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Topic

Design and implementation of a web application for the management of an IT equipment park.

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Dedication

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Meriem Rym

Dedication

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I want to dedicate this work to my dear mom and dad, for their endless support, encouragement, and sacrifices throughout my studies. This achievement would never have been possible without them. Words will never be enough to express how thankful I am to them.

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Aya

Dedication

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Meriem Maria

Dedication

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Ikram

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List of Abbreviations

IT: Information Technology

UML: Unified Modeling Language

HTML: HyperText Markup Language

CSS: Cascading Style Sheets

JS: JavaScript

PHP: Hypertext Preprocessor

DBMS: Database Management System

SQL: Structured Query Language

MySQL: My Structured Query Language

XAMPP: Cross-Platform, Apache, MySQL, PHP and Perl

VS Code: Visual Studio Code

UI: User Interface

ID: Identifier

BMM : Bon de Mouvement de Matériel / Material Movement Form

SH : Sonatrach

DP : Production Division

HMD : Hassi Messaoud

HR : Hassi R'mel

HBK : Haoud Berkaoui

GT : Gassi Touil

OHT: Ohanet

STH: Stah

INA: In Amenas

RNS: Rhourde El Nouss

TFT :Tin Fouyé Tabankort

REB: Rhous El Baguel

General Introduction

In modern organizations, information technology plays a crucial role in improving performance, productivity, and communication. The management of IT equipment, including computers, servers, and network devices, has become increasingly complex due to the growing number of assets and the need to ensure their monitoring, maintenance, and security.

Traditional management methods, such as manual tracking or the use of spreadsheets, present several limitations, including the risk of errors, lack of reliability, and difficulty in accessing real-time information. These constraints highlight the need for computerized solutions that enable more efficient and centralized management of IT resources.

In this context, web applications represent a suitable and powerful solution. They provide easy access, centralized data management, and improved collaboration between users.

This project focuses on the design and implementation of a web application dedicated to the management of an IT equipment park, with the aim of improving the organization, monitoring, and utilization of hardware resources.

Project Objectives

The main objective of this project is to design and implement a web application dedicated to the management of an IT equipment park, with the aim of:

- Improving the tracking and inventory of IT equipment (computers, printers, servers, etc.).
- Facilitating the management of equipment allocation to users and departments.
- Centralizing information related to equipment (status, location, maintenance).
- Optimizing the management of maintenance operations and the lifecycle of IT assets.

Methodology and Technologies Used

To carry out this project, a structured approach was adopted, consisting of the following steps:

1. Requirements Analysis: Identify user needs (administrators, technicians, end users) and define the system functionalities.

2. Design: Develop data models, design user interfaces, and define the different application workflows.

3. Development: Implement the technical solution following software engineering best practices, with a modular architecture and secure data management.

4. Testing and Validation: Ensure that the application meets user requirements and operates correctly through various testing procedures.

Structure of the Manuscript

The remainder of this manuscript is organized as follows:

• **Chapter 1** entitled **"Existing Systems Study":** This chapter presents the concepts related to IT equipment management, as well as existing solutions and tools used in this field.

• **Chapter 2** entitled **"Analysis and Design":** This chapter focuses on requirements identification, data modeling, and the design of the different components of the application.

• **Chapter 3** entitled **"Implementation":** This chapter details the technologies used, the development process, and the testing procedures carried out to validate the application.

Finally, the manuscript concludes with a general conclusion and a discussion of future perspectives and possible improvements.

CHAPTER 1

Study of The Existing System

Introduction

This section aims to analyze the current state of IT equipment management within the organization. It is essential to conduct a thorough analysis of the existing system to identify the system's capabilities, limitations, and potential vulnerabilities. In the context of system design, this step represents a crucial phase, as it helps in understanding the current environment and defining the requirements for an improved solution. The analysis of the existing system is not limited to a simple audit; it is a comprehensive study that examines the interaction between users and the system. This approach makes it possible to identify the key needs and information required to design an efficient and effective system.

But before that, it is necessary to present the host organization: The SONATRACH Group, a major actor in the petroleum industry. Also presents an overview of the Information Technology (IT) Department, and more specifically the Maintenance Department, where the practical part of this work will be carried out.

1. Presentation of the Host Organization

Founded in December 1963, SONATRACH is the largest oil and gas company and a leading energy player in Africa. Its main mission focuses on managing the complete hydrocarbon value chain, including exploration, production, pipeline transport, and petrochemical processing. Apart from its industrial role, the company is the primary provider of national energy security and a crucial factor for socio-economic growth. Currently, SONATRACH aims to optimize its resource management through digital transformation and technological innovation. Adapting to global energy changes allows it to strengthen its position in the international market while ensuring the sustainable development of the country's natural resources.[1]

1.1. Regional Directorates

The Production Division (SH/DP) of SONATRACH includes a central headquarters located in Algiers and eleven (11) regional directorates distributed across the southern regions of Algeria. This division is responsible for managing oil and gas production operations. It brings together more than 16,000 employees distributed among its directorates and departments.

The regional directorates are responsible for implementing and monitoring production programs, ensuring compliance with safety rules and procedures, optimizing the development of reservoirs and production facilities, supporting the start-up and operation of wells and related infrastructure. The main ones are as follows: Hassi Messaoud (HMD), Hassi R'mel (HR), Haoud Berkaoui (HBK), Gassi Touil (GT), Ohanet (OHT), Stah (STH), In Amenas (INA), Rhourde El Nouss (RNS), Tin Fouyé Tabankort (TFT), Rhous El Baguel (REB), and external sites (Oued Guetteni and Djebel Onk).

1.2. The Company's Organization Charts

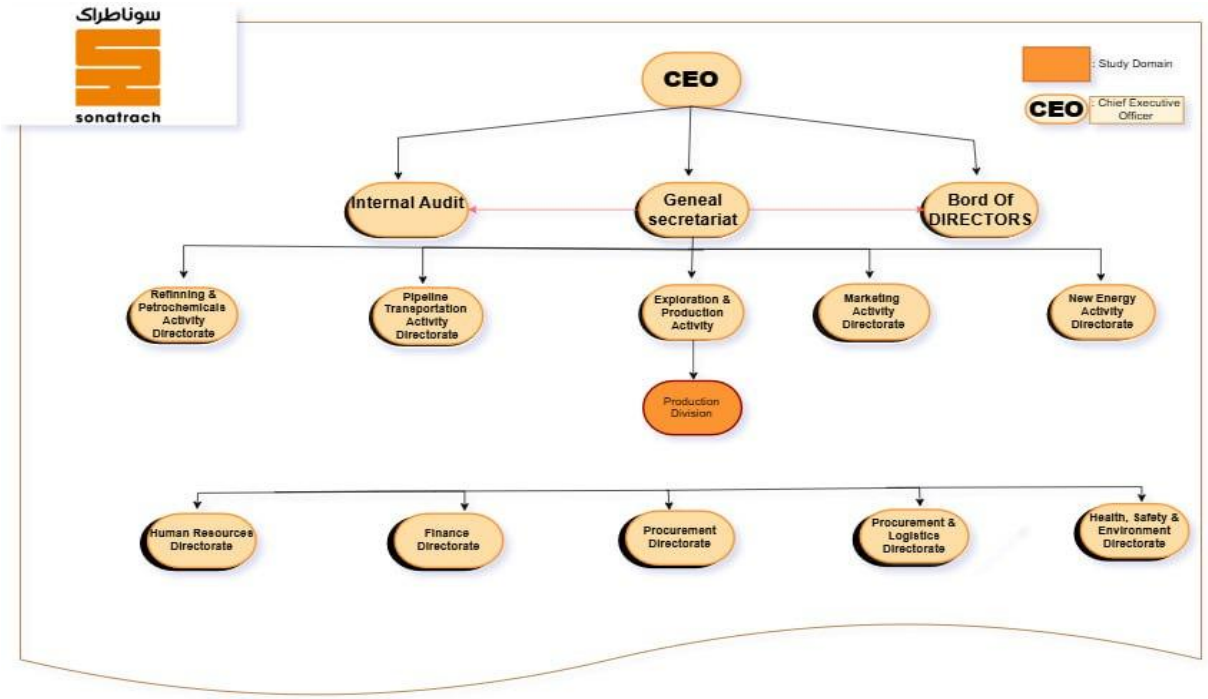


Figure 1.1: The organization chart

1.2.1. Production Division Chart

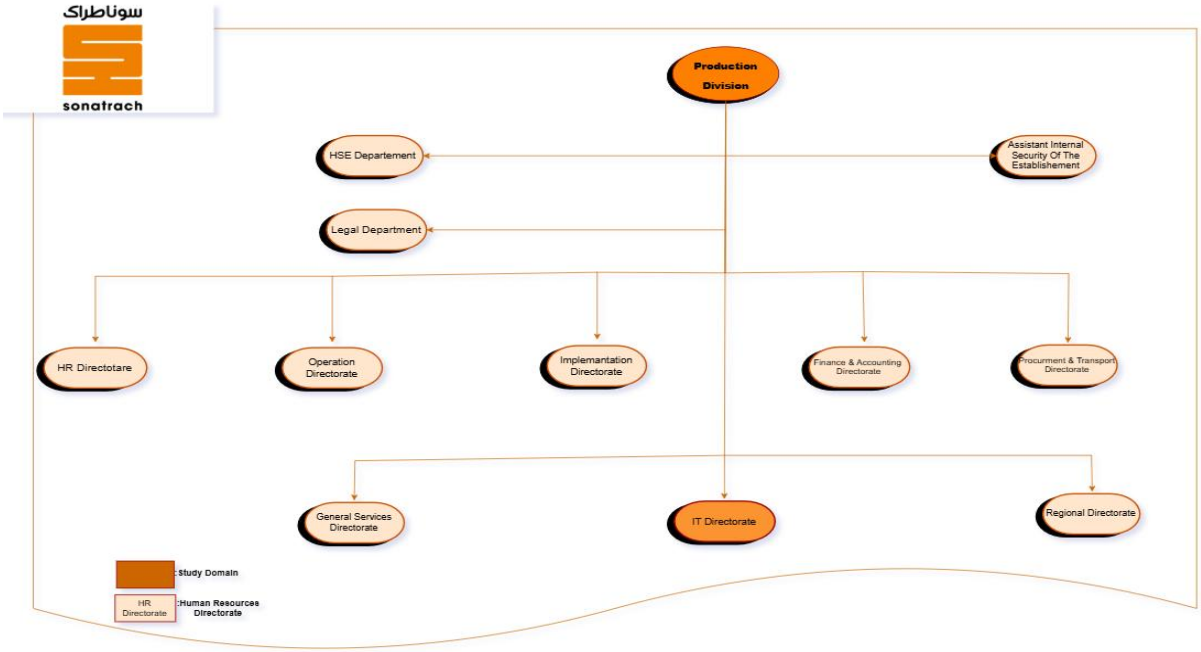


Figure 1.2: Production division chart

1.2.2. IT Department Chart:

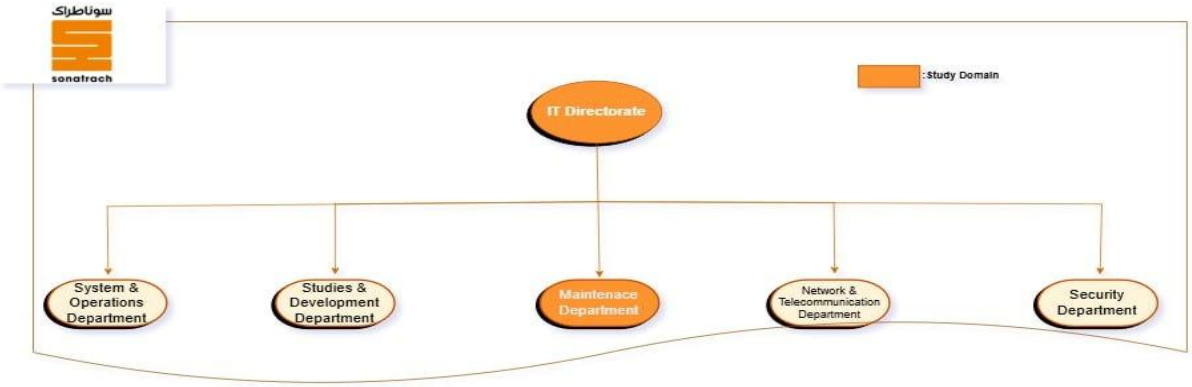


Figure 1.3: IT department chart

2. Current State Analysis

This section describes how IT equipment is currently managed and identifies the main issues that require improvement

2.1. Problem Statement

During our time in the IT department , we observed that the management of the IT park within the Production Division focuses on the processes of handling equipment requests, allocation, and maintenance , which is currently based on manual processes and basic tools such as paper-based documents and office files, due to the absence of a dedicated information system. This approach presents several limitations, including lack of efficiency, difficulty in tracking information, and risk of data loss. To better understand the existing system, we will examine the equipment request management process as an example.

Request Management follows a structured process starting with a paper-based request form submitted by the employee. The request is reviewed and approved by the head of the Maintenance Department and other responsible authorities. Once approved, it is forwarded to the maintenance team for processing. In cases where the equipment cannot be repaired or a replacement is required, a specific request form called BMM (Material Movement Form), it is used to formalize the operation and document equipment requests. It includes essential information such as the requester’s name, department, description of the required equipment, quantity, specifications, submission date, and the necessary approvals.

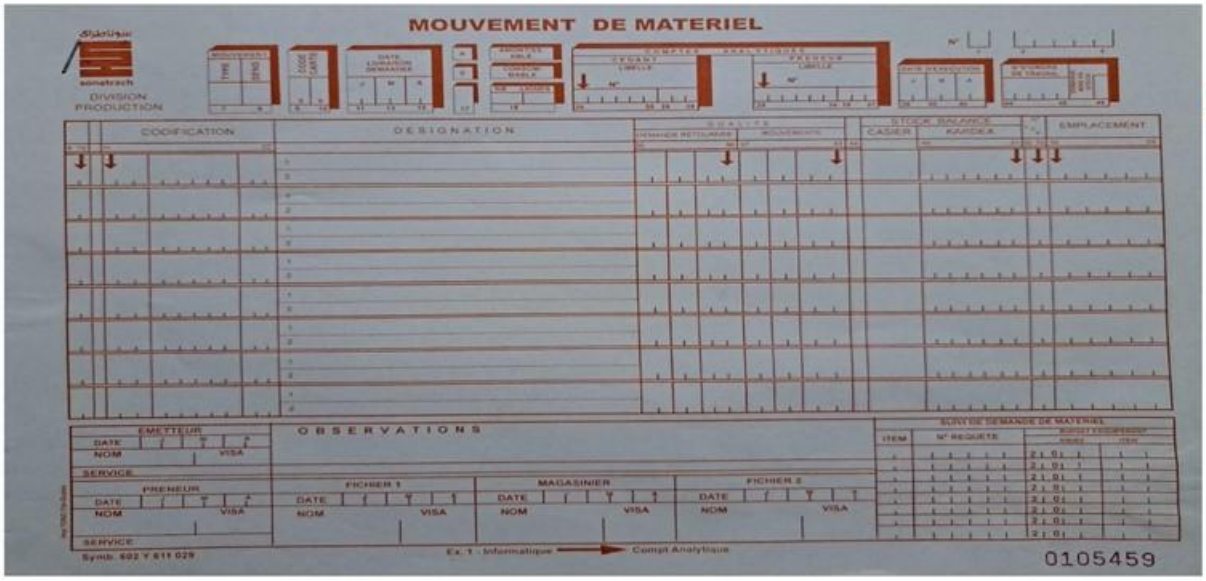


Figure 1.4: copy of equipment request form

2.2. Overview

The current system presents both advantages and limitations.

Advantages:

- Simplicity of use
- Traceability of requests and operations
- Clear accountability
- Availability of tangible records for administrative and legal purposes

Limitations :

- Slow workflow and processing time
- Time-consuming procedures
- Risk of data inaccuracy and information loss
- Lack of real-time monitoring and follow-up
- Difficulty in conducting audits and tracking historical data

2.3. Proposed Solution

Based on our analysis of the current situation, we propose the development of a web application that automates various processes related to IT park management. This application will provide a centralized database shared between services and offer users tools to manage incidents and track IT equipment efficiently. It will enable automatic processing of operations, ensure the unique identification of each piece of equipment, and allow detailed recording and monitoring of incidents. This solution aims to improve organization, enhance traceability, and optimize the overall management of the IT park.

Conclusion

In this chapter, we presented a study of the existing system by analyzing the current methods used for managing IT equipment within the organization. We examined the functioning of the system, as well as its advantages and limitations.

This analysis allowed us to identify the main shortcomings of the current approach, such as the lack of automation, limited traceability, and inefficient information management. Based on these findings, we were able to clearly define the problem and highlight the need for a more efficient and centralized solution.

In response to these limitations, we propose the design and implementation of a web-based application dedicated to the management of the IT equipment park.

The next chapter will focus on the specification of user requirements and system needs.

CHAPTER 2

Analysis and Design

Introduction

After analyzing the current situation and identifying the problem it's time to propose a structured approach for the development of a web application dedicated to the management of IT assets within SONATRACH. To achieve this, we rely on system modeling using the Unified Modeling Language (UML). The development process of a software system involves identifying user needs and defining the functional and structural requirements of the application. For this purpose, we will use several UML diagrams, including use case diagrams, sequence diagrams, and class diagrams, in order to clearly model the different aspects of the system.

1. Presentation of UML

Definition: The Unified Modeling Language (UML) is a standardized graphical modeling language used to specify, visualize, construct, and document the components of a software system. It provides a clear and structured way to represent various elements such as classes, objects, relationships, attributes, methods, and interactions within a system.[2]

Choice of UML: UML is a powerful visual modeling language that helps improve the understanding and communication of software system designs. It offers several advantages, including:

- Standardized and widely accepted notation ;
- Clear and structured graphical representation;
- Improved understanding of system architecture;
- Better communication between stakeholders ;
- Comprehensive documentation of system design.

The UML diagrams used: For the design of this project, we selected the following UML diagrams:

- **Use Case Diagram:** Identifies the actors of the system and the different functionalities (use cases) they can perform.
- **Sequence Diagram:** Describes the interactions between system components over time.
- **Class Diagram:** Represents the structure of the system by defining its classes, attributes, methods, and relationships.

2. Needs analysis and specification

One of the necessary steps in the software development process consists of identifying what we expect the system to offer based on the requirement. We can distinguish two types: functional requirements and non-functional requirements.

2.1. Functional Requirements

In the conception of a web application ,we should offer specific features that align with the users' needs. That's what makes functional requirements essential, since they define the behaviour and functionalities of the system.

Administrator: represents the highest privilege level within the system.

- Authentication : he can log into the system using a username and a password
- Users management : the administrator can create ,delete and modify users' accounts, consult the list of users while also being able to assign roles and define access privileges for each
- Request list consulting : he can see the request list along with the attached details

Technician: is responsible for handling maintenance requests assigned to them .

- Authentication :he can log into the system using a username and a password
- Request management : the technician can consult the list of submitted requests and handle those assigned to him and send back a report once the intervention is completed
- Equipment management : he can consult the IT equipment, track ownership and update the availability of each device

Employee: represents the end user of the system.

- Authentication : he can log into the system using a username and a password
- Personal request management : he can submit a request to report a problem or request a new device, at the same time the employee can track the status of their own requests.

2.2. Non Functional Requirements

While the functional requirements represent what the system should perform, the non functional ones are more focused on how the system should operate, by addressing security and reliability of the web application, the usability and performance of the system, and lastly its maintainability.[3]

3. Use case diagram

In the following figures, we will present the use cases that highlight the main functionalities of each actor in the system

General use case diagram

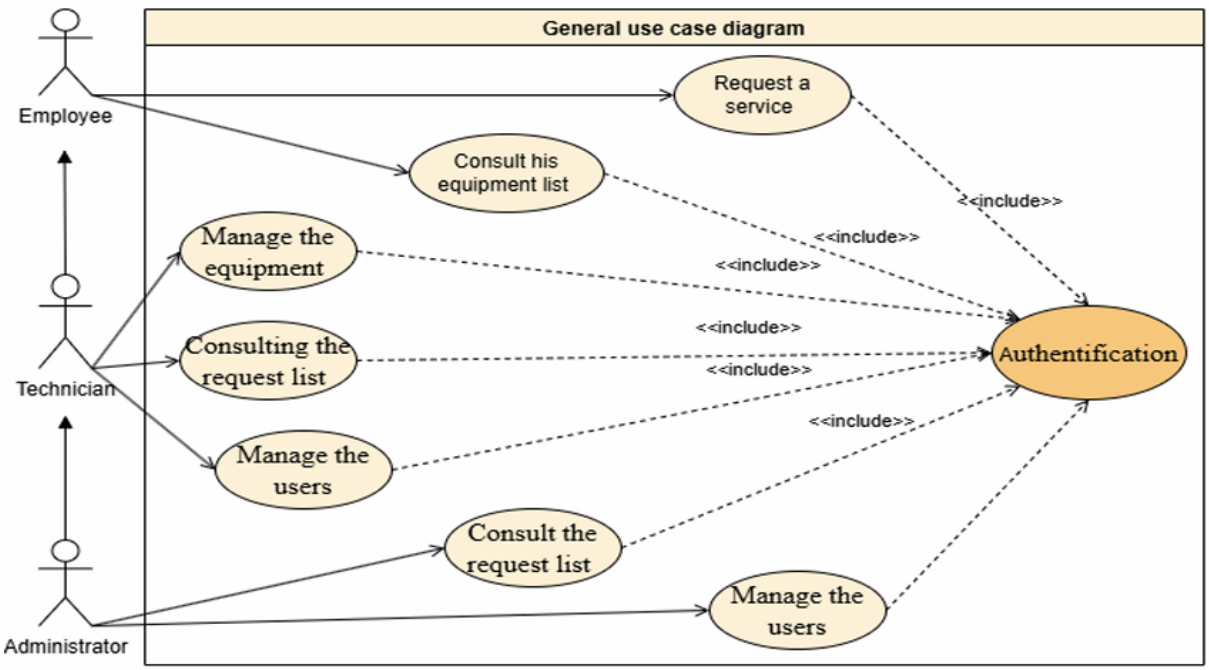


Figure 2.1: General use case diagram

Textual description of use case "Authentication "

Title	Authentication
Actors	Administrator , Employee , Technician .
Objective	Verify the identity of the user while securing access to the platform
Precondition	Having access to the platform
Séquence of events	1. The system displays the login page 2. The actor enter his username and password and submit it 3. The system verifies the given data 4. The system opens the Home page depending on their profiles

Alternative séquence of events	5. If the actor does not fill one of the input fields in step “2”, the login button cannot be pressed 6. In step “3” If one of the provided informations is invalid , the system displays an error message and go back to the step “1”
Post condition	Display the Home page

Use case diagram for the actor “Administrator”

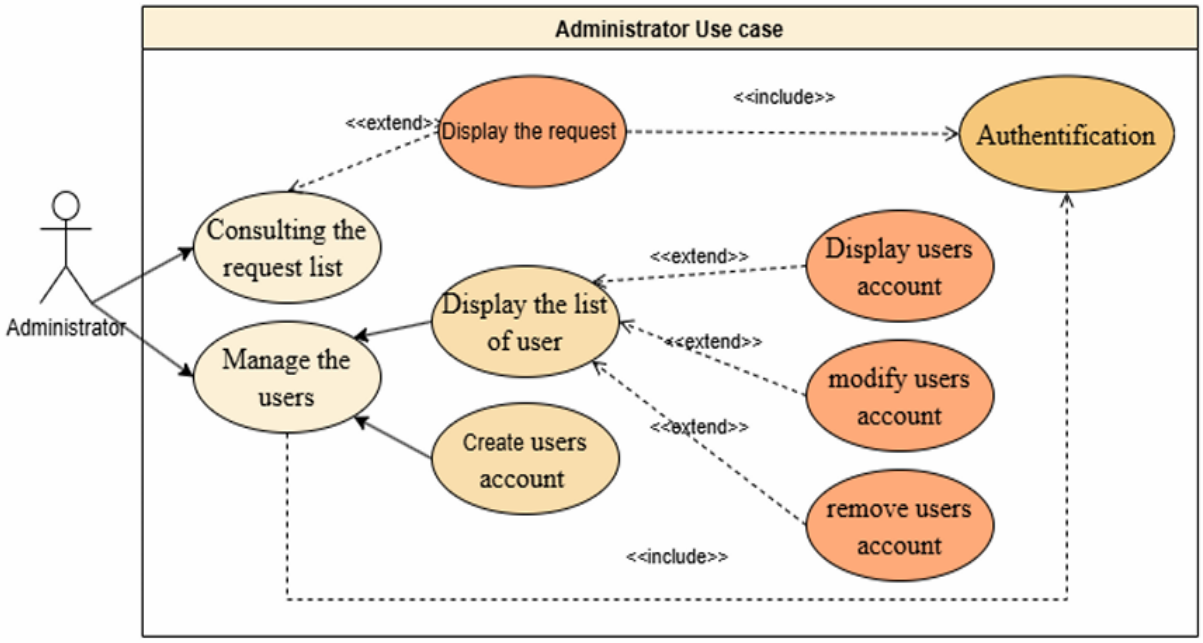


Figure 2.2: Use case diagram for the actor “Administrator ”

Use case diagram for the actor “Technician”

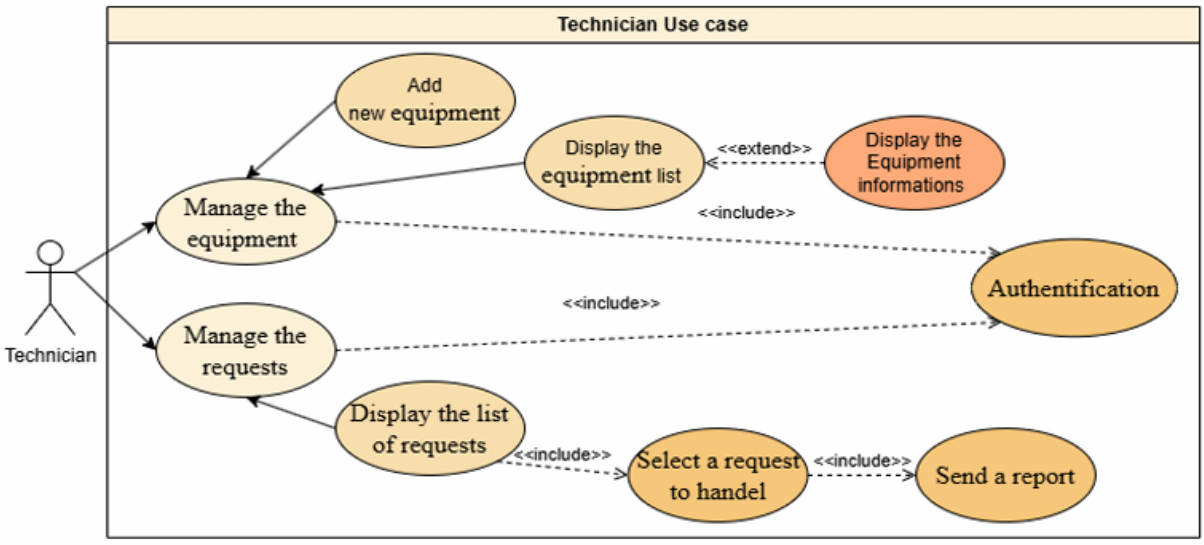


Figure 2.3: Use case diagram for the actor “Technician”

Textual description of use cases of the actor "Technician"

Description of "Manage requests"

Title	Manage Requests
Actors	Technician .
Objective	To allow the actor to oversee and process incoming service or work requests.
Precondition	Having access to the platform
Sequence of events	1.The actor selects the "Manage requests" option. 2.The system displays a list of pending or active requests. 3.The actor updates the status of a specific intervention (pending, In progress, resolved)
Alternative sequence of events	/
Post condition	The request status is updated in the database.

Description of "Manage the equipment"

Title	Manage the equipment
Actors	Technician .
Objective	To allow the actor to add, view, and update information about equipment in the system.
Precondition	Having access to the platform

Sequence of events	1.The actor selects the “Manage equipment” option. 2. The system displays the list of the existing equipment. 3.The actor can add new equipment by entering required details. 4. The actor can select an item from the list to view detailed information or edit it.
Alternative sequence of events	/
Post condition	The equipment database is updated with new entries or modifications, and information for future requests.

Use case diagram for the actor “employe”

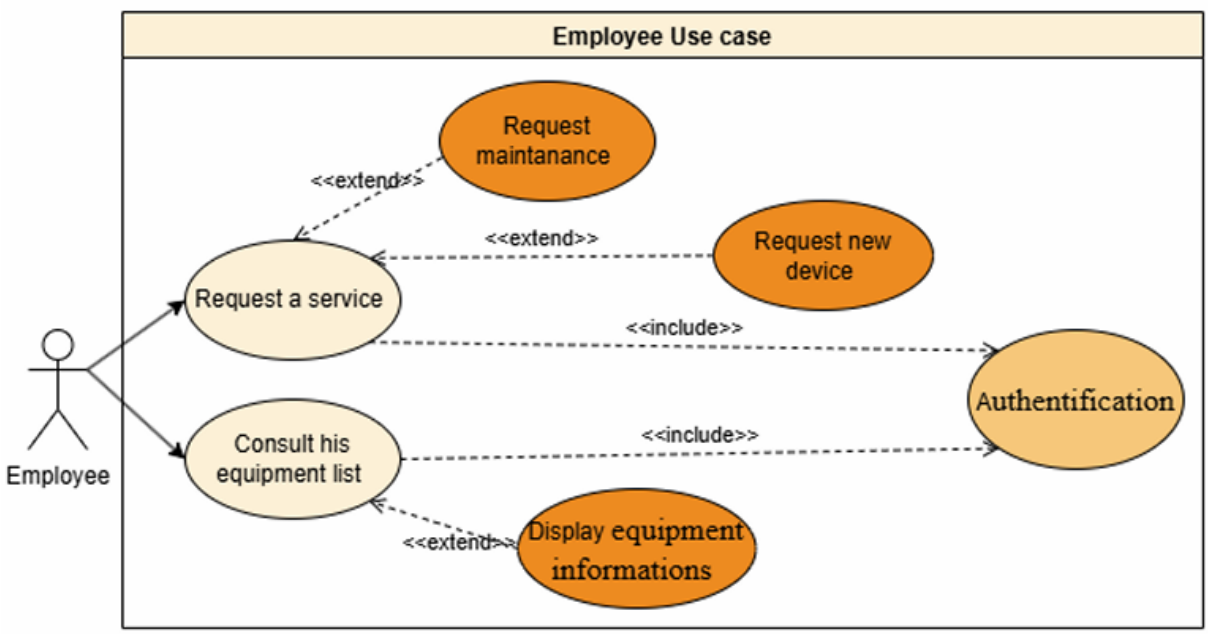


Figure 2.4: Use case diagram for the actor “employee”

Description of “ Request maintenance”

Title	Request maintenance.
Actors	Employee.

Objective	Request maintenance for equipment.
Precondition	The employee is already authenticated in the system and has access to the application
Sequence of events	1.The employee accesses the application. 2.he selects the option (request service). 3.the system displays a request form. 4.the user enters the required information (equipment,issue…) 5.the employe submits the request 6.the system saves the request in the database 7.the request is sent to the IT department for processing 8.the system notifies the user that the operation was successful
Alternative sequence of events	1-required information is incomplete 2-invalid information 3-possible system error 4-network failure In all these cases ,the system displays an error message.The user then either completes the missing information or corrects it if there is an error ,in case of a system malfunction ,the user can try again later ,and the same applies if there is a network issue
Post condition	The service request is successfully submitted and recorded in the system,and the user is authenticated.

4. Sequence Diagram

To provide a chronological view of events we need to highlighting the following key elements:

Authentication :

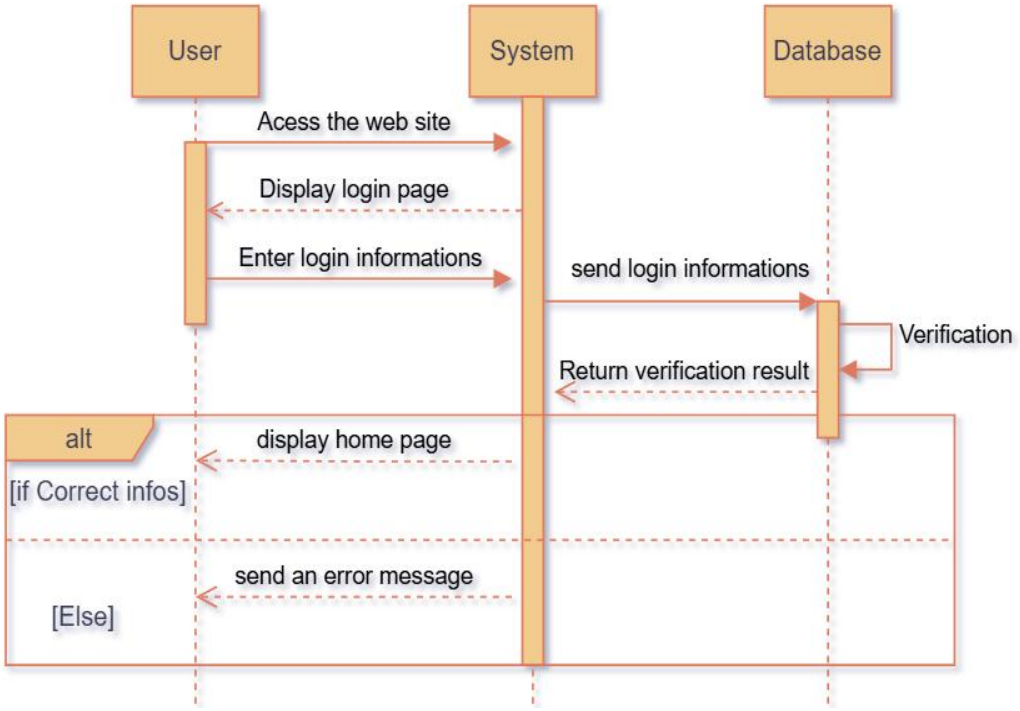


Figure 2.5: Sequence diagram for "Authentication "

Request a service :

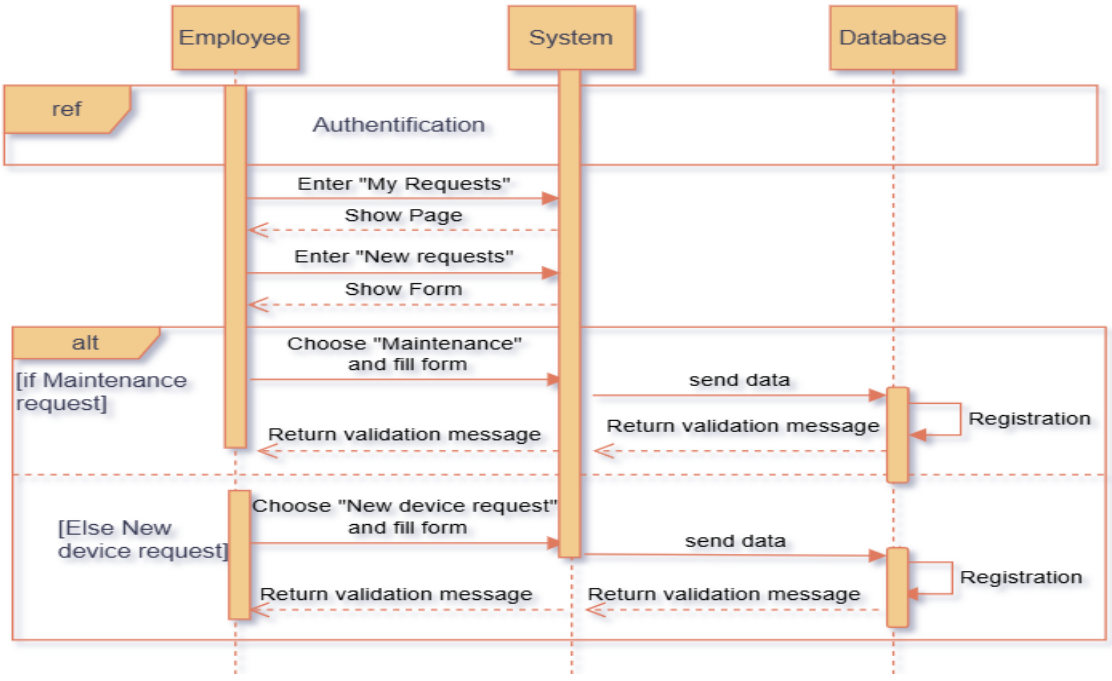


Figure 2.6: Sequence diagram "Request a service"

Requests management :

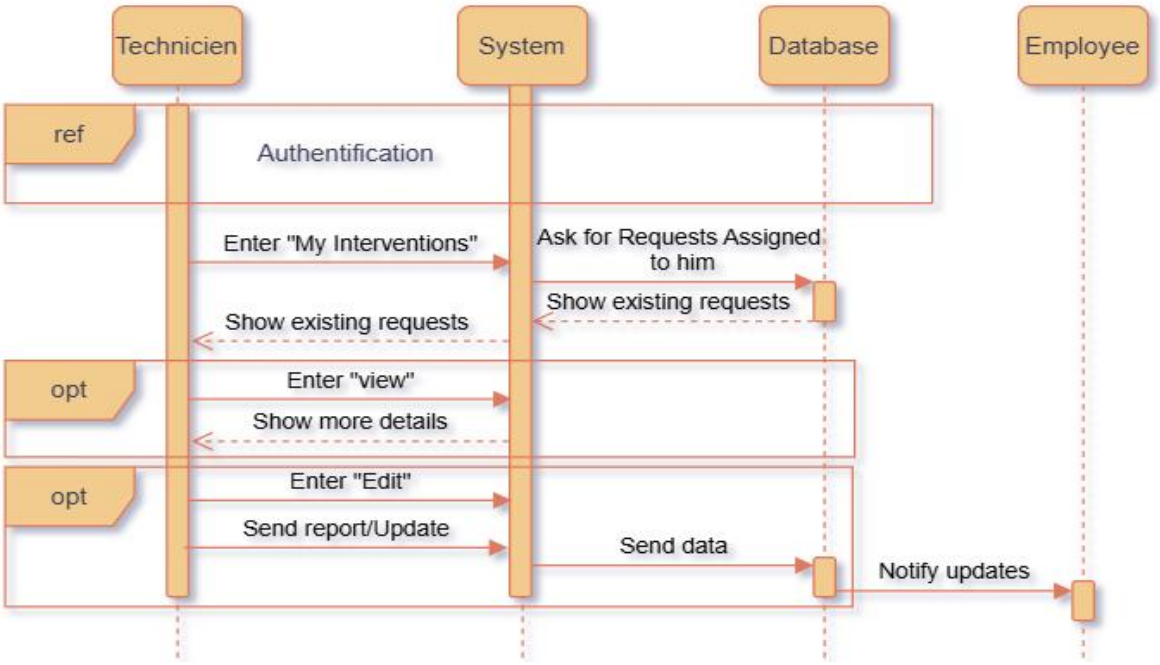


Figure 2.7: Sequence diagram "Request management"

Equipment management :

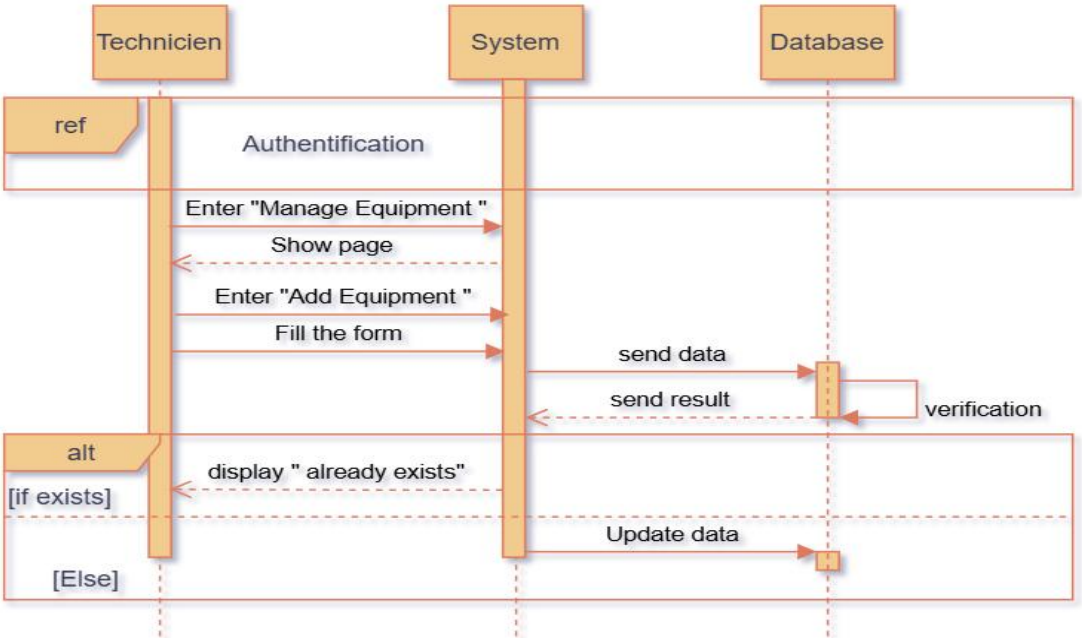


Figure 2.8: Sequence diagram "Equipment management"

5. Class diagram

Since the class diagram is considered the most important diagram in object-oriented modeling, and from this diagram, we identify the following structure of the different classes in our application.

5.1. Data Dictionary

Class	Attribute			Description
	Field	**Type**	**Size**	
Users	Id	ID	10	Unique identifier
	Name	VARCHAR	100	User name
	Email	VARCHAR	100	Email
	Password	VARCHAR	250	Password
	Phone	VARCHAR	20	User phone number
	Role	VARCHAR	20	User role
	created_at	DATETIME	8	Account creation date
Employee	ID	INT	10	Unique identifier
	Department	VARCHAR	100	Employee's department
	Division	VARCHAR	100	Employee division
Technician	ID	INT	10	Unique identifier
	Department	VARCHAR	100	Employee department
	Division	VARCHAR	100	Employee division
Administrator	ID	INT	10	Unique identifier

Request	Id Description Status Date Type equipment_id technician_id employee_id	ID TEXT VARCHAR DATE VARCHAR INT INT INT	10 500 10 — 50 10 10 10	Unique identifier of the request Description of the issue Status (Pending, In Progress, Resolved) Request Creation Date Request type Related equipment Assigned technician Employee who created the request
Equipment	Id Name Category_id Status serial_number purchase_date	ID VARCHAR VARCHAR VARCHAR VARCHAR DATE	10 10 10 10 100 —	Unique identifier of the equipment Equipment name Equipment category Status (Available,Assigned,Broken) Equipment serial number Equipment purchase date
Assignment	Id Date equipment_id employee_id	ID DATE INT INT	10 _ 10 10	Unique identifier Assignment date Assigned equipment Employee receiving equipment
Category	Id Name	ID VARCHAR	10 10	Unique identifier Category name (Computer, Printer…)

5.2. Management Rules

Rule 1 : Each user must have a unique identifier and a unique email address.

Rule 2 : A user must be authenticated to access the system.

Rule 3 : A user is classified as an Administrator, Technician, or Employee.

Rule 4 : Each equipment must have a unique identifier and belong to one category.

Rule 5 : Each equipment has a status that indicates its current condition.

Rule 6 : the Administrator can add, update, or delete equipment.

Rule 7 : Each equipment can be assigned to only one employee at a time.

Rule 8 : Only the Administrator can assign equipment to employees.

Rule 9 : Each request must be associated with one equipment.

Rule 10 : Each request must be handled by a technician.

Rule 11 : Only the technician can update the status of a request.

Rule 12 : A category may be associated with multiple equipment.

Class diagram:

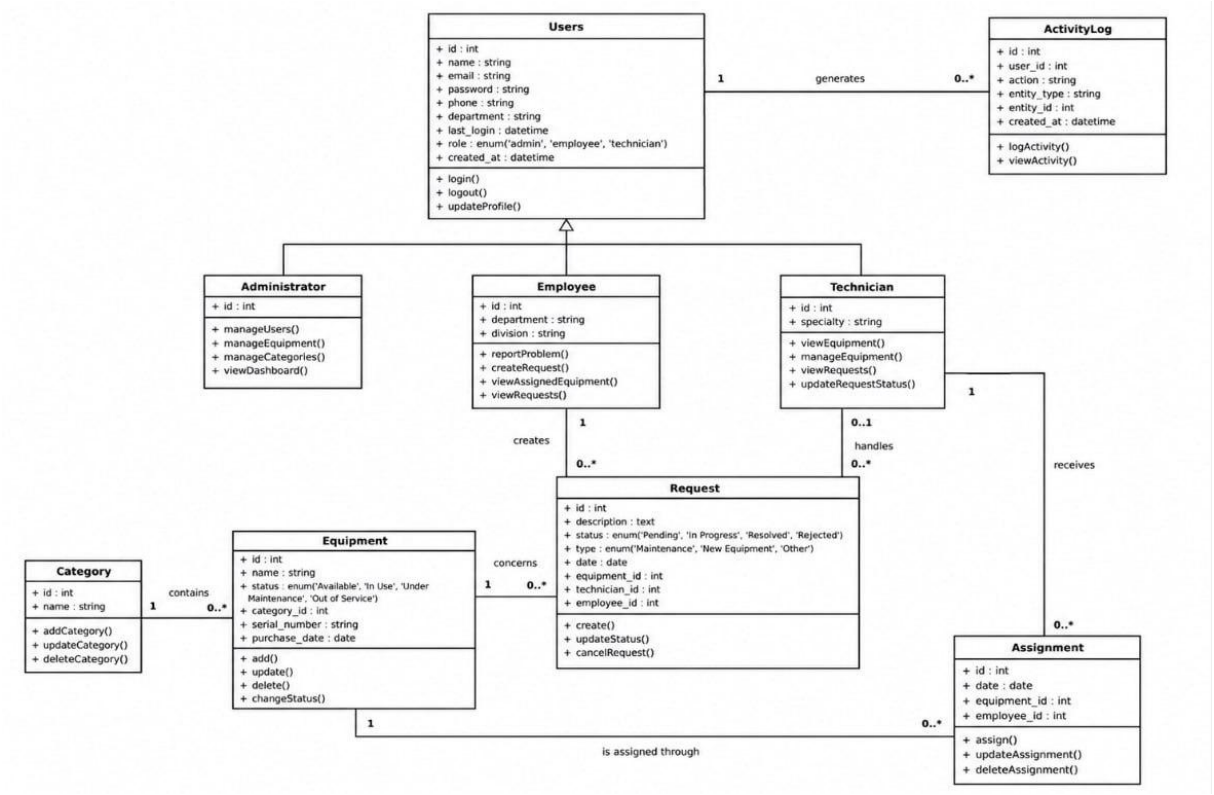


Figure 2.9: Class diagram

5.3. Relational Model

To construct a relational model it is crucial understand the transformation rules that allow the transition from a conceptual model represented in our case by a UML class diagram to a relational structure suitable for a database.These rules guide the conversion of classes, attributes, and relationships into relational database elements tables, columns, primary keys, and foreign keys. By applying these rules we are ensuring the consistency, integrity, and normalization of the future relational schema.[4]

The following textual relations represent the relational model derived from the UML class diagram of our system:

USER (id*, name, email, password,phone,role,created_at)

ADMINISTRATOR (id*)

TECHNICIAN (id*,specialty)

EMPLOYEE (id*, department,division)

EQUIPMENT (id*, name, status, category_id, serial_number, purchase_date)

CATEGORY (id*,name)

REQUEST (id*, description, status, date, type, equipment_id, technician_id, employee_id)

ASSIGNMENT (id*, date, equipment_id, employee_id)

Conclusion

This chapter on analysis and design constituted the core of our project. We began by identifying the system's needs and objectives, then conducted an analysis of the existing organizational processes,we determined gaps and opportunities for improvement. Based on these results, we designed a solid software architecture, defining the functional modules, interfaces, and interactions between them. Sequence and class diagrams were utilized to represent the system's dynamic behavior and static structure. Furthermore we identified potential risks and recommended mitigation measures.

The next chapter will be devoted to the website's design and implementation.

CHAPTER 3

Implementation

Introduction

In this chapter, we detail the different stages of implementation, starting with the development environment used and the structure of the application. We then describe the key features implemented and the challenges encountered, as well as the tests and validations carried out. Finally, we evaluate the results obtained and share our successes and lessons learned. The implementation of our application constitutes an essential step that brings us closer to our final goal, by transforming our design into a functional and operational solution.

1. Language and Development Tools

The choice of development tools and languages depends on several criteria that developers take into consideration, such as cost, ease of use, the application objective, performance, and reliability.

1.1. Choice of Languages

Our choice of languages is based on:

- Ease of use.
- Large developer community.
- Easy integration.
- Support for multiple platforms.
- Availability: HTML, CSS, and JavaScript are widely used and supported by all modern web browsers.

1.2. Hardware Tools

In our project, we used the Windows 11 operating system on an MSI Katana15 B12V laptop, equipped with a 12th Gen Intel® Core™ i7-12650H processor(2.30GHz), 16GB RAM, an NVIDIA GeForce RTX4060 GPU with 8GB graphics memory, Intel® Graphics, and 954 GB SSD storage and Windows 11 operating system on an HUAWEI computer processor AMD Ryzen 5 3500U with Radeon Vega Mobile Gfx (2.10 GHz) 8GB RAM, graphic card AMD Radeon(TM) Vega 8 Graphics and 512 GB SSD storage

1.3. Languages

HTML (HyperText Markup Language) can be translated as “hypertext markup language”.

CSS (Cascading Style Sheets) is a style sheet language used to describe the presentation of HTML pages.

JavaScript is a programming language used to make web pages interactive and dynamic.

PHP (Hypertext Preprocessor) is a server-side scripting language designed for web development.



Figure 3.1:Languages logos

1.4. Framework

React is a JavaScript library used to create dynamic and interactive user interfaces for web applications. It helps developers build reusable components and improve application performance.



Figure 3.2:React logo

1.5. Development tools

Visual Studio Code is a source-code editor developed by Microsoft, it was used as the main development environment because of its simplicity, lightweight performance, and support for multiple programming languages and extensions.[5]



Figure 3.3 :VSC logo

XAMPP is a free and open-source local server package. It provides a local server environment that allows developers to run and test web applications on their computers before deployment. It includes Apache and MySQL services required for web development.[6]



Figure 3.4: XAMPP logo

phpMyAdmin is a web-based tool used for managing MySQL databases. used to create and manage the project database, tables, relationships, and records through a simple graphical interface without writing complex SQL commands manually.



Figure 3.5: phpMyadmin

Draw.io is an online diagramming tool used to create UML diagrams, flowcharts, database schemas, and system designs.[7]



Figure 3.6: Drow.io

1.6. Database Management System

MySQL is an open-source relational database management system used to store and manage the application data. It offers good performance, reliability, security, and compatibility with web technologies



Figure 3.7:MySql logo

2. Presentation of the Application

This section highlights the current IT park management process within the organization

2.1. Authentication interface

Before being able to access the application , users must mandatorily fill out the following authentication

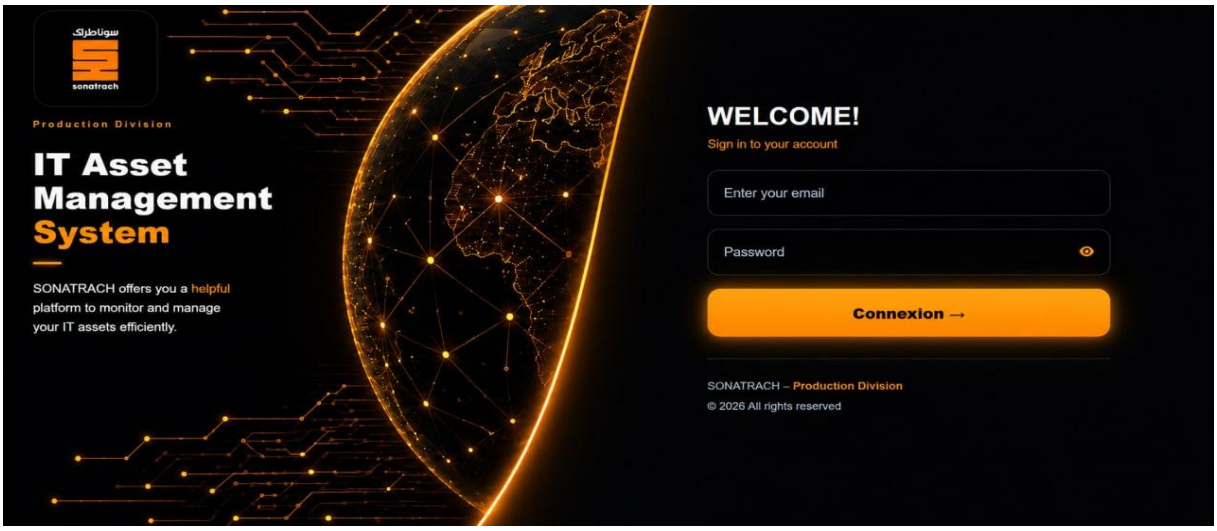


Figure 3.8:login interface

2.2. Dashboards : Admin interface

The Dashboard window is a graphical interface that presents the essential information of the application in a concise and visual way. It allows administrators to quickly monitor and analyze important data and system activities. Separate dashboards are also provided for employees and technicians, containing limited information and functionalities according to their roles.

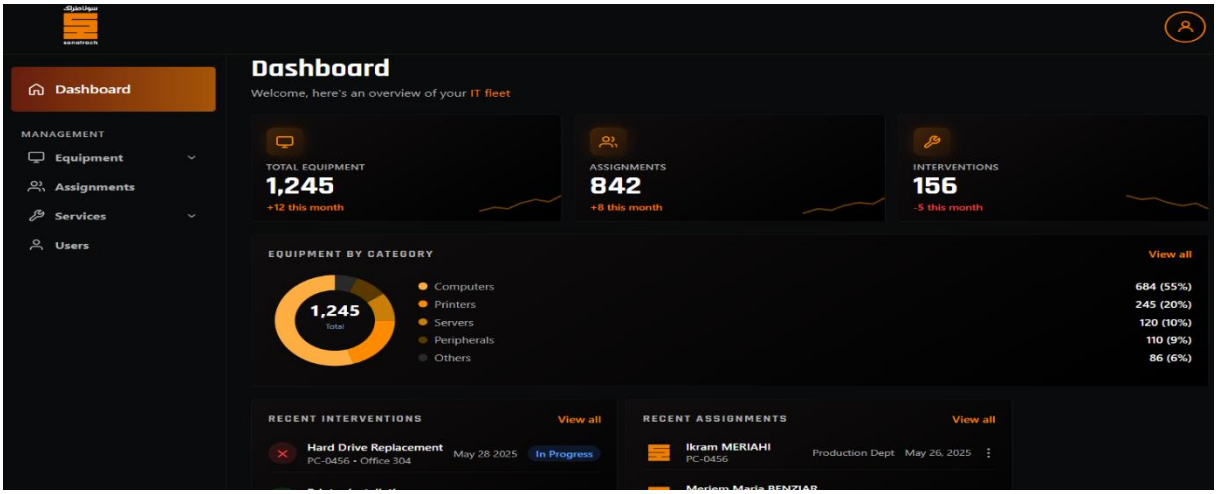


Figure 3.9: admin dashboard

2.3. Admin: Assign the device to the employee

The device assignment feature allows the administrator to assign computer equipment to employees efficiently. It helps track which employee is using each device and improves equipment management within the application.

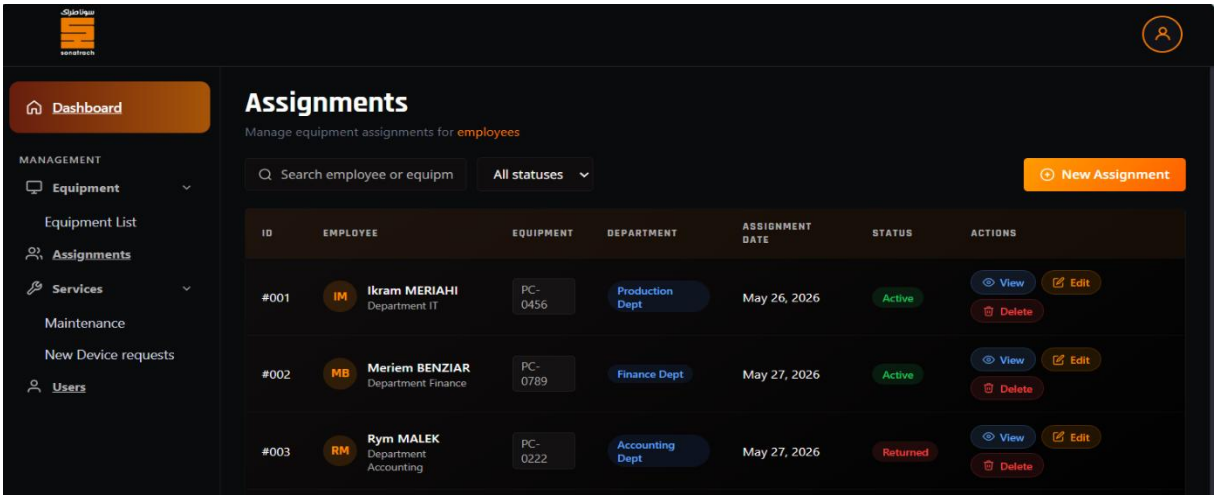


Figure 3.10: Assignments interface

2.4. Create new user

The user creation feature allows the administrator to add new users to the application by entering their personal information and role. It helps manage access to the system and organize user permissions efficiently.

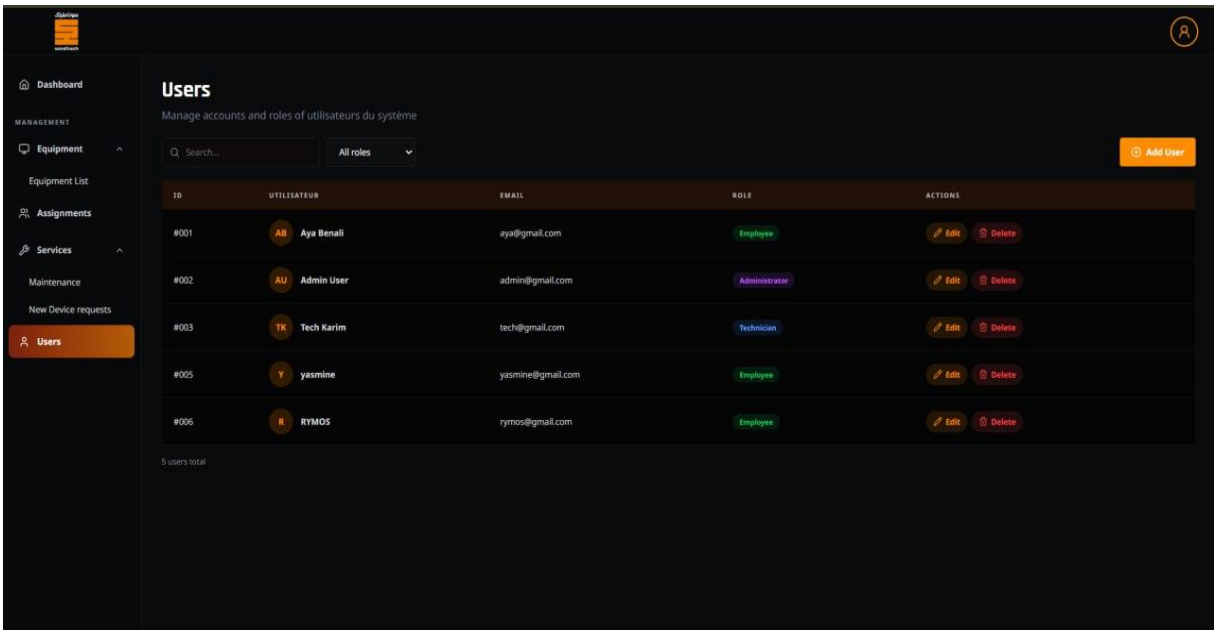


Figure 3.11: Users management

2.5. Employees Request interface

This interface allows employees to submit a new maintenance or equipment request by selecting the request type and the related equipment. It also enables users to describe the problem in detail before sending the request to the administrator or technician.

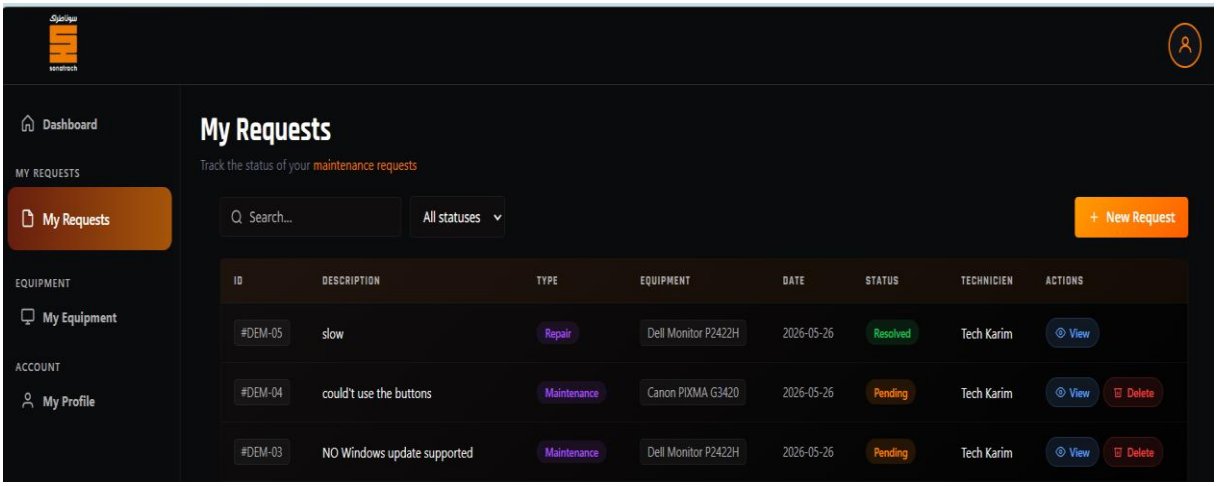


Figure 3.12: Requests list

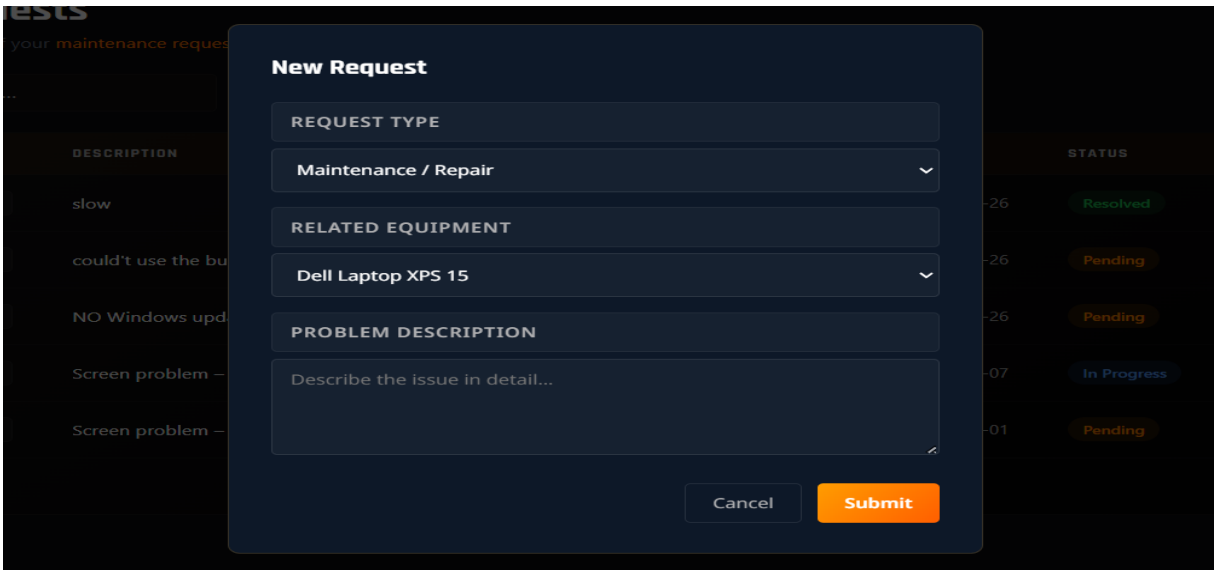


Figure 3.13: Request interface form

2.6. Technician interventions interface

This interface allows the technician to view, edit and create new requests if needed . It also displays all the interventions along with their informations .

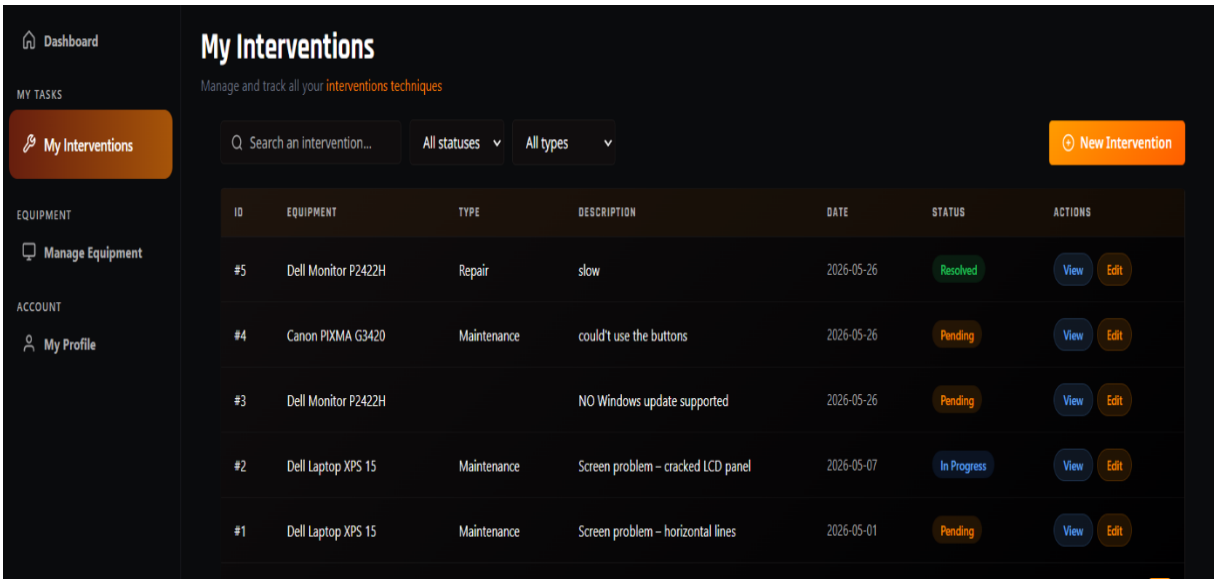


Figure 3.14 : Technician interventions interface

2.7. Manage equipment

This interface allows the technician to create new equipment and assign them to their attached owner while being able to view, edit and delete them.

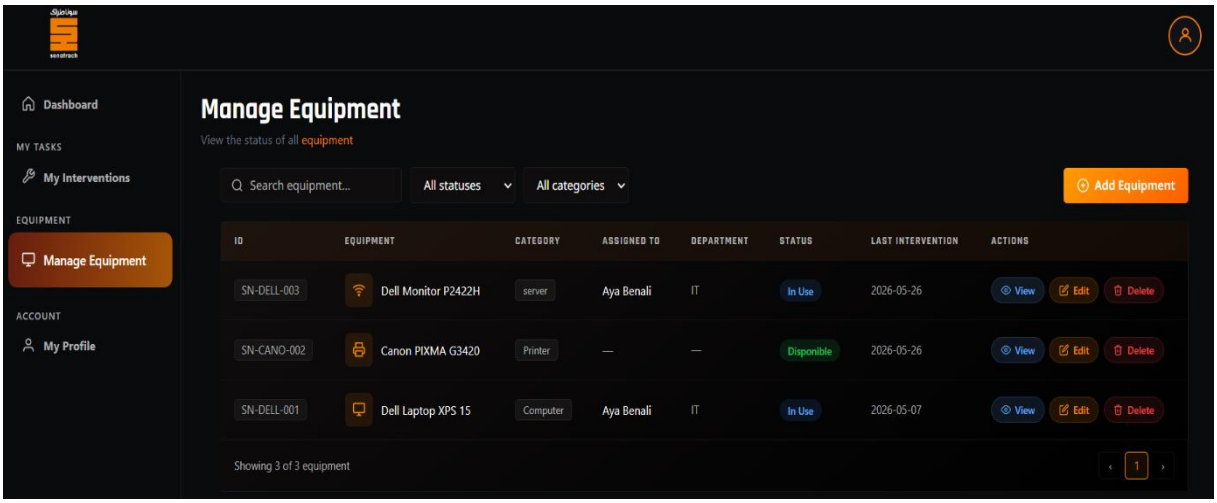


Figure 3.15 : Manage equipment interface

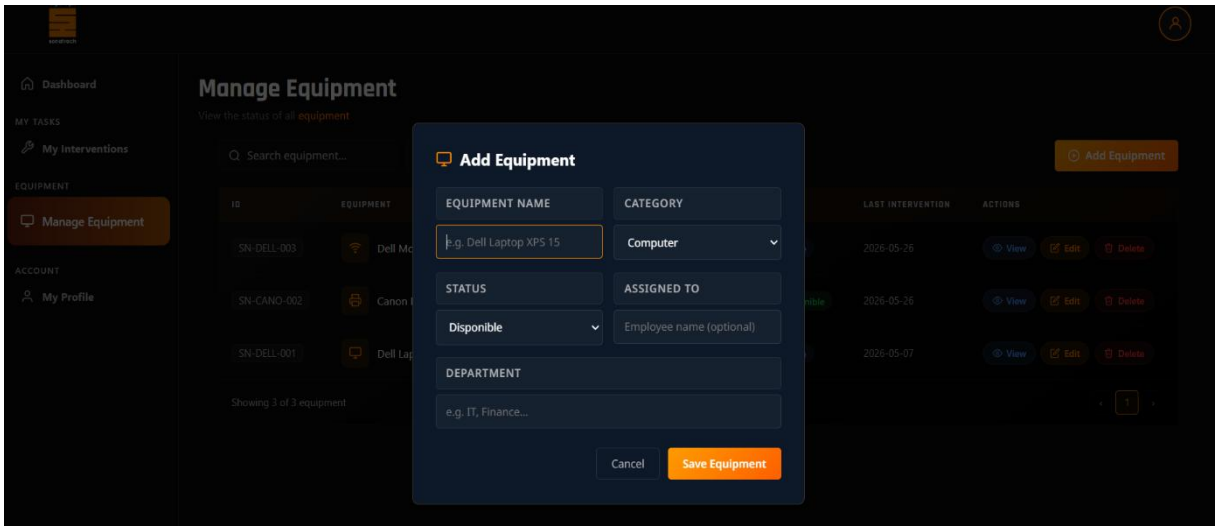


Figure 3.16 : Add new equipment interface

2.8. Profile

This interface is made to show the user's informations, activity and lastly offers the possibility to change the password.

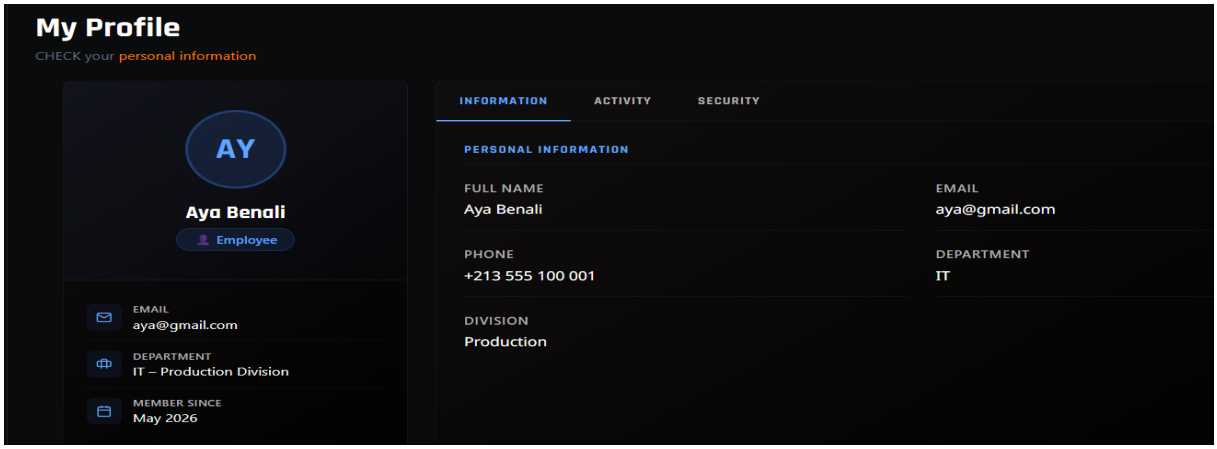


Figure 3.17 : User profil

Conclusion

In this chapter, we presented the implementation of our web application, including the tools used and the main developed interfaces. This phase allowed us to transform the proposed design into a functional solution for IT park management, it helps to improve equipment tracking, request handling, and intervention monitoring.

For more pictures click on the link

General Conclusion

The management of IT resources represents a strategic aspect within modern organizations, particularly in companies where information systems support daily activities and operational continuity. In this context, the IT park requires efficient monitoring, structured organization, and reliable management of equipment, assignments, and maintenance requests.

Within SONATRACH, the management of IT equipment involves several processes, including inventory tracking, equipment allocation, user requests, and maintenance interventions. However, the use of manual procedures and office-based tools can lead to delays, information loss, and difficulties in ensuring real-time follow-up

Our end-of-study project aimed to design and develop an IT park management web application for managing IT equipment and maintenance requests.

At this stage of development, we were able to create a computer-based solution. The design and implementation of this work started after identifying several needs expressed by the Information Systems Management department of the company, with the objective of developing a system capable of ensuring efficient management of the company's hardware resources.

The developed application allowed the company to efficiently manage its entire IT park. It provided an overview of the different IT equipment components, enabled monitoring of equipment status, helped organize maintenance operations, and facilitated the tracking of repairs and assignments. In addition, it improved the overall performance and productivity of the organization.

Through this work, we seek to provide a practical and organized solution adapted to the needs of the company, while applying the knowledge and skills acquired during our academic training in a professional environment.

Perspectives

As future improvements, the application could be enhanced by adding notification features, advanced statistics, automatic report generation, and deploy of the application on a real server to make it accessible within the organization's network

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