

My Dissertation Title

My Name

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## 0.1 General Introduction

The rapid advancements in information technology have transformed the way organizations operate and manage their processes. One such domain that has witnessed significant growth is the development of web applications for various purposes. In particular, web applications have become essential tools for improving the efficiency of service delivery and reducing operational costs for many organizations, including government institutions.

## 0.2 Problematic and Objectives

The National Social Security Fund ( CNAS : Caisse Nationale des Assurances Sociales des Travailleurs Salariés) in Algeria is one such organization that can benefit from the adoption of web-based solutions as it is responsible for providing a range of social security services to Algerian citizens, including health insurance, retirement benefits, and unemployment benefits. The organization serves a large number of people and has several applications that we will talk about in upcoming chapters.

Although the current system of managing queues at CNAS helps with the organization and the process of the work, it has proved to be inefficient and time-consuming for both the employees and the beneficiaries of social security, and it has been struggling to keep up with the increasing demand. For instance, imagine coming all the way to CNAS and having to wait for an hour just to get information about a document, knowing that it could be obtained in seconds through a web-based solution. This highlights the inefficiency of the current system, which is not only time-consuming but also inconvenient for the beneficiaries who have to take time off from work to visit CNAS. A web-based solution that streamlines the appointment management process will save time and effort for both the employees and the beneficiaries and will enhance the overall efficiency of the services provided by CNAS.

Therefore, the objective of this project is to create a web application that streamlines the appointment management process to improve the overall efficiency of the services provided by CNAS. The proposed web application has a key feature that enables users to choose the service and the task they want to do at CNAS before booking an appointment. At the beginning of the user's journey through the application, they are prompted to complete a questionnaire that helps generate a personalized Checklist of the necessary documents and steps they need to complete in order to achieve their goal. This questionnaire feature streamlines the process for the user by providing clear guidance and ensuring that no important documents or steps are missed. This feature ensures that the user is directed to the appropriate service desk for their needs, reducing the time wasted on unnecessary visits and allowing users to access all the necessary information online and plan their appointments accordingly.

Moreover, this web application will include a range of features designed to enhance the appointment management process, including the ability to track the status of appointments and documents, a reminder and notification system, customization of appointments and schedules, an authentication and security system, and multilingual support.

## 0.3 Dissertation Plan

The rest of the dissertation is organized as follows: Chapter 1 provides a review of the relevant literature, while Chapter 2 outlines the project overview, objectives, and scope. Chapters 2 and 3

delve into the conception....

# Chapter 1

## State of The Art

### 1.1 Virtual Counters

Virtual Counters, or Guichets Virtuels in French, are online platforms that allow users to access services remotely without having to physically visit a location. They are designed to facilitate the interaction between users and service providers in a user-friendly, efficient and secure manner. The rise of digital technology has led to the development of various types of virtual counters, each with its own features and benefits.

#### 1.1.1 Types of Virtual Counters

There are various types of virtual counters, such as:

- **Web-based virtual counters:** These virtual counters are accessible through a web browser, and they allow users to access various online services offered by service providers.
- **Mobile-based virtual counters:** These virtual counters are accessible through mobile devices such as smartphones and tablets, and they offer users the convenience of accessing services on the go.
- **Kiosk-based virtual counters:** These virtual counters are installed in designated locations and allow users to access various services through self-service kiosks.
- **Chat-based virtual counters:** These virtual counters use instant messaging applications to facilitate communication between users and service providers, allowing users to access services through a chatbot or live chat.

#### 1.1.2 Examples of Virtual Counters

Virtual counters have become increasingly popular in Algeria, and several organizations have adopted them to improve their services. Some examples of virtual counters in Algeria include:

- **ElHanna:** The Caisse Nationale de l'Assurance Maladie (CNAS) in Algeria has created an application called "El Hanna" that allows its members to access various services related to their health insurance coverage, such as checking their eligibility for medical procedures, viewing their medical history

- **BaridiMob:** Algérie Poste has developed a virtual counter that allows customers to access their banking services online, such as transferring funds and paying bills.
- **Sonelgaz:** Sonelgaz has developed a virtual counter that allows customers to access their energy bills and make payments online.
- **E-Paiement:** E-Paiement is a mobile application developed by the Algerian government that allows citizens to pay bills, purchase government services, and access information using their mobile devices. The application is available for download on both Android and iOS devices.

Virtual counters have also been implemented in other countries, such as:

- **eVisa:** The eVisa platform allows travelers to apply for visas online, reducing the need to physically visit an embassy or consulate.
- **eCNI:** The eCNI platform in France allows citizens to apply for their national identity cards online, reducing the need to visit a physical office.

In the next section, we will explore the benefits of virtual counters and their impact on the user experience.

### 1.1.3 Benefits of Virtual Counters

Virtual counters offer several benefits for both users and service providers. Some of the key benefits include:

- **Convenience:** Virtual counters can be accessed from anywhere with an internet connection, making it more convenient for people to access services without having to physically go to a government office.
- **Time-saving:** Virtual counters eliminate the need for users to physically visit a service center, saving them time and effort. Users can complete their transactions from the comfort of their own homes or offices, without having to wait in long lines or take time off work.
- **Accessibility:** Virtual counters provide users with greater accessibility to services. They can access services from anywhere, at any time, as long as they have an internet connection. This is particularly beneficial for people with disabilities or those who live in remote areas and have limited access to physical service centers.
- **Efficiency:** Virtual counters streamline the service delivery process by reducing paperwork, eliminating redundancies, and increasing transparency. This allows service providers to process transactions more efficiently and with greater accuracy.
- **Cost-effective:** Virtual counters are typically more cost-effective for service providers than physical service centers. They require less physical infrastructure, fewer staff, and have lower operating costs. This can help service providers reduce costs and improve their bottom line.



### 1.1.4 Challenges and Limitations

Despite the benefits of virtual counters, there are also some challenges and limitations to consider. These include:

- **Access and Connectivity**

One of the biggest challenges of virtual counters is ensuring that they are accessible to everyone, regardless of their location or technical ability. This requires reliable internet connectivity, as well as user-friendly interfaces and support for multiple languages.

- **Security and Privacy**

Virtual counters also raise concerns about security and privacy. Users may be hesitant to share sensitive personal information online, and there is always the risk of data breaches or cyber attacks.

- **Digital Divide**

Another limitation of virtual counters is the digital divide, which refers to the gap between those who have access to digital technologies and those who do not. This can be a particular challenge in developing countries or among low-income populations.

- **Technical Issues**

Finally, virtual counters may also face technical issues such as server downtime, software bugs, or compatibility problems with different devices and platforms. These can all affect the user experience and the efficiency of the service.

Despite these challenges, virtual counters have the potential to revolutionize the way we access public services and interact with government agencies. By addressing these limitations, we can ensure that virtual counters are accessible, secure, and efficient for everyone.

## 1.2 Introduction to CNAS Organization

### 1.2.1 Definition of CNAS organization

The CNAS (Caisse Nationale des Assurances Sociales) is a public institution with specific management under Article 49 of Law No. 88-01 of January 12, 1988. It has legal personality and financial autonomy and is considered a merchant in its relations with third parties. The CNAS is responsible for managing social insurance benefits (illness, maternity, disability, and death), as well as occupational accidents and diseases (AO/D), and family allowances on behalf of the state. It also manages the collection, control, and litigation of contributions for financing benefits, as well as the management of the litigation related to the collection of subscriptions for financing rendered.

The CNAS assigns a national registration number to insured persons and employers and contributes to promoting the policy of prevention of AO/D and managing the AO/D prevention fund. It also manages benefits for beneficiaries of bilateral social security agreements, carries out medical control of beneficiaries, and undertakes actions to provide workers and their dependents with collective benefits in the form of health and social achievements. The CNAS also manages the aid and relief fund and concludes agreements with healthcare providers while ensuring the information of beneficiaries and employers.

The CNAS provides benefits to salaried workers, apprentices, job seekers, students, trainees in vocational training, disabled persons, veterans, social security beneficiaries (pensioners and annuitants), and beneficiaries of the lump sum solidarity allowance (sick, elderly and inactive persons). Dependents, including the spouse, minor children, unmarried inactive daughters, and dependent ascendants, are also eligible for benefits.

The CNAS covers healthcare and medication costs at 80%, and in some cases 100% (particularly for chronic diseases). Compensation for sick leave is 50% of the salary for the first 15 days and is increased to 100% of the salary beyond the 16th day, with a maximum duration of three years. Maternity benefits are fully covered, and working women are entitled to a 98-day maternity leave. The minimum amount of invalidity pensions is equal to 75% of the guaranteed minimum wage. In the event of the insured person's death, a death benefit is paid to his or her dependents. Occupational risks are covered 100% for healthcare and sick leave, and annuities are paid in the event of bodily harm or death resulting from occupational accidents or diseases.<sup>1</sup>

## 1.2.2 Organization of CNAS

CNAS is managed by a Board of Directors and is under the supervision of the Minister of Labor, Employment and Social Security. Its headquarters is located in Algiers (BEN AKNOUN), and it has national jurisdiction with both central and local services.<sup>2</sup>

to fulfill its missions, CNAS has:

- A General Directorate.
- 49 provincial agencies (including 2 in Algiers).
- 826 payment structures, including:
  - 356 payment centers.
  - 401 payment branches.
  - 69 local correspondences.
- 4 specialized clinics (pediatric heart surgery, orthopedics and rehabilitation, ENT, dental).
- 4 regional centers for medical imaging.
- 35 diagnostic and treatment centers.
- 55 pharmaceutical offices.
- 30 nurseries and kindergartens.
- A printing house in Constantine.
- A family social center in Ben Aknoun.

*Source: CNAS website (<http://www.cnas.dz/>)*

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<sup>1</sup>CNAS. (n.d.). Presentation of CNAS. Retrieved from <https://www.cnas.dz/>.

<sup>2</sup>CNAS. (n.d.). Presentation of CNAS. Retrieved from <https://www.cnas.dz/>.

### 1.2.3 CNAS Organigram

the CNAS organigram is made up of various departments, subdivisions, and services that work together to manage CNAS operations and deliver services to its beneficiaries.

**Director:** This is the topmost position in the CNAS hierarchy and is responsible for overseeing all CNAS operations.

**Division of Benefits:** This department is responsible for managing CNAS' various benefit programs, including health, maternity, and disability benefits.

**Division of Administration and General Resources:** This department is responsible for managing CNAS' administrative operations, such as human resources, procurement, and general resource management.

**Data Processing Center:** This department is responsible for managing CNAS' information technology systems and infrastructure.

**Division of Recovery and Finance:** This department is responsible for managing CNAS' financial operations, including revenue collection and disbursement.

**Medical Control Division:** This department is responsible for monitoring and controlling the quality of medical services provided by CNAS.

**Contracting Service:** This department is responsible for managing CNAS' contracts with healthcare providers.

**Personnel Division:** This department is responsible for managing CNAS' human resources operations, including recruitment, training, and personnel records management.

**Statistics, Archives and Documentation Service:** This department is responsible for managing CNAS' data and document management systems.

**Recovery Division:** This department is responsible for collecting outstanding debts owed to CNAS.

**Medical Control Service:** This department is responsible for conducting medical audits and reviewing medical claims.

**Pharmacy Service:** This department is responsible for managing CNAS' pharmacy operations, including the provision of pharmaceutical services to CNAS beneficiaries.

**Conventions Service:** This department is responsible for managing CNAS' relationships with healthcare providers, including contract negotiations and payment processing.

**General Resources Division:** This department is responsible for managing CNAS' facilities, equipment, and other general resources.

**Internal Control Unit:** This department is responsible for ensuring compliance with CNAS policies and procedures.

**Prevention Service:** This department is responsible for promoting public health and disease prevention.

**Contentious Service:** This department is responsible for managing CNAS' legal affairs, including dispute resolution and litigation.

**Payment Structures:** This department is responsible for managing CNAS' payment processing systems.

**Realization Service:** This department is responsible for managing CNAS' development and construction projects.

**C.I.W.Q:** This is a service that is responsible for managing CNAS quality control.

**CHIFA Service:** This department is responsible for managing CNAS' maternal and child health services.

**Affiliation and Transfer Service:** This department is responsible for managing CNAS' beneficiary registration and transfer operations.

**CLRQP:** This department is responsible for managing CNAS' social and family benefits.

**Accounting Service:** This department is responsible for managing CNAS' accounting operations.

**Finance Service:** This department is responsible for managing CNAS' finance operations.

**Security Service:** This department is responsible for managing CNAS' security operations, including physical security and cybersecurity.

**Employer Control Service:** This department is responsible for monitoring employers' compliance with CNAS regulations.

**High-Risk Service:** This department is responsible for managing CNAS' high-risk cases.

**Legal Affairs Service:** This department is responsible for providing legal advice and support to CNAS.

Here is the organigram :

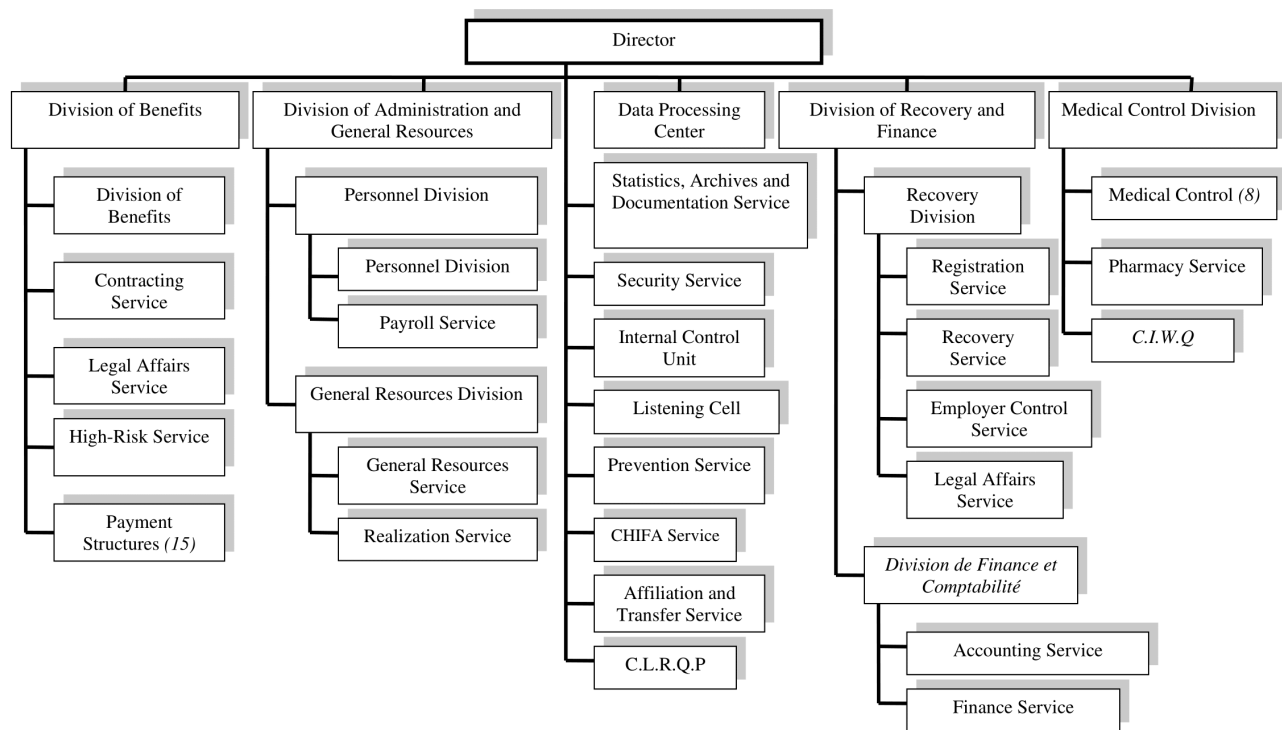


Figure 1.1: Organigram of CNAS

### 1.2.4 CNAS Services

CNAS provides a range of services related to social security and healthcare to the Algerian population. These services include:

- **Healthcare services:** CNAS operates its own specialized clinics and medical facilities, including four specialized clinics for cardiac surgery, orthopedics and rehabilitation, otorhinolaryngology, and dental care. It also runs 35 diagnostic and treatment centers, 55 pharmacies, and four regional medical imaging centers.
- **Social security services:** CNAS provides social security services to its members and their families, including health insurance, maternity leave benefits, disability benefits, and retirement pensions. It also offers services related to workplace safety and injury compensation.
- **Family services:** CNAS operates 30 nurseries and childcare centers to support working parents.
- **Payment services:** CNAS manages a network of payment centers and local correspondents to ensure the timely payment of social security benefits to its members.

### 1.2.5 Importance of CNAS services for the Algerian society

These services are essential for the Algerian society, as they help provide access to healthcare and social security benefits to millions of people. CNAS's role in ensuring workplace safety and providing compensation for work-related injuries is also crucial in protecting the rights and wellbeing of workers across Algeria.

## 1.3 Literature Review

There has been a significant amount of research on the use of virtual counters in various contexts, including government services, healthcare, and banking.<sup>3</sup> Virtual counters have been found to offer several benefits, including improved efficiency, reduced wait times, and increased convenience for users.<sup>4</sup>

One study found that virtual counters in government services were particularly effective in reducing wait times and improving the overall user experience.<sup>5</sup> Another study focused specifically on virtual counters in healthcare and found that they could help reduce patient anxiety and improve the efficiency of healthcare services.<sup>6</sup>

In the banking industry, virtual counters have been used to provide personalized services to customers, such as financial advice and investment planning.<sup>7</sup> These services have been found to be effective in improving customer satisfaction and loyalty.

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<sup>3</sup>Wang, Y., Wang, L., & Wang, F. (2020). A review on virtual service counters. *Journal of Service Science Research*, 12(1), 3-24.

<sup>4</sup>Yao, Y., Yang, Q., & Hu, Y. (2019). An evaluation of virtual counters in government services. *International Journal of Public Administration*, 42(8), 708-721.

<sup>5</sup>Jia, J., & Shi, Y. (2018). The impact of virtual service counters on customer satisfaction in government services. *Public Administration Review*, 78(2), 239-250.

<sup>6</sup>Liu, X., Li, Y., & Chen, G. (2021). The impact of virtual service counters on patient satisfaction in healthcare. *Journal of Healthcare Management*, 66(1), 24-34.

<sup>7</sup>Zhu, Q., Chen, L., & Fang, Y. (2019). The role of virtual service counters in enhancing customer satisfaction in the banking industry. *International Journal of Bank Marketing*, 37(6), 1426-1442.

### 1.3.1 Conclusion

Overall, the literature suggests that virtual counters can offer significant benefits in a variety of contexts, including government services, healthcare, and banking. These benefits include improved efficiency, reduced wait times, and increased convenience for users. Based on this research, it is reasonable to expect that the implementation of a virtual counter system at CNAS could result in similar benefits for its users.

## 1.4 Requirements analysis

The requirements analysis phase identified several key features that the virtual counter for CNAS must provide. First, the system should provide a questionnaire for users to fill out, generating a checklist of necessary documents that must be obtained before the appointment. Second, it should allow users to book appointments online and provide them with a ticket number to avoid the need to wait in long queues. Third, it should allow CNAS staff to manage and monitor the appointments, including rescheduling or cancelling them if necessary. Fourth, the system should allow users to view their appointment history and provide feedback on their experience with the virtual counter. Finally, the system should ensure the security and privacy of all user data.

These requirements will be used as a basis for the design, the conception and the implementation of the virtual counter system.

## 1.5 Conclusion

In this chapter, we have explored the current state of the art related to virtual counters, the organization of CNAS, and the literature review of virtual counters in various contexts. The use of virtual counters has been found to offer several benefits, including improved efficiency, reduced wait times, and increased convenience for users. CNAS, as an Algerian social security institution, provides a range of essential services to the Algerian society, including healthcare, childcare, and employment-related services.

Additionally, we have discussed the organization of CNAS and its numerous structures, such as its 49 Agences de wilaya and 826 structures de paiement.

Finally, we highlighted the importance of CNAS services for the Algerian society, emphasizing the need for modernization and innovation to ensure that these services continue to meet the evolving needs of its users.

Overall, this chapter provides a comprehensive understanding of the state of the art related to virtual counters and CNAS organization which serves as a foundation for the subsequent chapters in this dissertation.

# Chapter 2

## Conception

### 2.1 Purpose of the chapter

The purpose of this chapter is to present the conception of a virtual counter system for the Algerian National Social Security Fund (CNAS). This chapter will provide a detailed explanation of the system design and architecture, database design, as well as the different diagrams and models used during the conception phase. The virtual counter system aims to improve the current management system used by CNAS by providing users with a more efficient and user-friendly way to gather necessary information and book appointments.

### 2.2 Overview of the topics covered

This chapter focuses on the conception of the virtual counter system for CNAS. It includes the analysis and design of the system, from the identification of user requirements to the development of the system architecture and database design. The chapter also includes the presentation of the different diagrams that were created, such as the use case diagram, class diagram, sequence diagram, and flowchart. The aim of this chapter is to provide a comprehensive understanding of the virtual counter system, its components, and its functionalities.

### 2.3 System design and architecture

The system design and architecture of a virtual counter is a crucial aspect in developing a successful web application. It involves designing the components of the system and specifying how they interact with each other to achieve the desired functionality. In the case of a virtual counter for CNAS, the system design and architecture must take into account the different types of users, such as clients and agents, and the various tasks they need to perform. It must also ensure that the application is secure and reliable, with measures in place to protect user data and prevent unauthorized access. The system design and architecture will involve selecting suitable technologies and frameworks, such as Laravel and VueJs, and designing a database schema to store and retrieve data efficiently. Overall, a well-designed system architecture will contribute to the effectiveness and efficiency of the virtual counter and improve the user experience for both clients and agents.

### **2.3.1 Description of the overall system architecture**

The overall system architecture of the virtual counter for CNAS is designed to be a web-based application with a client-server architecture. The client-side will be a user-friendly interface, developed using Vue.js framework, that allows users to interact with the system and perform different tasks, such as filling in a questionnaire that will generate a checklist of required documents, booking appointments, and checking their status. On the other hand, the server-side of the application will handle all the processing and data storage. It will be developed using the Laravel framework, which is a powerful and reliable PHP web application framework that enables rapid application development with a robust and scalable codebase. The application will also use a MySQL database to store all the necessary data, such as user information, appointment schedules, and queue status. The overall system architecture is designed to be modular and scalable, allowing for easy maintenance and future updates.

## **2.4 Diagrams illustrating the different components of the system**

Diagrams can help to provide a visual representation of the different components and processes involved in the virtual counter system, making it easier to understand and communicate to stakeholders.

The use of UML (Unified Modeling Language) which is a standered Language for visualizing and creating views to illustrate the different parts of a system , presenting us with a various types of diagrams that facilitates the conception phase for the virtual counter and makes it more comprehensive .

### **2.4.1 Use case diagram**

Use case diagram is one of the most used static diagrams in UML , it consist on explaining the different actions preformed by the user and helps understanding the main functions that can be preformed by the system.

When the user is interacting with the system, the virtual counter enables him to consult the various services provided by CNAS without the need to log in.

Additionally, the user can also complete a variety of tasks, such as selecting a service and completing a questionnaire related to that service. The system will then generate a checklist of the documents he will need to submit. The user can stop at printing that checklist or he can move on to booking an appointment which will require him to be authenticated. When an appointment is booked, an appointment ticket, that contains the previous checklist along with some appointment details such as the date and time, the counter number and the name of the employee responsible for treating your concerns, will be available to print.

In the second hand of the virtual counter, both the employee and the supervisor have their own interactions with the system; however, in both their cases, they both need to be logged in order to access the various functionalities of the system. In addition to managing their work flow, both can manage the appointments by treating, rescheduling or canceling them if necessary.



Here is the diagram:

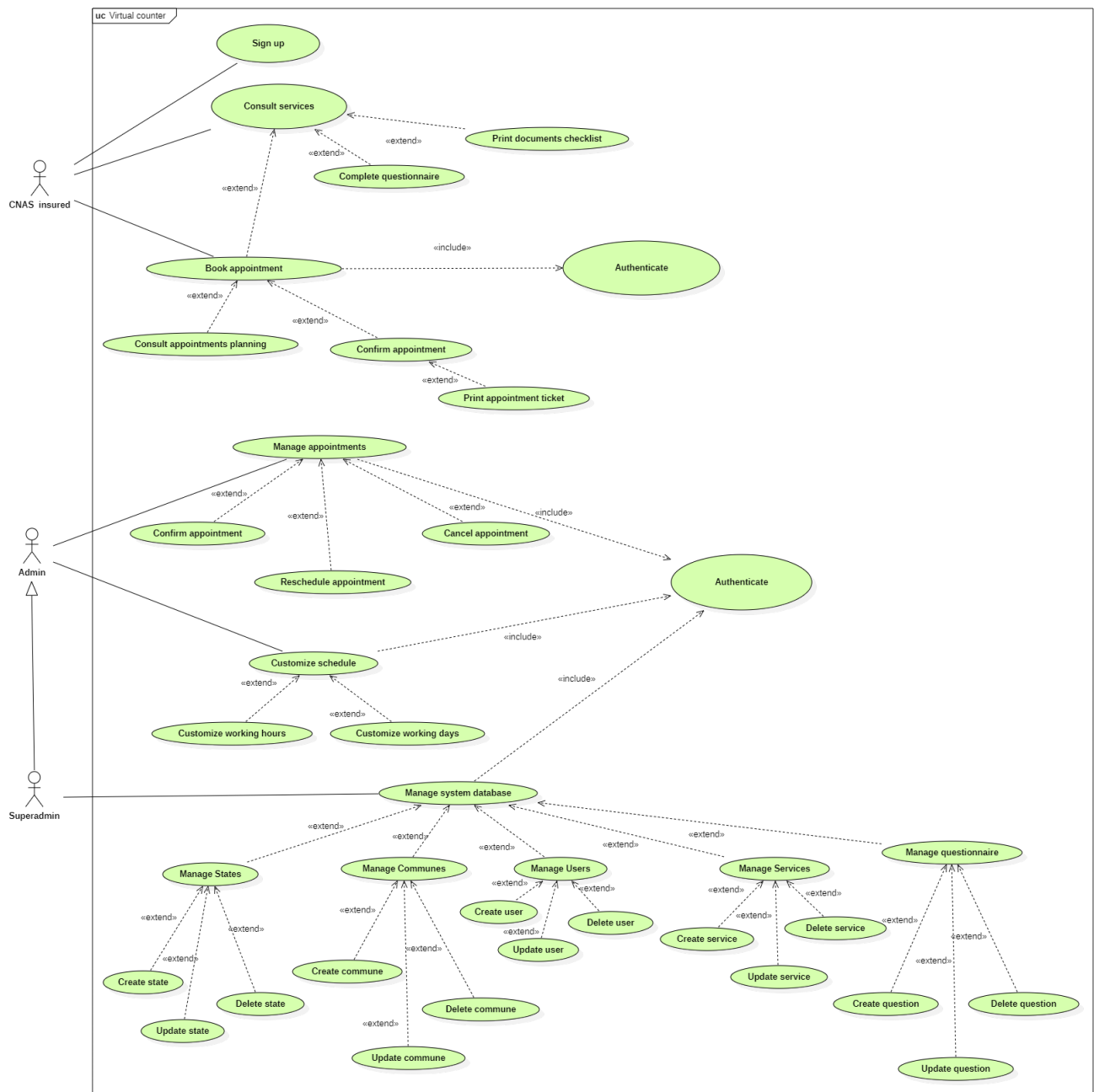


Figure 2.1: Use case diagram

## 2.4.2 Class diagram

A class diagram is a type of UML diagram that represents the structure of a system by showing the classes, interfaces, and their relationships. It is an important tool for software engineers to design and communicate the architecture of a system.

In this section, we present the class diagram of the CNAS virtual counter system. The diagram illustrates the key components of the system and their relationships, including the classes for managing users, services, appointments, and other relevant data. This diagram provides a visual representation of the system's architecture, which will help in understanding how the virtual counter works and how it can be further developed and maintained.

Here's the class diagram:

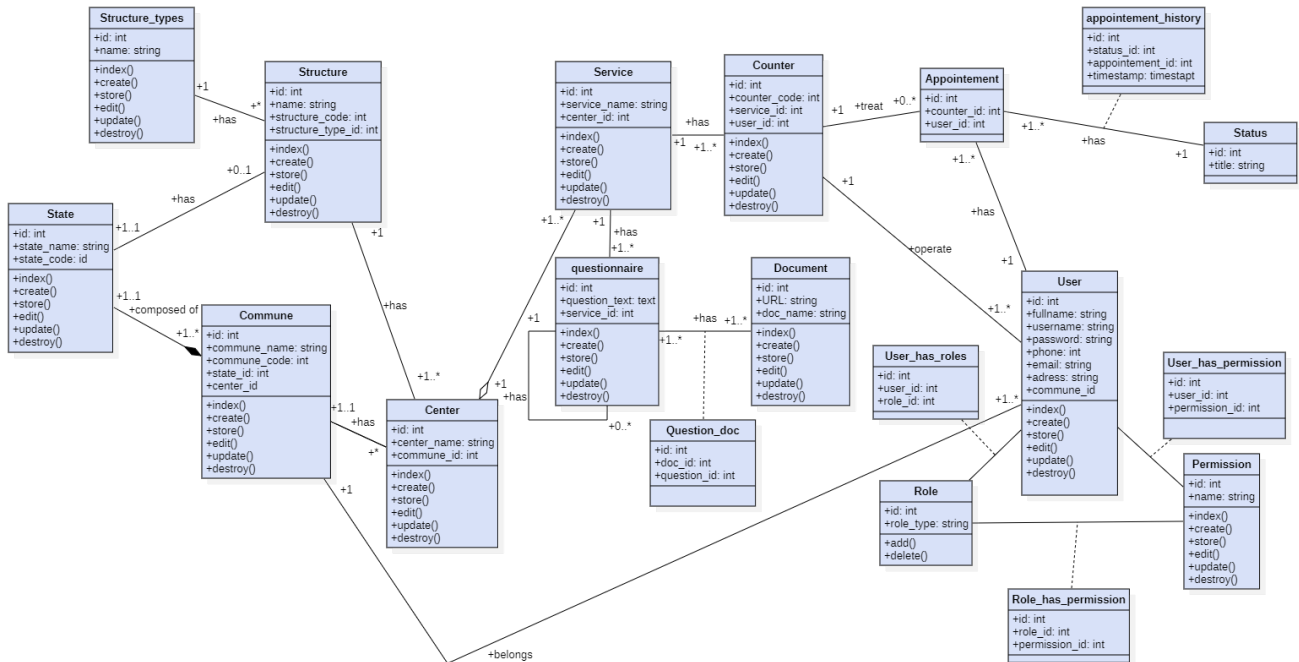


Figure 2.2: Class diagram

### 2.4.3 Sequence diagram

Sequence diagram is one of the well known dynamic diagrams that allow the overall understanding for the hidden functionalities, and streamlines the development phase.

Here are the different diagrams related to every user in the application as well as the registration system.

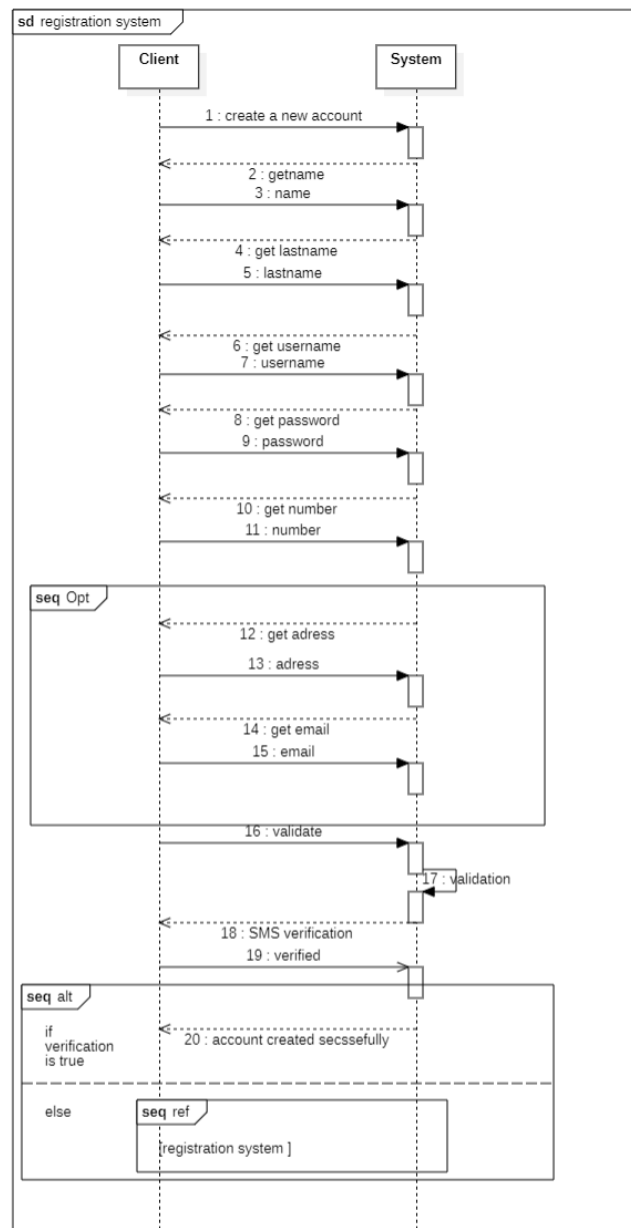


Figure 2.3: Sequence diagram for Registration

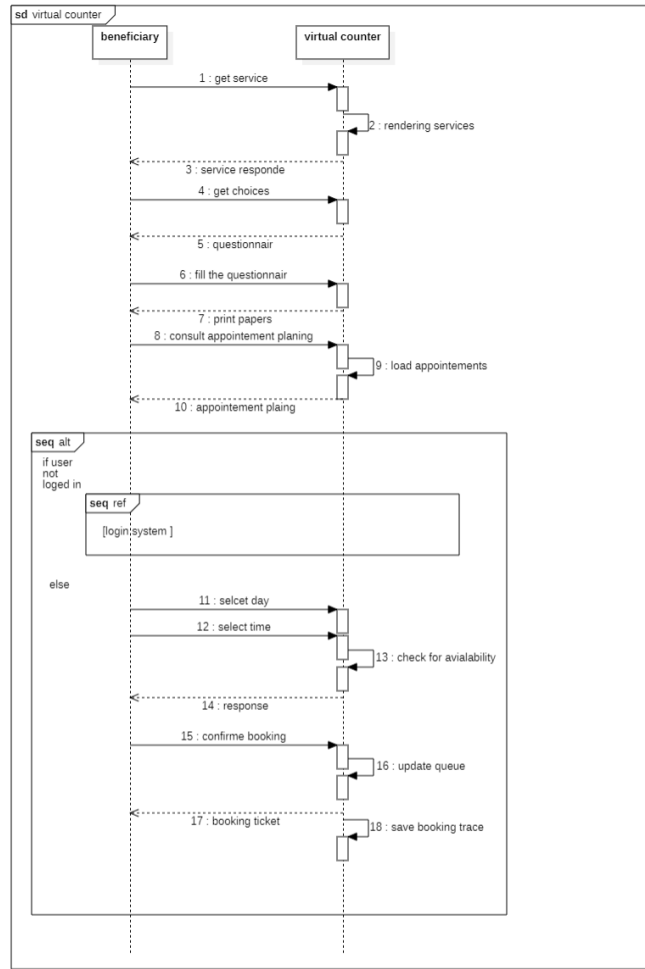


Figure 2.4: Sequence diagram for client interaction

#### 2.4.4 Discussion of the design decisions made

Overall, the decision discussions we had during the process of elaborating the UML diagrams helped us to refine the system's design and functionality and to ensure that it met the requirements and expectations of both the users and the organization. The final UML diagrams illustrate the system's architecture and behavior in a clear and concise manner, and provide a solid foundation for building a robust and efficient virtual counter system for CNAS.

We came to a final conception of the virtual counter on the basis of the notion of eliminating the waiting time in such an effective way and to ensure an efficient system, which can provide by far a great user experience and a sturdy system.

## 2.5 Database design

At this juncture of conception, our primary focus was on creating a reliable database because a well-designed database is crucial for the efficient functioning of any application, including the virtual counter. We also made sure that accessing the data would be a secure process while also allowing stakeholders to track and store their data effectively.

To dive in more, the virtual counter's database include .... table, we arrived at this effective design after thorough analysis and testing, its optimized for performance, scalability, and ease of maintenance, and it is capable of handling large volumes of data with minimal overhead.

We achieved this by carefully analyzing the data requirements of the CNAS virtual counter, identifying potential bottlenecks and inefficiencies and refining the design when it needed updates until we arrived at the final design that satisfies the performance goals.

### 2.5.1 Overview of the database schema

//

### 2.5.2 Explanation of the different tables and their relationships

//

### 2.5.3 Discussion of the design decisions made

//

# Chapter 3

## Implementation

### 3.1 Chapter Overview

In this chapter we will dive into the implementation details of the CNAS's virtual counter, and the different technologies used to build the system such as Version control tool GitHub, the web Development framework Laravel and the other web technologies that gave us the possibility to create an efficient web based application.

### 3.2 Introduction to Git

Software Development requires the management of a big sets of files and assets which are in a frequent change, as developers we need a tool that allows the administration of those files and keep a constant updates on them, that's why Git came handy for giving us the possibility to do such task with ease and flexibility. At its core, Git is a tool that allows multiple people to collaborate on the same project, while keeping track of all changes made to the code and files over time.

#### 3.2.1 GitHub implementation

In order to facilitate the Development phase for the virtual counter and to ensure efficient version control for the code and system files, we have implemented Github in our project, which provided us with centralized repository that we can use for managing updates as well as set of collaborative tools and features.

GitHub is a web-based platform that serves as a central repository for Git-based version control systems. It provides a range of tools and features that allow developers to collaborate on projects, manage code and track changes, and share their work with others with ease. The use of such tool facilitates the collaborative work by partitioning the development between us. We focused on the development in both its sides front-end and back-end so that we can share the work equally, and we managed to overcome the problem of sharing the code in traditional ways.

We made sure that every step in this particular phase is controlled and followed in the project repository, we've started by creating the whole steps for making a reliable web application as well as noting the notions that we are going to need along the development.

### **3.2.2 Advantages of using Github in Development**

Using a version control tool such as GitHub to manage the virtual counter Development gave us so many tools and features that we used in our favor to ease the development process.

GitHub made the collaboration more easier for us, it provided us with a platform that allowed us to share code, simply by using issues and pull requests. In addition to this, code review feature enabled us to review the changes before one of us merge the code to the main source code, and this helped us to ensure that the code is high-quality code, maintainable, and bug-free.

In general, GitHub's code review tools make it simple for us to work together productively and identify problems early in the development cycle. By using these tools we could ensure high-quality and bug-free code, which will result a high-quality and a robust application.

### **3.2.3 Github commands and screenshots**

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### **3.2.4 Discussion on the use of Github**

In the development of our project, we have implemented Github as a version control system and a collaborative platform. Github was a crucial in this phase, it simplified the collaboration as well as partitioning the work between us, its efficiency was in its set of tools and features which helped us to focus more on the application it self rather than code problems and bugs.

Overall, the use of GitHub was essential to the success of our project. By providing a centralized repository, collaborative features, efficient version control, and powerful code review tools, GitHub helped us work more effectively as a team and deliver a better end product.

## **3.3 Laravel implementation**

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### **3.3.1 Overview of the Laravel framework**

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### **3.3.2 Explanation of the different components of the system implemented using Laravel**

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### **3.3.3 Code snippets and screenshots to illustrate the implementation details**

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### **3.3.4 Discussion of the challenges faced and how they were overcome**

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## **3.4 VueJs implementation**

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### **3.4.1 Overview of the VueJs framework**

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### **3.4.2 Explanation of the different components of the system implemented using VueJs**

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### **3.4.3 Code snippets and screenshots to illustrate the implementation details**

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### **3.4.4 Discussion of the challenges faced and how they were overcome**

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## **3.5 Integration of Laravel and VueJs**

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### **3.5.1 Explanation of how Laravel and VueJs were integrated to create the final system**

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### **3.5.2 Code snippets and screenshots to illustrate the integration details**

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### **3.5.3 Discussion of the challenges faced and how they were overcome**

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## **3.6 Conclusion**

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### **3.6.1 Summary of the key points covered**

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### **3.6.2 Reflection on the overall implementation process**

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### **3.6.3 Discussion of future work and potential improvements**

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