be feasible, which would prevent it from satisfying the organisation's branding and user experience needs.

3.2.1.3 Relationship to the proposed research work

Critical findings on user expectations, safety circumstances, and performance metrics are presented by the review conducted on DocuSign. Understanding the UX elements that DocuSign offers, its integration possibilities, and regulatory compliance procedures will form the foundation of our E-notarization platform. It can also serve as a benchmark against which our project can evaluate its progress and strive to surpass others by offering enhanced security, additional features, and superior services compared to what DocuSign provides.

3.2.2 Notarize

Users can use Notarize to remotely notarize their documents. It makes notarization easier for users from all domains [2].

3.2.2.1 Summary of the research item

Notarize is an innovative digital platform that has revolutionized the notarization procedure for both individual and corporate clients. Users may ensure accurate document execution from home with its user-friendly design and cutting-edge technology, which allows them to contact a commission notary via a video link.

3.2.2.2 Critical analysis of the research item

Strengths are:

- Notarize is widely recognized for being an expert in online remote notarization, enabling individuals to perform an official notary act at any time, from any location.
- In this situation, security is crucial, requiring multi-factor authentication and encrypting both user and notarized data.
- Document handling is made simple by Notarize's integration with numerous document management cloud storage services.
- It is significant to remember that the platform's legality depends on its compliance with state laws and industry standards.

Weaknesses are:

- As a result, some users have voiced concerns about arranging notarization because they may encounter difficulties getting in contact with the necessary notary, particularly when numerous people wish to use the site at once.
- But Notarize is not suited to serve as a one-stop shop for publishers, solicitors, and investors.
- Although its price list is quite transparent, small businesses and people who don't frequently engage notaries may view it as expensive.

3.2.2.3 Relationship to the proposed research work

It can be helpful to design comparable capabilities for "NotaryNow" if one is aware of how Notarize manages user authentication, document security, and regulatory compliance. By addressing any shortcomings in Notarize, including improving notary availability or looking at other services like investor connections and publication choices, this research can assist our project in finding opportunities to set itself apart.

3.2.3 NotaryCam

NotaryCam is an online notarization solution. It expedites and simplifies the notarization procedure. Clients can use it to notarize documents remotely from the comfort of their homes by connecting with qualified notaries through video conference [3].

3.2.3.1 Summary of the research item

NotaryCam has especially facilitated notarial acts across borders. Users join a live video session with a certified notary. They have to upload their documents before the session. The notary then proves his identity and ensures the document is legally compliant. He then digitally signs the document and performs notarization by using an electronic seal and signature. This process outputs a document that is tamper-proof and legally binding. NotaryCam's quick and safe method ensures a variety of legal and transactional demands. It satisfies both individuals and companies and maintains the highest standards of legality.

3.2.3.2 Critical analysis of the research item

Strengths are:

- It facilitates cross-border notarizations through real-time audio and video interactions. This involves notaries from across the globe. NotaryCam is known for its worldwide reach. It can meet the demands of clients on a global scale.
- It is an effective solution for clients who can not be physically present for a notarization session.
- NotaryCam ensures international regulations and complicity with across-border statutes to ensure its global clientele.
- Due to overcoming global barriers, NotaryCam has become a renowned application in Remote Online Notarizations.

Weaknesses are:

- Price-conscious consumers may be concerned about NotaryCam's services. It can be more expensive than other RON alternatives due to its global offerings.
- Despite providing cross-border notarization, it might provide as many extra services as some other platforms. This limits its popularity to particular user groups.
- Availability of cross-border notaries is also a major constraint leading to longer wait hours, with more issues during peak times.

3.2.3.3 Relationship to the proposed research work

NotaryCam gives us important information on how to provide service to a global clientele. It informs us on how to deal with issues that arise with across-the-border notarization. We can use this information to offer comparable features in our application and achieve complicity with various in-state and international standards. This analysis is also helpful in finding affordable solutions for across-the-border notarizations. This will involve considering possible customizations and availability of Notaries Public from multiple locations.

3.2.4 SIGNiX

SIGNiX is well known for digital signature and document management. People and companies can use SIGNiX to electronically sign papers. It also offers Remote Online Notarization [4].

3.2.4.1 Summary of the research item

SIGNiX satisfies strict industry criteria related to electronic records, electronic signatures, and remote online notarization (RON). RON is one of the prominent services offered by SIGNiX, providing a simple way to complete notarial transactions eliminating the necessity for in-person notarizations. They serve a wide range of industry sectors including but not limited to banking, real estate, and law. They ensure that consumers handle their documents legally and with utmost confidence.

3.2.4.2 Critical analysis of the research item

Strengths are:

- This platform ensures accountability and transparency by using audit trails.
- Application provides a flexible user interface. This enables businesses to customize notarization according to their specific needs and branding.
- SIGNiX is a reliable option for companies due to its regulatory compliance and interoperability with other industry software solutions.
- It provides transparent authentication methods, encryption, and secure electronic signature solutions hence improving document security.

Weaknesses are:

- Use of this application may need formal training as too many personalization options can perplex simple users.

- More personalizations come with more cost, which might not be affordable for every company.

3.2.4.3 Relationship to the proposed research work

We can learn lessons about making documents secure and preventing alterations. Development of these security features can be streamlined if the developers of NotaryNow have an understanding of how SIGNiX provides these functionalities. We can also work on improving the pricing problems that arise with higher levels of customization and personalization.

3.2.5 Adobe Acrobat Sign x Notarize

Known for its software products like Photoshop and Acrobat, Adobe is a major participant in the electronic signature and digital notarization market. Adobe Sign is part of the Adobe family.

3.2.5.1 Summary of the research item

Adobe Sign provides several features, such as notarization services. These features are other than its basic use cases for delivering, signing, tracking, and managing electronic documents. Notarization with Adobe Sign involves the company's separate contract with the Notarize service [5]. Notarization of electronic documents using Adobe Sign x Notarize is legally binding and compliant. It is an effective solution for businesses and sole owners to digitize their business processes.

3.2.5.2 Critical analysis of the research item

Strengths are:

- Adobe Sign puts security first. It uses encryption, authentication, and compliance to ensure that notarized documents are accurate and securely stored.
- Individuals, businesses, and organizations use the platform because of its user-friendly design.
- Its integration features with cloud services and third-party apps further augment its adaptability to diverse company requirements.

Weaknesses are:

- It is not a main player in the E-Notarization domain.
- The pricing structures of Adobe Sign may be high for individual users or small businesses especially if they want many features.
- This platform is too complex for beginners and may require formal training.

- Another important factor to consider is that Adobe uses third-party services for E-Notarization and does not provide any guarantees for these services.

3.2.5.3 Relationship to the proposed research work

Our project may learn a lot about how to offer a comprehensive and user-friendly e-notarization solution by analyzing this application. This is especially helpful in understanding how to integrate our application with third-party services. The emphasis on security and user-friendliness can serve as a guide for the implementation of user interfaces and authentication systems. Furthermore, this research might help us identify opportunities to offer customising options but with better pricing structures.

3.2.6 Pavaso

Pavaso is a technological company. It specializes in digital closure and electronic notarization [6]. It simplifies the whole real estate transaction closing process. It also offers remote E-Notarization services. The platform is used by real estate professionals, notaries, mortgage lenders, and title companies to perform safe and quick electronic transactions.

3.2.6.1 Summary of the research item

Pavaso is capable of providing all the tools and capabilities required for electronic notarization and digital closings. It was launched to make real estate transactions more efficient and convenient while keeping them legally compliant. all current regulations. It offers remote and electronic notarial services. Online notarial acts, document submission, and identity verification eliminate the need for in-person notarial transactions. It also removes the need for extensive paperwork.

3.2.6.2 Critical analysis of the research item

Strengths are:

- It is used by many real estate business customers due to easy and friendly user experience.
- Pavaso offers a comprehensive collection of tools making it a one stop solution.
- It ensures a legally binding process by following legal requirements of electronic notarization and conforming to government rules and standards.
- Because of the platform's user-friendly design, it may be used by a variety of real estate industry users.

Weaknesses are:

- The legal and regulatory framework of an area may have an impact on the effectiveness of Pavaso's services. This happens because not all locales have completely implemented electronic notarization.
- The cost of hiring Pavaso's services varies. This may lead to this being a very expensive solution for small enterprises or individual notaries.

3.2.6.3 Relationship to the proposed research work

Understanding Pavaso's advantages and disadvantages might be very effective when designing our own application. This can help us build user-friendly interfaces. We can ensure compliance with all legal requirements, and effectively take care of financial problems. If our market allows, it can help us in expanding our RON services. Pavaso's digital closure and e-notarization features might help in designing similar features of our application.

3.2.7 NotaryAct

NotaryAct is a mobile application. It is designed to allow notaries public to do notarial actions and manage paperwork [7]. It enables notaries by providing the materials and tools to swiftly conduct notarizations. It maintains track of transactions, and ensures compliance with notary standards.

3.2.7.1 Summary of the research item

Notaries may use it to sign, and store digital notarial certificates. It can also be used to keep a record of previously notarized documents. Document storage, electronic signatures, and audit reports are all important features of the Notary Act mobile application.

3.2.7.2 Critical analysis of the research item

Strengths are:

- It streamlines notarial activities by reducing manual record-keeping and paperwork.
- This application has a very friendly user interface. This makes it effective for both experienced notaries and beginners.
- It keeps a digital record of all current and past transactions. These records are more secure and accessible than paper records.
- It ensures law abidance by requiring extensive reports.

Weaknesses are:

- NotaryAct was largely a smartphone app, which may not suit everyone's interests or work patterns, especially those who prefer desktop-based alternatives.
- Some of the features necessary for more complicated e-notarization tasks may be missing.

3.2.7.3 Relationship to the proposed research work

It can help us select which features and attributes to add to our e-notarization application. It is critical to prioritise efficiency, digital record-keeping, and user-friendly interfaces. We can also make an informed decision on whether to make a web, mobile or hybrid application. A crucial differentiation in the market for E-Notarization could be how we design our application to cater to the particular demands of notaries.

3.3 Literature Review Summary Table

Table 3.1: Literature Review Summary Table
The table contains the Summary of the Literature Reviews

No	Name	Inventor	Year	Input	Output	Description
1	DocuSign, [1]	Thomas Gonser	2003	Documents, Signatories, Preferences	Signatures, Records, Notifications	Streamlined digital document signing
2	Notarize, [2]	Pat Kinsel and Adam Pase	2015	Digital documents	Legally binding notarized documents	Notarize is an innovative online platform that allows for remote notarization of digital documents
3	NotaryCam, [3]	Rick Triola	2012	Digital documents, device with camera access	Digitally notarized document	Digitally notarizes documents through live video sessions

No	Name	Inventor	Year	Input	Output	Description
4	SIGNiX, [4]	SIGNiX, Inc.	2002	Digital documents, Web browser or dedicated software	Electronically signed documents, Legally binding notarized documents	Trusted provider of digital signature and document management solutions, offering electronic signatures and remote online notarization services
5	Adobe Acrobat Sign x Notarize, [5]	Adobe Systems Incorporated	2021	Digital Documents	Legally compliant Notarized Documents	Adobe Acrobat Sign integrates with the Notarize platform to give you seamless access to online notarizations.
6	Pavaso, [6]	Mark McElroy	2010	Digital Documents	Legally binding Notarized Documents	Streamlines the closing process and supports remote online notarization (RON)
7	NotaryAct, [7]	Big Fish Creations	2012	Document upload, input digital signatures, record notarial acts, capture signers' information	Digital notarial certificates, summary of notarial activities, alerts for appointments	Mobile application designed to streamline notarial acts and document management for notaries public

3.4 Conclusion

Our literature review and associated research in the area of electronic notarization reveal a dynamic environment driven by technological improvements and the requirement for secure and reliable notarization

procedures. We have investigated numerous e-Notarization platforms and solutions, each with its own advantages and disadvantages. As a result, we have gained important knowledge about user expectations, security norms, usability standards, and customization possibilities. Some well-known names in the E-Notarization space include DocuSign, Notarize, NotaryCam, SIGNiX, NotaryAct, Pavaso, and Adobe Acrobat Sign x Notarize. The current situation and challenges for implementing E-Notarization in many countries have also been explored by our review, emphasizing the significance of legal frameworks, technical infrastructure, internet connectivity, IT policies, and cooperation with service providers. These observations can guide the creation of our ”NotaryNow” project, assisting us in creating a thorough, user-friendly, and secure E-Notarization platform that caters to the particular requirements and difficulties of our target users. In conclusion, our literature review and related work analysis give our ”NotaryNow” project a strong foundation, directing us as we create an innovative E-Notarization platform that complies with legal requirements, security standards, and user expectations.

Chapter 4 Software Requirement Specifications

This chapter comprises of description of the software specifications for our system. It also includes a graphical user interface design for NotaryNow Application. It maintains a list of features the system is supposed to provide, discusses functional and non-functional requirements, and uses Use Cases to elaborate workflow. It also enlists Hardware and Software specifications. Last but not least, it includes ER Diagrams, Data Dictionary, and a risk analysis.

4.1 List of Features

This list of features has been identified by carefully considering the system's objectives. While it may not be exhaustive, this list will serve as a guide for forthcoming requirement specifications and the development process. Our web-based application will provide the following set of features and functionalities:

- User authentication and authorization ensuring secure access to the application
- Option to sign up/sign in as Notary Public or Client
- Sign out Functionality for both Notary/Client
- Separate portals for Notary Public and Client
- Notary Profile management including notary's availability schedule, notarization fee, and physical location of Notary's office
- Notary's Seal creation with personalized information of the Notary
- Client profile management including management of uploaded/notarized documents
- Appointment creation and management for client and notary
- Search functionality to find Notary based on time, payment, and location preferences
- Ability to view upcoming appointments
- Notifying clients and notaries about appointment confirmation and reminders
- Appointment cancellation and rescheduling functionality
- Supports document upload from local storage or drive
- Video calling feature to support E-meeting of the Notary and Client
- Multiple participants feature in video calls to support conference calls

- Viewing a document during the Video call
- Supports documents to upload, e.g. Copy of CNIC for identification purposes, during a video call
- Client's identity verification during a video call
- Real-time chat during a video call
- Affixing Notary's seal to the document required to be Notarized
- Secure storage of Notarized document
- Viewing and sharing of Notarized documents with third-party applications
- Security solutions and policies to prevent tampering and deletion of uploaded documents
- Responsive web application to support the use of the application on mobile devices

4.2 Functional Requirements

The following section outlines the functional requirements for the system including functional requirements for Notary and Client portals and System. It details various features that will be included in the final version of the system.

4.2.1 Functional Requirements for System

4.2.1.1 Sign-up/Sign-in Functionality

- The system shall redirect to the Notary Public Portal by opting for the "Continue as Notary Public" option.
- The system shall redirect to the Client Portal by opting for the "Continue as Client" option.
- The system shall allow users to sign in as Notary Public or Client.
- The system shall provide a sign-up option to new users.
- The landing page shall display buttons to "Continue as Notary Public" or "Get Document Notarized".
- The system shall send a confirmation email to the registered email.
- The system shall automatically redirect to the sign-in page of the application upon confirmation of the email.
- The system shall send OTP to the registered contact number as part of the sign-in process.

4.2.1.2 Notary's seal and stamp creation

- The system shall use a pre-made template to create the Notary's seal and stamp by populating it with the respective Notary's information.
- The system shall store the Notary's seal and the stamp in the database.
- The Notary's seal and stamp shall reflect any updates in the Notary's profile information.

4.2.1.3 Appointments management

- The system shall generate free slots from a Notary's availability form.
- The system shall show free slots as available for appointment.
- The system shall mark booked slots as unavailable.
- The system shall maintain a separate list of unconfirmed and upcoming appointments for each Notary Officer.
- The system shall maintain a separate list of unconfirmed and upcoming appointments for each Client.
- The system shall send details of the appointment and prompt to make payment to the Client's Email and Contact Number.
- The system shall add the appointment to the "Upcoming Appointments" list for both Notary and Client only after being marked as "Paid" by the Notary.
- The system shall send appointment confirmations and reminders to the Client and the Notary.
- The system shall cancel an unconfirmed appointment if it is not marked confirmed by the Notary at least 30 minutes before commencement.

4.2.1.4 Video Calling functionality

- The system shall support the video calling feature for the Client and the Notary.
- The system shall allow multiple participants to join the video call.

4.2.1.5 Chatting During Video Call

- The system should support real-time chat in the video call.

4.2.1.6 Uploading/Viewing Documents

- The system shall support document upload from local storage.
- The system shall require the upload of the document for notarization before the appointment commences.
- The system shall only allow the upload of documents for identity verification (CNIC, Passport, and Driver's License) during video call.
- The system shall allow users to view uploaded documents.
- The system shall allow users to view/open uploaded documents during video calls.

4.2.1.7 Functionality for Identity Verification

- The system shall support Electronic signatures using HTML5 Canvas, Touchscreen, Signature Pad Libraries, et cetera.
- The system shall support biometric authentication methods like fingerprint or facial recognition for added security.
- The system shall send OTP before accepting e-signatures for devices that do not have biometric support.

4.2.1.8 Storing Notarized Documents

- The system shall secure the notarized documents in ImmuDB.
- The system shall set the access rights of Notarized documents to view-only.
- The system shall not allow editing/deletion of Notarized documents.

4.2.2 Functional Requirements for Notary

4.2.2.1 Sign up as Notary Public

- The Notary shall sign up for the application by providing their Name, Username, Email, Contact No, Profile Picture, CNIC No, Designation, Notification No, Seal Issue and Expiry Date, a scanned copy of the Notary Public License, and password, and agreeing to the Terms and Conditions.
- The Notary will receive an account confirmation email on the registered email.
- After receiving the confirmation email, the Notary shall click the verification link to confirm their

email address.

4.2.2.2 Sign in as Notary Public

- The Notary shall sign in by providing a username, password, and an OTP.
- The Notary shall enter OTP on the sign-in page to log in successfully.
- The Notary shall be able to sign out from the Application using the Sign-out button.

4.2.2.3 Availability schedule specification

- The Notary shall input his working hours and days on an availability form.

4.2.2.4 Profile Management

- The Notary shall not be able to change Name, Username, and CNIC No.
- The Notary shall be able to change Email Address, Contact No, Profile Picture, and Designation.
- The Notary shall upload a new copy of the license after the license's expiration date.
- The Notary's Dashboard will enlist his schedule and availability.
- The Notary shall be able to view the Notary seal and stamp.

4.2.2.5 Appointment Confirmation

- The Notary shall be able to view a list of unconfirmed appointments.
- The Notary shall confirm an appointment only after receiving the payment (Payment is not part of the system, done outside the realm of the NotaryNow application, but is marked as ”paid” in the system).
- The Notary shall be able to view a list of upcoming appointments.

4.2.2.6 Appointment execution

- The Notary shall initiate a video call with the Client.
- The Notary shall be able to add multiple witnesses to the call.
- The Notary shall be able to share screen.
- The Notary shall bring up the document for the Notarization process.
- The Notary shall be able to view the IDs the Client will upload for identity verification.

- The Notary shall be able to require and view the Client's E-signature.
- The Notary shall affix the stamp and seal to the end of the document to be notarized once the Client's identity is verified.
- The Notary shall use Electronic Signature functionality to sign the document.
- The Notary shall save the notarized document.
- The Notary shall terminate the video calling session.

4.2.2.7 Viewing Notarized Documents

- The Notary shall be able to view a list of previously notarized documents.
- The Notary shall be able to open and view notarized documents.
- The Notary shall not be able to edit, delete, or tamper with the notarized document.

4.2.3 Functional Requirements for Client

4.2.3.1 Sign up as Client

- The Client shall sign up for the application by providing their Name, Username, Email, Contact No, Profile Picture, CNIC No, and password, and agreeing to the Terms and Conditions.
- The Client will receive an account confirmation email on the registered email address.
- After receiving the confirmation email, the Client shall click the verification link to confirm their email address.
- The system shall automatically redirect to the sign-in page of the application upon confirmation of the email.

4.2.3.2 Sign in as Client

- The Client shall be able to sign in by providing a username, password, and an OTP.
- The Client shall enter OTP on the sign-in page to log in successfully.
- The Client shall be able to sign out from the Application using the Sign-out button.

4.2.3.3 Profile Management

- The Client shall not be able to change Name and CNIC No.

- The Client shall be able to update the username, Email Address, Contact number, and Profile Picture.

4.2.3.4 Uploading/Viewing Documents

- The Client shall be able to upload documents for notarization from local storage.
- The Client shall be able to upload documents for Identity verification during the video call.
- The Client shall be able to view uploaded documents.
- The Client shall be able to delete uploaded (non-notarized) documents.

4.2.3.5 Appointment Creation

- The Client shall be able to select a Notary from a list of all Notaries.
- The Client shall be able to search for a specific Notary by providing the Notary's Full name.
- The Client shall be able to filter Notaries from the list of all Notaries based on their payment, time, and location preferences.
- The Client shall be able to view the public profile information of a Notary.
- The Client shall be able to book an appointment with a Notary.
- The Client shall be able to view available slots enlisted on the selected Notary's profile.
- The Client shall be able to choose any of the available slots.
- The Client shall be able to view a list of unpaid appointments.
- The Client shall be able to view a list of upcoming/confirmed appointments.

4.2.3.6 Attending the appointment

- The Client shall be able to accept video calls initiated by the Notary.
- The Client shall be able to view the Notary's screen.
- The Client shall be able to upload IDs during video calls.
- The Client shall be able to showcase an electronic signature when prompted.
- The Client shall be able to use biometric authentication methods during video calls.
- The Client shall be able to receive OTP during the video call.

4.2.3.7 Viewing/Sharing Notarized Documents

- The Client shall be able to view a list of his notarized documents.
- The Client shall be able to open a notarized document.
- The Client shall be able to share Notarized documents with third-party applications.
- The Client shall not be able to edit, delete, or tamper with the notarized document.

4.3 Quality Attributes

This section highlights the quality attributes the system will possess to enhance the notary and client experiences.

4.3.1 Usability

The system should be very easy to navigate, and its user interface should be highly intuitive. Users should find the system straightforward to use and perform their tasks.

4.3.2 Compatibility

The system should be compatible with various browsers and devices, including desktops and mobile devices.

4.3.3 Scalability

The system should be designed to handle future growth and development, and it should remain open to changing requirements. Additionally, the system should be capable of handling increased traffic without compromising performance.

4.3.4 Security

The system should use digital signatures to secure documents during notarization. Furthermore, it should secure documents after notarization for future purposes using a secure database.

4.4 Non-Functional Requirements

4.4.0.1 Reliability

The system should be highly reliable and available at all times. It must be fault-tolerant to ensure that the failure of one component does not result in data loss.

4.4.0.2 Security

The system should provide multi-factor authentication for its users. It should also secure notarized documents in a way that prevents tampering or alterations.

4.4.0.3 Usability

The system should be user-friendly and easy to use. The user interface must be intuitive, following established design principles for a user-friendly and intuitive experience.

4.4.0.4 Compliance

The system should be able to comply with E-Notarization laws and regulations specific to the region.

4.4.0.5 Scalability

The system shall allow the seamless addition and integration of new resources and functionalities. It should be efficient enough to accommodate high and growing traffic.

4.4.0.6 Data Management

The system should be capable of retaining notarized documents for a specified period of time in accordance with the law. Additionally, data backup and restoration procedures should be high-performance.

4.5 Assumptions

This section highlights the assumptions that we made to ensure a comprehensive and precise document. These assumptions are based on and in accordance with the scope, limitations, and goals of our project. It is important to note that these assumptions just provide an initial framework for the project and may evolve as we proceed further in the development phase. The assumptions are enlisted below:

- The system assumes that the users have a basic understanding of how to use web-based apps.
- The system assumes that all users have access to a reliable internet connection.
- The system assumes that all the listed notary officers are verified and have a government-approved license.
- The system assumes that the dummy NADRA database used is real and updated.
- The system assumes that all the users own mobile wallets for fee transactions.

4.6 Use Cases

4.6.1 Sign-up as Notary

Table 4.1: Sign-up as Notary
The table contains the description of Sign-up as Notary use case

Name	Sign-Up		
Actors	Notary		
Summary	The user shall enter credentials, agree to the Terms and Conditions, and shall be redirected to the login form upon successful verification.		
Pre-Conditions	The system should be working properly. The user should be on the Notary Portal. The user must not already be signed up.		
Post-Conditions	The user's account will be created and the information will be recorded in the database. The user will be redirected to the Login page.		
Special Requirements	The user must verify the account using a verification link sent to the registered Email.		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the Sign-up button.	2	The sign-up page opens, showing the sign-up form.
3	The user enters credentials, accepts the Terms and Conditions, and clicks "Create Account."	4	The system verifies the entered information and sends a verification link to the registered Email address.
5	The user opens the email and clicks the verification link.	6	The system makes a Notary account, a Seal & stamp, and goes to the Notary Dashboard, saving user data.
Alternative Flow			
3	The user enters invalid information	4-A	The system shows an "Invalid details" error.
3	The user skips the required fields.	4-B	The system displays a "Required Information" error.

4.6.2 View Unpaid Appointments

Table 4.2: View Unpaid Appointments
The table contains the description of View Unpaid Appointments use case

Name	View Unpaid Appointments		
Actors	Client		
Summary	The user shall be able to view a list of appointments he has booked but has not yet been confirmed.		
Pre-Conditions	The user must be logged in. The user must have booked an appointment.		
Post-Conditions	The system shall display a list of appointments.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the "Unpaid Appointments" button.	2	A list of all unpaid/unconfirmed appointments is displayed.
No Alternative Flow			

4.6.3 Sign-up as Client

Table 4.3: Sign-up as Client
The table contains the description of Sign-up as Client use case

Name	Sign-Up		
Actors	Client		
Summary	The user provides credentials, agrees to the Terms and Conditions on the Sign-up form, and upon successful verification, is redirected to the login form.		
Pre-Conditions	The system should be working properly. The user should be on the client portal and must not already be signed up.		
Post-Conditions	The user's account will be created and the information will be recorded in the database. The user will be redirected to the Login page.		
Special Requirements	The user must verify the account using a verification link sent to the registered Email.		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the Sign-up button.	2	The sign-up page opens, showing the sign-up form.
3	The user enters credentials, agrees to the Terms, and click "Sign-up."	4	The system verifies information, sends a verification link to the email, and ask the user to click and verify.
5	The user opens the email and clicks the verification link.	6	The system creates the user's account, saves their information, and redirects to the Client Dashboard.
Alternative Flow			
3	The user enters invalid information	4-A	The system displays an "Invalid details" error.
3	The user skips the required fields.	4-B	The system displays a "Required Information" error.

4.6.4 Sharing Notarized Documents

Table 4.4: Sharing Notarized Documents
The table contains the description of Sharing Notarized Documents use case

Name	Sharing Notarized Documents		
Actors	Client		
Summary	The user shall be able to share the document with third-party applications.		
Pre-Conditions	The user must be logged in. The user must have a document opened.		
Post-Conditions	The system shall redirect to the third-party application. The document will be shared successfully.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the "Share" button.	2	A share menu pops up.
3	The user selects an option from the menu.	4	The system redirects to the third-party application to continue the sharing process.
No Alternative Flow			

4.6.5 User Login

Table 4.5: User Login
The table contains the description of Login use case

Name	Login		
Actors	Notary, Client		
Summary	The user shall be able to provide their username and password on the login form and enter OTP. The user shall be redirected to the user dashboard upon successful verification.		
Pre-Conditions	The user must have a current account in the database records. The user must not be logged in already.		
Post-Conditions	The user's session is established successfully and redirects to the user's dashboard.		
Special Requirements	The user must provide OTP.		
Basic Flow			
Actor Action		**System Response**	
1	The user selects the "Get Document Notarized" or "Continue as Notary" option.	2	The login page is displayed with username and password fields.
3	The user logs in with a valid username and password.	4	The system verifies credentials and sends a 6-digit OTP to the registered mobile, and redirects to the OTP screen.
5	The user enters OTP within 1 minute.	6	The system verifies OTP and redirects to the user dashboard.
Alternative Flow			
3	The user enters invalid username or password.	4-A	The system responds with an error message: Invalid Credentials
5	The user enters an invalid OTP.	6-A	The system displays an error message: "Invalid OTP. Click 'Resend OTP' for a new one."

4.6.6 User Logout

Table 4.6: User Logout
The table contains the description of Logout use case

Name	Logout		
Actors	Notary, Client		
Summary	The user shall click on the Sign-out button available on the Dashboard page and the system will redirect to the Application Home page.		
Pre-Conditions	The user must be logged in already to use this functionality.		
Post-Conditions	The system will redirect to the Application Home Page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks on the Logout.	2	The system redirects to the Application home page.
No Alternative Flow			

4.6.7 Update Notary's Profile

Table 4.7: Update Notary's Profile
The table contains the description of Update Notary's Profile use case

Name	Update Notary's Profile		
Actors	Notary		
Summary	The user shall be able to edit his profile by clicking on the "Edit" button available on the dashboard and the system will redirect to the Update Information page.		
Pre-Conditions	The user must be logged in. The user must be on the Notary Dashboard.		
Post-Conditions	The system will redirect to the Notary Dashboard. The Dashboard will show updated information.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks on the edit profile	2	The system redirects to the Update Information Page.
3	The user updates one or more fields and clicks Save.	4	The system saves the changes, updates the Notary's profile, and refreshes the Stamp with new information.
Alternative Flow			
3	The user tries to update non-modifiable fields.	4-A	The system shows a warning message: This field can not be modified.

4.6.8 Update Client's Profile

Table 4.8: Update Client's Profile
The table contains the description of Update Client's Profile use case

Name	Update Client's Profile		
Actors	Client		
Summary	The user shall be able to edit profile information by clicking on the "Edit" button available on the Client Profile and the system will redirect to the Update Information page.		
Pre-Conditions	The user must be logged in. The user must be on the Client Dashboard.		
Post-Conditions	The system will redirect to the Client Profile. The Dashboard will show updated information.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks on the edit profile button.	2	The system redirects to the Update Information Page.
3	The user updates fields and clicks "Save."	4	The system saves the changes and redirects to the Client's profile.
Alternative Flow			
3	The user tries to update non-modifiable fields.	4-A	The system shows a warning message: This field can not be modified.

4.6.9 Specify Availability Schedule

Table 4.9: Specify Availability Schedule
The table contains the description of Specify Availability Schedule use case

Name	Specify Availability Schedule		
Actors	Notary		
Summary	The user shall specify his availability by filling out an availability form accessible through a “Specify Availability” button. on Notary Dashboard.		
Pre-Conditions	The user must be logged in. The user must be on the Notary Dashboard.		
Post-Conditions	The system will redirect to the Notary Dashboard.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks on the Availability Form button.	2	An availability form is displayed.
3	The user sets their hours and schedule and click ”Save”.	4	The system generates free slots for a Notary from this information.
No Alternative Flow			

4.6.10 Viewing Notarized Documents

Table 4.10: Viewing Notarized Document
The table contains the description of Viewing Notarized Document use case

Name	Viewing Notarized Documents		
Actors	Notary, Client		
Summary	The user shall be able to view notarized documents by selecting the “Notarized Documents” option.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	A list of notarized documents shall be displayed with the functionality to open individual documents.		
Special Requirements	The user must have had at least one appointment.		
Basic Flow			
Actor Action		**System Response**	
1	The user selects the “Notarized Documents”.	2	For Clients, it shows their notarized document list. For Notaries, it displays the documents they’ve notarized.
3	The user selects the card displaying the document’s preview information.	4	The system opens the selected document and displays it on the screen.
No Alternative Flow			

4.6.11 Upload a Copy of License

Table 4.11: Upload Copy of License use case
The table contains the description of Upload Copy of License use case

Name	Upload a Copy of License		
Actors	Notary		
Summary	The user shall upload the new license by selecting the "Update License" option available on the Notary Profile page.		
Pre-Conditions	The user must be logged in. The user must be on the Notary Profile page.		
Post-Conditions	The new license will be displayed. The system shall stay on the same page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the "Update License" button.	2	A file selection dialog pops up.
3	The user selects a new license and clicks save.	4	The new license is displayed and the system stays on the same page.
Alternative Flow			
3	The user selects a file with an invalid format.	4-A	The system responds with an error message: Invalid format. Please select another file.

4.6.12 View Notary Seal and Stamp

Table 4.12: View Notary Seal and Stamp
The table contains the description of View Notary Seal and Stamp use case

Name	View Notary Seal and Stamp		
Actors	Notary		
Summary	The user shall be able to view their stamp and seal by selecting the View The Seal and Stamp option is available on the Dashboard and entering their password for added security.		
Pre-Conditions	The user is logged in. The stamp and seal have been created already.		
Post-Conditions	The stamp and seal are displayed.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user selects "View Stamp and Seal."	2	The system prompts the user to enter the account password.
3	The user enters the account password.	4	The Notary Seal and Stamp are displayed.
Alternative Flow			
3	The user enters an invalid password	4-A	The system responds with an error message: Incorrect Password. Cannot Display Seal/Stamp.

4.6.13 Search/Filter Notaries

Table 4.13: Search/Filter Notaries
The table contains the description of Search/Filter Notaries use case

Name	Search/Filter Notaries		
Actors	Client		
Summary	The system allows the Client to look for specific Notaries by using the search or filter functionality.		
Pre-Conditions	The user must be logged in. The user must be on the Client Dashboard. The user has selected the Create Appointment option.		
Post-Conditions	A list of matching Notaries is displayed.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user searches for Notary info by entering details and clicking ”Search.”	2	The system lists all Notaries that match the criteria. Users can see their profiles.
3	The user applies search filters.	4	A new list of Notaries is curated based on selected filters.
No Alternative Flow			

4.6.14 Appointment Cancellation

Table 4.14: Appointment Cancellation
The table contains the description of Appointment Cancellation use case

Name	Appointment Cancellation		
Actors	System		
Summary	The system shall cancel an appointment if it is not confirmed at least 30 minutes before the scheduled time.		
Pre-Conditions	The appointment must exist in the list of Unconfirmed Appointments.		
Post-Conditions	The appointment will be removed from the list of Unconfirmed appointments and the Client will be notified about the cancellation.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	An appointment isn’t marked as paid if it’s within 30 minutes of its start.	2	The appointment is removed from the Notary’s Unconfirmed list and the Client’s Unpaid Appointments list. The client is notified of the cancellation.
No Alternative Flow			

4.6.15 Appointment Creation

Table 4.15: Appointment Creation
The table contains the description of Appointment Creation use case

Name	Appointment Creation		
Actors	Client		
Summary	The user shall book an appointment with a Notary by opening his profile and selecting an available slot on the Notary's profile page.		
Pre-Conditions	The user must be logged in. The user must be on the Client Dashboard.		
Post-Conditions	An Appointment will be created and the system will redirect to the "Unpaid Appointments" page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user selects on the Create an Appointment option.	2	A list of all Notaries is displayed.
3	The user chooses a Notary by clicking on their information card.	4	The system directs to the selected Notary's profile page, showing a list of available slots below their profile information.
5	The user chooses an available slot and clicks "Book Appointment."	6	The system blocks slots, updates the user's and Notary's appointments, and redirects to the user's "Unpaid Appointments."
No Alternative Flow			

4.6.16 Appointment Confirmation

Table 4.16: Appointment Confirmation
The table contains the description of Appointment Confirmation use case

Name	Appointment Confirmation		
Actors	Notary		
Summary	The user shall confirm an appointment by marking the appointment as Paid. The appointment shall be confirmed and added to the list of Upcoming appointments.		
Pre-Conditions	The user must be logged in. The user must be on the Notary Dashboard. The appointment must exist in the list of Unconfirmed Appointments.		
Post-Conditions	The confirmed appointment will be removed from the list of Unconfirmed Appointments and added to the list of Upcoming Appointments. The system will redirect to the Upcoming Appointments page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user shall click on the "Unconfirmed Appointments".	2	The system redirects to a new page displaying a list of unconfirmed appointments.
3	The user checks the Mark Confirmed box.	4	The system moves the appointment to the Upcoming list for both the Notary and the Client, then redirects to the Upcoming Appointments page on the Notary's Dashboard.
No Alternative Flow			

4.6.17 Uploading Documents for Notarization

Table 4.17: Uploading Documents for Notarization
The table contains the description of Uploading Documents for Notarization use case

Name	Uploading Documents for Notarization		
Actors	Client		
Summary	The user shall upload a document(s) for notarization by selecting the Upload Document option on the Dashboard and choose one or more Documents.		
Pre-Conditions	The user must be logged in. The user must be on the Client Dashboard. The document(s) must be in local storage or Drive.		
Post-Conditions	The document will appear in the list of all uploaded documents.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks on the Upload Document button.	2	A page is displayed with an option to upload a new button and a list of all documents uploaded previously.
3	The user clicks on the Upload button.	4	A file selection dialog pops up.
5	The user selects a document and clicks save.	6	The system displays a “Link with an Appointment” or “Cancel” button.
7	The user clicks “Link with an Appointment”.	8	A list of all Upcoming Appointments is displayed.
9	The user selects one of the appointments from the list.	10	The system displays ”Uploaded Successfully,” adds the document to the list, and redirects to all uploaded documents.
Alternative Flow			
7	The user clicks cancel.	8-A	The system displays ”Document Upload Cancelled” and redirects to the list of all uploaded documents.

4.6.18 View Upcoming Appointments

Table 4.18: View Upcoming Appointments
The table contains the description of View Upcoming Appointments use case

Name	View Upcoming Appointments		
Actors	Client, Notary		
Summary	The user shall be able to view a list of upcoming appointments.		
Pre-Conditions	The user must be logged in. The user must have an appointment booked.		
Post-Conditions	The system shall display a list of all upcoming appointments.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the “Upcoming appointments”.	2	It displays upcoming appointments with Clients for Notaries and with different Notaries for Clients.
No Alternative Flow			

4.6.19 Join Notarization Session

Table 4.19: Join Notarization Session
The table contains the description of Join Notarization session use case

Name	Join Notarization Session		
Actors	Client		
Summary	The system shall allow the user to join a notarization session with the Notary by attending a video call initiated by the Notary Documents.		
Pre-Conditions	The user must be logged in. The user must have an appointment scheduled with the Notary initiating the video call.		
Post-Conditions	A Notarization session is successfully started.		
Special Requirements	An Appointment must exist to start a Notarization session. The user must use a device with camera functionality.		
Basic Flow			
Actor Action		**System Response**	
1	The user accepts the Notary's initiated call.	2	The system successfully launches a notarization session between the user and the Client.
Alternative Flow			
1	The user declines the video call initiated by the Notary.	2-A	The system cancels the appointment and informs the initiating Notary.

4.6.20 Start Notarization Session

Table 4.20: Start Notarization Session
The table contains the description of Start Notarization Session use case

Name	Notarization Session		
Actors	Notary		
Summary	The system shall allow a user to start a notarization session with the Client using a video call feature.		
Pre-Conditions	The user must be logged in. The user must have an appointment scheduled with the respective Client.		
Post-Conditions	The session shall result in a notarized document securely saved to the Database.		
Special Requirements	An Appointment must exist to start a Notarization session. The user must use a device with camera functionality. The Client must be logged in.		
Basic Flow			
Actor Action		**System Response**	
1	The user selects the "Start Notarization Session" option.	2	The system directs to a page with the details of the earliest appointment and a button to start a video call with the Client.
3	The user clicks the "Start Video Call" button.	4	The system initiates a video call and notifies the corresponding Client.
No Alternative Flow			
3	The user clicks the "Preview Uploaded Documents".	4-A	The system opens the document(s) uploaded by the client in a non-modifiable view.

4.6.21 Notarization of Uploaded Document

Table 4.21: Notarization of Uploaded Document
The table contains the description of Notarization of Uploaded Documents use case

Name	Notarization of Uploaded Document		
Actors	Notary		
Summary	The user shall Notarize a document by affixing the Notary's Seal and Stamp to the uploaded document.		
Pre-Conditions	The Notarization session must be launched successfully. The document must be uploaded. prior to the session's commencement.		
Post-Conditions	A legally binding Notarized document will be saved to ImmuDB. The session will be concluded by the Notary.		
Special Requirements	The user must be able to access the document uploaded by the client.		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the "Open Document" button.	2	The system opens the document and displays it on the screen.
3	The user clicks the "Add Seal" button.	4	The system affixes the Seal to the end of the document.
5	The user clicks the "Add Stamp" button	6	The system affixes the Stamp next to the Seal.
7	The user clicks the "Add Signature" button.	8	The system adds the Notary's E-signature to the Stamp.
9	The user clicks the "Complete" button.	10	The system saves the notarized document to the database and ends the notarization session.
Alternative Flow			
9	The user clicks the "Terminate" button.	10-A	The notarization process is aborted and the system responds with a message: E-Notarization Aborted. Choose a new document or start again.

4.7 Hardware and Software Requirements

4.7.1 Hardware Requirements

4.7.1.1 Hardware requirements during development phase

- A computer with a minimum of 8GB of RAM, a CPU with a minimum of four cores, and a modern operating system.
- Storage of minimum 10GB to deploy files, database, and backups.
- Stable internet connection with a minimum speed of 6Mbps.
- Desktop device of minimum 4Gb RAM, 64-bit operating system, a webcam for a video session, and a microphone for desktop testing.

- Smartphone with minimum 4GB RAM, front camera, and microphone for mobile testing.
- An external hard drive of a minimum of 10GB for data backups to ensure the security of data.

4.7.1.2 Hardware requirements for users

- Desktop device with a minimum of 4GB RAM, 64-bit operating system, a webcam, and a microphone.
- A Mobile device with a minimum of 4GB RAM, front camera, and microphone.
- Stable internet connection with a minimum speed of 4Mbps for smooth client and notary video sessions.

4.7.2 Software Requirements

4.7.2.1 Software requirements during development phase

- Visual Studio Code
- GitHub and Git
- ReactJS
- NodeJS
- ExpressJS
- ImmuDB
- Windows OS
- Trello/Notion
- Web Browsers such as Google Chrome, Microsoft Edge, or Mozilla Firefox

4.7.2.2 Software Requirements for Users

- Desktop or mobile device with a web browser such as Google Chrome, Microsoft Edge, or Mozilla Firefox.

4.8 Graphical User Interface

4.8.1 Home Page

The user navigates to the application and this is displayed as the landing page. The user can select ”Get Documents Notarized” to proceed as Client or ”Continue as Notary” to proceed as Notary Public. The ’Get Documents Notarized’ redirects the user to the Client Dashboard and ’Continue as Notary’ redirects the user to the Notary Dashboard as shown in figure 4.1. It covers use case 4.6.3.

Figure 4.1: Home Page GUI
The default landing page that allows the user to proceed as a Client or Notary.

4.8.2 Sign-Up as Notary

The user enters the required information, uploads the license, agrees to the Terms and Conditions, and signs up for a Notary Public account. This results in the creation of a Notary’s Account, Stamp, and Seal, as described in figure 4.2. It covers use case 4.6.1.

4.8.3 Log-in as Notary

The notary logs in to the existing notary account by entering the username and password to get access to the notary dashboard as shown in figure 4.3. It covers the use case 4.6.3.

4.8.4 Sign-Up as Client

The user enters the required information agrees to the Terms and Conditions and signs up for a Client account. This results in the creation of a Client’s Account. It covers use case 4.6.2 and is shown in the figure 4.4.

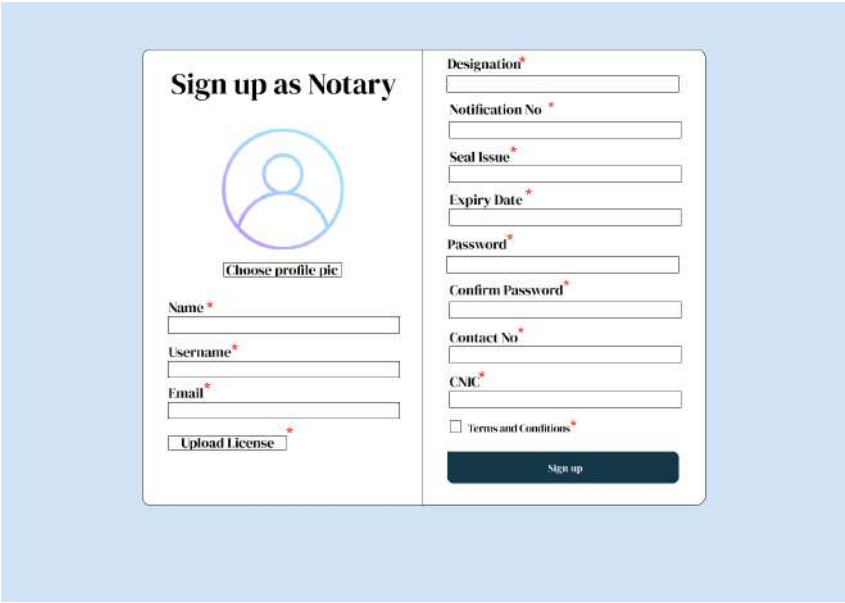

Figure 4.2: Sign-up as Notary GUI

The sign-up page where users can enter information to proceed as Notary.

Figure 4.3: Login as Notary GUI

The login page where the Notary enters username and password to get access to the notary dashboard.

4.8.5 Log-in as Client

The Client logs in to the existing notary account by entering the username and password to get access to the client dashboard as shown in figure 4.5. It covers the use case 4.6.3.

4.8.6 Notary Dashboard

The system redirects to this page after a successful login. The left side of the dashboard contains all the options to navigate the Notary portal. A Sign-out button is available to sign out of the application and an

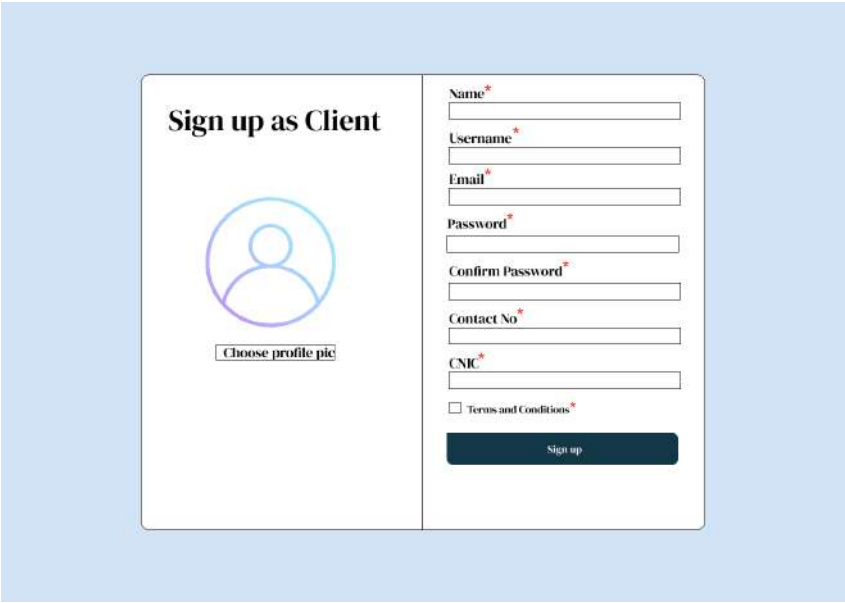

Figure 4.4: Sign-up as Client GUI
The sign-up page where users can enter information to proceed as Client.

Figure 4.5: Login as Client GUI
The login page where the Client enters username and password to get access to the client dashboard.

edit profile button is available to update profile information. It does not specifically cover a use case but serves as an entry point for other functionalities. The graphical user interface for the notary dashboard is shown in figure 4.6.

4.8.7 Client Dashboard

The system redirects to this page after successful login. The left side of the dashboard contains all the options to navigate the Client portal. A Sign-out button is available to sign out of the application and an

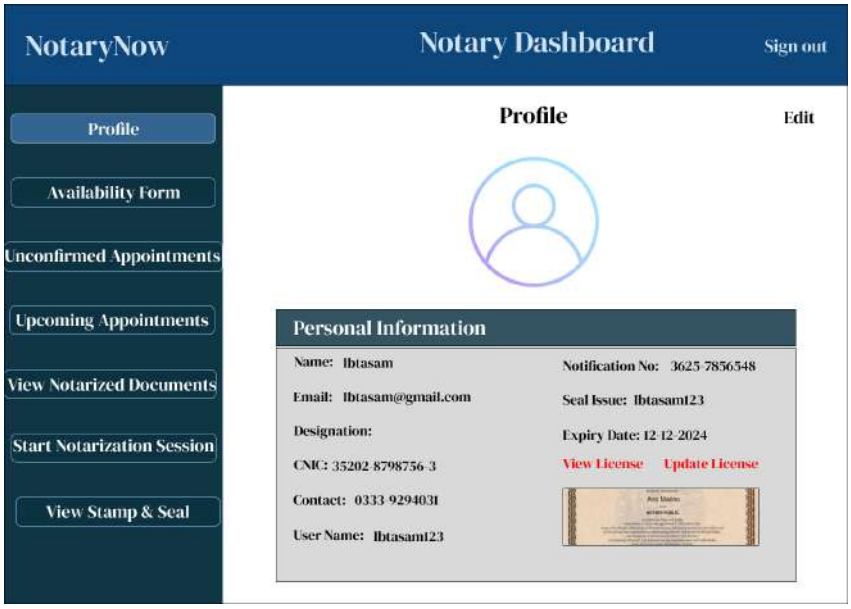

Figure 4.6: Notary Dashboard GUI

Landing page of the Notary Portal facilitating all functionalities for the Notary.

edit profile button is available to update profile information. It does not specifically cover a use case but serves as an entry point for other functionalities. The graphical user interface for the client dashboard is shown in figure 4.7.

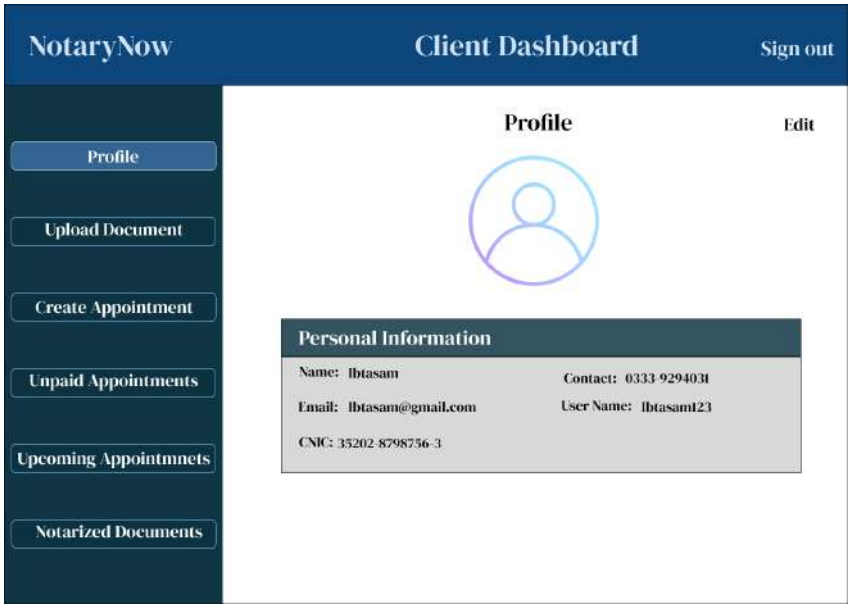

Figure 4.7: Client Dashboard GUI

Landing page of the Client Portal facilitating all functionalities for the Client.

4.8.8 Specify Availability Schedule

The Notary can select the Availability Form option to specify his work schedule. This will open up a form to enter work days and times. The system will generate appointment slots from this information

and display these on the Notaries Profile as shown in figure 5.15. It covers use case 4.6.7

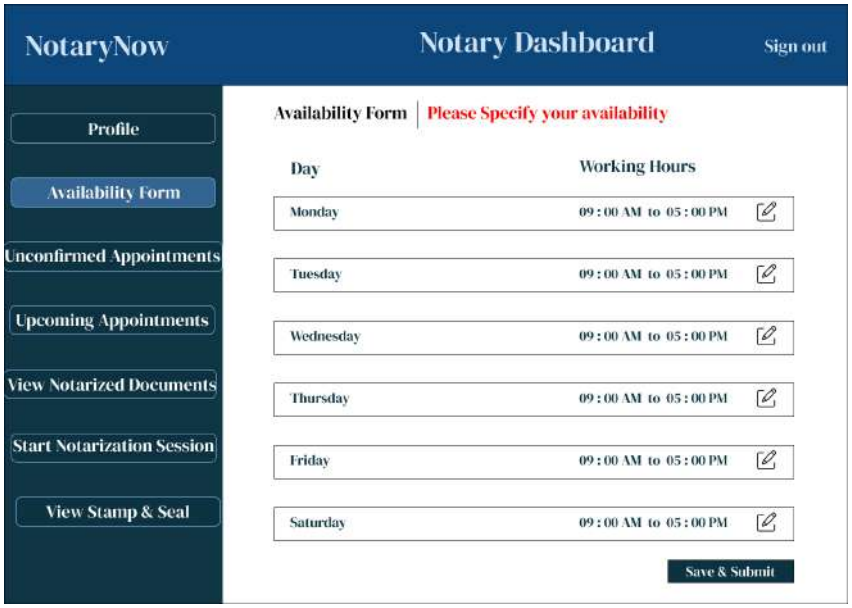

Figure 4.8: Availability Form GUI

A form to specify a working schedule so that the Client may book an appointment with the Notary.

4.8.9 Selecting a Notary Public

The client can select/search a Notary from a list of all Notaries. The Client can view a Notary's profile and available slots. This is shown in figure 4.9 and covers use case 4.6.10.

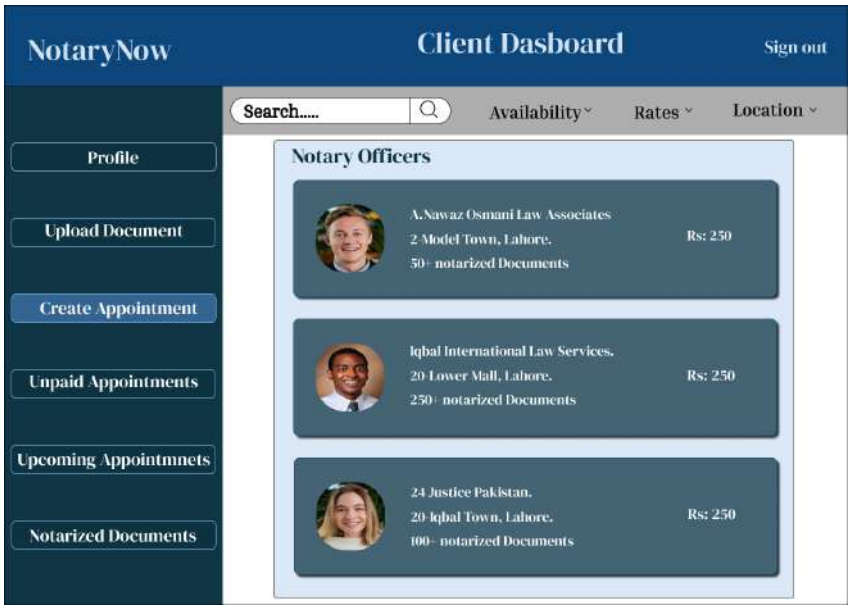

Figure 4.9: Create Appointment GUI

Page that display the list of all notaries and search/filter options

4.8.10 Book Appointment

The Client can book an appointment by opting for an available slot listed on the selected Notary's profile and clicking book appointment as shown in figure4.10. It covers use case 4.6.11.

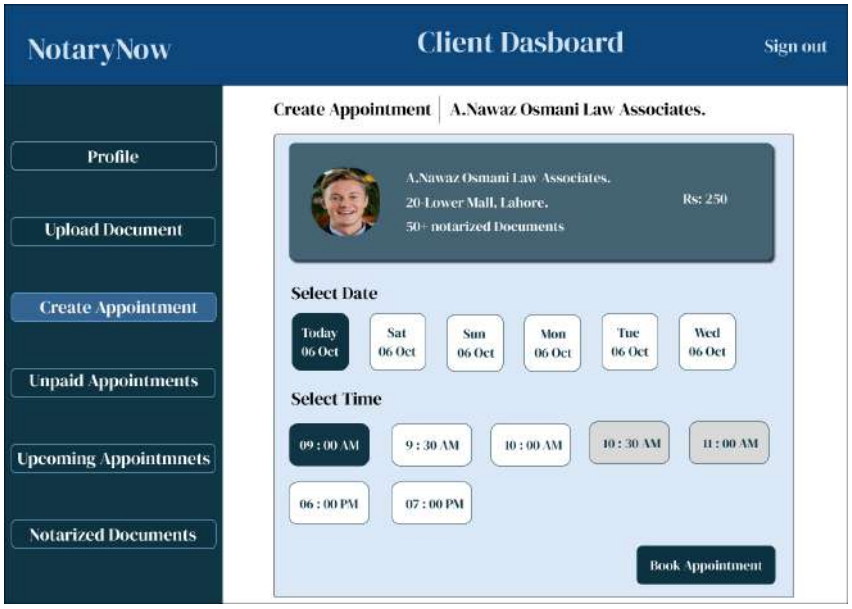

Figure 4.10: Book Appointment GUI
A page to allow users to pick a suitable slot for an appointment.

4.8.11 View Unpaid Appointments

The Client can select this option to view the list of appointments that he has booked but has not been confirmed so far. The graphical user interface for viewing unpaid appointments is shown in figure 4.11. It covers use case 4.6.20.

4.8.12 View Upcoming Appointments (Client)

The user can select this option to view the list of Upcoming/Confirmed appointments. These appointments have been confirmed by the corresponding notaries. The graphical user interface for viewing upcoming appointments is shown in figure 4.12. It covers use case 4.6.21.

4.8.13 Upload Document

The user can select this option to upload a document after booking an appointment. The uploaded document has to be linked to an upcoming appointment. This is shown in figure 4.13 and covers use case 4.6.14

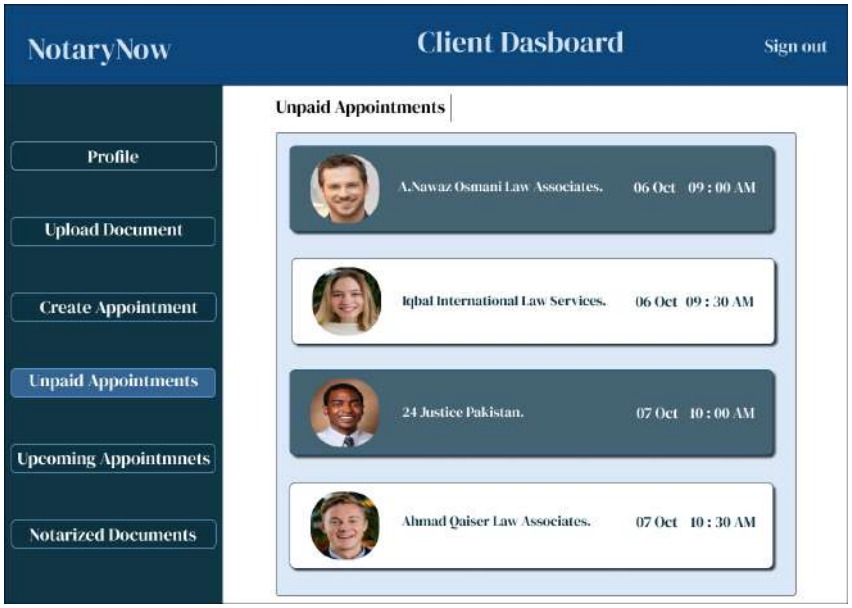

Figure 4.11: Client Unpaid Appointments GUI
This page displays the List of a Client's Unpaid Appointments.

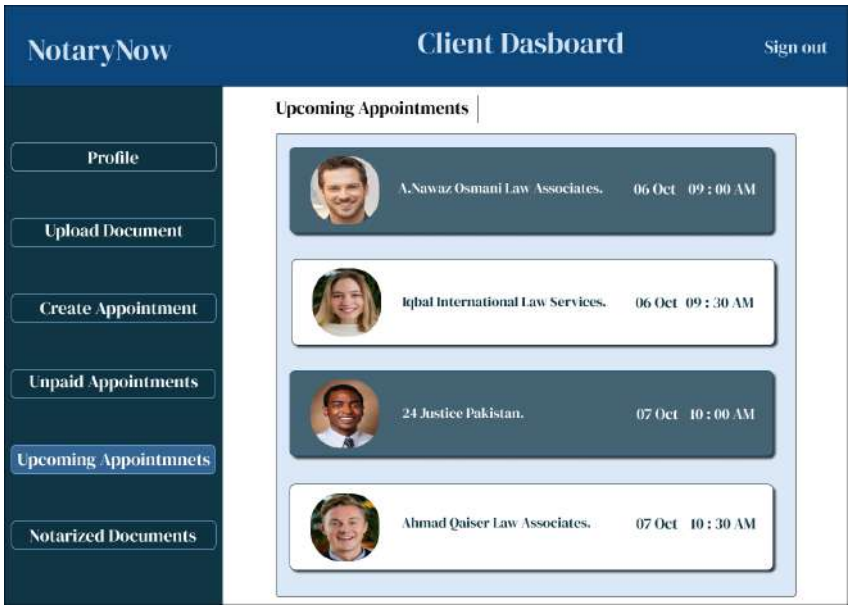

Figure 4.12: Client Upcoming Appointments GUI
This page displays the List of Client's Upcoming Appointments.

4.8.14 Appointment Confirmation

The Notary can select this option to view the list of unconfirmed appointments. He can mark an appointment as confirmed to move it to the list of Upcoming appointments. The graphical user interface for appointment confirmation is shown in figure 4.14. It covers use case 4.6.12.

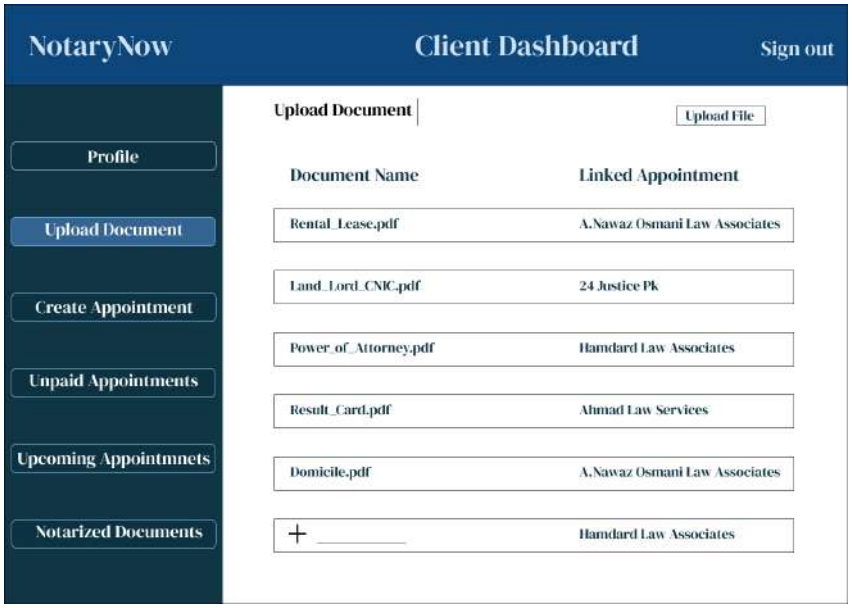

Figure 4.13: Upload Document GUI

This page displays the document uploading for notarization.

Figure 4.14: Notary Unconfirmed Appointments GUI

This page displays the List of all Unconfirmed appointments for the Notary.

4.8.15 View Upcoming Appointments (Notary)

The Notary can select this option to view the list of Upcoming appointments he has with Clients. He can see the information on upcoming sessions. The graphical user interface for viewing upcoming appointments for the notary is shown in figure 4.15. It covers user case 4.6.21.

Figure 4.15: Notary Upcoming Appointments GUI
This page displays the List of all Upcoming Appointments.

4.8.16 Notarization Session

The Notary can start a Notarization session with a Client when it's time for the appointment. The Notary can select the Start Notarization Session option and it will display the Information of the upcoming session as shown in figure 4.16. It partially covers use case 4.6.15.

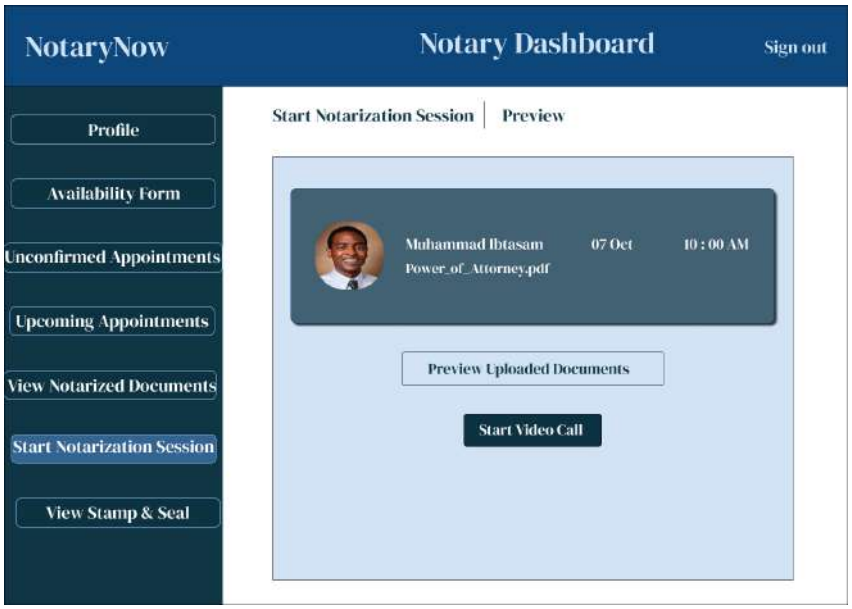

Figure 4.16: Preview Notarization Session GUI
This displays the information about the appointment with an option to view a document or start a video call.

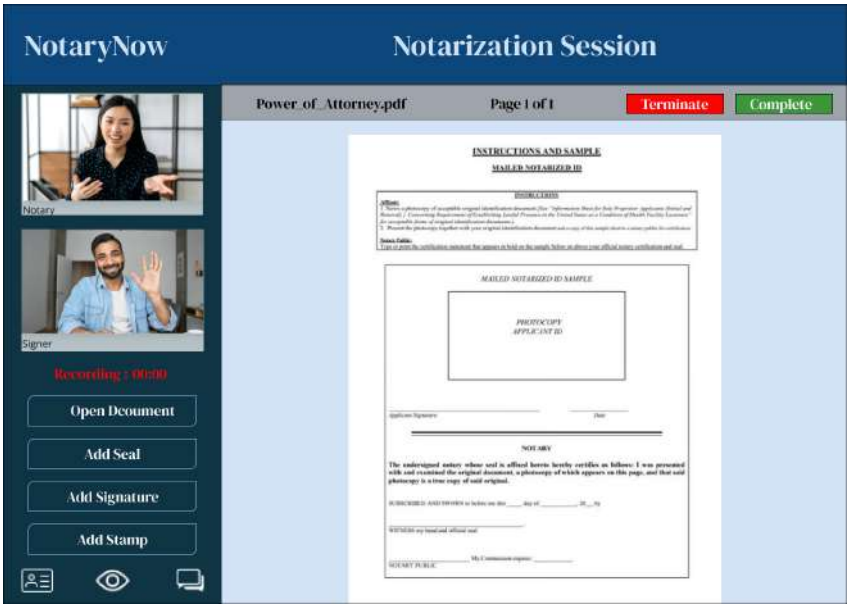

Figure 4.17: Video Call GUI

This displays the video call and notarization interface of our application.

4.8.17 Video Call

The Notary can start a video call with the client and the client can join this session for RON as shown in figure 4.17. It covers use cases 4.6.15, 4.6.16, and 4.6.17.

4.9 Database Design

4.9.1 ER Diagram

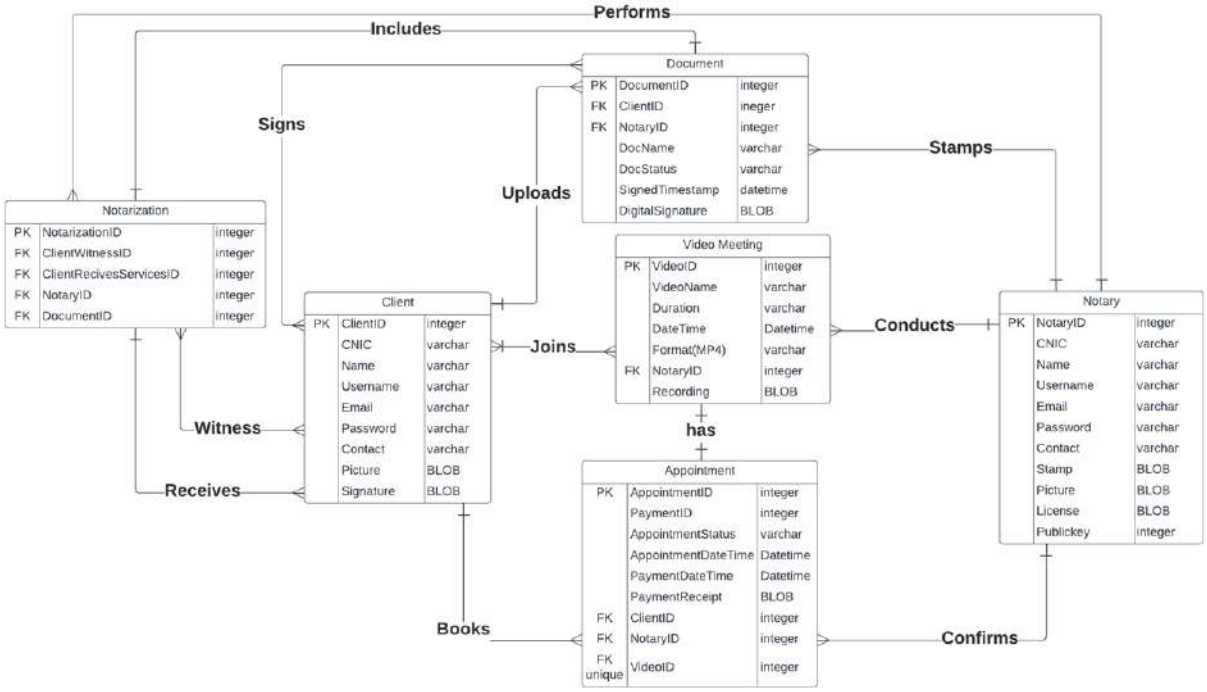

Figure 4.18: ER Diagram of NotaryNow

The figure shows the Entity-Relationship Diagram of the project

4.9.2 Data Dictionary

Table 4.22: Data Dictionary

The table shows the attributes and their data types of different entities

Entity	Attributes	Data Type	Nullable	Description
Notary	NotaryID	integer	No	Primary key of notary
	CNIC	varchar	No	Cnic of notary public
	Name	varchar	No	Name of notary public
	Username	varchar	No	Username of notary public
	Email	varchar	No	Email of notary public
	Password	varchar	No	Password of notary public account
	Contact	varchar	No	Contact of notary public
	Stamp	BLOB	No	Stamp of notary public

	Signatures	BLOB	No	Signatures of the notary public
	Picture	BLOB	Yes	Picture of notary public
	License	BLOB	No	Official License of Notary public
	PublicKey	integer	No	Public key of notary used for decryption of digitally signed documents
Client	ClientID	integer	No	Primary Key of client
	CNIC	varchar	No	CNIC of the client
	Name	varchar	No	Name of the client
	Username	varchar	No	Username of client
	Email	varchar	No	Email of the client
	Password	varchar	No	Password of the client's account
	Contact	varchar	No	Contact of the client
	Picture	BLOB	Yes	Picture of the client
	Signatures	BLOB	No	Signatures of the client
Document	DocumentID	integer	No	Primary Key of document
	ClientID	Integer	No	Foreign Key of client from Client
	NotaryID	integer	No	Foreign key of notary public from Notary
	DocName	varchar	No	Name of the document
	DocStatus	varchar	No	Status of document whether notarized or to be notarized
	SignedTimestamp	Datetime	Yes	The date and time at which the document is notarized
	DigitalSignatures	BLOB	Yes	Digitally signed document encrypted with notary's public key
Notarization	NotarizationID	integer	No	Primary Key of the table

	ClinetWitnessID	integer	Yes	Foreign key of witnessing client from Client
	ClientID	integer	No	Foreign key of the client who booked service from Client
	NotaryID	integer	No	Foreign key of the notary who performs notarization
	DocumentID	integer	No	Foreign key of the document being notarized from Document
Appointment	AppointmentID	integer	No	Primary Key of the table
	PaymentID	integer	No	Payment to be paid to the notary officer
	AppointmentStatus	varchar	No	Foreign key of the client who booked service from Client
	AppTimeStamp	datetime	No	Date and time at which the appointment is booked
	PaymentTimeStamp	datetime	Yes	Date and Time at which payment is made
	PaymentReceipt	BLOB	Yes	Receipt of the payment made by client
	ClientID	integer	No	Foreign key of the client who booked the appointment
	NotaryID	integer	No	Foreign key of the notary who is booked for notarization
	VideoID	integer	Yes	Foreign key from Video Meeting
Video Meeting	VideoID	integer	No	Primary Key of the table
	VideoName	varchar	No	Name of recorded video file
	Duration	varchar	No	Duration of the video
	VideoTimeStamp	datetime	No	The date and time at which video is recorded

	Format(MP4)	varchar	No	The format in which video is stored after recording
	NotaryID	integer	No	Foreign key of notary who performs notarization from Notary
	RecordedFile	BLOB	No	Recorded file of the video

4.10 Risk Analysis

E-Notarization systems offer convenience and efficiency in the notarization procedures but they also come with certain challenges and risks. Some possible risks associated with the E-Notarization system are listed below.

4.10.1 Security Breach

In an e-notarized system, unauthorized access can happen when someone tries to enter the system without proper authentication. This may involve exploiting the vulnerabilities or stealing passwords. Also, the unauthorized accessor can attempt to steal sensitive information including notarized documents, user information, etc. It can also involve the tempering of the documents which can create integrity issues for the signed documents.

4.10.2 Electronic Signature Forgery

Electronic signature forgery can be a serious concern for any E-Notarization system. If the system does not employ strong encryption and authentication methods, digital signatures can be forged, altered, or manipulated, posing a threat to the integrity of notarized documents.

4.11 Conclusion

In conclusion, this chapter provides a comprehensive overview of the project's requirements, encompassing both functional and non-functional aspects, as well as hardware and software specifications. It also delves into detailed use cases, exploring both basic and alternative scenarios. Furthermore, the chapter incorporates Graphical User Interfaces (GUIs) to enhance the user experience. Finally, it concludes with the presentation of the Entity-Relationship Diagram, with its data dictionary, followed by a risk analysis associated with the project.

Chapter 5 High-Level and Low-Level Design

This section details the high and low-level design of ”NotaryNow”. Beginning with a system overview and design considerations, it moves on to visual aspects of system design. This part entails architecture diagrams for the entire system as well as subsystems. In addition to this, we have included class diagrams and sequence diagrams for important operations.

5.1 System Overview

Dedicated to enhancing Remote Online Notarization (RON) services, our project provides Electronic Notarization services to both Notaries Public and Clients. Remote online notarization (RON) enables the notarization of electronic documents using electronic signatures and live online appearances by signers before commissioned notaries.
Our Application follows modular architecture design guidelines. It is made up of six key components, which are listed below.

5.1.1 Dedicated Portals for Notary Public and Client

Our application provides specific portals for each user. These portals are personalized for each system user's needs. Our website facilitates communication between notaries and customers. Customers enjoy an easy-to-use interface. This user interface is specially adapted to their unique needs. Notaries benefit from the tools and capabilities required for the notarization process within their portal. This dual-portal strategy significantly improves system efficiency and overall client satisfaction

5.1.2 Appointment Booking

Clients can use the module to find available Notaries and select one that suits their requirements. Clients can also filter notaries using a range of criteria. The Client can then select a time and set up an appointment with the chosen Notary. This module also handles services such as appointment confirmation and cancellation.

5.1.3 Identity Verification

This module is designed to detect identity forgery and fraud through specific methods. Users are prompted to provide a CNIC, and the barcode/QR code on the CNIC is scanned to extract the user's information. Subsequently, this information is utilized to retrieve corresponding records from the NADRA database. The textual details on the CNIC are then compared with the records obtained from NADRA,

enabling the detection of CNIC swapping frauds, where certain information on the CNIC is altered to match a person to whom the card does not belong. In addition, this module conducts Knowledge-Based Assessments(KBA) based on questions from users' personal information in official records.

5.1.4 Video Call Module

This module enables the Notary Public and the Client to join an audio-visual session. At the scheduled time, the Notary Public initiates a video call. The Client can choose to accept or reject this call. On acceptance, the audio-visual session is launched successfully to proceed with Remote Online Notarization(RON). Additional witnesses and parties can join the call as required.

5.1.5 Remote Online Notarization

This module enables the process of Remote Online Notarization. The Client is required to upload the document before the E-Notarization session. The Notary public opens this document during the session. Both the Client and the Notary sign the document. The Notary applies his seal and stamp on this document and saves it. The system then securely stores this Notarized document concluding RON.

5.1.6 Digital Signatures

This module involves the application of digital signatures to documents. After the Notary signs and stamps the document, it undergoes hashing using SHA-256. A key pair, generated for the Notary through RSA, utilizes the private key to encrypt the hash. The resulting digital signature is embedded in the document and securely stored in ImmuDB. During verification, the document is decrypted using the Notary's public key, and its hash is compared with the original. Matching hashes assure that the stamp, signature, or seal is authentic, ensuring the document's integrity.

5.2 Design Considerations

This section encompasses aspects that need to be detailed before development commences.

5.2.1 Assumptions and Dependencies

Some assumptions are as follows:

5.2.1.1 Device and Internet Access

This system will be designed under the assumption that users will have access to a PC, tablet, or smartphone that can connect to the internet.

5.2.1.2 Third Party Services

This system relies on external services to provide comprehensive capabilities such as QR scanning, PDF editing, and digital signatures.

5.2.2 General Constraints

Some general constraints are as follows:

5.2.2.1 Privacy and Security

This system must adhere to the same privacy and security requirements as systems in the markets comply with. These standards include regulations such as the Electronic Transactions Ordinance 2002 (ETO), the Prevention of Electronic Crimes Act 2016 (PECA), and the Pakistan Telecommunications Re-organisation Act 1996 (PTA Act).

5.2.2.2 Hardware and Software Environment

Our application is SERN-based(SQL, Express, React, Node.js). It requires server hosting. It requires a JavaScript-compatible modern browser on the client side. HTTPS will be used for secure communication. This technology stack lays the groundwork for a secure and rapid e-notarization platform.

5.2.2.3 End-User Environment

The system should be implemented in such a way as to function in some end-user settings. Users with varying levels of technical skills should be able to use it. The user interface should be easy to use, and responsive.

5.2.2.4 Availability or Volatility of Resources

The system should be efficient and fault-resistant. It should be equipped with protection against data loss or middleman attacks.

5.2.2.5 Standard Compliance

The system should comply with relevant industry standards and regulations, such as X.509, and PKCS (Public-Key Cryptography Standards) etc.

5.2.2.6 Interoperability Requirements

Our application should be built to interface smoothly with other systems and apps. It should be able to guarantee working with other softwares. It is critical to adhere to industry standards for data sharing. Integration methods should be followed to support interoperability. This will improve efficiency and compatibility. This method facilitates integration with other systems, such as legal databases or document management solutions.

5.2.2.7 Interface/Protocol Requirement

Interfaces of software (frontend in ReactJS) can run on browsers where JavaScript is installed. Client and server communication is carried out using HTTPS. Port numbers are used by the Client and Server side to communicate.

5.2.2.8 Data Repository and Distribution Requirements

ImmuDB will be used as the database for secure storage of Notarized documents. It will also be used for storage of user data and other application data.

5.2.2.9 Security Regulations

Authentication is performed for all users. Verification of CNIC is done using QR/Barcodes. Digital Signatures are used to prevent document forgery.

5.2.2.10 Performance Requirements

Proper Integration of modules must be ensured. A steady internet connection is required to support smooth performance.

5.2.3 Goals and Guidelines

5.2.3.1 Secure and Trusted Transactions

The application will maintain the utmost security to foster confidence in notarization transactions. To ensure safe user interactions, use multi-factor authentication, digital signatures, and encryption.

5.2.3.2 Effortless User Experience

We will create an easy-to-use interface to ensure that the notarization process runs well. The uploading of documents, identification verification, and general navigation will be given top priority. User will be able to proceed with RON via a secure Audio-Visual Session from the comfort of their home.

5.2.3.3 Identity Verification Merits

A multi-step identity verification system, including uploading photos of IDs, forensic analysis of Images, and Knowledge-Based Assessment will be in place to make Identity verification as flawless as possible.

5.2.3.4 Document Integrity Assurance

The application ensures the integrity and authenticity of notarized documents through advanced cryptographic measures. Users will be provided with verifiable digital certificates for enhanced document validation.

5.2.3.5 Privacy-Centric Design

Users' privacy and the security of notarized papers will be given first priority. Data protection law-compliant privacy safeguards will be in place to provide users peace of mind that their personal data and documents are saved securely.

5.2.3.6 Scalable Performance

A scalable architecture that can handle different user activity levels will be ensured. At times of high demand, our system shall be reliable in order to deliver a constant and effective service.

5.2.3.7 Transparent and Traceable Operations

To encourage openness, a thorough audit trail of all notarization-related activity shall be maintained. Users will have the ability to view comprehensive transaction histories and monitor the status of their notarization.

5.2.4 Development Methods

We have opted for Scrum as our preferred development methodology. Operating within the agile framework, Scrum incorporates sprints, typically lasting one week, and daily stand-up meetings. These daily check-ins serve as opportunities to synchronize efforts, ensuring that our development tasks are progressing smoothly. Throughout the one-week sprint, the team will focus on the assigned tasks, and at the end of each sprint, we will reevaluate and reassign tasks as necessary. This iterative approach allows us to adapt swiftly to project needs, maintain close collaboration, and deliver incremental progress consistently.

5.3 System Architecture

The architecture offers a high-level representation of significant modules of the system. It provides an overview of the subsystems and their contribution to the overall product. There are six main components that contribute to the system architecture:

- Dedicated Portals for Notary and the Client
- Appointment Booking
- Identity Verification
- Video Call Module
- Remote Online Notarization
- Digital Signatures

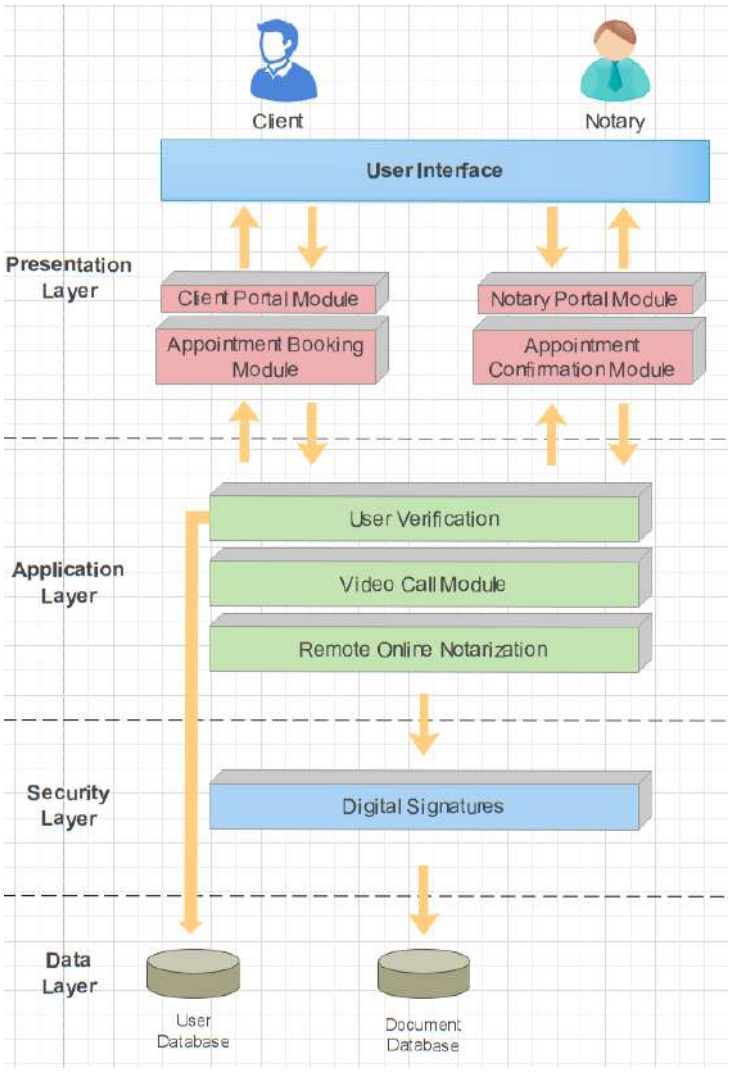

Figure 5.1: System Architecture Diagram of NotaryNow
The figure shows the System Architecture Diagram of the project

5.3.1 Subsystem Architecture

5.3.1.1 Dedicated Portals for Notary and the Client

Our application includes separate portals for clients and notary officers. Both the clients and notary officers can benefit from a range of specialized tools and features within their portals.

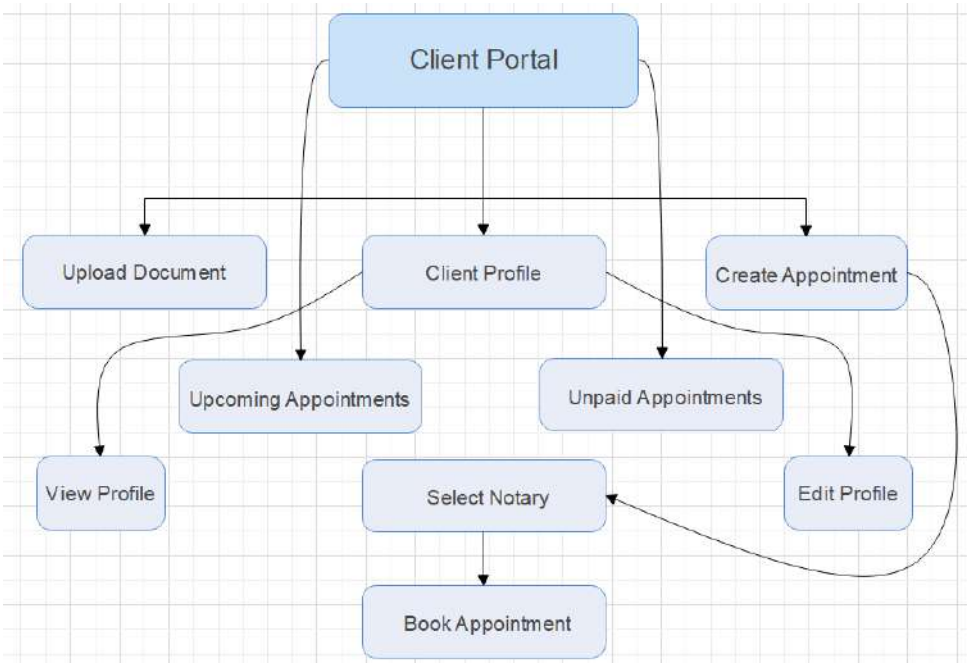

Figure 5.2: Component Diagram of Client Portal
The figure shows the Component Diagram of the Client Portal

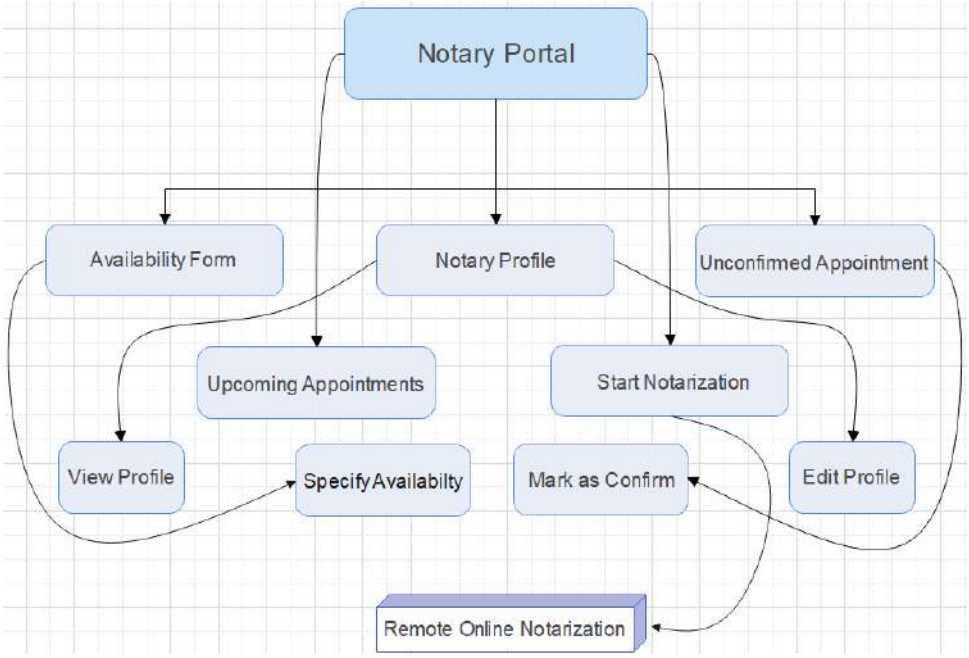

Figure 5.3: Component Diagram of Notary Portal
The figure shows the Component Diagram of the Notary Portal

5.3.1.2 Remote Online Notarization

This module enables Remote Online Notarization. First, the Client has to upload the document before the online notarization session. Then, during the session, a special person known as a Notary opens and looks at the document. Both the Client and the Notary put their signatures on the document. The Notary also adds a special mark called a seal and stamp. After that, the system saves this paper securely. This finished process is called Remote Online Notarization.

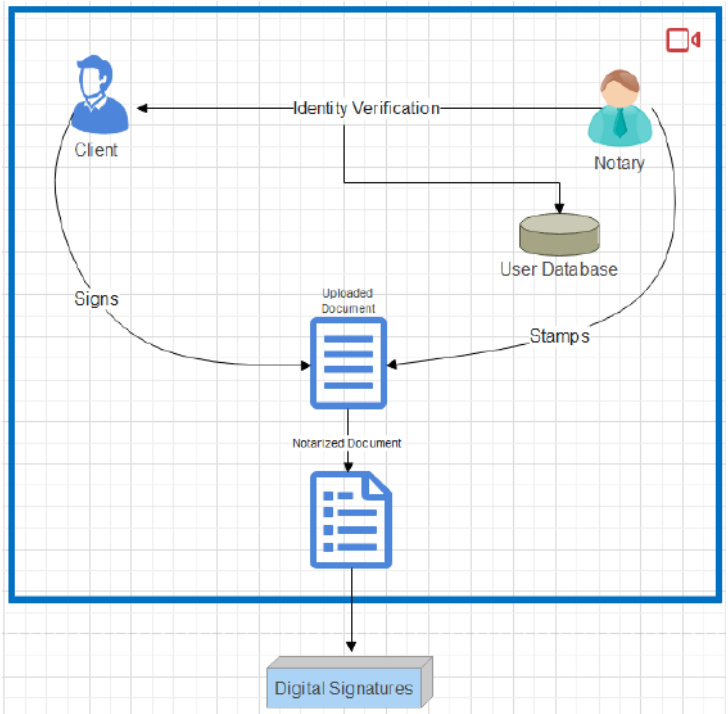

Figure 5.4: Architecture of RON Module
The figure shows the Architecture of the Module RON

5.3.1.3 Digital Signatures

This part of the system uses digital signatures on documents. Once the Notary signs and stamps a document, it goes through a process called hashing using SHA-256. The Notary has a key pair used for encryption and decryption of the hash. The private key is used to encrypt the hash, creating a digital signature. This signature is then added to the document and kept safe in ImmuDB. When someone checks the document later, it's unlocked using the Notary's public key, and the hash is compared with the original. If they match, it means the stamp, signature, or seal is real, ensuring the document is unchanged.

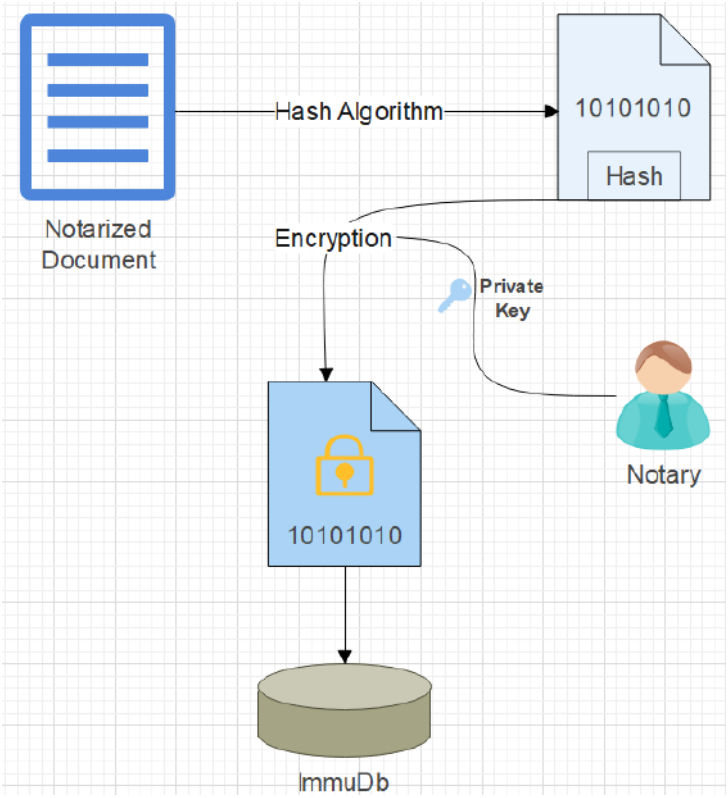

Figure 5.5: Architecture of Digital Signatures Module
The figure shows the Architecture of the Module Digital Signatures

5.4 Architectural Strategies

Following are the main architectural strategies that will be followed while making this project.

5.4.1 Software Development Frameworks

The project development will utilize Node js and Express js for the application, React for user interfaces, and ImmuDB as the secure and tamper-proof database. The implementation will be based on the latest versions of these languages and frameworks, ensuring compatibility and optimal performance.

5.4.2 Robust Error Handling

Our project will feature robust error detection and recovery mechanisms. User-friendly error messages will be implemented for invalid inputs, enhancing the overall user experience.

5.5 Domain Model/Class Diagram

The class diagram represents the structure of the system. We have used UML to illustrate the class diagram of our web application.

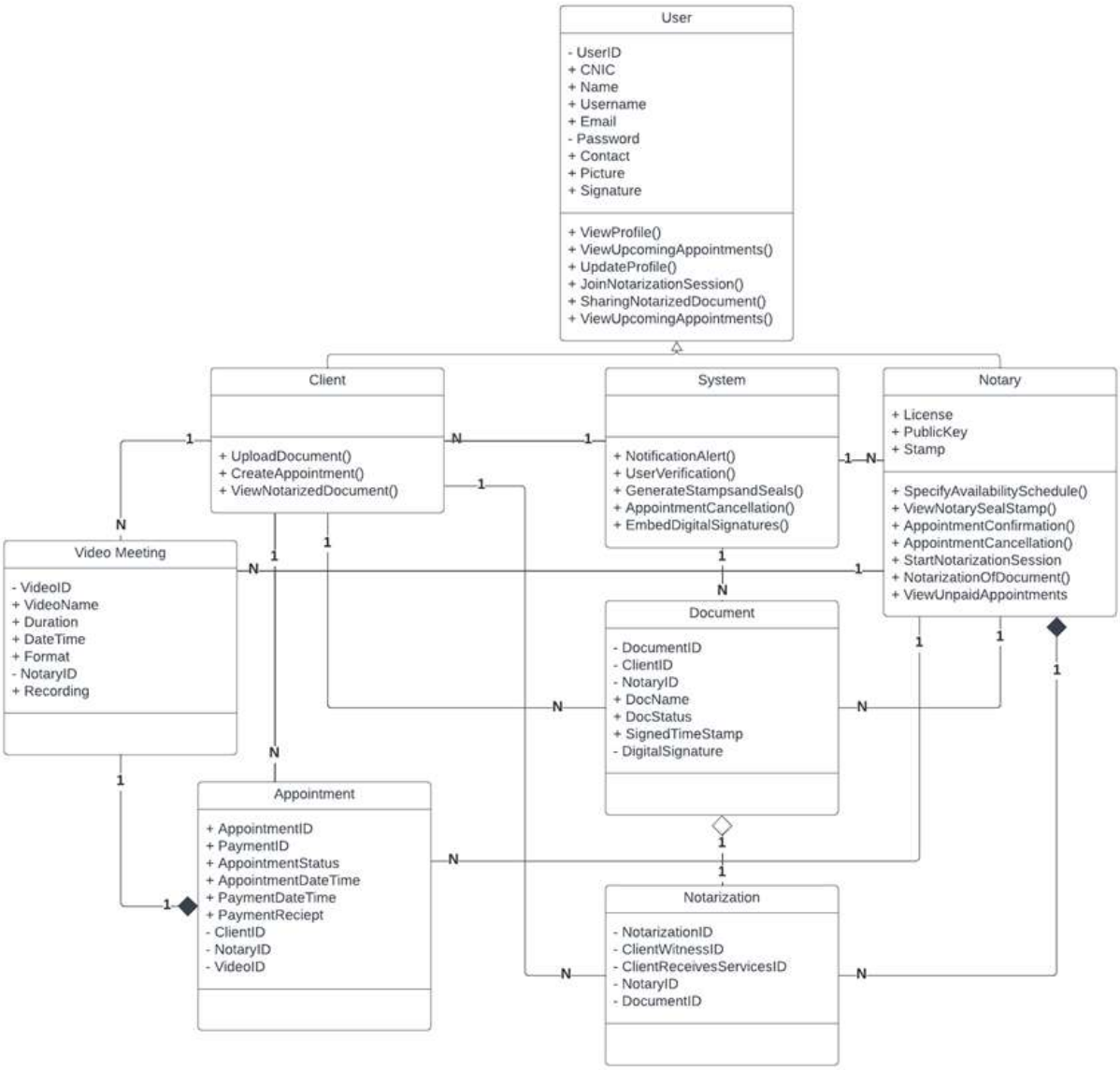

Figure 5.6: Class Diagram of NotaryNow
The figure shows the Class Diagram of the project

5.6 Sequence Diagrams

Sequence Diagrams detail how the process and operations are carried out. These diagrams show the steps performed at the actor, system, and database levels. The major sequence diagrams of our project are shown below.

5.6.1 Apply Digital Signature

The use of digital signatures on documents is shown in this diagram. The document is hashed using SHA-256, once the Notary signs and stamps it. A key pair is created for the Notary via RSA. The private key is used to encrypt the hash using the private key. The generated digital signature is integrated

in the document. This document is securely saved in ImmuDB. During verification, the document is decrypted with the Notary's public key. The decrypted hash is compared to the original hash. If the hashes match, this means the stamp, signature, or seal is genuine, hence confirming the document's integrity. This is shown in Figure 5.7.

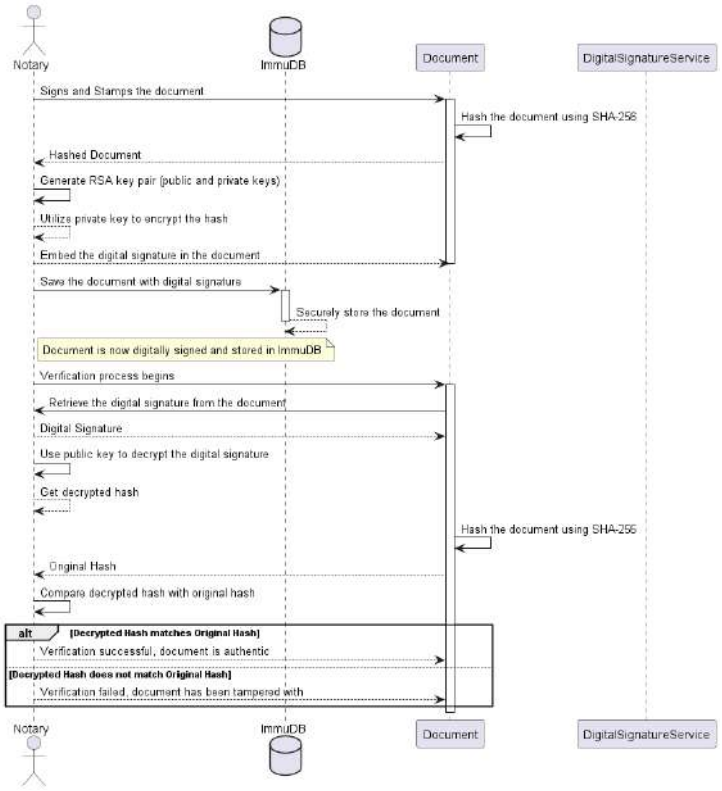

Figure 5.7: Apply Digital Signatures Sequence Diagram
The above figure shows the sequence diagram for Applying Digital Signatures

5.6.2 Appointment Cancellation

This sequence diagram shows the workflow for the cancellation of an appointment. If an appointment is not confirmed 30 minutes before the appointment time, it is cancelled. The corresponding appointment is then removed from the database. This is shown in Figure 5.8.

5.6.3 Sign-up as Notary

This sequence diagram shows the workflow of events during the sign-up process as a Notary. It includes the main scenario for this event. It also shows an alternative flow for handling invalid information. It also shows system errors when required fields are skipped. This is shown in Figure 5.9.

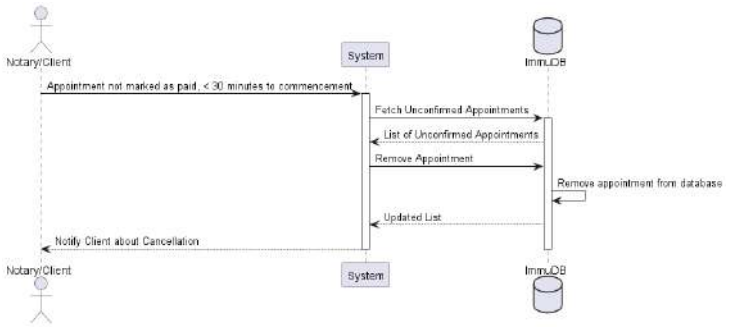

Figure 5.8: Appointment Cancellation Sequence Diagram
The above figure shows the sequence diagram for Appointment Cancellation

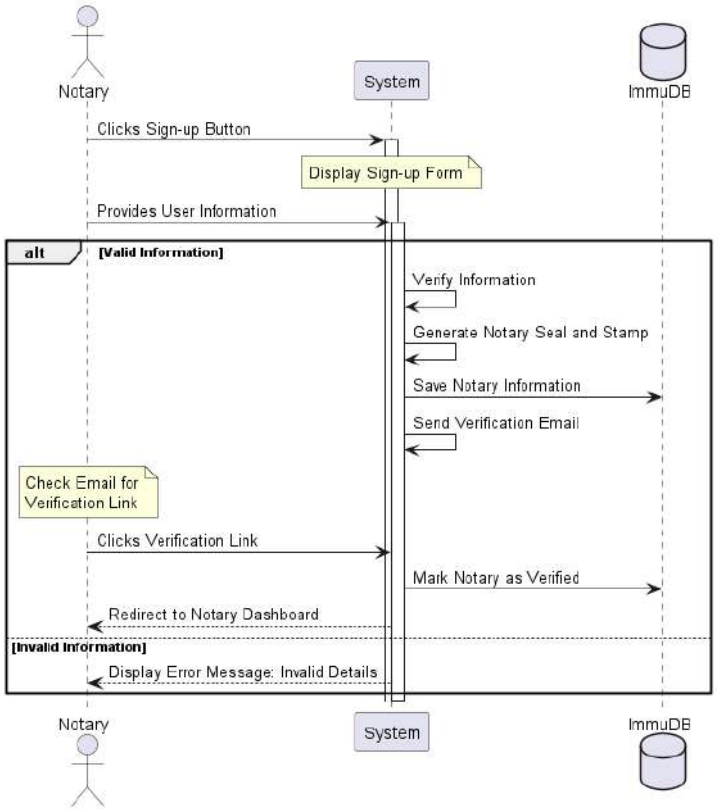

Figure 5.9: Sign-up as Notary Sequence Diagram
The above figure shows the sequence diagram for Signing-up as Notary

5.6.4 Sign-up as Client

This sequence diagram shows the workflow of events during the sign-up process as a Client. It includes the main scenario for this event. It also shows an alternative flow for handling invalid information. It also shows system errors when required fields are skipped. This is shown in Figure 5.10.

5.6.5 User Login

This sequence diagram shows the workflow for the ”Login” functionality. It includes the main scenario for both the Notary and the Client. This is shown in Figure 5.11.

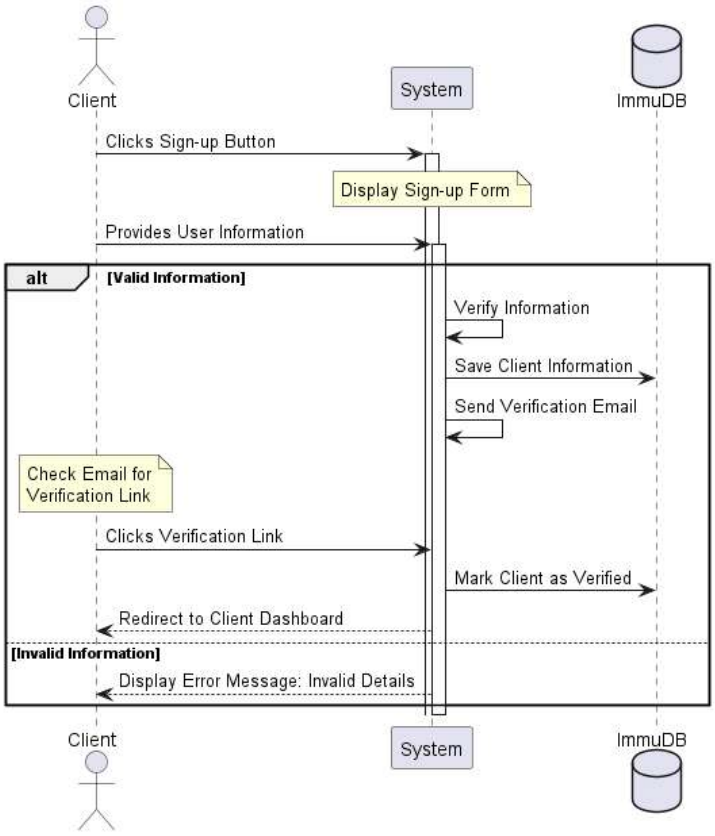

Figure 5.10: Sign-up as Client Sequence Diagram

The above figure shows the sequence diagram for Signing-up as Client

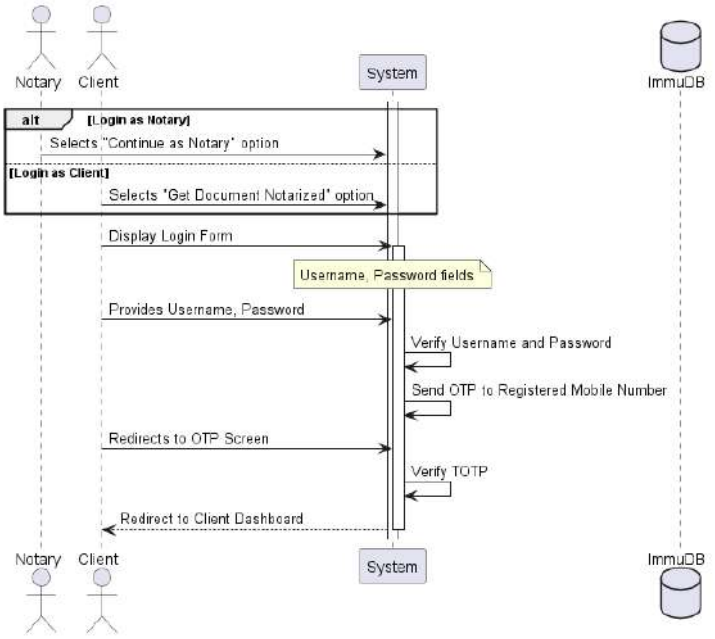

Figure 5.11: User Login Sequence Diagram

The above figure shows the sequence diagram for User Login

5.6.6 User Logout

This sequence diagram illustrates the workflow for the ”Logout” functionality. It includes the main scenario for both the Notary and the Client. This is shown in Figure 5.12.

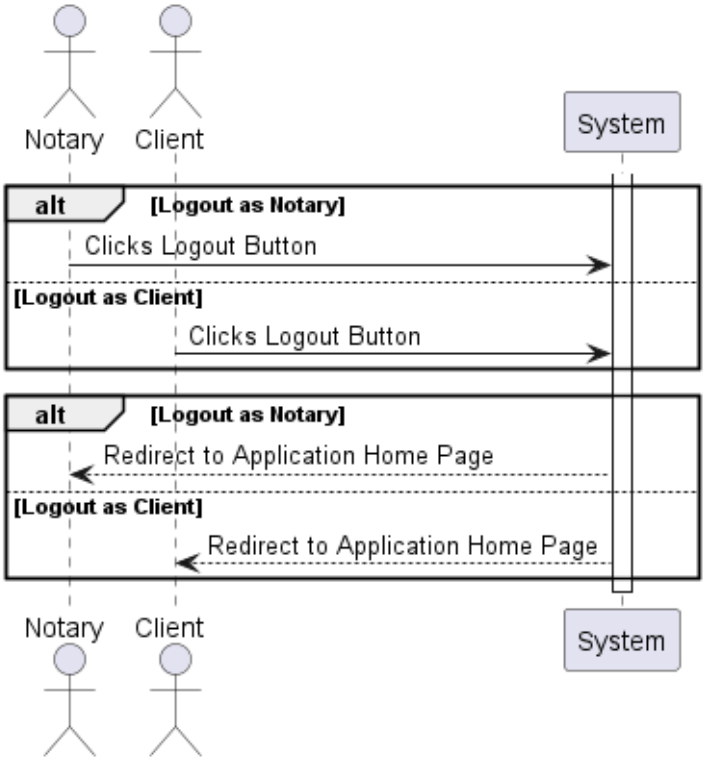

Figure 5.12: User Logout Sequence Diagram
The above figure shows the sequence diagram for User Logout

5.6.7 Update Notary Profile

The sequence diagram shows the flow of events when a Notary clicks the ”Edit Profile” button. The System validates modifiable fields. It saves changes if valid and updates the Notary’s profile. It also updates the seal and stamp. For the invalid flow of events, a warning message is displayed, and no changes are saved. This is shown in Figure 5.13.

5.6.8 Update Client Profile

The sequence diagram shows the flow of events when a Client clicks the ”Edit Profile” button. The System validates modifiable fields. It saves changes if valid and updates the client’s profile. For the invalid flow of events, a warning message is displayed, and no changes are saved. This is shown in Figure 5.14.

5.6.9 Specify Availability Schedule

This sequence diagram shows the workflow for the ”Specify Availability Schedule” functionality. It includes the main scenario where the Notary specifies their availability by filling out an availability form. The system generates free slots based on this information. This is shown in Figure 5.15.

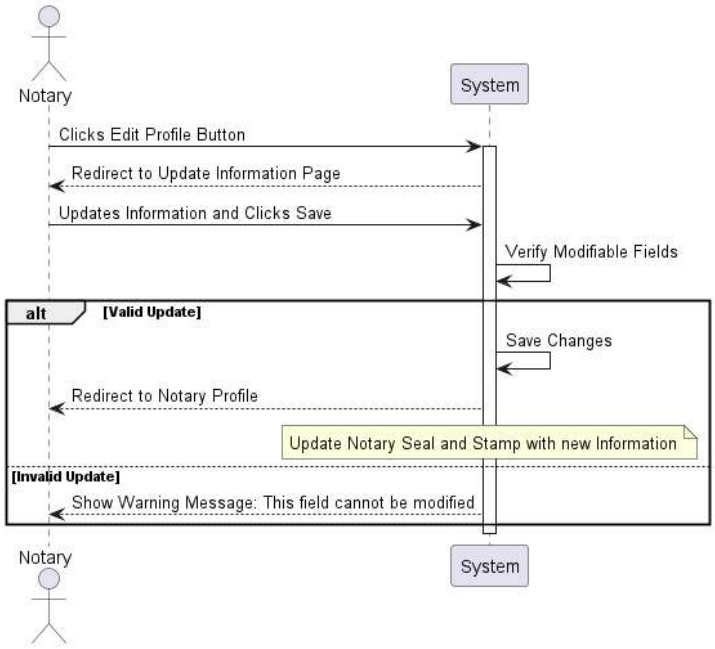

Figure 5.13: Update Notary Profile Sequence Diagram

The above figure shows the sequence diagram for Updating Notary Profile

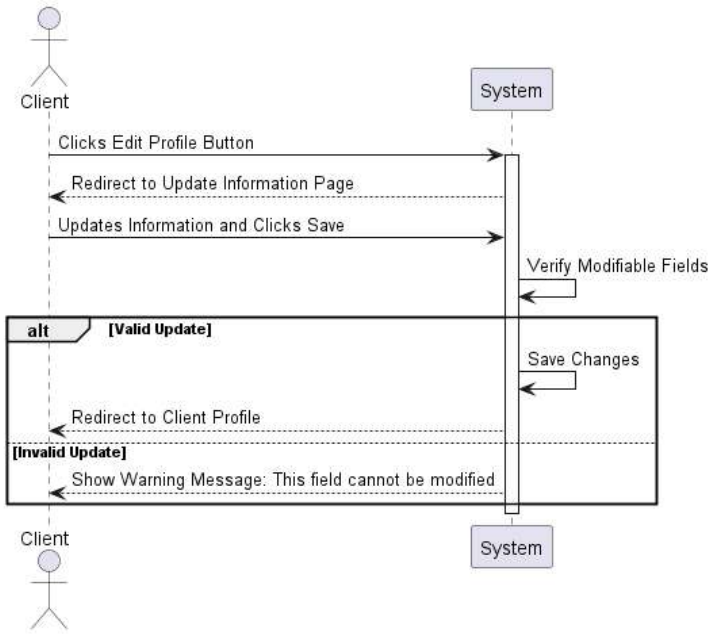

Figure 5.14: Update Client Profile Sequence Diagram

The above figure shows the sequence diagram for Updating Client Profile

5.6.10 Upload new license

The sequence diagram shows the license update process. The System displays a file selection dialogue. When the user uploads a file, the system validates the file's format. It either saves the valid license or shows an error message saying "invalid format". This is shown in Figure 5.16.

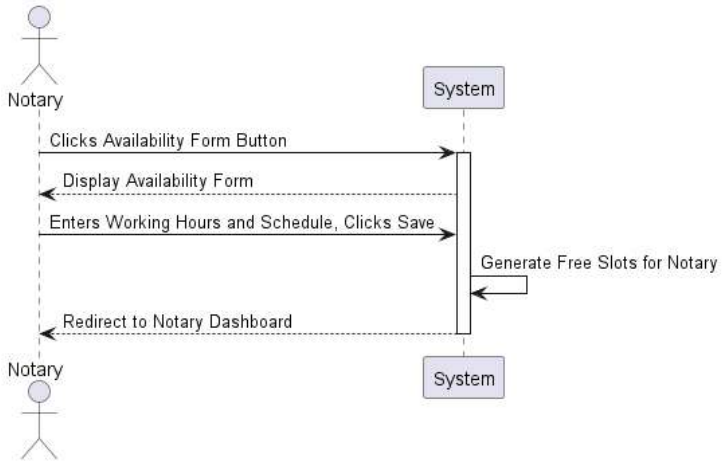

Figure 5.15: Specify Availability Schedule Sequence Diagram
The above figure shows the sequence diagram for Specifying Availability Schedule

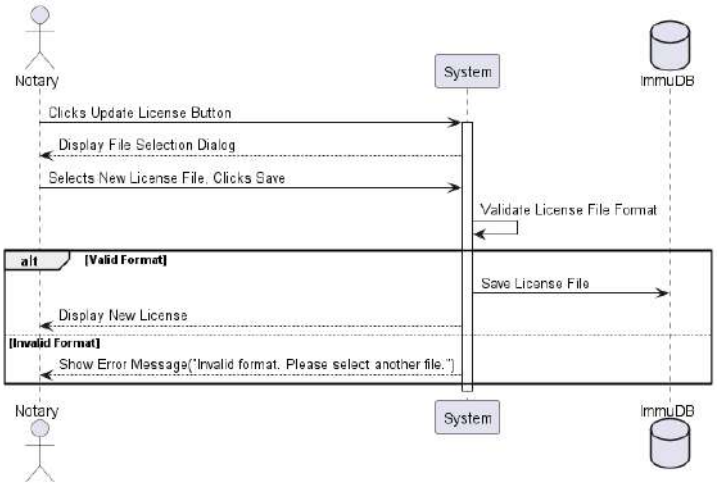

Figure 5.16: Upload new license Sequence Diagram
The above figure shows the sequence diagram for Uploading a new license

5.6.11 Search Notary

The sequence diagram shows the sequence when a Client searches for Notaries. The System interacts with ImmuDB and gets a list of matching notaries.This list of Notaries is based on the entered information and prefered filters. This is shown in Figure 5.17.

5.6.12 Appointment Creation

This sequence diagram depicts a Client creating an appointment. The System communicates with ImmuDB to fetch Notaries, display profiles with available slots, mark the chosen slot as unavailable, and update appointment lists. Finally, the client is redirected to the list of unpaid appointments. This is shown in Figure 5.18.

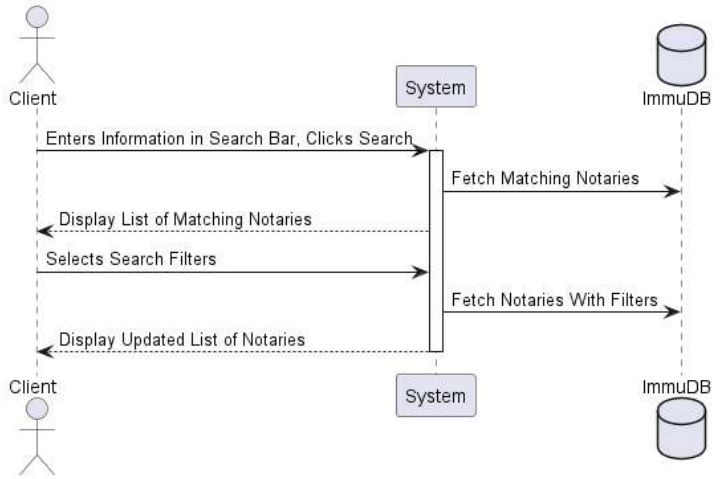

Figure 5.17: Search Notary Sequence Diagram
The above figure shows the sequence diagram for Searching Notary

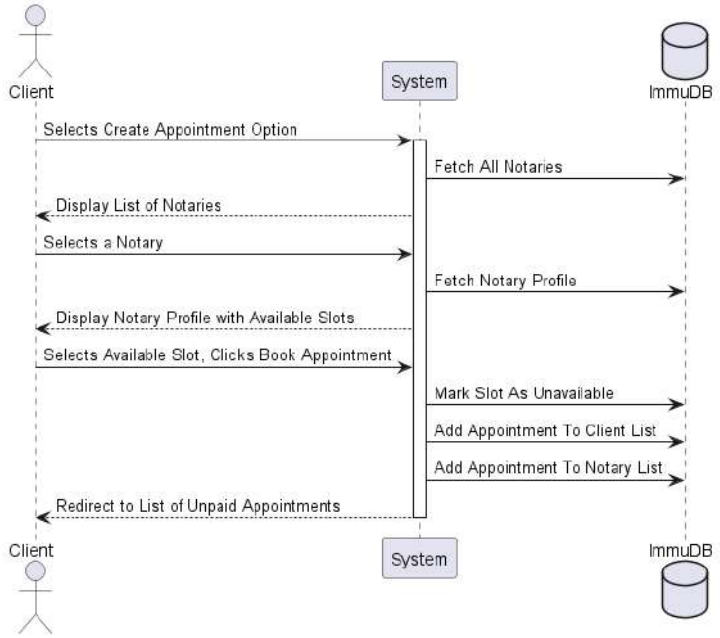

Figure 5.18: Appointment Creation Sequence Diagram
The above figure shows the sequence diagram for Appointment Creation

5.6.13 Appointment Confirmation

Notary clicks ”Unconfirmed Appointments” the system displays a list of all unconfirmed appointments. Notary checks ”Mark Confirmed,” and the system moves the appointment to the list of upcoming appointments. The system redirects to the Upcoming Appointments page. This is shown in Figure 5.19.

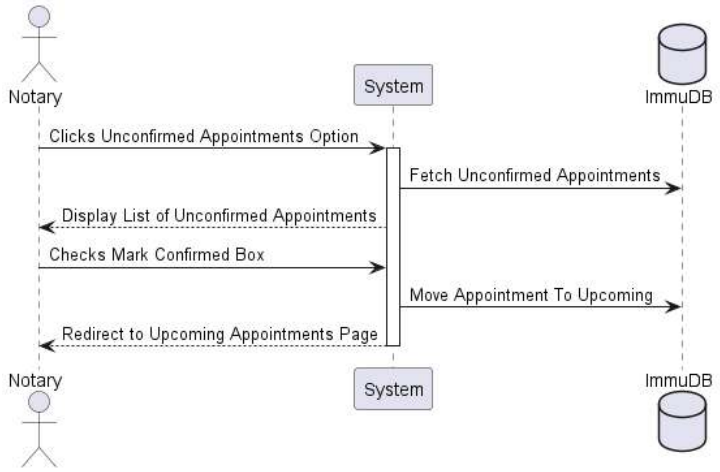

Figure 5.19: Appointment Confirmation Sequence Diagram
The above figure shows the sequence diagram for Appointment Confirmation

5.6.14 Upload Document

This diagram shows the process of document(s) upload for RON. The client selects the ”Upload Document” Option. The system opens a file selection dialog. The client chooses a document and clicks save. The system prompts the user to link the document with an appointment or cancel the upload process. This is shown in Figure 5.20.

5.6.15 Start Notarization Session

This sequence diagram shows the flow of events for the ”Notarization Session”. It involves the start of a video call between the Notary and the Client. This process includes E-Notarization. The notarized document is then securely saved to the database. The alternative flow handles the case where the client declines invitation to the session. This is shown in Figure 5.21.

5.6.16 Remote Online Notarization

In this sequence diagram, the Notary notarizes a document by adding a seal, stamp, and signature. The completed notarization process includes applying a digital signature and saving the notarized document to the database. The alternative flow handles the case where the Notary decides to terminate the notarization process, and the system responds accordingly. This is shown in Figure 5.22.

5.6.17 View a notarized document

This diagram depicts the process of a user (Client or Notary) opening notarized papers. The system obtains the list of documents when the user requests the notarized papers. The user then chooses a document, and the system obtains and shows its contents. This is shown in Figure 5.23.

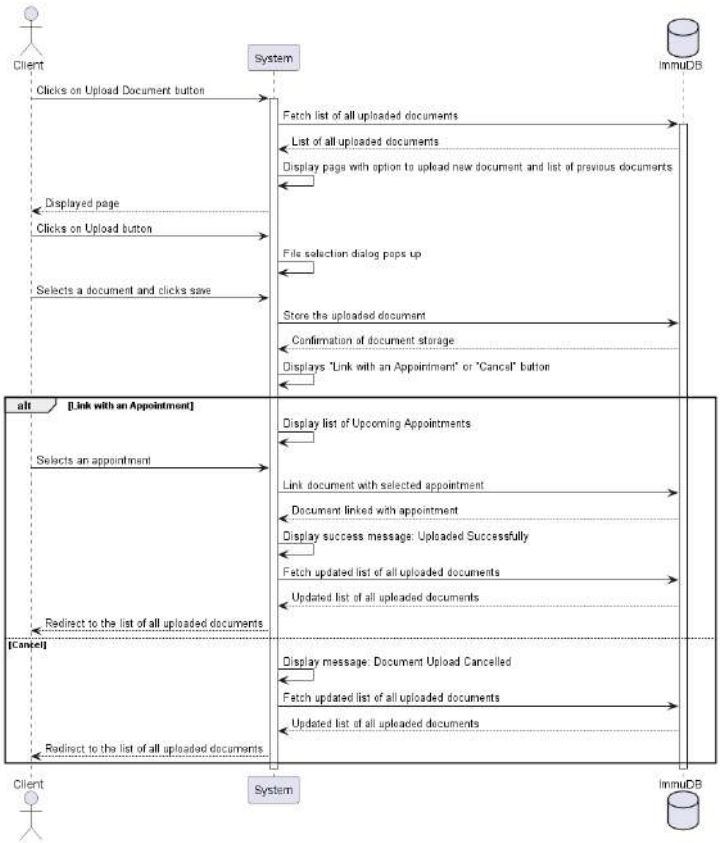

Figure 5.20: Upload Document Sequence Diagram

The above figure shows the sequence diagram for Uploading Document

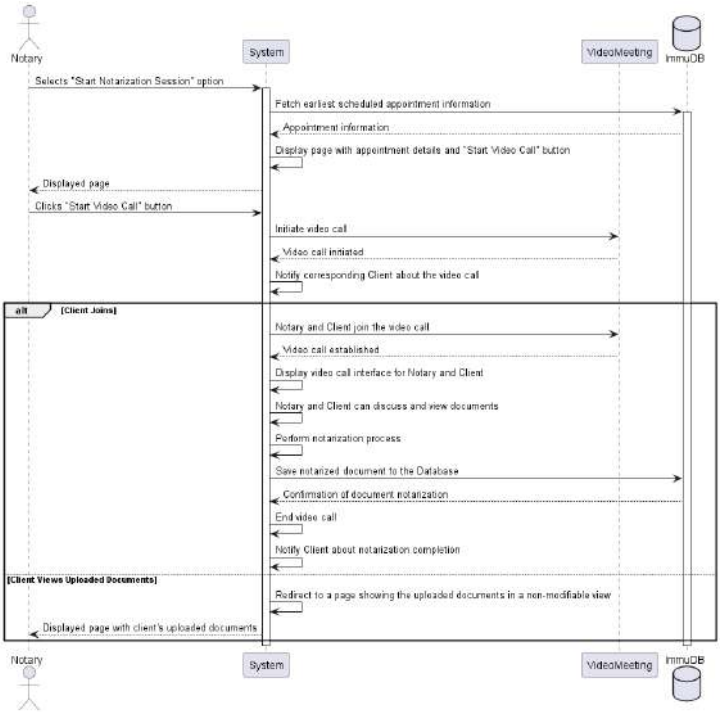

Figure 5.21: Start Notarization Session Sequence Diagram

The above figure shows the sequence diagram for Starting Notarization Session

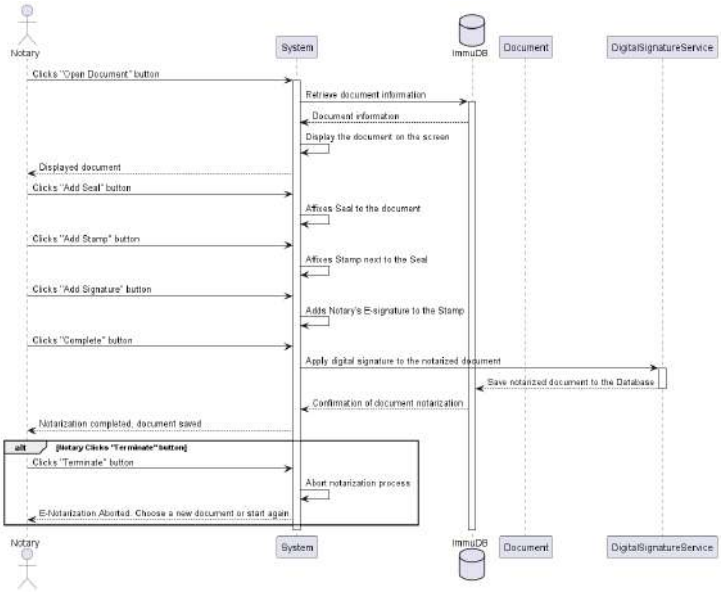

Figure 5.22: Remote Online Notarization Sequence Diagram

The above figure shows the sequence diagram for Remote Online Notarization

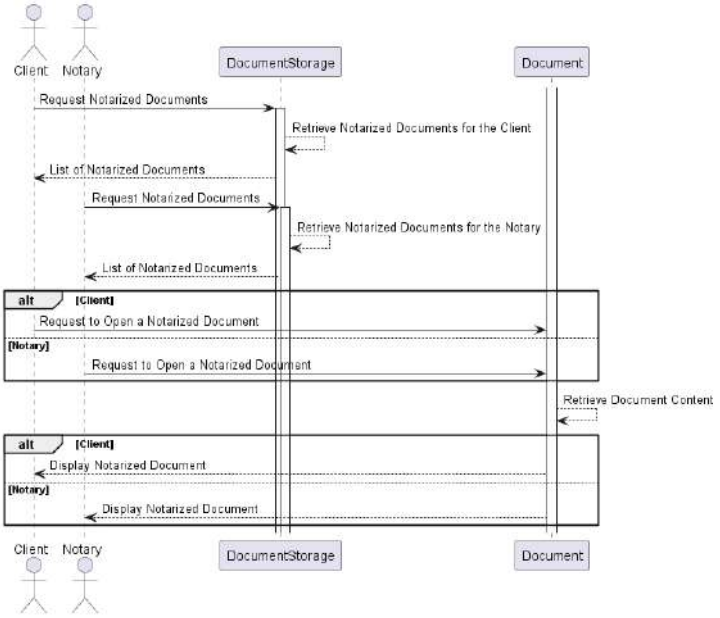

Figure 5.23: View a notarized document Sequence Diagram

The above figure shows the sequence diagram for Viewing a notarized document

5.6.18 View Upcoming Appointments

This diagram shows how a user views their upcoming appointments. The system confirms the user's login and displays the appropriate list. This is shown in Figure 5.24.

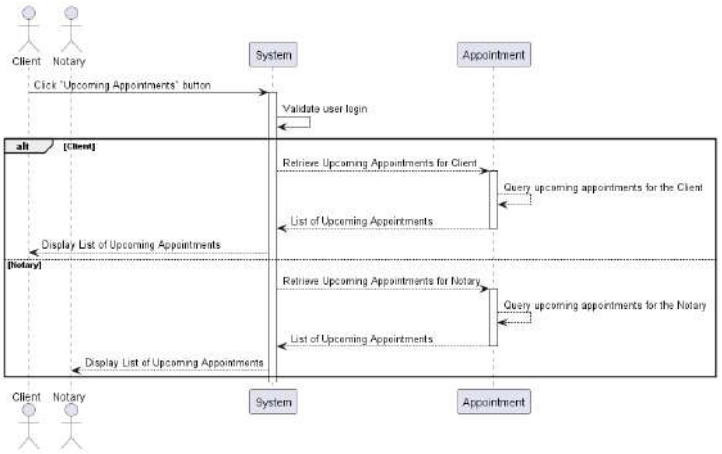

Figure 5.24: View Upcoming Appointments Sequence Diagram

The above figure shows the sequence diagram for Viewing Upcoming Appointments

5.7 Policies and Tactics

Some policies and tactics that will be followed for our project are as follows:

5.7.1 Technological Framework

Our project is based on SQL, Express.js, React.js, and Node.js. This collectively makes the SERN framework. This decision targets to deliver a seamless, secure, efficient, and user-friendly application to its users within a reliable framework.

5.7.2 Code Development Standards

We are aiming to adhere to the coding conventions within the industry. This helps in ensuring the production of high-quality code. Also, we emphasize clean, well-crafted, and well-commented code.

5.7.3 Quality Assurance and Testing

To make sure the product is under development with reliability and excellence, rigorous testing will be conducted. We will follow the white-box and black-box testing techniques to check and test the modules of the project.

5.7.4 Robust Data Security Measures

We will use strong secure measures to ensure the security of our project. To make documents tamper-proof and secure, we will use digital signatures. Also, to make the system secure for the users, we will use multi-factor authentication techniques. Moreover, all the industry-standard security protocols will be followed as well.

5.8 Conclusion

Wrapping up this chapter, our design builds on assumptions, including internet availability, while addressing constraints like network communication that impact the system's structure. Additionally, we realize goals such as modifiability through our design. We've implemented the SCRUM development method and provided a detailed overview, encompassing a system architecture diagram, component architecture, and strategic considerations. The documentation extends to include class diagrams, sequence diagrams outlining various user operations, and discussions on policies and tactics influencing changes in the system's interface.

Chapter 6 Description of Prototype Developed

This chapter details the implementation details of the prototype and modules implemented so far.

6.1 Prototype Implementation

Thus far, we have made considerable progress in the development of the client-side front-end. We have also implemented the authentication module for login/signup functionalities. Additionally, modules for verifying the validity and originality of the CNIC provided by the user, as well as a module for the digital signatures process, have been implemented.

6.1.1 Client Portal's Frontend

The front-end of our application has been created using React Js in conjunction with Material UI for a seamless and user-friendly experience. Our Implementation so far contains a comprehensive list of features for the client. The key functionalities integrated into the React-Js-based front-end contain:

6.1.1.1 Client Profile

A dedicated page providing a comprehensive view of the client's details and information.

6.1.1.2 Upload Document for Notarization

A dedicated page allows users to upload documents for the notarization process.

6.1.1.3 Create Appointment

An efficient mechanism to allow users to schedule an appointment by selecting a notary from a list of available notary officers.

6.1.1.4 View Unpaid Appointments

A user-friendly interface to allow the client to view unpaid appointments.

6.1.1.5 View Upcoming Appointments

A dedicated page allows the client to view their upcoming appointments with the selected notary.

6.1.1.6 View Notarized Document

A component allowing the client to view the document he got notarized through notary public so far.

The utilization of React-Js with Material-UI not only ensures a high level of performance but also allows the implementation of responsive and visually appealing interfaces. By adhering to the GUI outlined in Chapter 4, we have maintained an intuitive and consistent design throughout the client portal, ultimately enhancing the user experience.

6.1.2 Notary Portal's Frontend

The front-end of our application has been created using electron js, an open-source platform for creating cross-platform desktop applications. By using electron js with web technologies such as React js and Material UI, we have successfully created the complete frontend of the notary portal of our application. The key functionalities that are to be implemented on backend side include:

6.1.2.1 Notary Portal

A dedicated page provides a comprehensive view of the notary's details and information.

6.1.2.2 Appointment Confirmation

A user-friendly interface for the notary to confirm the unconfirmed appointments after receiving the payments through external wallets.

6.1.2.3 View Notarized Documents

A notary can view the list of documents he has previously notarized.

6.1.2.4 Appointment Execution

A notary, after confirming an appointment can initiate a video conference to carry out the notarization of the documents.

6.1.3 CNIC Verification Module

Once a user shares their CNIC, the Bar/QR code on the ID card is scanned to extract the information embedded in the code. This information will be then used to verify the authenticity of the ID card. This module utilizes computer vision and image processing techniques to extract information from the Bar/QR code on the user's ID card. First, the image is read using OpenCV and the original image is displayed. The image is then transformed to grayscale to make Bar/QR code detection easier. The code locates and decodes the Bar/QR code inside the grayscale image using the Pyzbar library. The script uses OpenCV to create a visual bounding box and extracts the bounding box coordinates for each Bar/QR code that is recognized. Next, the picture containing the highlighted Bar/QR code is displayed. Finally,

the data stored in the Bar/QR code is decoded and returned for further verification. This data represents information from the ID card.

6.1.4 Video Conferencing Module

This module facilitates real-time communication and messaging between the Notary Public, Client and Witnesses. It allows all parties to join a meeting room using a meeting code. Multiple participants can join the notarization session to complete the remote notarization procedure in real-time. This module provides a user with the following features: publish video and audio, share screen, and a chat channel. In addition, the users are notified when somebody joins or leaves the session. Users can also see all active participants. This module requires the user to have a working laptop or desktop with a working camera, mic and an internet connection.

6.1.5 Digital Signatures Module

This module includes the implementation of PDF self-signing by leveraging OpenSSL RSA for generating public certificates and private keys. This module also uses the node signPDF library. The main steps included in this module are:

- Identifying placeholders
- Creating a signature object
- Generating SHA-256 digest
- Encrypting data with private keys

6.2 Conclusion

This chapter detailed the implementation details of the prototype developed. It includes a description of Client Side's frontend. It includes the details of the Basic Authentication Module that comprises Login and Signup. The CNIC verification module highlights the implementation details of the module that detects fake CNICs to avoid forgery. The digital Signatures module details the process of creating and embedding a digital signature in a document. Furthermore, a video conferencing module will assist in making the notarization process more streamlined and will help to carry out the notarization sessions. These features will be integrated into the system later on.

Chapter 7 Conclusion and Future Work

7.1 Results

At this point, we have successfully implemented the login/signup functionality for the users. The Bar/QR Code module can successfully extract data from Barcodes and QR Codes effectively facilitating the Identity verification process. The Digital Signatures module is capable of digitally signing PDFs, paving the way to enhanced security of notarized documents. Client Portal is ready to be integrated with the frontend.

7.2 Future Work

We are committed to fulfilling our promise to create a digital platform for Notarization. NotaryNow, currently in the development stage, will eventually evolve into an effective RON solution. As of now, the basic authentication module, digital signature module, CNIC verification module, and frontend for the Client's Portal have been developed. Our next objectives include the implementation of three major modules including Notary verification, Appointment Scheduling module, and Video Calling feature. In addition, a crucial focus is on advancing the backend development, including API creation. The frontend for the Notary portal shall be developed concurrently with the backend development. Our plan includes conducting thorough manual and automated testing once the application is fully developed. Using a shift-left methodology, we have planned to start unit testing early on in the development cycle, to effectively reduce blockers and expedite the development process without compromising on quality.

7.3 Conclusion

Thus far, we have reviewed related applications and investigated how comparable current systems operate. In addition, we have described the software requirement specifications for the project. It includes the functional, non-functional, and hardware/software requirements as well as risk analysis. Additionally, a list of thorough use cases is supplied for each actor. We have provided the system overview in the high-level and low-level design sections. Designs for frontend of the application have also been included. Visual representations, including architecture, sequence, and class structure diagrams, are covered in Chapter 5. Sequence Diagrams for important use cases have been included in chapter 6. Additionally, we have included distinct sections with thorough explanations for every topic we cover, including general restrictions, assumptions, aims, rules, regulations, and techniques. Finally, we have included a description of how the prototype is implemented and what our future development goals are.

Thus far, we have effectively integrated the sign-up and login operations, as well as the client front end and some security-focused modules.

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