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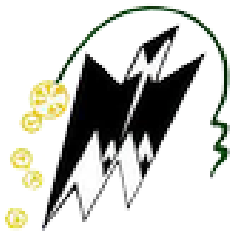

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Par

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Thème

Application web collaborative pour l'optimisation de l'utilisation des ressources d'eaux en Algérie

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Abstract

In this work, we present the process followed in our final year project to obtain a Master's degree in Networks and Telecommunications, with the theme "Collaborative web application for optimizing the use of water resources in Algeria."

The main objective of our web application is to accurately report water leaks and locate water-related problems, as well as to reveal water sources. It also allows for discussions on any water-related topics.

This work begins with the presentation of several collaborative applications, followed by an analysis and design phase illustrating the required functionalities for our system using the UML language. Based on this design, we then proceeded to the implementation phase, where we present the final product, including various interfaces, as well as the tools and development environment used. Finally, the annex part provides explanatory diagrams detailing the operation of our application.

Keywords: Collaborative Application, Water Management, Water Wise, Water Issues, Leak Reporting, Water Sources, Community Engagement, Environmental Conservation, Water Conservation, Sustainable Water Use, Real-time Reporting, Public Awareness, Resource Management, Geo-location Services, Water Forum.

Résumé

Dans ce travail, nous présentons le processus suivi dans notre projet de fin d'étude en vue de l'obtention d'un diplôme de master en réseaux et télécommunications, ayant pour thème "Application web collaborative pour l'optimisation de l'utilisation des ressources d'eaux en Algérie".

L'objectif majeur de notre application web est de signaler les fuites d'eau avec précision et de localiser les problèmes liés à l'eau, ainsi que de dévoiler des sources d'eau. Il permet également de discuter de tout sujet en lien avec l'eau.

Ce travail débute par la présentation de plusieurs applications collaboratives, suivie par une phase d'analyse et de conception illustrant les fonctionnalités requises pour notre système à l'aide du langage UML. En nous appuyant sur cette conception, nous avons entrepris la phase de réalisation, où nous présentons le produit final, y compris diverses interfaces, ainsi que les outils et l'environnement de développement utilisés. Enfin, la partie annexe fournit des diagrammes explicatifs détaillant le fonctionnement de notre application.

Les mots clés: Application collaborative, Gestion de l'eau, Water Wise, Problématiques liées à l'eau, Signalement de fuites, Sources d'eau, Engagement communautaire, Conservation de l'environnement, Conservation de l'eau, Utilisation durable de l'eau, Rapports en temps réel, Sensibilisation du public, Gestion des ressources, Services de géolocalisation, Forum sur l'eau.

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Introduction Générale

Internet est devenu accessible à un large éventail d'appareils, notamment les ordinateurs et les téléphones portables, à une époque de croissance et d'expansion rapides. Le numérique est un lieu dynamique où des solutions logicielles innovantes sont introduites, transformant notre relation avec la technologie ainsi que la fourniture et la consommation de services. Les applications web sont de plus en plus répandues dans les entreprises, remplaçant les installations traditionnelles et favorisant une plus grande flexibilité et efficacité. La transformation numérique de la gestion de l'eau est un moyen d'améliorer les opérations, d'améliorer la qualité des services et d'impliquer efficacement les parties prenantes grâce aux technologies. La gestion de l'eau est un processus complexe, une réponse à la croissance démographique et au climat. Waterwise, une application web collaborative, est un exemple de cette innovation, car elle permet aux utilisateurs de gérer efficacement leur consommation d'eau, favorisant ainsi la conservation et la sensibilisation à l'eau.

Dans le cadre de notre projet de fin d'études, le rapport actuel est divisé en quatre sections distinctes. Tout d'abord, l'introduction établit le contexte du projet. Ensuite, la première section se concentre sur l'état de l'art, offrant une description des différentes applications web collaboratives. La deuxième section, dédiée à l'analyse et conception, implique la modélisation des objectifs à atteindre, ainsi que la description et la planification de leur fonctionnement. La troisième section, intitulée 'Mise en œuvre', vise à concrétiser les objectifs énoncés en une solution informatique tangible. Enfin, la quatrième section, axée sur l'annexe, présente les diagrammes définissant le fonctionnement des interfaces de notre application. La conclusion et les perspectives, fournissent une synthèse des résultats obtenus et des orientations futures du projet.

Introduction

With an explosive growth, the Internet has become widely accessible through numerous devices like computers, mobile phones, and many more. Thus, creative software solutions occupy the central place on this vibrant stage digital world. Through connectivity on such an unprecedented scale, how we interact with technology has been innovated. Therefore, ways of delivering services have transformed in their very consumption. Now organizations are increasingly harnessing the power of the internet to make those very same applications available as services that can be accessed via the web-no local installation required. Scalability, and efficacy that let businesses respond dramatically faster to market demand and needs of end users. Embracing this technological evolution, businesses are bringing in solutions of the cutting edge seamlessly, thereby making their businesses more efficient and also raising the level of user experience. It is leveraging advances in cloud computing, big data analytics, and artificial intelligence to develop more intuitive, responsive, and personalised applications. They take cognizance, ahead of others within their domains of water, of the advantages that web-based solutions and the associated benefits can bring. This trend marks the increasing adoption of the transformable power that Internet-driven software solutions can have across many sectors, including that of water management. The better management organizations can adopt these innovations to make operations work for themselves and allow better service delivery and stakeholder interaction. As an example, implementing devices of the Internet of things will allow real-time monitoring and managing the water resource will give insights that are measurable and can be put into action: better decision making and resource allocation. Climate variability is among the factors that contributes to the effect of increased demand for water, hence presenting a situation where only sophisticated approaches in the management of water will guarantee sustainability in the use of this natural resource. In order to ensure availability and sustainability, such systems are developed based on advanced optimization techniques, whereby the main objective would be minimization of wastes while maximizing usage of available resources. These range from predictive analytics aimed at forecasting demand to automation systems that would ensure greater effectiveness in controlling the distribution networks.

Water resource optimization occurs in a number of ingenious ways, figuring among

which is the proactive identification and reporting of leaks. Such a vigilant will waste minimal water and is an example of how technologies can partner with communities in a very innovative way that will maximize the use of the little water available. Additionally, community engagement platforms encourage public participation in water conservation efforts, fostering a culture of sustainability and collective responsibility.

With this in mind, we conceived "WaterWise", a collaborative web application designed for optimizing water usage.WaterWise is more than just an application: it symbolizes a collective endeavor where individuals and societies come together to have a tangible impact on our water resources. It allows the user to play their role in the proper maintenance of this liquid resource, a guarantee that the precious liquid can be around for generations to come. In extension, by application, this testifies to the fact that collaboration and innovation can help solve, or at least put the focus on, one of the most pressing issues that we should be facing, such as water sustainability. WaterWise, through its user-friendly interface and powerful functionality, gives the tools to its users needed to proactively manage their water consumption in an easy and effective way, helping to present and secure a better, sustainable, and more resilient future for everyone.

Chapter I

Related works

I.1 Definition of collaborative application

Collaborative application: A collaborative application refers to software or digital tools designed to enable users to access, contribute, share, and leverage open data sets in a collaborative and transparent manner. Its significance lies in its capacity to deliver information to users without constraints, ensuring unrestricted access for a diverse audience. This inclusivity makes the application a valuable resource accessible to users of all types, enhancing its utility and broadening its impact. Crucially, these applications are inherently reliant on the active participation of users who provide the necessary data, emphasizing the collaborative nature that drives their functionality, providing a platform where users can benefit from shared resources and knowledge.

I.2 Existing collaborative applications

Collaborative applications have become widespread in many domains over the past few years due to their effectiveness and usefulness. Notable examples include:

- **Dropcountr:** Connecting people and water utilities to drive water conservation via data and engagement tools.[1]
- **Aqueduct Water Risk Atlas:** Maps and evaluates current as all as future water risks across locations globally.[2]
- **mWater:** A platform to map and share data on water, sanitation, and health using mobile devices.[3]
- **River Watch:** A community-driven platform for surveillance and reporting rivers biology along with pollution problems.[4]

- **Clean Water Hub:** an online platform connecting the dots for tracking, reporting, and advocacy for clean water initiatives.[5]
- **EarthEcho Water Challenge:** An international program that teaches people to analyze and defend local water sources with citizen science.[6]
- **Waterkeeper Alliance:** Supports a global network of advocates focused on defending clean water in communities through monitoring and reporting.[7]

In our work, we have decided to focus on the applications mentioned above as they are highly relevant to our project.

I.2.1 WATER REPORTER

Figure I.1: WATER REPORTER Logo.[8]

I.2.1.1 Definition

Water Reporter is an online community of individuals and organizations working to map and protect their local water resources.

This mobile application was created to crowd source geo-referenced images of a waterway as well as report water quality threats to growing network of restoration professionals.[8]

I.2.1.2 Functionalities

Featuring four specific functions:

- *Reporting:* Users can submit observations, including photos and descriptions, of water-related issues such as pollution.
- *Mapping:* The application provides a map interface where users can view reported observations geographically.
- *Data Visualization:* Water Reporter offers tools to visualize reported data over time.
- *Community Engagement:* The platform fosters community engagement by allowing users to interact with each other, discuss issues, share insights, and collaborate on solutions.

I.2.1.3 Objective

The primary goal of Water Reporter is to democratize water monitoring and environmental stewardship by empowering individuals, citizen scientists, advocacy groups, and government agencies to actively participate in the protection and restoration of water resources.

By harnessing the collective efforts of a diverse community of users, Water Reporter aims to increase transparency, accountability, and action around water-related issues, ultimately leading to improved water quality, habitat conservation, and sustainable management of freshwater ecosystems.

I.2.1.4 Results

- Enhanced public awareness of water quality issues.
- Increased community involvement in water monitoring.
- Better data collection for water quality management.

I.2.2 Uisce Éireann

Figure I.2: Uisce Éireann Logo.[9]

I.2.2.1 Definition

The application serves as an online platform provided by Irish Water, the national water utility company in Ireland, designed for the reporting and management of leaks specifically on public property.

I.2.2.2 Functionalities

- *Reporting Leaks:* The primary functionality of the application is to allow users to report leaks on public property to Irish Water.

- *Contact Information:* The page likely provides contact information such as phone numbers, email addresses, or online forms through which users can report leaks. This ensures that individuals can easily notify the utility about any issues they encounter.

- *Location Identification:* The application include a geographical map to help users accurately identify the location of the leak they are reporting.

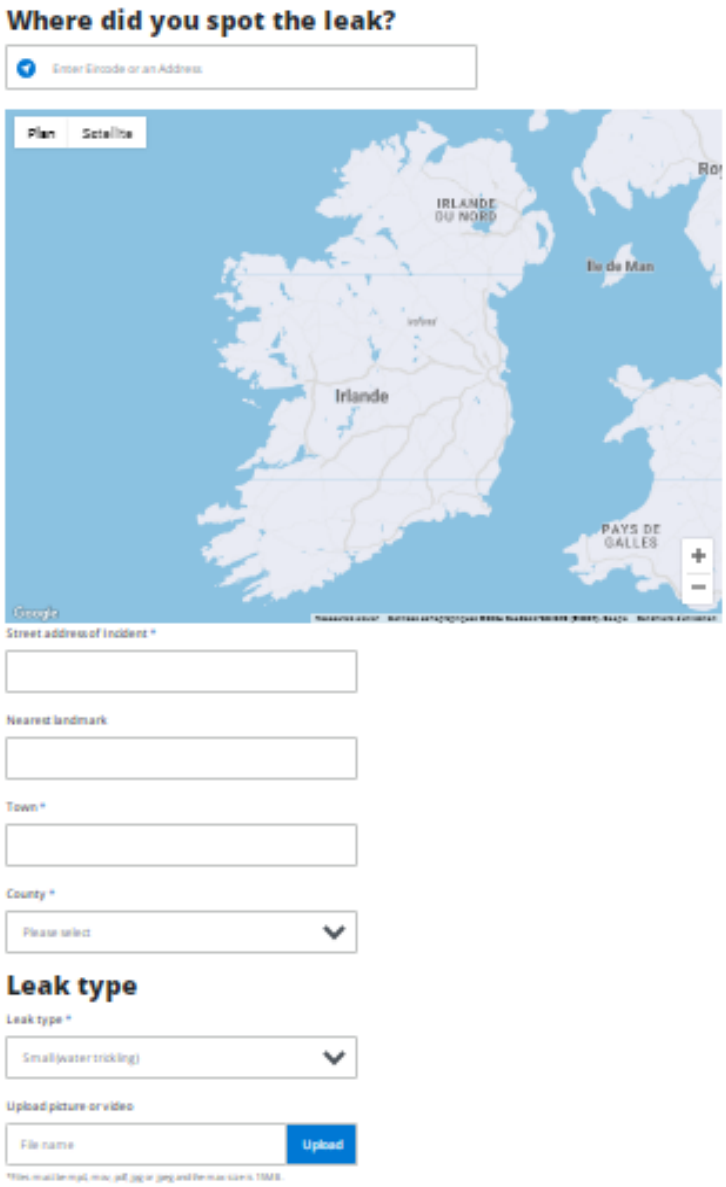

Figure I.3: Uisce Éireann FORM[9].

I.2.3 Global Water Watch

Figure I.4: Global Water Watch Logo.[10]

I.2.3.1 Definition

Global Water Watch is looking forward to building a vast body of people with knowledge about this natural resource, who also care about it so much that they can actually stop its destruction for ever since. This means that if we give all citizens enough information and power, then there would be a chance for nobody else to cash in on this vital necessity and get away scot free when others march on empty-handed at the same time! This includes educating individuals from various walks of life through partnerships or training programs as well as developing new technology such as visualization models; things that have never been done before by any one organization in the world.

I.2.3.2 Functionalities

Featuring four specific functions:

1. **Data Collection Tools:**
    - Provides standardized water quality monitoring kits for parameters like pH, dissolved oxygen, turbidity, temperature, and more.
    - Offers mobile and web-based applications for recording and uploading data.
2. **Training and Support:**
    - Conducts training workshops for community members and organizations on how to monitor water quality and use the provided tools.
    - Offers ongoing technical support and resources for volunteers.
3. **Data Management and Visualization:**
    - Maintains an online database where users can store, access, and manage their water quality data.

- Features mapping tools for visualizing spatial distribution of water quality data.
- Provides analytical tools for interpreting data and identifying trends.

4. **Community Engagement:**
   - Facilitates the formation of local monitoring groups to foster collaboration and collective action.
   - Promotes public education and awareness through outreach programs and educational materials.
5. **Collaboration and Networking:**
   - Encourages partnerships with local governments, academic institutions, and other stakeholders.
   - Integrates community-collected data with larger monitoring networks and databases to support regional and global water quality initiatives.

I.2.3.3 Objectives

- *Empower Communities:* Equip local communities with the knowledge, skills, and tools needed to monitor and protect their water resources.
- *Enhance Data Quality:* Provide reliable, high-quality data on water quality to inform decision-making and resource management.
- *Foster Collaboration:* Build a network of engaged citizens, organizations, and stakeholders working together to improve water quality.
- *Raise Awareness:* Increase public understanding of water quality issues and the importance of protecting water resources.
- *Support Sustainable Management:* Promote sustainable water resource management practices based on community-collected data and collaborative efforts.

I.2.3.4 Results

- *Improved Water Quality Monitoring:* Enhanced capacity for local communities to conduct regular and accurate water quality assessments.
- *Increased Public Participation:* Greater involvement of citizens in water resource management and environmental protection efforts.

- *Data-Driven Decision Making:* Availability of high-quality data to support informed decisions and policy development for water management.
- *Stronger Community Networks:* Formation of active and collaborative networks focused on water quality improvement and sustainability.
- *Heightened Awareness and Advocacy:* Increased public awareness and advocacy for clean and healthy water bodies.

I.2.4 Global Water Forum

Figure I.5: Global Water Forum Logo.[11]

I.2.4.1 Definition

is an online resource and community platform dedicated to addressing global water challenges. It aims to provide a space for sharing research, ideas, and discussions about water management, policy, and sustainability.

I.2.4.2 Functionalities

- *Articles and Research Papers:* A repository of articles and research papers on various topics related to water management, policy, and sustainability.
- *Opinion Pieces:* Space for experts to share their perspectives on current water issues and debates.
- *Discussion Forums:* Online forums where members can engage in discussions, ask questions, and share insights on water-related topics.
- *Newsletter:* Subscription-based newsletter providing curated content and updates on global water issues.
- *Resource Library:* A collection of resources including reports, guidelines, and tools for water management.

I.2.4.3 Objectives

- *Disseminate Knowledge:* Share high-quality research and information about global water issues.
- *Facilitate Dialogue:* Encourage discussions and exchanges of ideas among water professionals, researchers, policymakers, and the public.
- *Promote Sustainable Water Management:* Advocate for policies and practices that ensure the sustainable use and management of water resources.
- *Support Education and Awareness:* Raise awareness about water challenges and educate stakeholders on effective solutions.
- *Foster Collaboration:* Provide a platform for collaboration among individuals and organizations working on water-related issues.

I.2.4.4 Results

- *Increased Awareness:* Greater public and professional awareness of global water challenges and solutions.
- *Enhanced Knowledge Sharing:* Improved dissemination and exchange of research and ideas among the water community.
- *Policy Influence:* Contributions to the development and implementation of sustainable water policies through shared insights and recommendations.
- *Educational Impact:* Support for education initiatives by providing accessible resources and information on water management.
- *Collaborative Projects:* Facilitation of collaborative projects and partnerships among water professionals and organizations.

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Chapter II

Analysis and Design

II.1 Introduction to UML

II.1.1 UML definition

UML stands for Unified Modeling Language, is a standardized modeling language that comprises a cohesive set of diagrams. Its purpose is to offer a simple and universally accepted method for visualizing a software system's inherent architectural properties, while also facilitating business modeling and applications beyond software. UML encapsulates a range of established engineering practices, particularly beneficial for modeling large and complex systems. Central to object-oriented software development, UML predominantly utilizes graphical notations to illustrate software project designs. Utilizing UML aids in effective communication within project teams, facilitates design exploration, and validates software architectural decisions.[1]

II.1.2 UML diagrams

The UML uses elements and combines them in different ways to form diagrams, which are essential for providing a visual representation of processes, offering insight into the entire flow. Furthermore, 14 sub-types of UML diagrams are divided into two groups:

II.1.2.0.1 Structure Diagrams: show the static structure of the system and its parts on different abstraction and implementation levels:

- ***Class Diagram:*** describes the types of objects in the system and various kinds of static relationships which exist between them.
- ***Component Diagram:*** it describes the flow of control of the target system, such as the exploring complex business rules and operations, describing the use case also the business process.

- ***Deployment Diagram:*** shows architecture of the system as deployment of software artifacts.
- ***Object Diagram:*** shows a snapshot of the detailed state of a system at a point in time.
- ***Package Diagram:*** shows packages and dependencies between the packages.
- ***Composite Structure Diagram:*** shows the internal structure of a class and the collaborations that this structure makes possible.
- ***Profile Diagram:*** enables to create domain and platform specific stereotypes and define the relationships between them.

II.1.2.0.2 Behavior diagrams: show the dynamic behavior of the objects in a system, which can be described as a series of changes to the system over time:

- ***Use Case Diagram:*** describes a system's functional requirements in terms of use cases.
- ***Activity Diagram:*** graphical representations of workflows of step wise activities and actions with support for choice, iteration and concurrency.
- ***State Machine Diagram:*** describe the behavior of systems which is based on the concept of state diagrams.
- ***Sequence Diagram:*** shows how the objects interact with others in a particular scenario of a use case.
- ***Communication Diagram:*** used to model the dynamic behavior of the use case.
- ***Interaction Overview Diagram: :*** focuses on the overview of the flow of control of the interactions.
- ***Timing Diagram:*** shows the behavior of the object(s) in a given period of time.

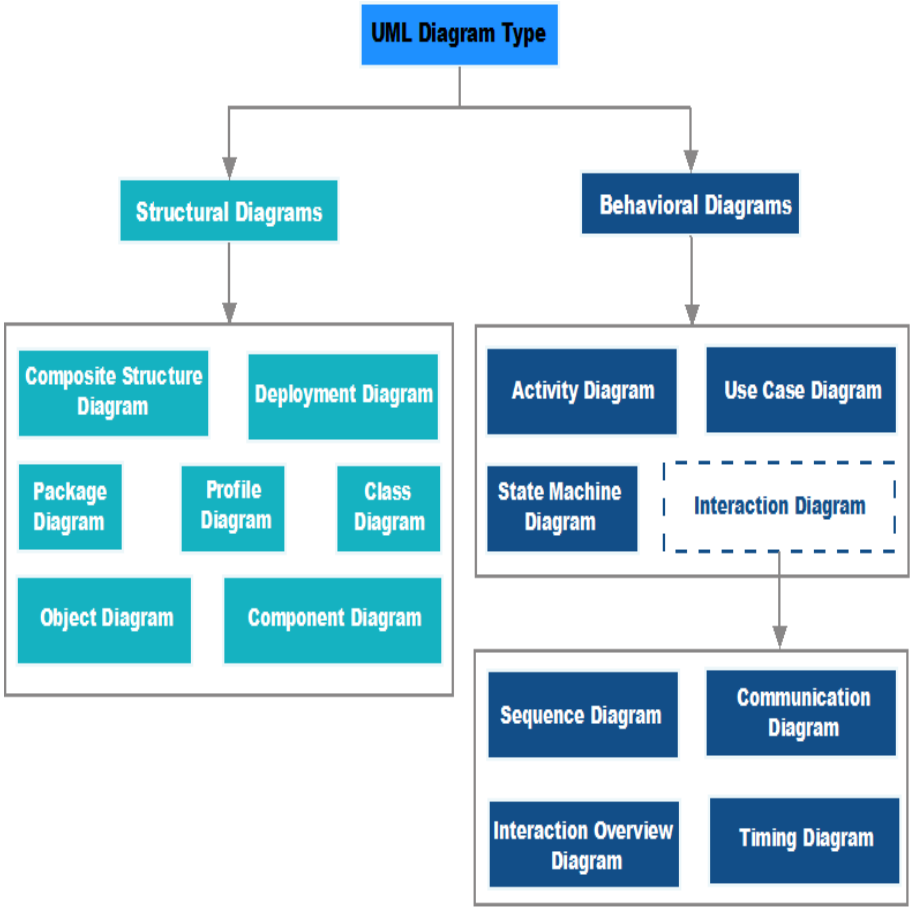


Figure II.1: UML diagram Type.

II.2 Analysis of current situation

We have observed a prevalent trend in water administration applications, they primarily serve bill payments, neglecting crucial functionalities like leak reporting. Our analysis underscores the urgency of prioritizing these overlooked aspects for enhanced efficiency and service quality. The genesis of our collaborative application dedicated to the broader community, was inspired by the need to address these gaps and by a myriad of problems, with the majority stemming from:

- Observing a visible water leak without a straightforward avenue for reporting it.
- Encountering a water leak or any water-related issue without the luxury of time to summon a technician, or perhaps the problem does not warrant expert intervention but still demands a solution.
- Lacking a convenient method to detect concealed water sources or springs.

II.3 Requirements Specification

Software Requirement Specification is a complete specification and description of requirements of the software that need to be fulfilled for the successful development of the software system. These requirements can be functional as well as non-functional depending upon the type of requirement. The interaction between different customers and contractors is done because it is necessary to fully understand the needs of customers.[2]

II.3.1 Requirements Identification

In this section, our paramount concern revolves around addressing the requirements of the users, both in terms of functionality and non-functional aspects, to ensure the creation of an exceptional website that fulfills the following stringent requirements:

II.3.1.1 Functional Requirements:

functional requirements define the basic demands of the end user that are to be met by the system. All these functionalities need to be necessarily incorporated into the system. To achieve this, our system will:

- Enable users to :
  - Report water leaks.
  - Add and reveal water sources.
  - Pay their bills and display the unpaid ones.
  - Have a forum space where they can discuss their water issues.
- Enable technicians to:
  - Display assigned tasks.
  - Reject tasks.
  - Validate Completed tasks.
- Allow the administrator to manage the entire application.

II.3.1.2 Non Functional Requirements:

non functional requirements define the criteria that can be used to judge the operation of the system. They represents the behavior and performance that the software must have in order to guarantee the quality of the execution of functional requirements.[3]

- ***Compatibility and portability:*** Compatibility with all web browsers and various devices such as PCs, iPads, or mobile phones.

- ***Security:*** Prioritize data protection to maintain user trust and integrity.
- ***Reliability:*** The application must operate consistently, without errors for user satisfaction.
- ***Performance:*** Optimize responsiveness and efficiency for a smooth user experience.
- ***Flexibility:*** Offer customised features to adapt to diverse user needs and preferences.

II.3.2 Actors Identification

Definition: an actor represents a set of roles played by a process, hardware device, human user, or any external entity that interacts directly with the system.

In the following, we present the main actors involved in our application:

- ***Visitor:*** defined as any individual accessing the website without authentication. However, their browsing privileges are significantly restricted.
- ***User:*** encompasses individuals who register and log in to the application. These members have unrestricted access to all application functionalities.
- ***Technician:*** refers any individual or team tasked with resolving maintenance issues.
- ***Administrators:*** oversees and manages the application, with exclusive access to their own space. They play a central role in controlling and maintaining the application's operations.

From the actors outlined above, we construct the following context diagram:

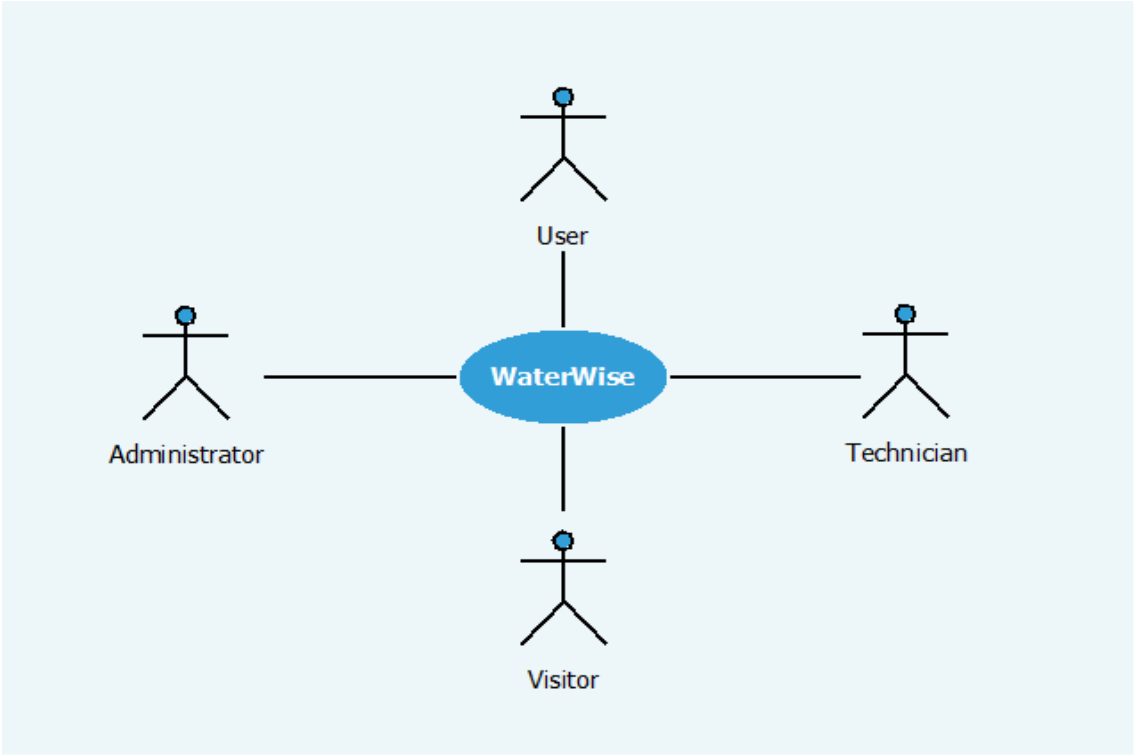


Figure II.2: Context Diagram.

II.3.3 Tasks Specification

Definition: a task comprises a distinct set of functions accessible by a precisely defined actor.

Each of the actors we previously defined performs a certain number of tasks, which we summarize in the following table:

Actors	**Tasks**
Visitor	**T1**: Accessing the application.
	T2: Navigating through the application.
	T3: Reporting water leaks.
	T4: Add a water source.
	T5: Searching for water sources.
	T6: View posts and their location on a geographical map.
	T7: Sending the administrator a message.
	T8: Creating an account (signing up as a user).
User	**T1**: Authenticate.

	T2: Recover forgotten password.
	T3: Save login information.
	T4: Navigating through the application.
	T5: View profile information.
	T6: Edit profile information.
	T7: Request account deletion.
	T8: Search for a water source post.
	T9: Display the searched water source position on the map.
	T10: Add a new post.
	T11: View owned posts.
	T12: Edit a post.
	T13: Delete a post.
	T14: View added posts.
	T15: Comment on a post.
	T16: Like a post.
	T17: Add post to favorites.
	T18: Display favorite posts.
	T19: View favorite post position on the map.
	T20: Remove a post from favorites.
	T21: Access the forum.
	T22: View owned topics.
	T23: Delete a topic.
	T24: View published topics.
	T25: Publish a new topic.
	T26: Answer a topic.
	T27: Pay bills.
	T28: Request unpaid bills.
	T29: Display consumption graph.
	T30: Logout.
Administrator	**T1**: Authenticate.
	T2: Edit profile.
	T3: Change password.
	T4: Display Messages.
	T5: Delete a message.

	T6: Display water reports.
	T7: Assign reports to technicians.
	T8: Validate a technician's work.
	T9: Reject a technician's work.
	T10: Reassign work to another technician.
	T11: Add a new user.
	T12: Display the list of members.
	T13: Modify a member.
	T14: Delete a member.
	T15: Display the list of administrators.
	T16: Display the list of technicians.
	T17: Add a technician.
	T18: Display published topics.
	T19: Delete a topic.
	T20: Display water source posts.
	T21: Delete a water source post.
	T22: Billing management.
	T23: Logout.
Technician	**T1**: Authenticate.
	T2: Edit profile.
	T3: Change password.
	T4: Add phone number.
	T5: Display assigned reports.
	T6: Accept the task.
	T7: Reject the task.
	T8: Display reassigned reports.
	T9: Logout.

Table II.1: Tasks Specification

II.3.4 Scenario Specification

Definition: a scenario is a sequence of specific actions that demonstrate a particular behavior. It can be thought of as a logical sequence of actions and events that occur from the beginning to the end of a use case.

Each of the tasks performed by the actors described above will be detailed by a set of scenarios as follows:

Actors	Tasks	Scenario
Visitor	**T1**: Accessing the application.	**S1**: Enter the website's URL into the browser.
	T2: Navigating through the application.	**S1**: View the links and the text appearing on the homepage.
	T3: Reporting water leaks.	**S1**: Click on the link "Publish" in the navigation bar. **S2**: Fill out the form by entering the name of the location, latitude, and longitude (or automatically obtaining them by clicking on the map), and specify the type as 'water issue' adding an optional photo and description. **S3**: Click on "Share" button.
	T4: Add a water source.	**S1**: Click on the link "Publish" in the navigation bar. **S2**: Fill out the form by entering the name of the location, latitude, and longitude (or automatically obtaining them by clicking on the map), and specify the type as 'water source' adding an optional photo and description. **S3**: Click on "Share" button.
	T5: Searching for water sources.	**S1**: Click on the "Search bar" in the navigation bar. **S2**: Enter text like a place name. **S3**: Click on search icon to search.
	T6: View posts and their location on a geographical map.	**S1**: View all posts on the geographic map. **S2**: Select a pin to view the details of the post.

	T7: Sending the administrator a message.	**S1**: Click on the link "Contact" in the navigation bar (Scroll down to the contact section). **S2**: Fill out the form by entering name, email, phone number, subject and the message. **S3**: Send the message by clicking on “Send Message” button.
	T8: Creating an account (signing up as a user).	**S1**: Click the "sign up" link. **S2**: Fill out the registration form. **S3**: Click on "Signup” button.
User	**T1**: Authenticate.	**S1**: Click on the "login" link. **S2**: Fill out the login form (with an email and a password). **S3**: Click on the "Login" button.
	T2: Recover forgotten password.	**S1**: Click on the "Forgot password" link on the login page. **S2**: Provide an email address. **S3**: Click on the link sent to the email. **S4**: Enter a new password and confirm.
	T3: Save login information.	**S1**: Click on "Remember me" Checkbox on the login page.
	T4: Navigating through the application.	**S1**: Access all functionalities.
	T5: View profile information.	**S1**: View the profile on the homepage. **S2**: Click on the "Edit Profile" link and view the profile information.
	T6: Edit profile information.	**S1**: Click on the "Edit Profile" link. **S2**: Fill out the form with the desired information to be modified or added. **S3**: Validate changes by clicking on “Save” button.

T7: Request account deletion.	**S1**: Click on the profile picture on the navigation bar to access the dropdown menu. **S2**: Click on the "Delete Account" link. **S3**: Confirm by clicking on “yes”.
T8: Search for a water source post.	**S1**: Click on the "Search bar" in the navigation bar. **S2**: Enter text like a place name. **S3**: Click on search icon to search.
T9: Display the searched water source position on the map.	**S1**: Click on the "Search bar" in the navigation bar. **S2**: Enter text like a place name. **S3**: Click on search icon to search. **S4**: Click on “View in map” button.
T10: Add a new post.	**S1**: Click on the "Upload" button in the navigation bar. **S2**: Fill out the form by entering the name of the location, latitude, and longitude (or automatically obtaining them by clicking on the map), and specify the type adding an optional photo and description. **S3**: Click on "Share" button.
T11: View owned posts.	**S1**: Scroll in profile.
T12: Edit a post.	**S1**: Click on the three dots on the right to display the drop down menu. **S2**: Click on “Edit Post” button. **S3**: Save by a click on “Save”.
T13: Delete a post.	**S1**: Click on the three dots on the right to display the drop down menu. **S2**: Click on “Delete Post” button. **S3**: Confirm by a click on “Save”.

T14: View added posts.	**S1**: View all posts on the geographic map displayed on homepage. **S2**: Select a pin to view the details of the post.
T15: Comment on a post.	**S1**: Click on the message icon link under the post. **S2**: Fill out the form. **S3**: Click on "Share" icon.
T16: Like a post.	**S1**: Click on hand icon under the post.
T17: Add a post to favorites.	**S1**: Click on “Delete” button.
T18: Display favorite posts.	**S1**: Click on the profile picture on the navigation bar to access the dropdown menu. **S2**: Click on the "Favorites" link.
T19: View favorite post position on the map.	**S1**: Click on “View in map” button.
T20: Remove a post from favorites.	**S1**: Click on “Delete from favorites” button.
T21: Access the forum.	**S1**: Click on the "Forum" link in the navigation bar.
T22: View owned topics.	**S1**: Click on the "Forum" link in the navigation bar. **S2**: Click on the title of your topic in the container “My Forum”.
T23: Delete a topic.	**S1**: Click on the "Forum" link in the navigation bar. **S2**: Click on the trash icon of your topic in the container “My Forum”.
T24: View published topics.	**S1**: Click on the "Forum" link in the navigation bar. **S2**: Click on the title of the topic in the container “Forum Space”.

T25: Publish a new topic.	**S1**: Click on the "Forum" link in the navigation bar. **S2**: Click on the "Create Forum" link. **S3**: Fill out the form by entering the title of the topic, description and adding an optional photo.
T26: Answer a topic.	**S1**: Click on the title of the topic. **S2**: Fill out the fixed form below by entering the answer and an optional photo. **S3**: Click on the share icon.
T27: Pay bills.	**S1**: Click on the profile picture on the navigation bar to access the dropdown menu. **S2**: Click on the "Pay Bills" link. **S3**: The user will be redirected to the official link for water bill payment in Algeria.
T28: Request unpaid bills.	**S1**: Click on "Bill" link in the navigation bar. **S2**: Click on the "Enter index" link and fill in the form. **S3**: Click on the "Unpaid Bills" link.
T29: Display consumption graph.	**S1**: Click on "Bill" link in the navigation bar. **S2**: Click on the "Consumption Graph" link.
T30: Logout.	**S1**: Click on the profile picture on the navigation bar to access the dropdown menu. **S2**: Click on the "Logout" link.

Administrator	**T1**: Authenticate.	**S1**: Fill in the login form (with a fullname and a password). **S2**: Select the role “Administrator”. **S3**: Click on the "Login" button.
	T2: Edit profile.	**S1**: Click on the "Edit Profile" link in the navigation bar. **S2**: Fill in the form.
	T3: Change password.	**S1**: Click on the "Change password" link in the navigation bar. **S2**: Fill in the form.
	T4: Display messages.	**S1**: Click on the "Messages" link in the navigation bar.
	T5: Delete a message.	**S1**: Click on the "Delete" button.
	T6: Display water reports.	**S1**: Click on the link cards: - Total reports. - Processing reports. - Processed reports.
	T7: Assign reports to technicians.	**S1**: Click on the link “Total reports”. **S2**: Select a technician. **S3**: Click on “Submit” button.
	T8: Validate a technician’s work.	**S1**: Click on the link “Processed reports”. **S2**: Click on “Approve” button.
	T9: Reject a technician’s work.	**S1**: Click on the link “Processed reports”. **S2**: Click on “Reject” button.
	T10: Reassign work to another technician.	**S1**: Click on the link “Processed reports”. **S2**: Click on “Shift” button.
	T11: Add a new user.	**S1**: Click on the link “Add new user”.
	T12: Display the list of members.	**S1**: Click on the link “Users”.
	T13: Modify a member.	**S1**: Click on the link “Users”. **S2**: Click on “Modify” button.

	T14: Delete a member.	**S1**: Click on the link “Users”. **S2**: Click on “Delete” button.
	T15: Display the list of administrators.	**S1**: Click on the link “Admins”.
	T16: Display the list of technicians.	**S1**: Click on the link “Technicians”.
	T17: Add a technician.	**S1**: Click on the link “Add a technician”.
	T18: Display published topics.	**S1**: Click on the link “Subjects”.
	T19: Delete a topic.	**S1**: Click on the link “Subjects”. **S2**: Click on “Delete” button.
	T20: Display water source posts.	**S1**: Click on the link “Water source posts”.
	T21: Delete a water source post.	**S1**: Click on the link “Water source posts”. **S2**: Click on “Delete” button.
	T22: Billing management.	**S1**: Click on “Bills” link.
	T23: Logout.	**S1**: Click on the logout icon link.
Technician	**T1**: Authenticate.	**S1**: Fill in the login form (with a fullname and a password). **S2**: Select the role “Technician”. **S3**: Click on the "Login" button.
	T2: Edit profile.	**S1**: Click on the link “Edit profile” in the navigation bar.
	T3: Change password.	**S1**: Click on the link “Change Password”.
	T4: Add phone number.	**S1**: Click on the link “Add password”.
	T5: Display assigned reports.	**S1**: Click on the link “Assigned reports”. **S2**: Click on “Accept” button.
	T6: Accept the task.	**S1**: Click on the link “Assigned reports”. **S2**: Click on “Accept” button.

T7: Reject the task.	**S1**: Click on the link "Assigned reports" on dashboard. **S2**: Click on "Reject" button. **S3**: Fill out the form by entering the reason of the rejection. **S4**: Click on "Submit" button.
T8: Display reassigned reports.	**S1**: Click on the link "Reassigned reports" on dashboard.
T9: Logout.	**S1**: Click on the logout icon link.

Table II.2: Scenario Specification

II.3.5 Use Case Diagram

Definition: use case diagrams in UML outline a system's behavior and requirements, focusing on its functions, interactions with users (actors), and scope. They capture what the system does and how actors utilize it, without detailing internal operations. These diagrams are developed early in projects to define system scope and are used throughout development as reference points. They can represent a whole system or its components and aid in communication among stakeholders.

1. **Association:** represents the relationship between an actor and a use case, showing actor involvement.

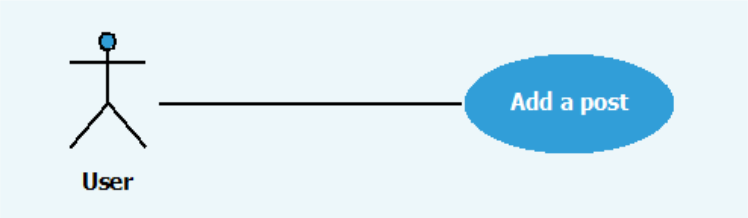


Figure II.3: Association Relation.

2. **Inclusion:** defines identical behavior between source and destination use cases, enabling behavior decomposition.

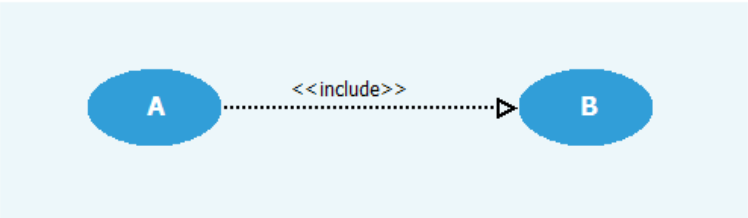


Figure II.4: Inclusion Relation.

3. **Extension:** indicates that one use case extends another, adding behavior with optional conditions.

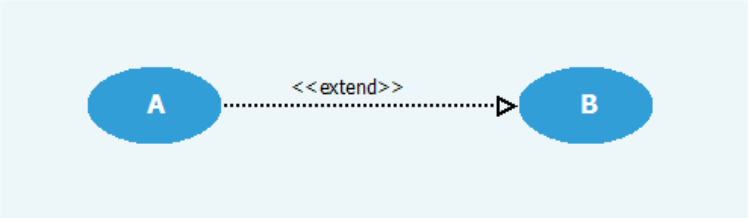


Figure II.5: Extension Relation.

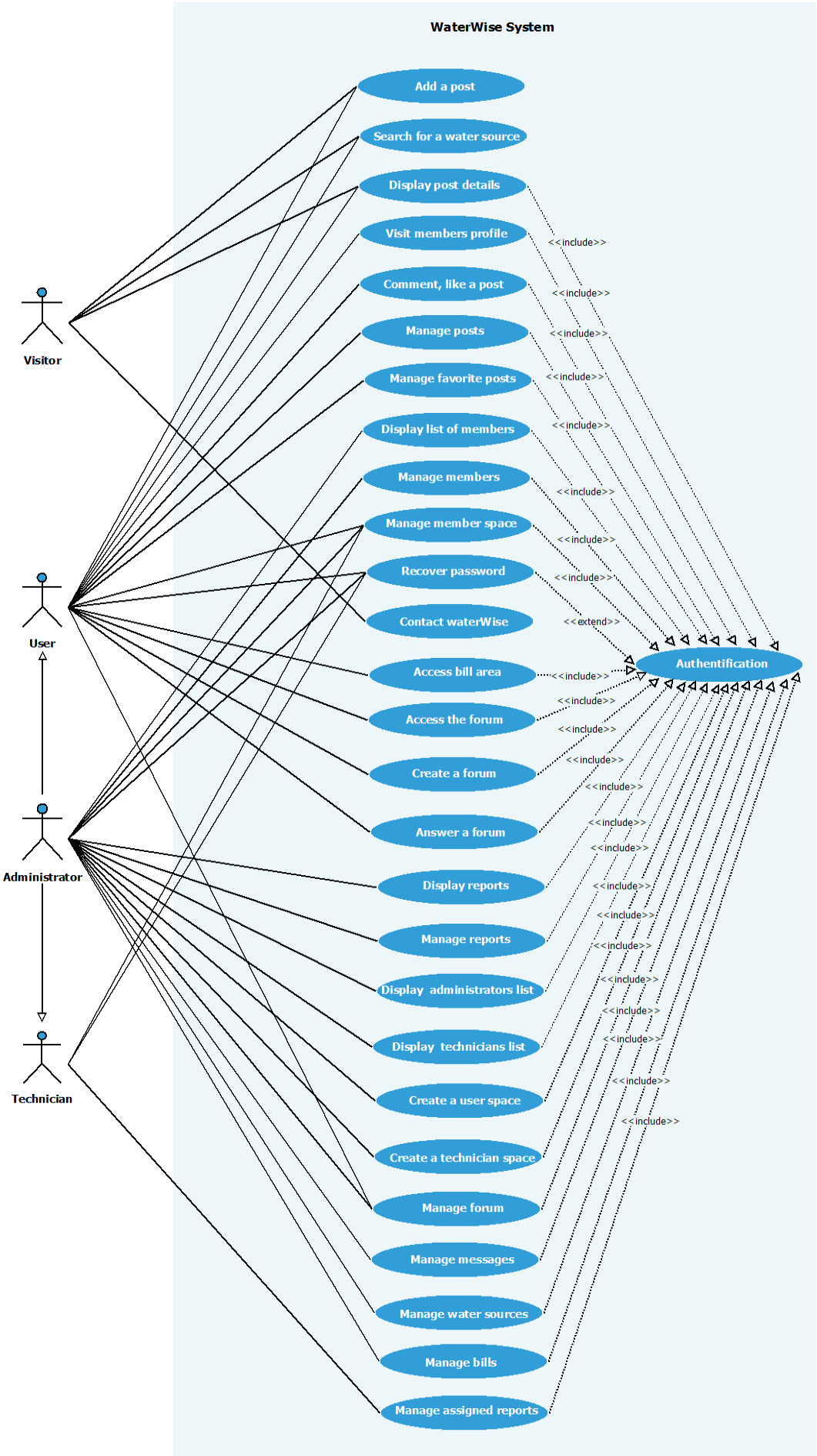


Figure II.6: Global use case diagram.

The subsequent figures demonstrate the use case diagram of all actors depicted in the preceding diagram:

- **Visitor use case diagram:**

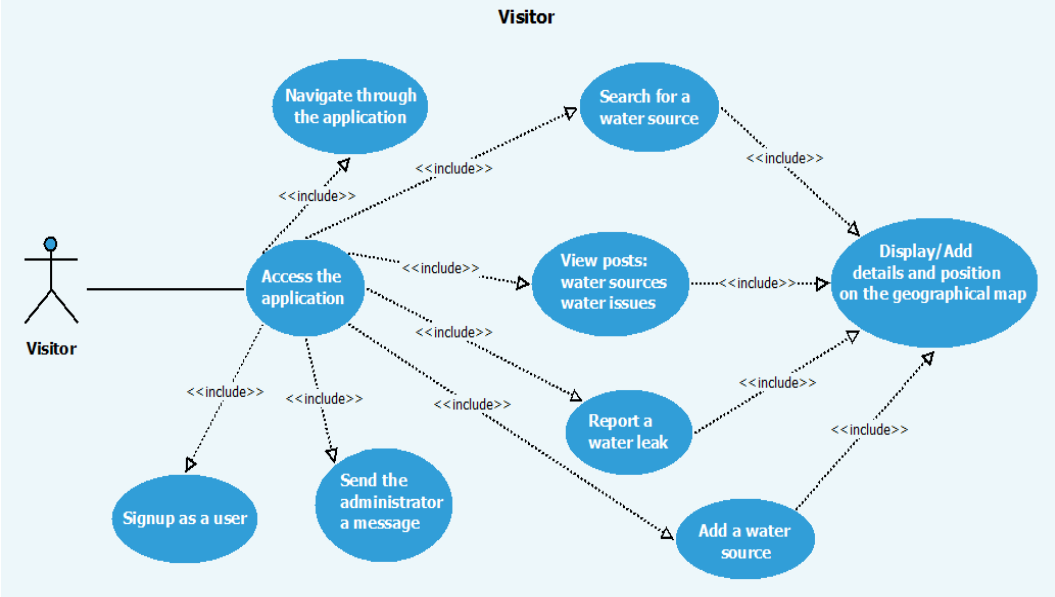


Figure II.7: Visitor use case diagram.

- **User use case diagram:**

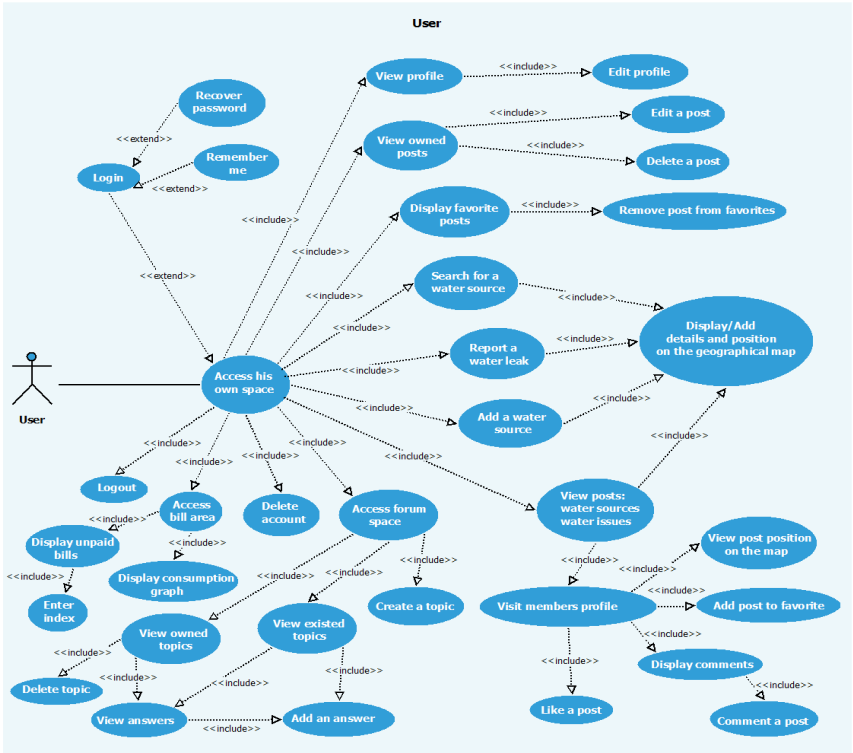


Figure II.8: User use case diagram.

- **Administrator use case diagram:**

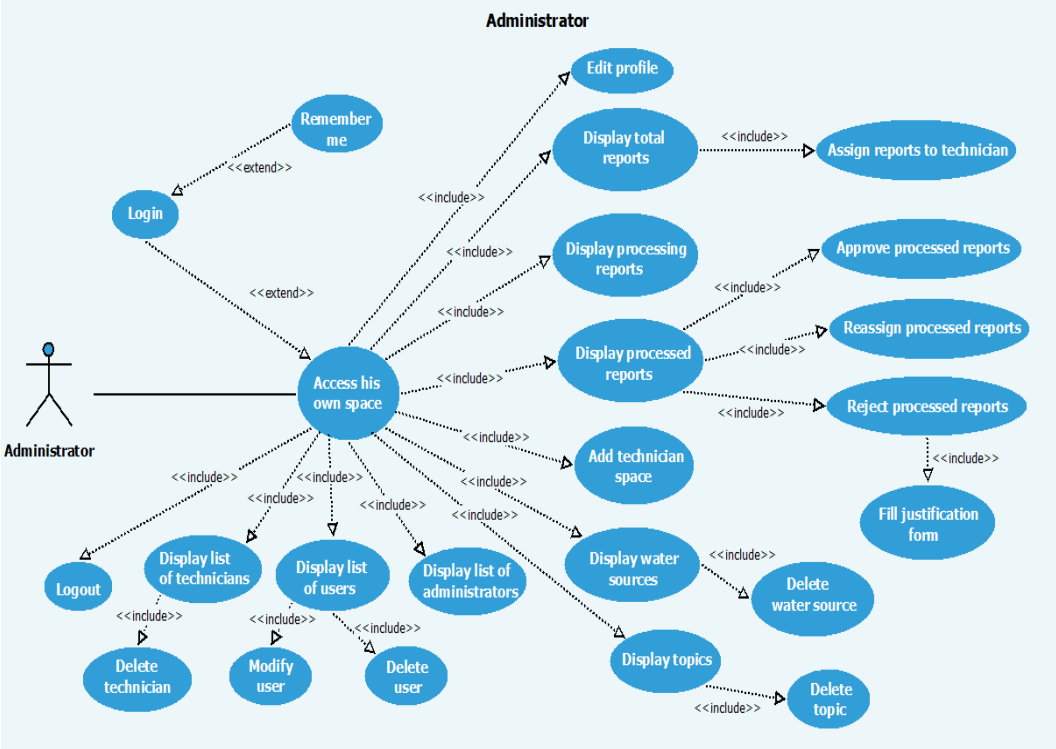


Figure II.9: Administrator use case diagram.

- **Technician use case diagram:**

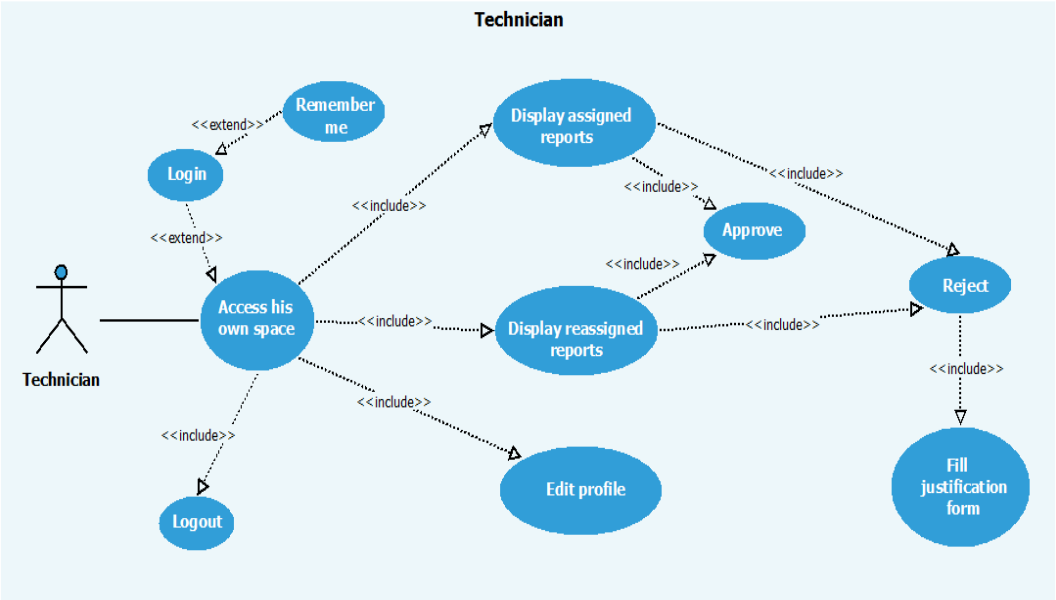


Figure II.10: Technician use case diagram.

II.4 Class Diagram

Definition: The class diagram is one of the most useful types of UML diagram, because it clearly describes the internal structure of a particular system by modeling its classes, attributes, operations and the relationships and the relationships between its objects.

This diagram is part of the static part of UML, as the temporal factor is not taken into account in the system's behavior.

The following class diagram clarifies our application's various classes and the relationships between them.

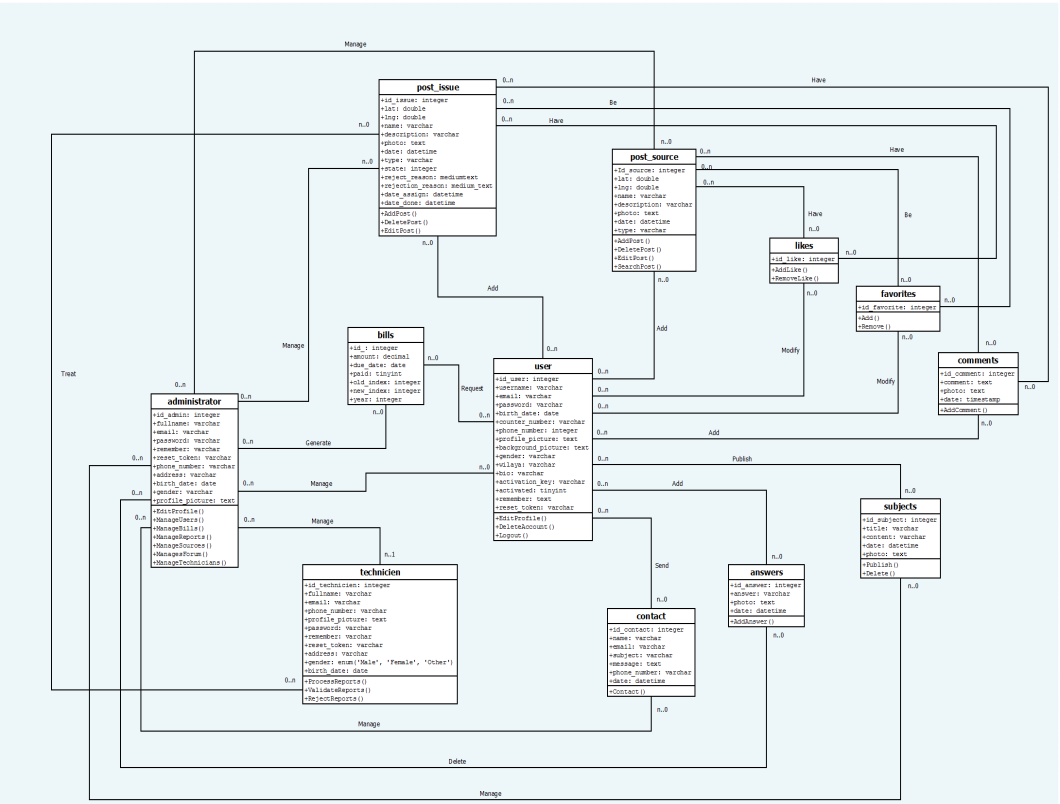


Figure II.11: Class Diagram

II.5 Relational Model

Definition: the relational model is a way of representing the relationships existing between several items of information, and of ordering them.

From the preceding class diagram, we can make a transition to the relational model

by respecting the transition rules.

- **user** (id_user, username, email, password, birth_date, counter_number, phone_number, profile_picture, background_picture, gender, wilaya, bio, activation_key, activated, remember, reset_token, id_admin*)
- **administrator** (id_admin, fullname, email, password, remember, reset_token, phone_number, address, birth_date, gender, profile_picture)
- **technicien** (id_admin, fullname, email, phone_number, profile_picture, password, remember, reset_token, address, gender, birth_date, id_admin*)
- **contact** (id_contact, name, email, subject, message, phone_number, date)
- **post_issue** (id_issue, lat, lng, name, description, photo, date, type, state, reject_reason, rejection_reason, date_assign, date_done, id_user*, id_technicien*)
- **post_source** (id_source, lat, lng, name, description, photo, date, type, id_user*)
- **bills** (id_bill, amount, due_date, paid, year, old_index, new_index, id_user*)
- **subjects** (id_subject, title, content, date, photo, id_user*)
- **answers** (id_answer, photo, answer, date, id_subject*, id_user*)
- **comments** (id_comment, photo, comment, date, id_post*, id_subject*)
- **favorites** (id_favorite, id_user*, id_post*)
- **likes** (id_like, id_user*, id_post*)

References

[1] [Fowler M. UML Distilled; a brief guide to the standard object modeling language.]

[2] Software Requirement Specification (SRS) Format - GeeksforGeeks. GeeksforGeeks. https://www.geeksforgeeks.org/software-requirement-specification-srs-format/

[3] Functional and Non-Functional Requirements in Software Engineering | Board Infinity. Board Infinity. https://www.boardinfinity.com/blog/functional-and-non-functional-requirements-in-software-engineering/

Chapter III

Realization

III.1 Objectives of the application

Having identified the problems, we will now introduce the basic functionalities that we have implemented to address them:

- The application is provided to users without any associated fees or charges; it's totally free!
- The collaborative nature of the application not only harnesses the collective efforts of contributors but also assists authors in addressing various challenges.
- The application empowers users to report water leaks and unveil hidden water sources with precision, tailored to their specific geographical location, notably users can enhance their reports by adding a photo, providing further clarity and context.
- Within the website's forum, users engage in open dialogue to highlight and tackle water-related challenges, seeking solutions or contributing to existing discussions. Moreover, the forum encourages users to share relevant photos, fostering better understanding and collaboration among participants.
- The website empowers individuals to effortlessly access and promptly settle their bills.

III.2 Development Environment

In this section, we will assertively delineate the languages we have deployed to achieve the final application.

III.2.1 Customer side

III.2.1.1 HTML language

HTML, which is an abbreviated form of HTML (HyperText Markup Language), is one among the primary markup languages used for creating a website that can be viewed in web browsers. The simplicity of HTML lies in the fact that it is a markup language that helps in structuralizing and arranging page content on a logical level which may include subliminal elements e.g. images, input forms, or software programs. It provides the framework that is most commonly used with programming languages that includes CSS to allow HTML to add additional visual effects and functionality.

Figure III.1: HTML Logo.

III.2.1.2 CSS language

Cascading Style Sheets is also indicated by the same abbreviation of CSS. It was created as a markup language to allow for the main document to be written in either html or xml. It provides additional parts for the page, such as Table of Content, footnotes, page numbers, and so on. CSS renders files in one out causes the outer appearance of elements that can go on screen, on paper or even as a voice. It dictates the placement, coloring, fonts, and others aspects of visual style of webpage, letting developers separate content from the aesthetic features, thus maintain a whole website or different pages in the same style. CSS work by putting the rules that apply to the HTML elements in HTML, sending to each element what appearance and behavior it should have.

Figure III.2: CSS Logo.

III.2.1.3 JS language

JavaScript stands for a scripting and object-based language used within web pages to fulfil interactivity with visitors like animating and publishing dynamic effects. As compared to server side languages, JavaScript functions on the client side running directly within users' browsers. They let developers add interactive forms, form validation, and dynamic elements, and all these are the pillars of an excellent experience on a website.

Figure III.3: JS Logo.

III.2.1.4 JQuery

The JQuery is a fast, lightweight, and feature rich JS library that proves to be an amazing tool used for navigating through HTML documents, listening to events, animating elements, and Ajax interactions. It distills down several complicated operations into simple practices that could be effortlessly enforced with less codes. It constitutes the pinnacle and the most common JavaScript framework, that is mature and advanced proof of having maximum number of features. Some of them involve animation tools, bugs from

cascading style sheet, event handling, and so much more.

Figure III.4: JQuery Logo.

III.2.1.5 Bootstrap5

Bootstrap 5 is the version of Bootstrap Suite, which is the most popular front-end framework. Offering better accessibility to build mobile first and responsive websites and applications. It gives developers a choice of a variety of preset modules, including tables, inputs, buttons, and dropdowns, while the utility classes offer a quick bootstrap.

Figure III.5: Bootstrap5 Logo.

III.2.1.6 Font Awsome

The Font awesome, widespread and excellent icon library serves as a platform for icons to grant the user easy access to versatile and scalable vector icons and icon fonts for free.

Figure III.6: Font Awesome Logo.

III.2.1.7 cdnjs

CDNJS, a free, open-source-oriented content delivery network (CDN), provides a rich variety of JavaScript libraries and frameworks in addition to other web-related resources, including CSS frameworks, fonts, and others.

Figure III.7: cdnjs Logo.

III.2.1.8 Chart js

Chart js is a free JavaScript library for making HTML-based charts. It is one of the simplest visualization libraries for JavaScript.

Figure III.8: Chart js Logo.

III.2.1.9 Open Street Map

OpenStreetMap (OSM) is a project that involves a virtual map that is open to everyone and includes satellite imagery as well as geographic data for users globally. It provides

freedom in comparison with the “traditional” mapping services by giving the users the capability of adding, editing, and utilizing the geographic information unrestrictedly.

Figure III.9: OpenStreetMap Logo.

III.2.1.10 Leaflet

Leaflet is a JavaScript library for making maps with an interactive map seed. Using it with OpenStreetMap data implies having to deal with OSM data to develop specific maps which are easy to use and to customize for various purposes. Besides, Leaflet offers developers with a well-structured API and wide plugin world that help technicians build great and impressive map tools on the web platform.

Figure III.10: Leaflet Logo.

III.2.2 Server side

III.2.2.1 PHP language

PHP or (Hypertext Preprocessor) is a language that is widely used as a server-side language for web programming. It has proved to be very adaptable and with high acceptance, allowing web developers to make sophisticated and interactive web pages and

applications. PHP scripts, in turn, are executed on the server, ship HTML that the client's web browser will receive and interpret. Being PHP along with OOPs is among the other major benefits of this platform.

Figure III.11: PHP Logo.

III.2.2.2 SQL language

SQL (Structured Query Language) is a programming language used universally for manipulating database, speculating and developing data. The use of SQL is for the creation of a set of commands and syntax for querying, updating, inserting, and also deleting of data stored in a database managing system (DBMS).

Figure III.12: SQL Logo.

III.3 Development Tools

In this section, we will introduce the development tools employed throughout the creation of the application.

III.3.1 WampServer

The WampServer is built as a very powerful and stable Windows environment for Apache, MySQL and PHP. It is primarily used for developing and testing websites and web applications at Windows machines more precisely. This platform serves as a medium for PHP scripts exceptionally. Since the creation involves running these scripts locally, you can run tests and make modifications to these codes without any need of an Internet connection or external hosting services. Not just being a piece of a software, WampServer is rather a set of vital components, namely, Apache, an indispensable webserver, MySQL,

a strong database management system as well as PHP, an innovative server-side scripting language. Furthermore, it features phpMyAdmin, a popular tool for easy manipulation and administration of MySQL databases, making the users' work faster on database-related activities.

Figure III.13: WampServer Logo.

III.3.2 phpMyAdmin

phpMyAdmin is a graphical interface tool which is run through the web browser and used to manage MySQL databases. It is the tool via which administrators and developers can run MySQL related database tasks on them like creating databases, tables as well as executing SQL queries. phpMyAdmin is not a server and this meaning, it is just a tool that provides an ability to administer and interact with databases by using the web browser sessions.

Figure III.14: phpMyAdmin Logo.

III.3.3 MySQL

MySQL is an open-source relational database management system (RDBMS), which is not just a powerful and scalable platform to store, structure, and manage the data but also a productive and scalable environment to manage the data in a high performing way. While being arguably the most popular database system used in the world, MySQL has

gained fame for its speed and reliability properties as well as the feature of simplicity of its usage. It provides various functionalities such as multi-user support, transaction management, and powerful security systems, hence suitable for small-scale website, medium size enterprize levels and multi-national corporations. MySQL uses SQL (Structured Query Language) as a standard way a program should interact with the data.

Figure III.15: MySQL Logo.

III.3.4 phpMailer

PHPMailer has established itself as the leading open source library in the area of sending PHP email. This is the simplest and most flexible way to send emails, email messages could be attached, their content can be HTML, and the authentication can be done with SMTP, making it very friendly for PHP applications that need email messages.

Figure III.16: PHPMailer Logo.

III.3.5 Dia

Dia is an open-sourced diagramming software which could make a wider variety of diagramming including UML diagrams and electronic schematics; beside this, it offers

quite well and appropriate functionalities. Users will be able to develop flowcharts, network diagrams, entity-relationship diagrams, boxes, and arrows, and much more. Its eminence is enforced by the ease of interface and a broad catalogue of shapes that attract both professionals and amateur artisans.

Figure III.17: Dia Logo.

III.3.6 Visual studio code

Visual Studio Code (VS Code), a free and open-source code editor available for Windows, macOS, and Linux, from Microsoft. It supplies the debugger, the syntax-coloring engine, the code completion smarts, snippets, and the refactoring feature. VS Code gives out richer tools named extensions that are available for a programmer to increase its efficiency, raising its adaptability to numerous languages and development workflows. It has earned well-deserved reputation within the developer community for its speediness, customizabilities, and cutting-edge feature set.

Studio Code.png Studio Code.png

Figure III.18: Visual Studio Code Logo.

III.4 Data Base

In this section, we will present the tables of the database that underlie our application:

- ***User:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_user	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	username	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
3	email	varchar(191)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
4	password	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
5	birth_date	date			Oui	*NULL*			Modifier Supprimer Plus
6	counter_number	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
7	phone_number	varchar(128)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
8	profile_picture	text	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
9	background_picture	text	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
10	gender	varchar(128)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
11	wilaya	varchar(128)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
12	bio	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
13	activation_key	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
14	activated	tinyint(1)			Oui	0			Modifier Supprimer Plus
15	remember	text	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
16	reset_token	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
17	id_admin	int			Oui	*NULL*			Modifier Supprimer Plus

Figure III.19: Table User.

- ***Administrator:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_admin	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	fullname	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
3	email	varchar(191)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
4	password	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
5	remember	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
6	reset_token	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
7	phone_number	varchar(15)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
8	address	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
9	birth_date	date			Oui	*NULL*			Modifier Supprimer Plus
10	gender	enum('Male', 'Female', 'Other')	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
11	profile_picture	text	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus

Figure III.20: Table Administrator.

- ***Technician:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_technicien	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	fullname	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
3	email	varchar(191)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
4	phone_number	varchar(20)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
5	profile_picture	text	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
6	password	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
7	id_admin	int			Oui	*NULL*			Modifier Supprimer Plus
8	remember	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
9	reset_token	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
10	address	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
11	gender	enum('Male', 'Female', 'Other')	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
12	birth_date	date			Oui	*NULL*			Modifier Supprimer Plus

Figure III.21: Table Technician.

- ***Post Issue:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_issue	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	lat	double			Non	*Aucun(e)*			Modifier Supprimer Plus
3	lng	double			Non	*Aucun(e)*			Modifier Supprimer Plus
4	name	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
5	description	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
6	photo	text	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
7	date	datetime			Non	*Aucun(e)*			Modifier Supprimer Plus
8	type	varchar(255)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
9	state	int			Non	*Aucun(e)*			Modifier Supprimer Plus
10	reject_reason	mediumtext	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
11	rejection_reason	mediumtext	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
12	id_user	int			Oui	*NULL*			Modifier Supprimer Plus
13	id_technicien	int			Oui	*NULL*			Modifier Supprimer Plus
14	date_assign	datetime			Oui	*NULL*			Modifier Supprimer Plus
15	date_done	datetime			Oui	*NULL*			Modifier Supprimer Plus

Figure III.22: Table Post issue.

- ***Post Source:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_source	int			Non	Aucun(e)		AUTO_INCREMENT	Modifier Supprimer Plus
2	lat	double			Non	Aucun(e)			Modifier Supprimer Plus
3	lng	double			Non	Aucun(e)			Modifier Supprimer Plus
4	name	varchar(255)	utf8mb4_0900_ai_ci		Non	Aucun(e)			Modifier Supprimer Plus
5	description	varchar(255)	utf8mb4_0900_ai_ci		Non	Aucun(e)			Modifier Supprimer Plus
6	photo	text	utf8mb4_0900_ai_ci		Oui	NULL			Modifier Supprimer Plus
7	date	datetime			Non	Aucun(e)			Modifier Supprimer Plus
8	type	varchar(255)	utf8mb4_0900_ai_ci		Non	Aucun(e)			Modifier Supprimer Plus
9	id_user	int			Oui	NULL			Modifier Supprimer Plus

Figure III.23: Table Post Source.

- ***Subjects:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_subject	int			Non	Aucun(e)		AUTO_INCREMENT	Modifier Supprimer Plus
2	title	varchar(35)	utf8mb4_0900_ai_ci		Non	Aucun(e)			Modifier Supprimer Plus
3	content	varchar(10000)	utf8mb4_0900_ai_ci		Non	Aucun(e)			Modifier Supprimer Plus
4	date	datetime			Non	Aucun(e)			Modifier Supprimer Plus
5	photo	text	utf8mb4_0900_ai_ci		Non	Aucun(e)			Modifier Supprimer Plus
6	id_user	int			Non	Aucun(e)			Modifier Supprimer Plus

Figure III.24: Table Subjects.

- ***Bills:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_bill	int			Non	Aucun(e)		AUTO_INCREMENT	Modifier Supprimer Plus
2	id_user	int			Non	Aucun(e)			Modifier Supprimer Plus
3	amount	decimal(10,2)			Non	Aucun(e)			Modifier Supprimer Plus
4	due_date	date			Non	Aucun(e)			Modifier Supprimer Plus
5	paid	tinyint(1)			Non	0			Modifier Supprimer Plus
6	old_index	int			Oui	NULL			Modifier Supprimer Plus
7	new_index	int			Oui	NULL			Modifier Supprimer Plus
8	year	int			Oui	NULL			Modifier Supprimer Plus

Figure III.25: Table Bills.

- ***Contact:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_contact	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	name	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
3	email	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
4	subject	varchar(255)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
5	message	text	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
6	phone_number	varchar(20)	utf8mb4_0900_ai_ci		Oui	*NULL*			Modifier Supprimer Plus
7	date	datetime			Non	*Aucun(e)*			Modifier Supprimer Plus

Figure III.26: Table Contact.

- ***Comments:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_comment	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	id_post	int			Non	*Aucun(e)*			Modifier Supprimer Plus
3	id_user	int			Non	*Aucun(e)*			Modifier Supprimer Plus
4	photo	text	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
5	comment	text	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
6	date	timestamp			Oui	CURRENT_TIMESTAMP		DEFAULT_GENERATED	Modifier Supprimer Plus

Figure III.27: Table Comments.

- ***Answers:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_answer	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	photo	text	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
3	answer	varchar(10000)	utf8mb4_0900_ai_ci		Non	*Aucun(e)*			Modifier Supprimer Plus
4	date	datetime			Oui	*NULL*			Modifier Supprimer Plus
5	id_subject	int			Non	*Aucun(e)*			Modifier Supprimer Plus
6	id_user	int			Non	*Aucun(e)*			Modifier Supprimer Plus

Figure III.28: Table Answers.

- ***Favorites:***

#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
1	id_favorite	int			Non	*Aucun(e)*		AUTO_INCREMENT	Modifier Supprimer Plus
2	id_user	int			Oui	*NULL*			Modifier Supprimer Plus
3	id_post	int			Oui	*NULL*			Modifier Supprimer Plus

Figure III.29: Table Favorites.

- ***Likes:***

	#	Nom	Type	Interclassement	Attributs	Null	Valeur par défaut	Commentaires	Extra	Action
☐	1	id_like	int			Non	Aucun(e)		AUTO_INCREMENT	Modifier Supprimer Plus
☐	2	id_post	int			Non	Aucun(e)			Modifier Supprimer Plus
☐	3	id_user	int			Non	Aucun(e)			Modifier Supprimer Plus

Figure III.30: Table Likes.

III.5 Application Interfaces

WaterWise: WaterWise is the name we chose for our application designed to tackle water-related issues. This name signifies our commitment to conserving water wisely and finding intelligent solutions.

Also, we have made a logo for our application featuring a water droplet alongside the name.

Figure III.31: WaterWise application's Logo.

III.5.1 Visitor space

- **Home page:**

  Upon launching the application, we are greeted with this interface.

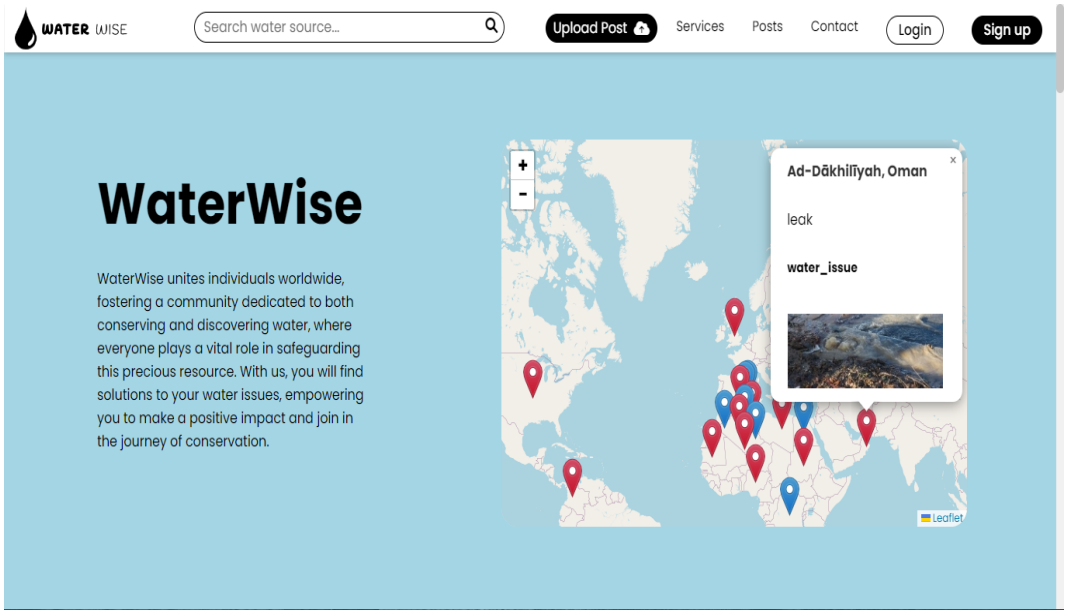


Figure III.32: Home page.

- **Search page:**

  The search page allows both signed-up members and visitors to search a water source and displays its details.

  The following figure represents the result of a search:

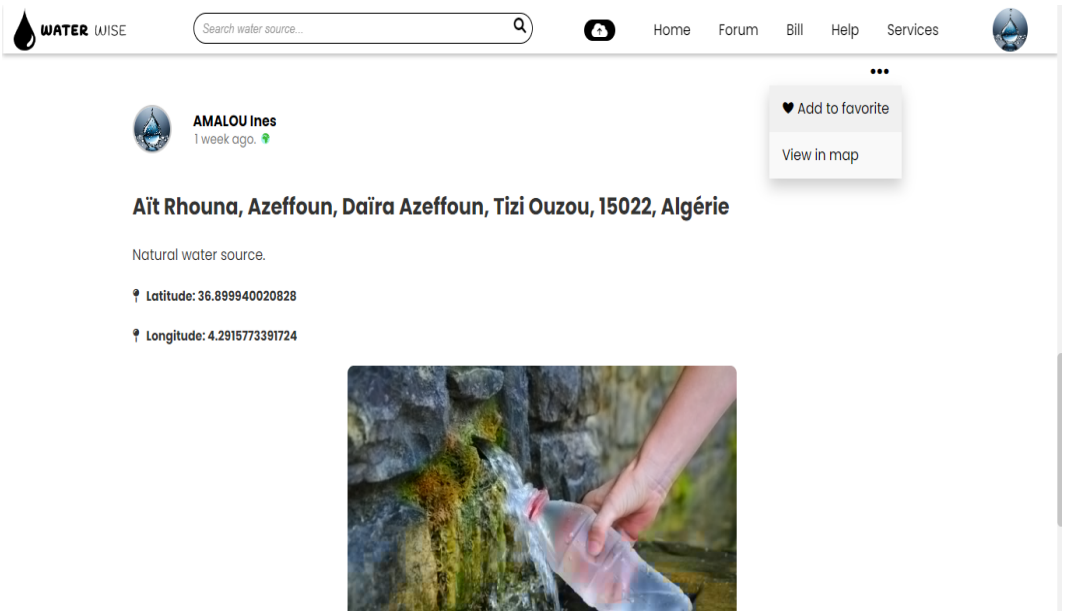


Figure III.33: Search page.

To view the position of the resulted search on a geographical map, simply click on the "View in Map" button as shown in the following figure:

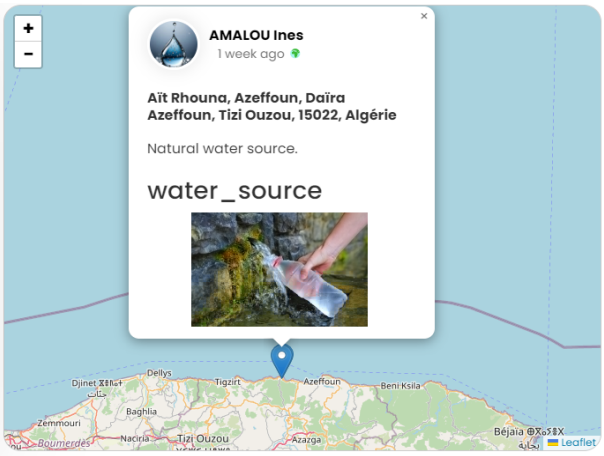


Figure III.34: Search position page.

- **Add post page:**

  On our Add Post page, visitors can report water issues or add new water sources. Below is the interface displayed for this purpose.

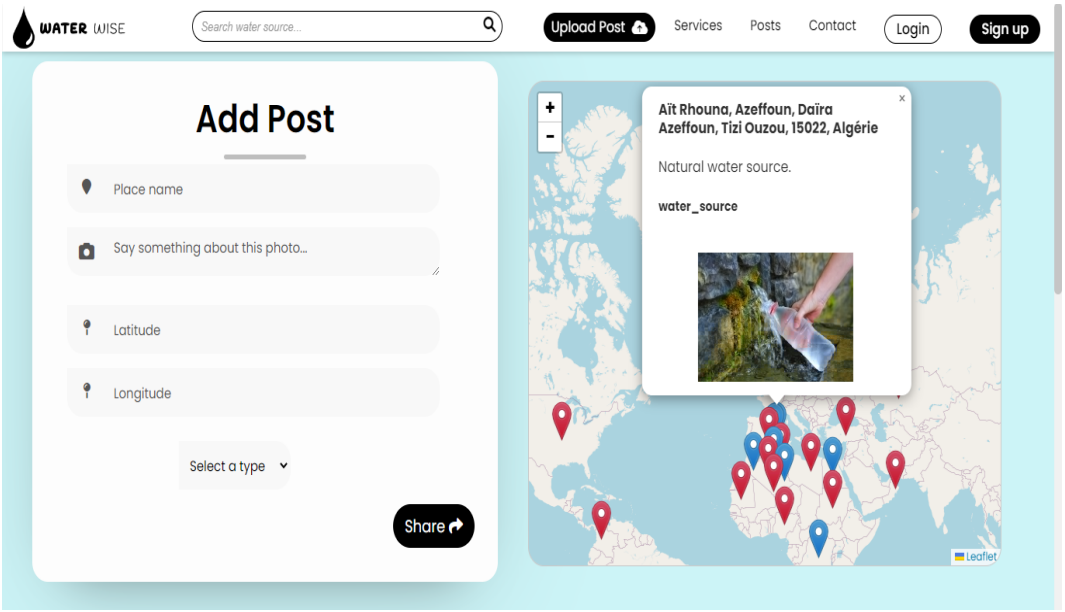


Figure III.35: Add Post page.

- **Services section:**

  In the following, we will find the interface of the Services section, where we detail all the available services provided.

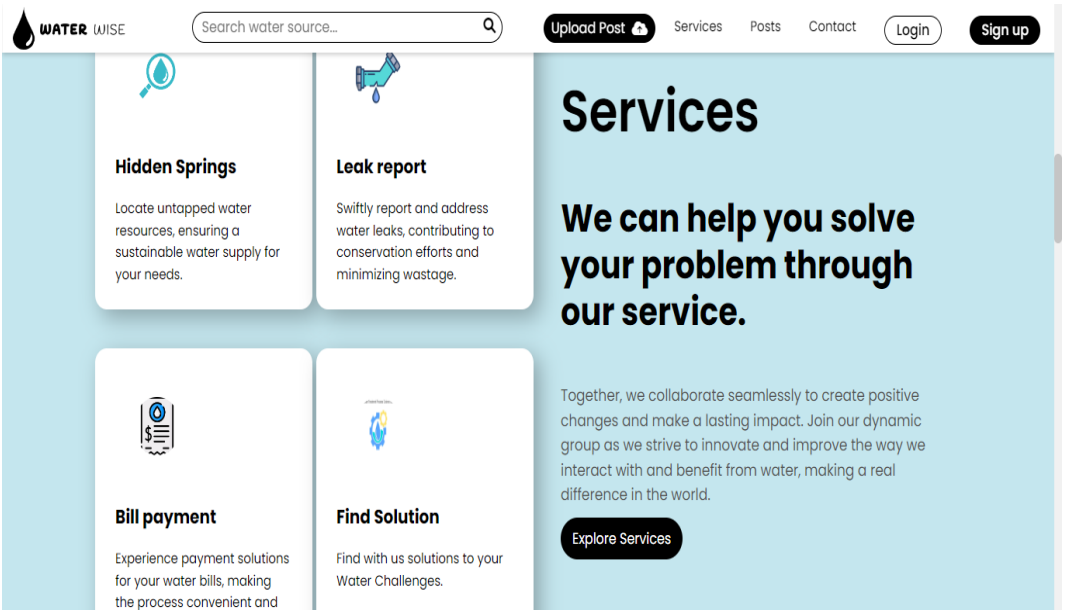


Figure III.36: Services section.

- **Posts sections:**

  In the Posts section, we prominently feature the four most recent posts.

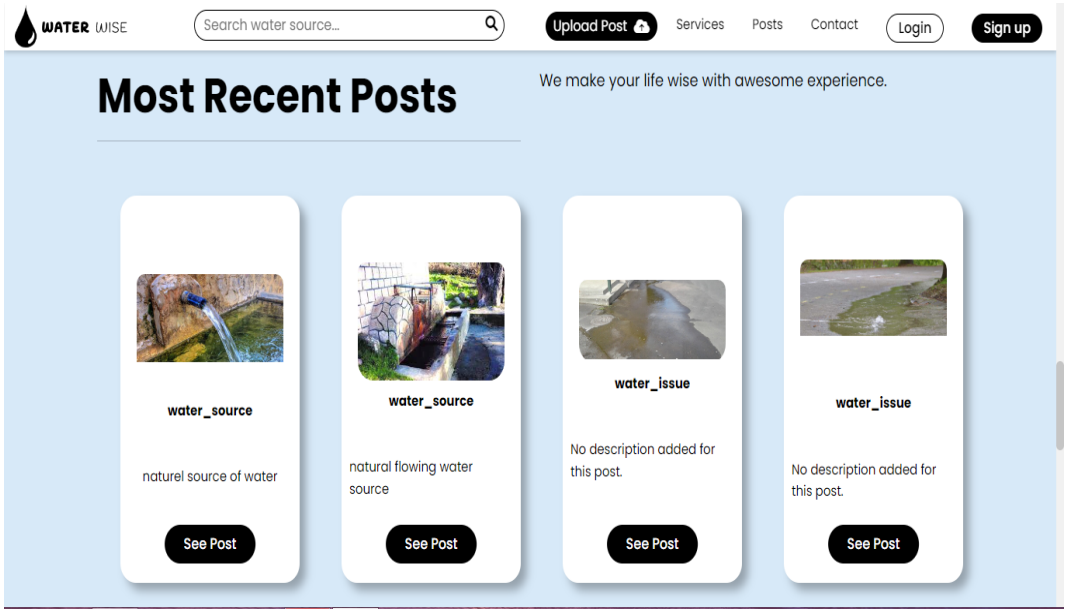


Figure III.37: Posts section.

- **Contact Us section:**

  In the Contact Us section, we provide two cards brimming with our direct phone numbers and email addresses for seamless communication.
  Moreover, a concise form is provided for sending messages, as depicted below:

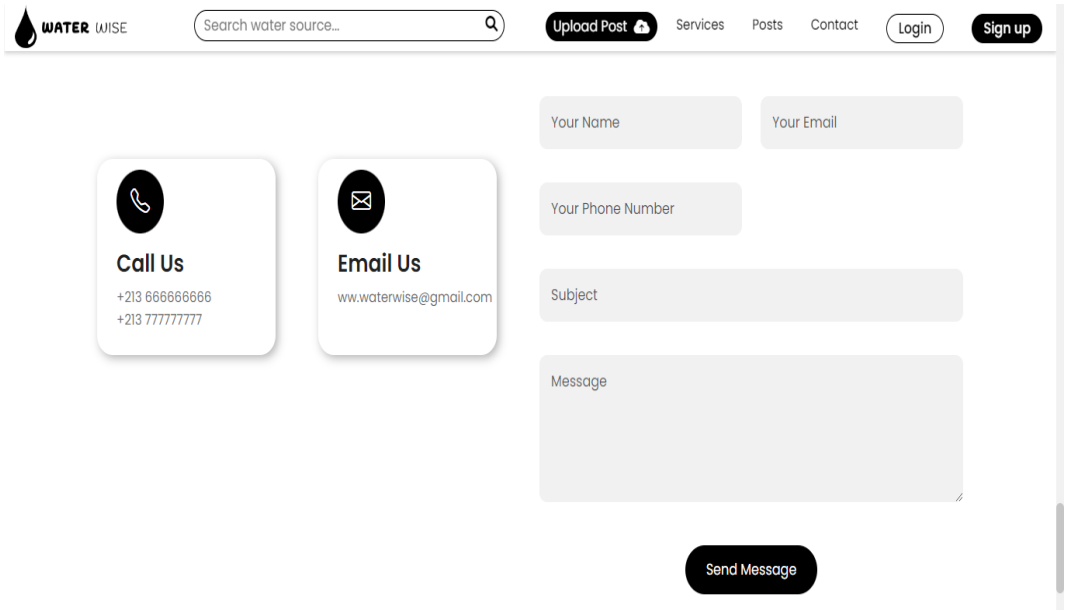


Figure III.38: Contact Us page.

- **Registration page:**

  If a visitor wants to create an account to access other member-exclusive features, he must register on the application by clicking on the "Sign Up" option from the homepage.

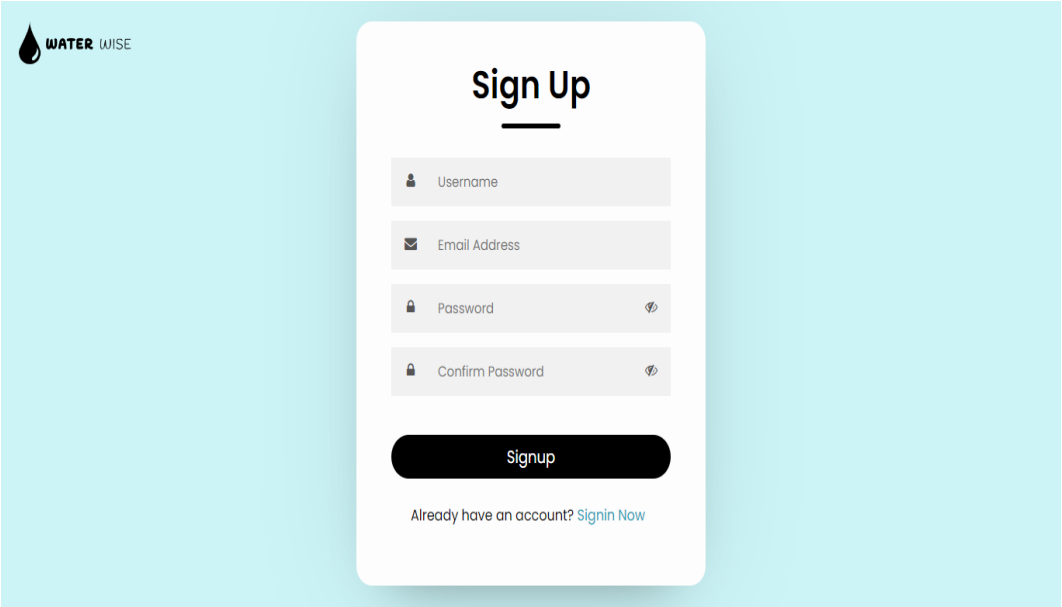


Figure III.39: Registration page.

Upon successful registration, a confirmation email will be promptly dispatched to the user. This email serves the vital purpose of verifying both the registration and the validity of the provided email address.

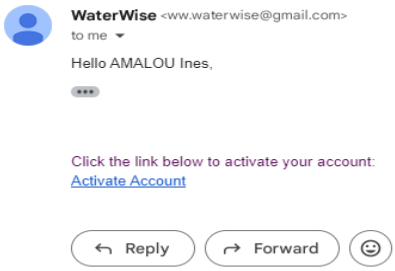


Figure III.40: Confirmation message.

- **Authentication page:**
  The login page efficiently identifies users and directs them to their profiles.

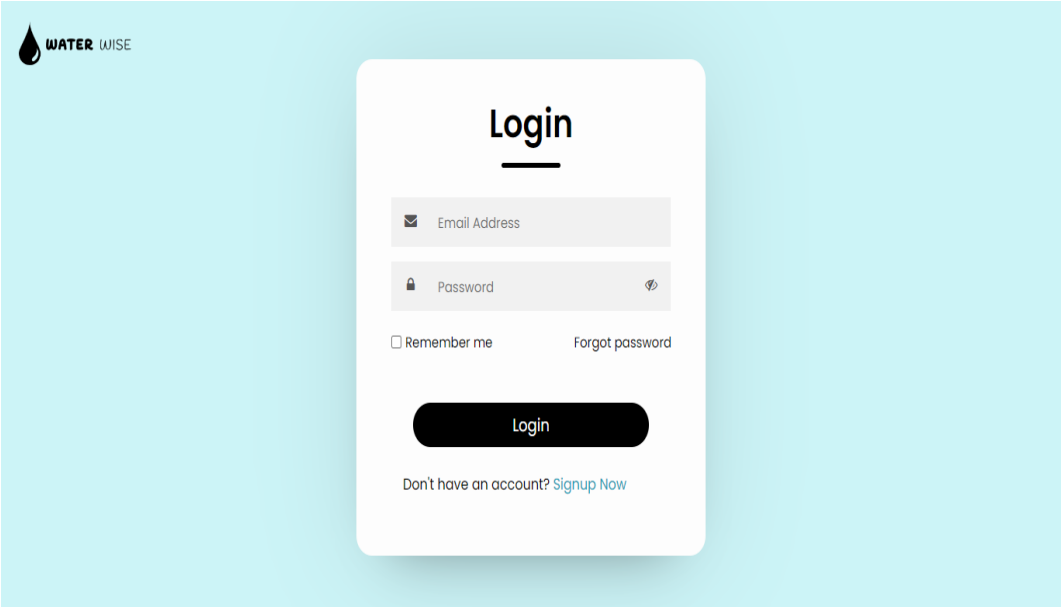


Figure III.41: Authentication page.

- **Recover forgotten password page:**

  To access the password recovery page, users must click on the "Forgot Password" option on the login page.

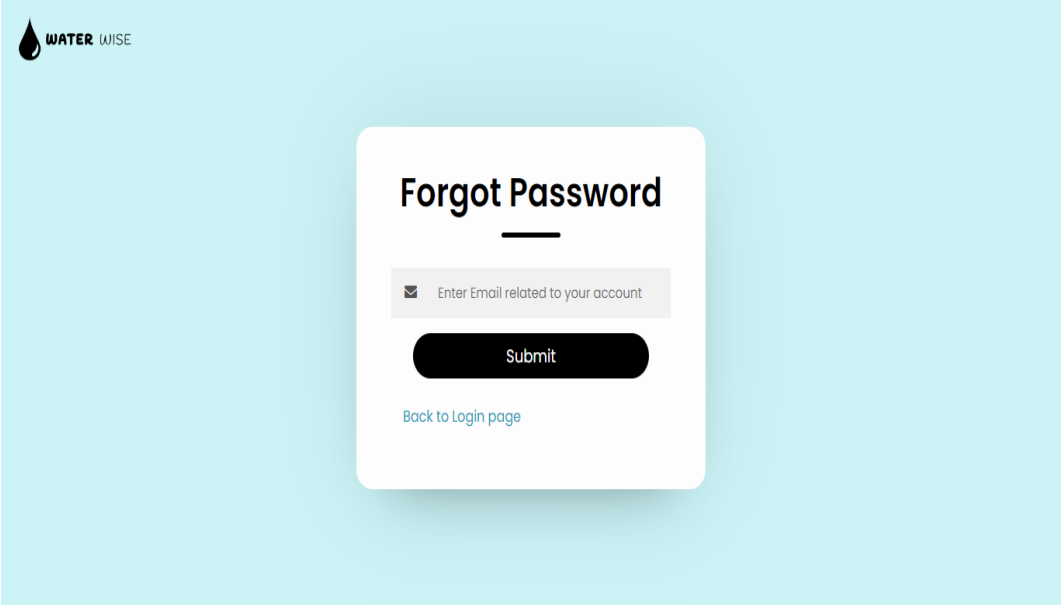


Figure III.42: Recover forgotten password page.

By entering the email associated with the account, a notification will be promptly dispatched to the user's email to reset the password.

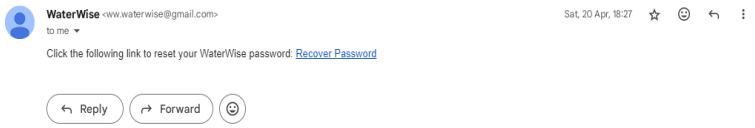


Figure III.43: Reset password message.

III.5.2 User space

- **Home page:**

  Once a user has successfully logged in, they will be redirected to their profile page, which serves as their home page. This page contains their personal information, a map with posts, a form to add new posts, and a section displaying their own posts that they can edit and delete.

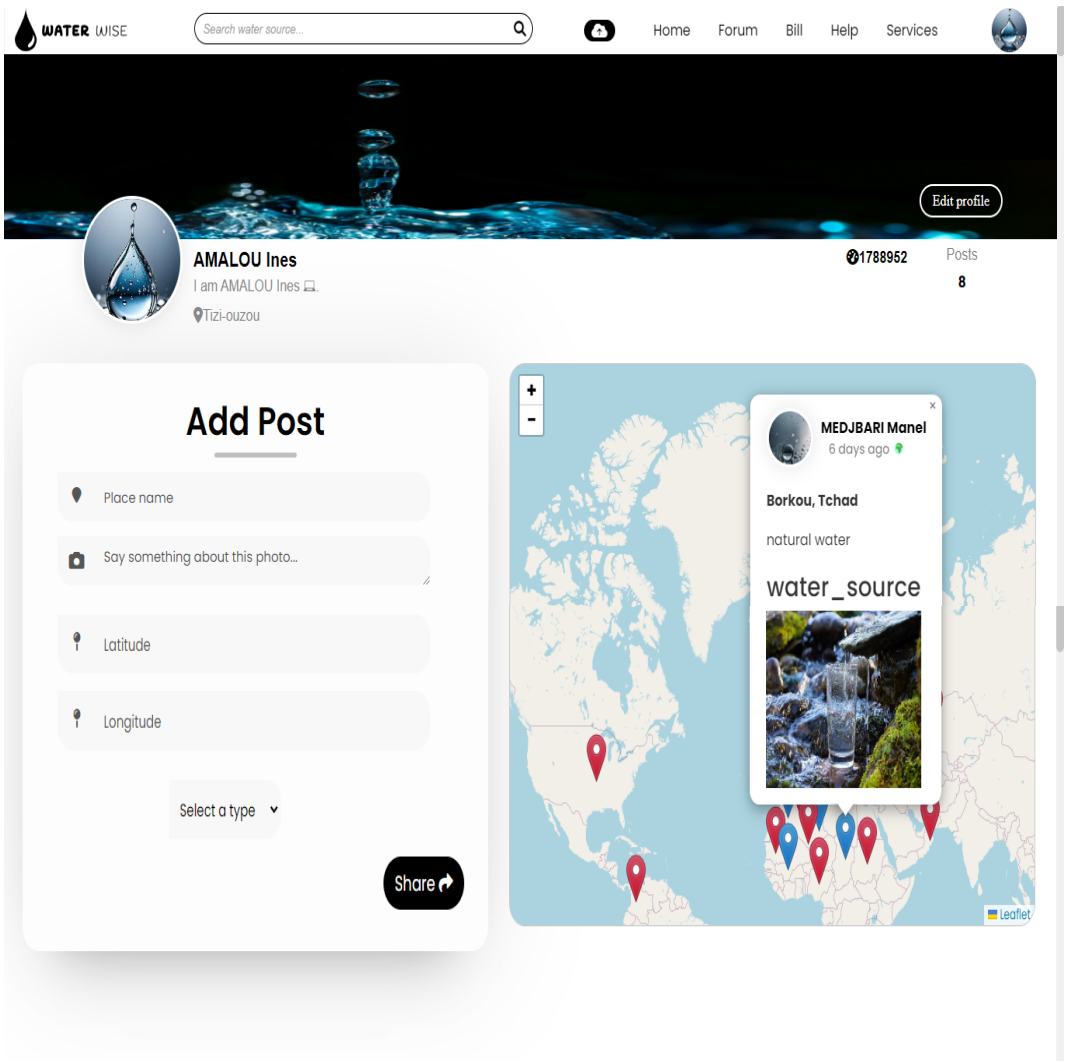


Figure III.44: Profile section.

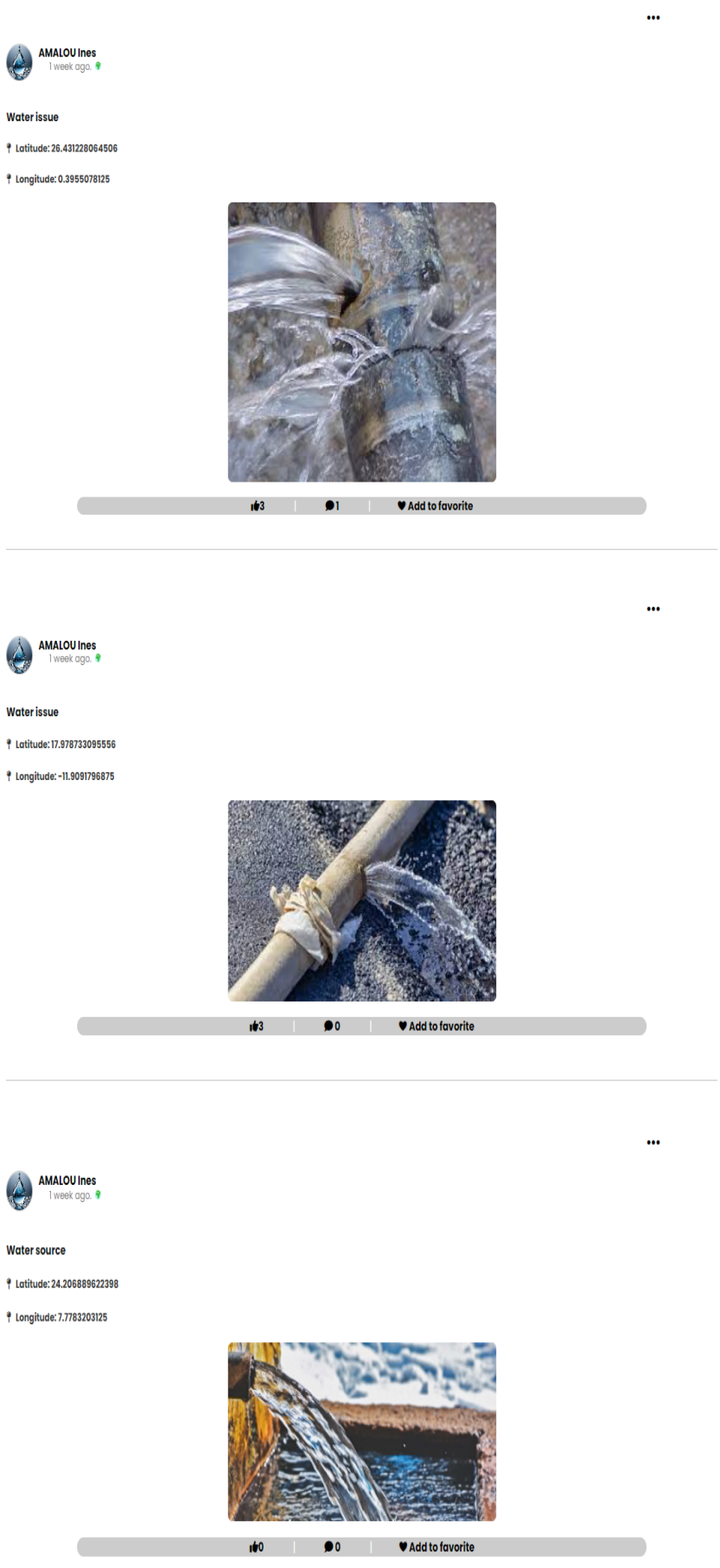


Figure III.45: Posts section.

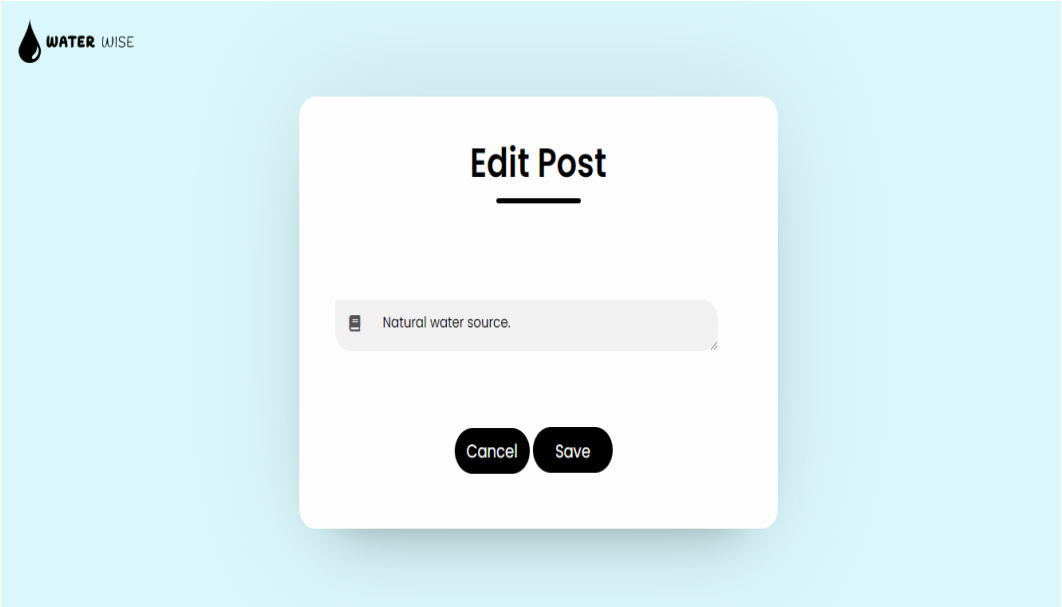


Figure III.46: Edit post page.

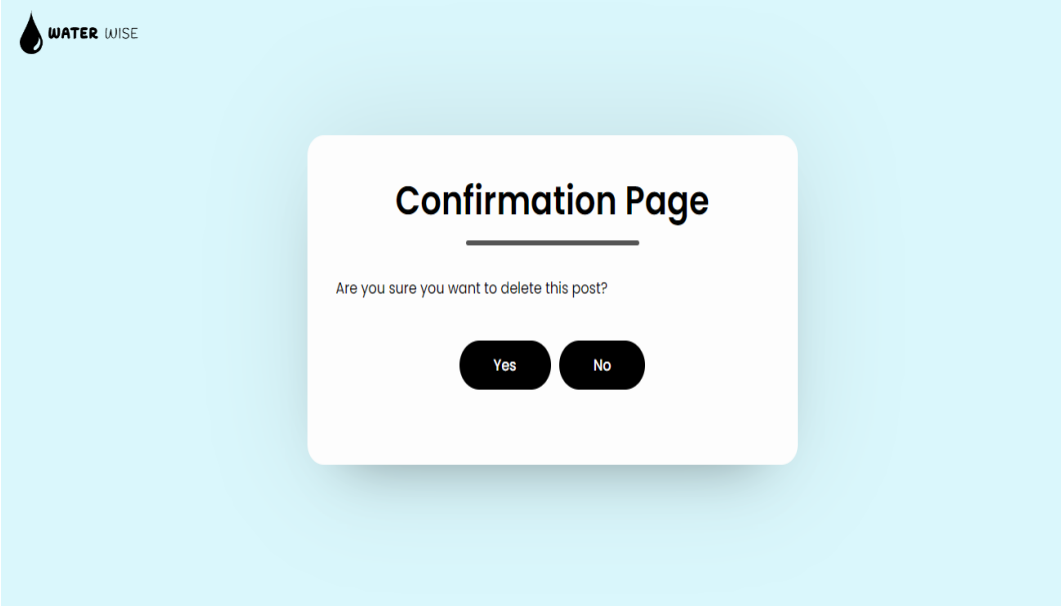


Figure III.47: Delete post page.

- **Edit profile page:**

  On the home page, there is a button labeled "Edit Profile" overlaid on the background picture. When clicked, it navigates to a page where users can edit their personal information.

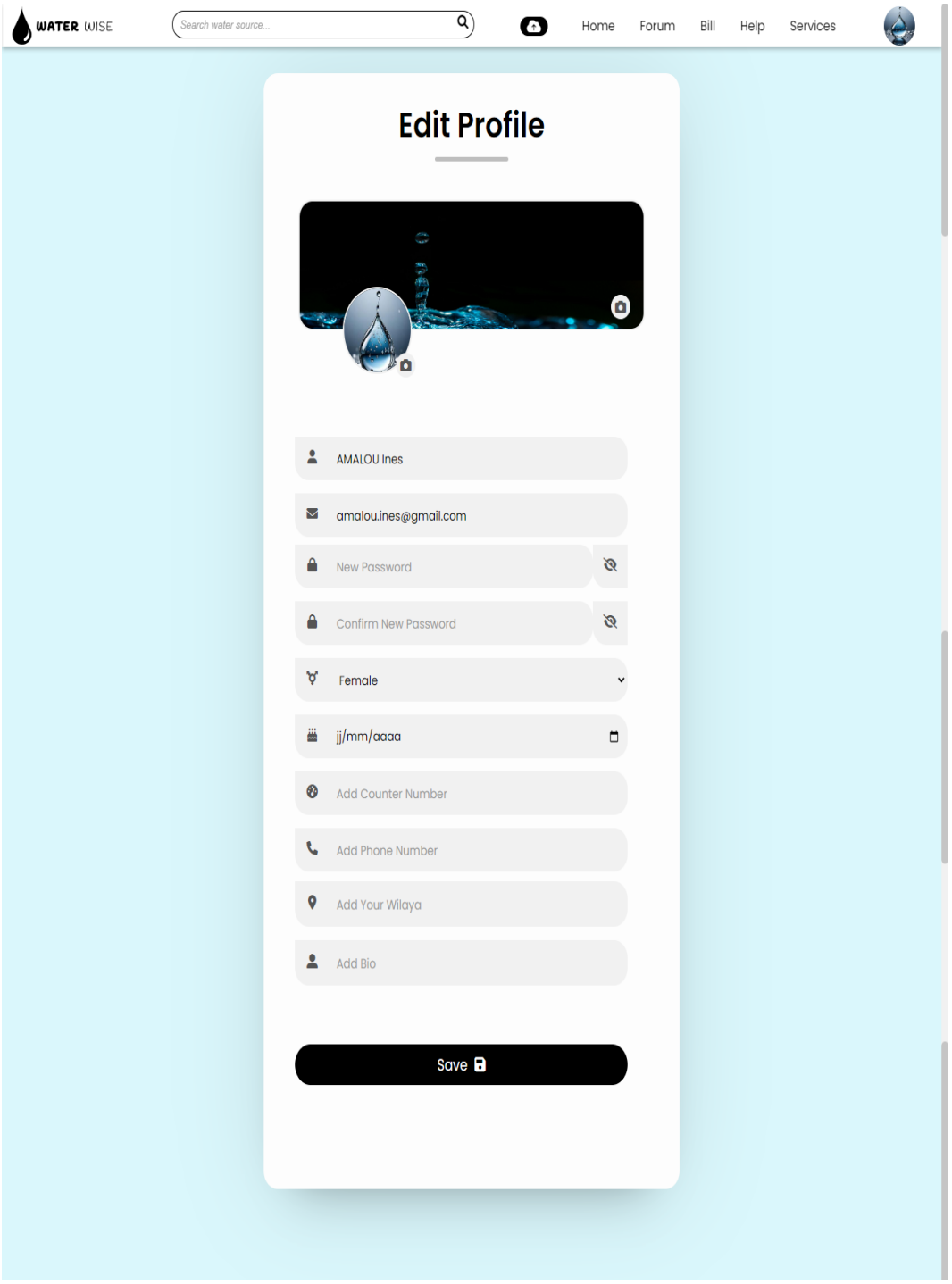


Figure III.48: Edit profile page.

In the navigation bar, there are several links that we will describe, starting with the search bar and a publish button that functions as mentioned earlier. Next, there is the forum link, which appears as follows:

- **Forum page:**

  On the forum page, there are two sections: "My Forums," which displays the user's forums, and "Forum Space," which shows all existing forums. Clicking on a

topic will display its details and provide a form for adding answers.

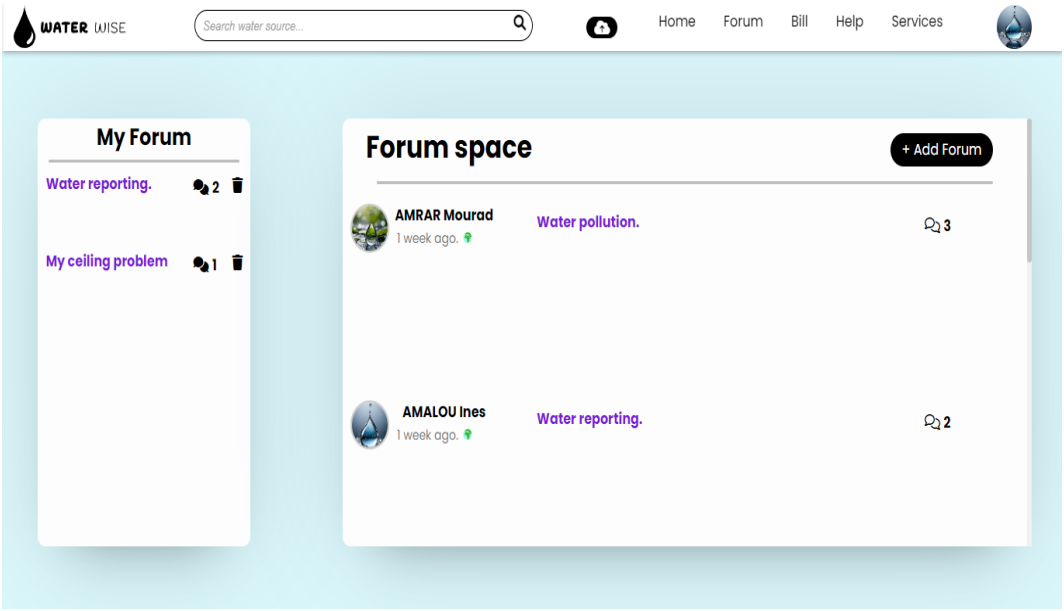


Figure III.49: Forum page.

Here is a topic with its details:

- **Topic page:**

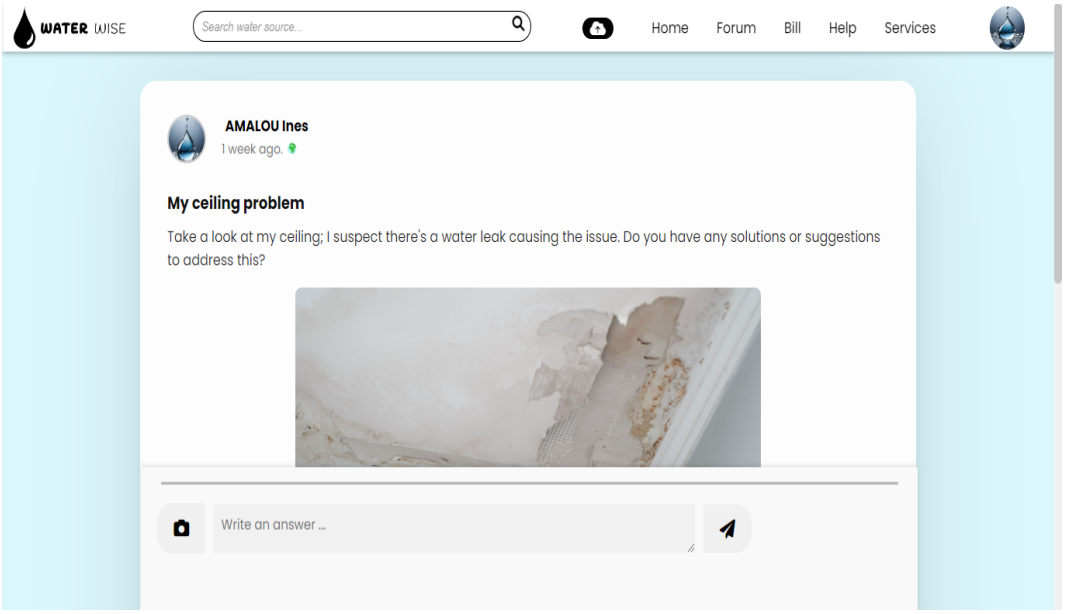


Figure III.50: Topic page.

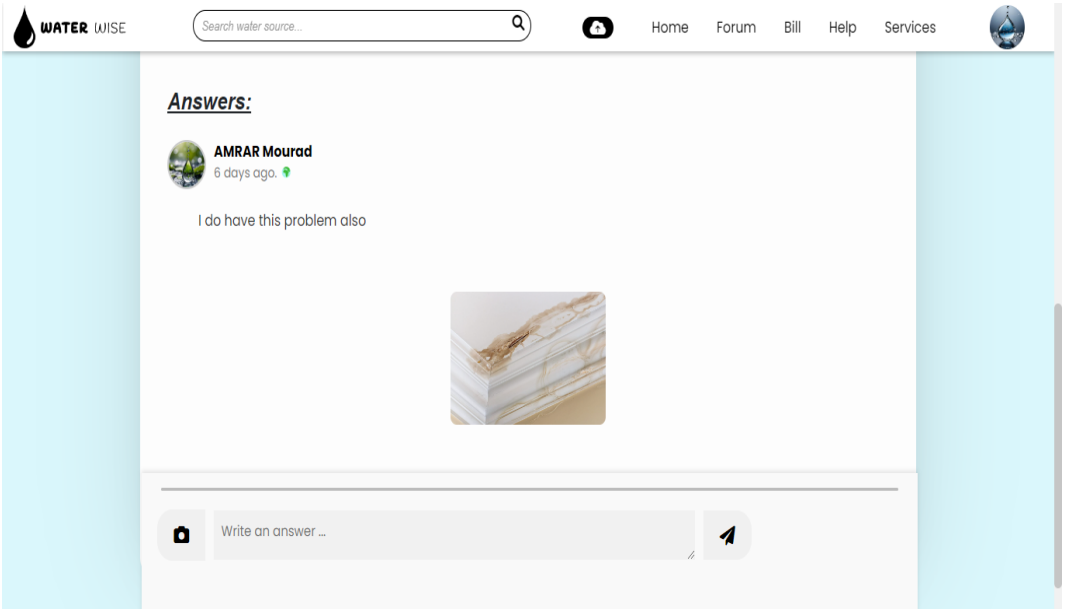


Figure III.51: Topic's answers.

- **Bill page:**

  The bill page includes a consumption graph that represents four years of consumption statistics. Additionally, there is an "Enter Index" link where users can input their old and new index values. These index values reflect their water consumption, which they can read from their home water meter. Once the indices are entered, users can request bill generation. The generated bill can be found under the "Unpaid Bill" link.

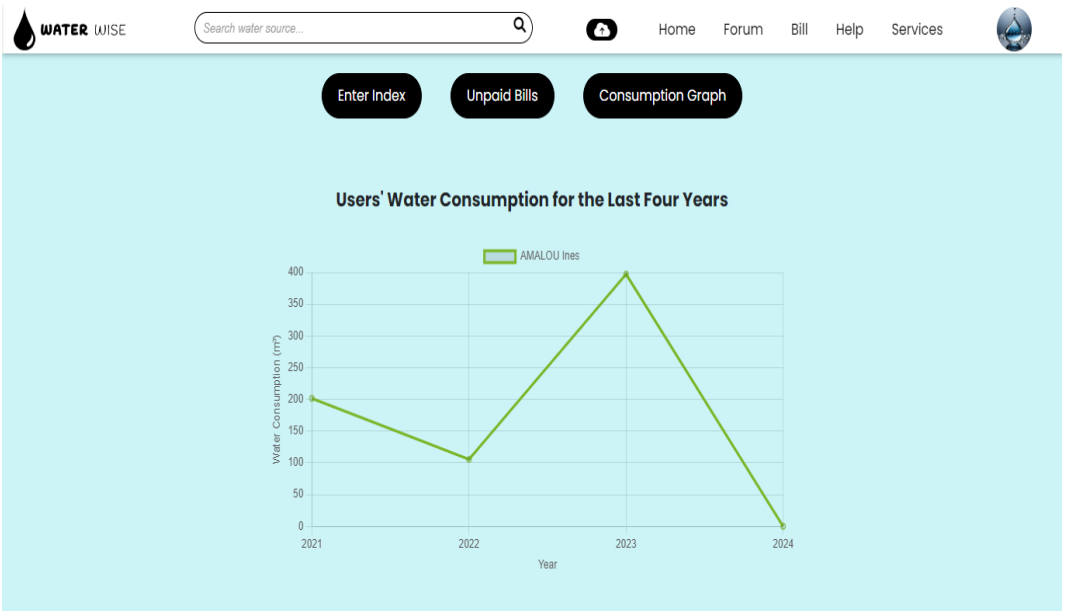


Figure III.52: Bill page.

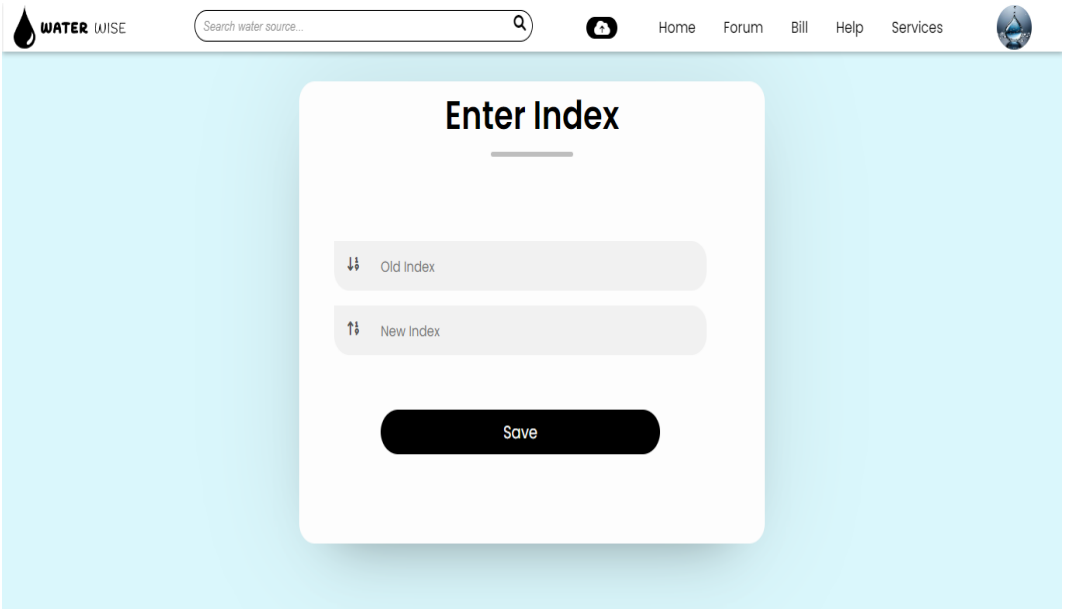


Figure III.53: Enter Index.

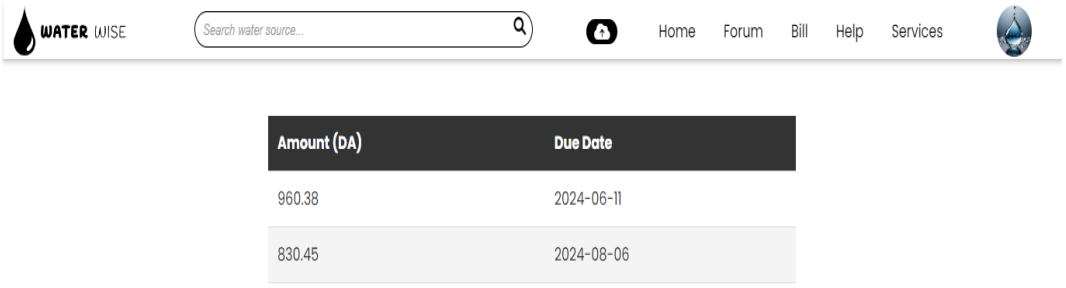


Figure III.54: Unpaid Bill.

- **Dropdown menu:**

  The small profile picture located at the top right represents a dropdown menu containing four links and a logout button.

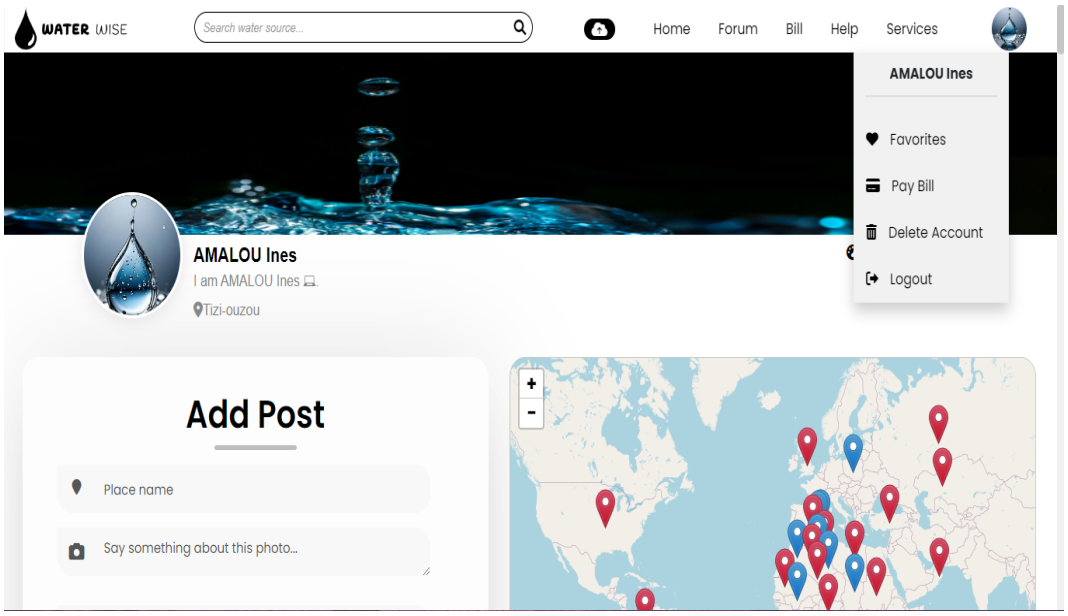


Figure III.55: Dropdown menu.

- **Favorites page:**

  The Favorites page is where users can find all the posts they have marked as favorites. It includes a "Remove from Favorites" button for each post, allowing users to easily manage their favorites. Additionally, there's a "View in Map" link associated with each post, enabling users to visualize the post's location on a geographical map.

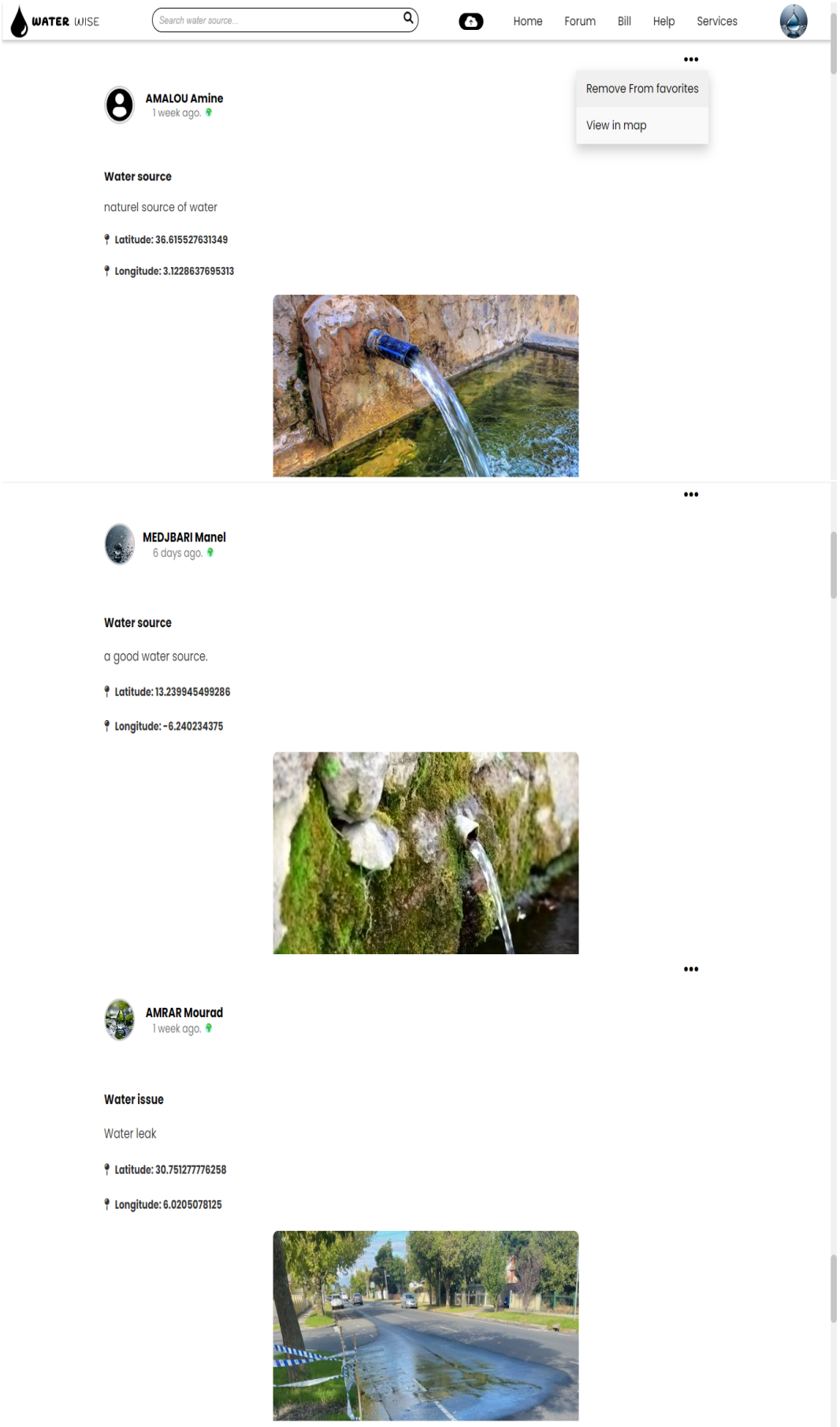


Figure III.56: Favorites page.

- **Delete account page:**

  The Delete Account page simply displays a confirmation message, as shown below:

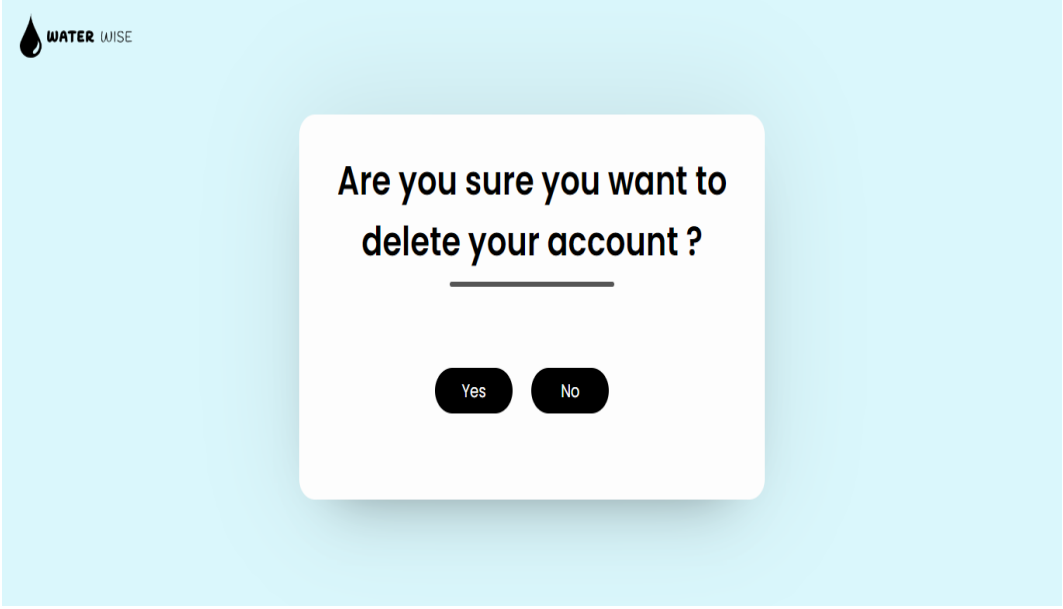


Figure III.57: Delete account page.

- **User's profile:**

  To access a user's profile, simply click on their username wherever it appears (whether in the forum space, in answers, on the geographical map, or in searched posts), and their profile will be displayed. Here, you can find their personal information, along with their posts which you can like, comment on, or even add to favorites.

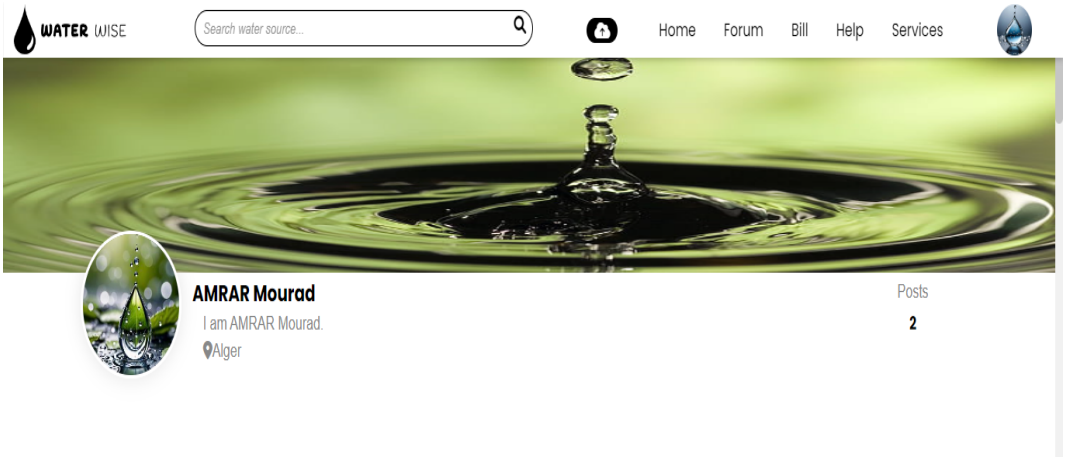


Figure III.58: A user's profile page.

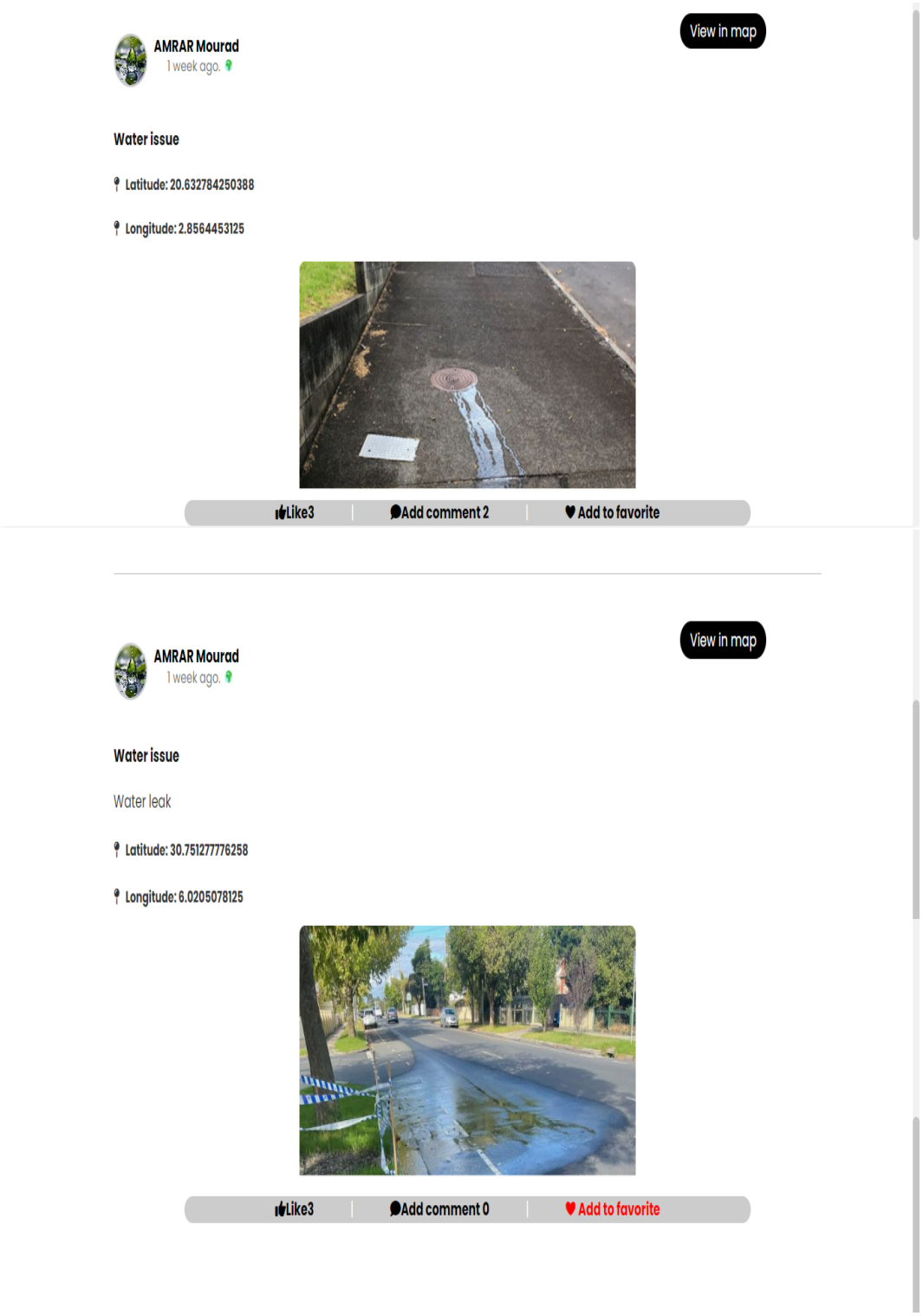


Figure III.59: A user's posts.

III.5.3 Administrator space

- **Authentication page:**

  The authentication page displayed below allows both administrators and users to log in by selecting the appropriate role.

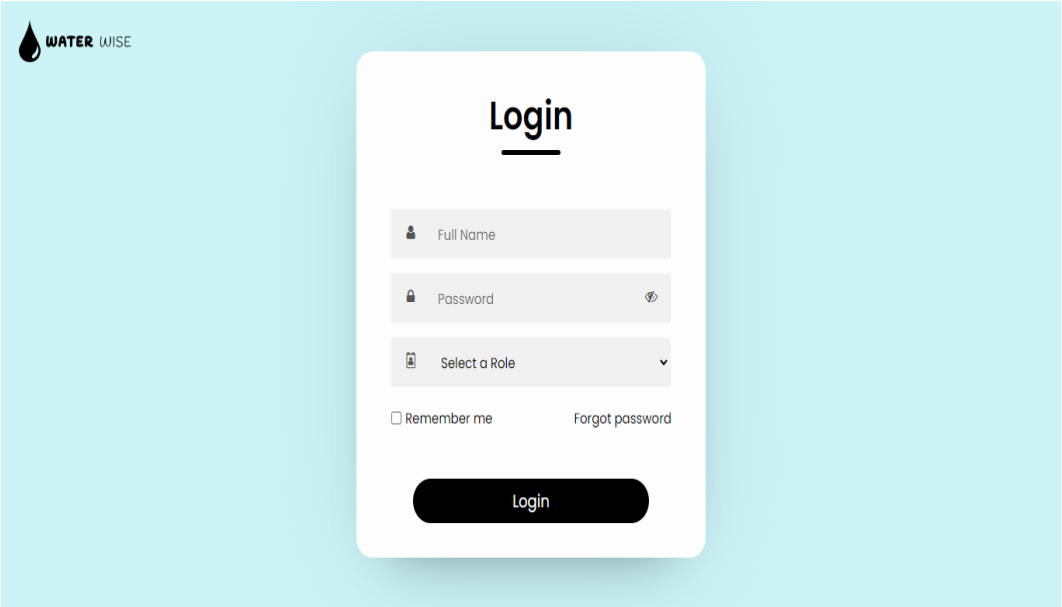


Figure III.60: Authentication page.

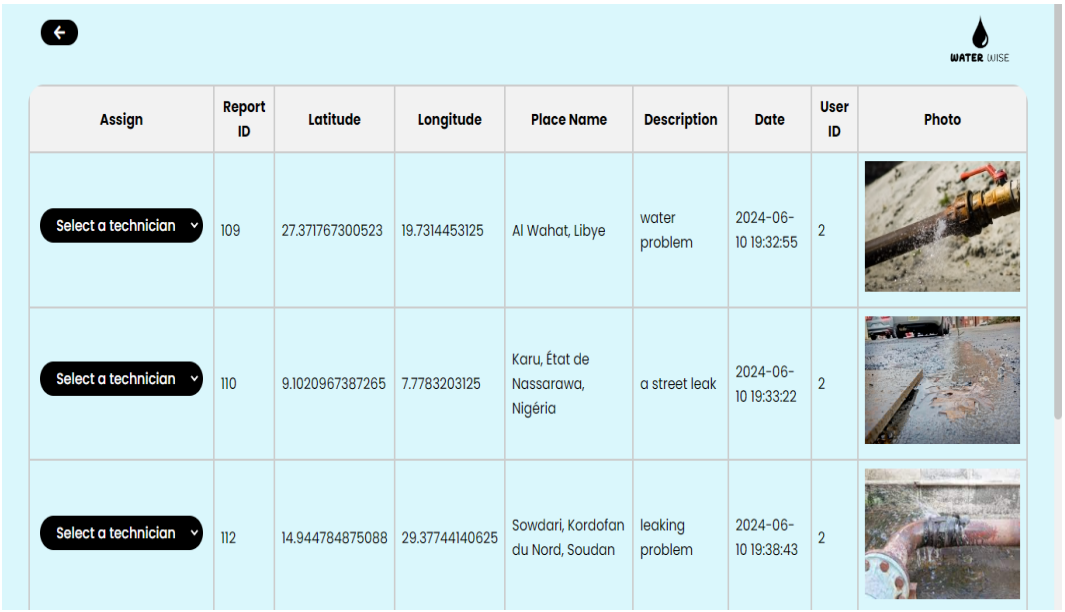
- **Dashboard page:**

  Once an administrator is logged in, they are directed to the homepage, which serves as their dashboard.

Figure III.61: Dashboard page.

- **Total reports page:**

  At the dashboard, an admin will find five cards. The first card is "Total Reports," which enables the display of all water reports submitted by a user, including all necessary details. It also includes a dropdown menu that allows the administrator to assign the report to a specific technician.

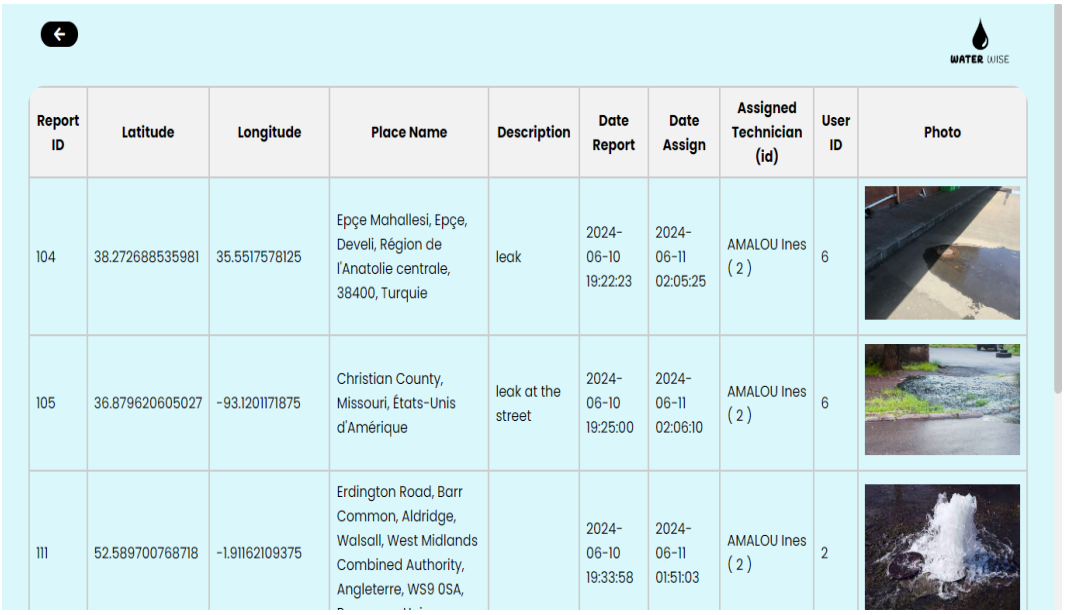


Assign	Report ID	Latitude	Longitude	Place Name	Description	Date	User ID	Photo
Select a technician	109	27.371767300523	19.7314453125	Al Wahat, Libye	water problem	2024-06-10 19:32:55	2	
Select a technician	110	9.1020967387265	7.7783203125	Karu, État de Nassarawa, Nigéria	a street leak	2024-06-10 19:33:22	2	
Select a technician	112	14.944784875088	29.37744140625	Sowdari, Kordofan du Nord, Soudan	leaking problem	2024-06-10 19:38:43	2	

Figure III.62: Total reports page.

- **Processing Report page:**

  The next card is "Processing Reports." This card displays all the assigned reports that a technician is currently working on, specifying the name of the assigned technician.



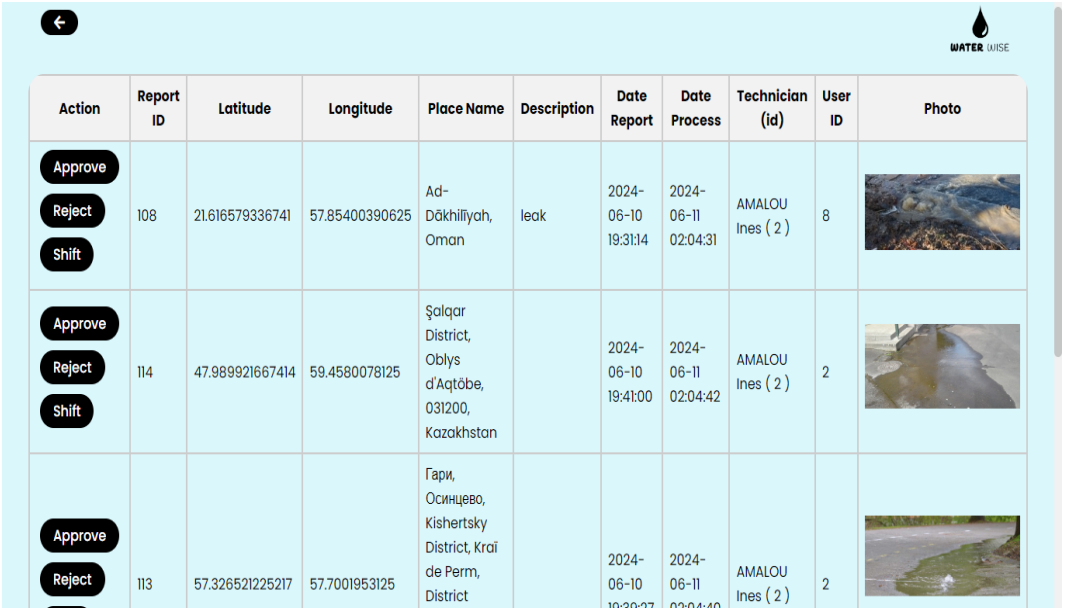
Report ID	Latitude	Longitude	Place Name	Description	Date Report	Date Assign	Assigned Technician (id)	User ID	Photo
104	38.272688535981	35.5517578125	Epçe Mahallesi, Epçe, Develi, Région de l'Anatolie centrale, 38400, Turquie	leak	2024-06-10 19:22:23	2024-06-11 02:05:25	AMALOU Ines (2)	6	
105	36.879620605027	-93.1201171875	Christian County, Missouri, États-Unis d'Amérique	leak at the street	2024-06-10 19:25:00	2024-06-11 02:06:10	AMALOU Ines (2)	6	
111	52.589700768718	-1.91162109375	Erdington Road, Barr Common, Aldridge, Walsall, West Midlands Combined Authority, Angleterre, WS9 0SA,		2024-06-10 19:33:58	2024-06-11 01:51:03	AMALOU Ines (2)	2	

Figure III.63: Processing Reports page.

- **Processed Report page:**

  Next, we have the "Processed Reports" card, which displays all the reports that technicians have completed and validated. In this card, an administrator has three

actions: approve the work if it is satisfactorily completed, reject the work so that the technician can redo it, or reassign the work to another technician.

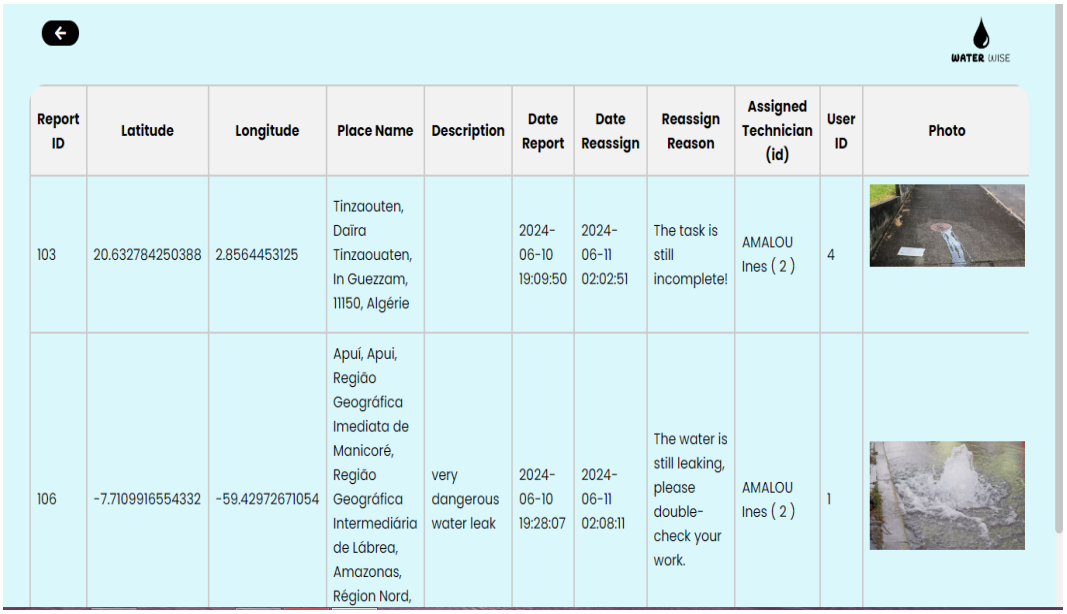


Action	Report ID	Latitude	Longitude	Place Name	Description	Date Report	Date Process	Technician (id)	User ID	Photo
Approve Reject Shift	108	21.616579336741	57.85400390625	Ad-Dākhilīyah, Oman	leak	2024-06-10 19:31:14	2024-06-11 02:04:31	AMALOU Ines (2)	8	
Approve Reject Shift	114	47.989921667414	59.4580078125	Şalqar District, Oblys d'Aqtöbe, 031200, Kazakhstan		2024-06-10 19:41:00	2024-06-11 02:04:42	AMALOU Ines (2)	2	
Approve Reject	113	57.326521225217	57.7001953125	Гари, Осинцево, Kishertsky District, Kraï de Perm, District		2024-06-10	2024-06-11	AMALOU Ines (2)	2	

Figure III.64: Processed Reports page.

- **Reassigned Report page:**

  We also have the "Reassigned Reports" card, which displays the reports that a technician needs to redo, including the reason for rejection.



Report ID	Latitude	Longitude	Place Name	Description	Date Report	Date Reassign	Reassign Reason	Assigned Technician (id)	User ID	Photo
103	20.632784250388	2.8564453125	Tinzaouten, Daïra Tinzaouaten, In Guezzam, 11150, Algérie		2024-06-10 19:09:50	2024-06-11 02:02:51	The task is still incomplete!	AMALOU Ines (2)	4	
106	-7.7109916554332	-59.42972671054	Apuí, Apui, Região Geográfica Imediata de Manicoré, Região Geográfica Intermediária de Lábrea, Amazonas, Région Nord,	very dangerous water leak	2024-06-10 19:28:07	2024-06-11 02:08:11	The water is still leaking, please double-check your work.	AMALOU Ines (2)	1	

Figure III.65: Reassigned Reports page.

- **Rejected Report page:**

Finally, there is a card for "Rejected Reports," which lists all the reports rejected by technicians along with the reasons for rejection. This card also includes a drop-down menu where the administrator can reassign the work to another technician.

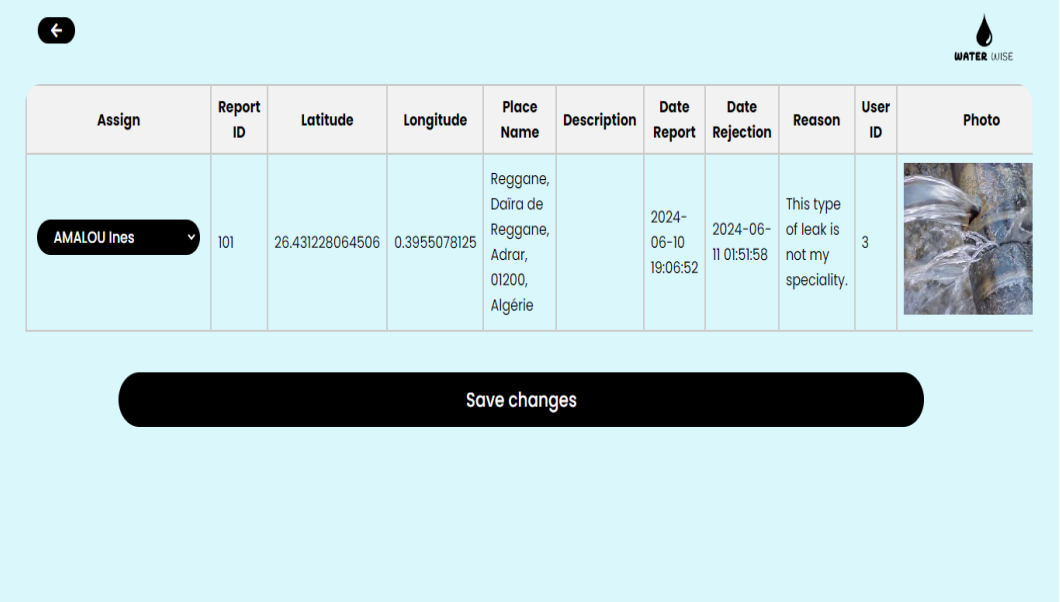


Figure III.66: Rejected Reports page.

- **Edit Profile page:**

  An administrator also has an "Edit Profile" page, which allows them to update their personal information.

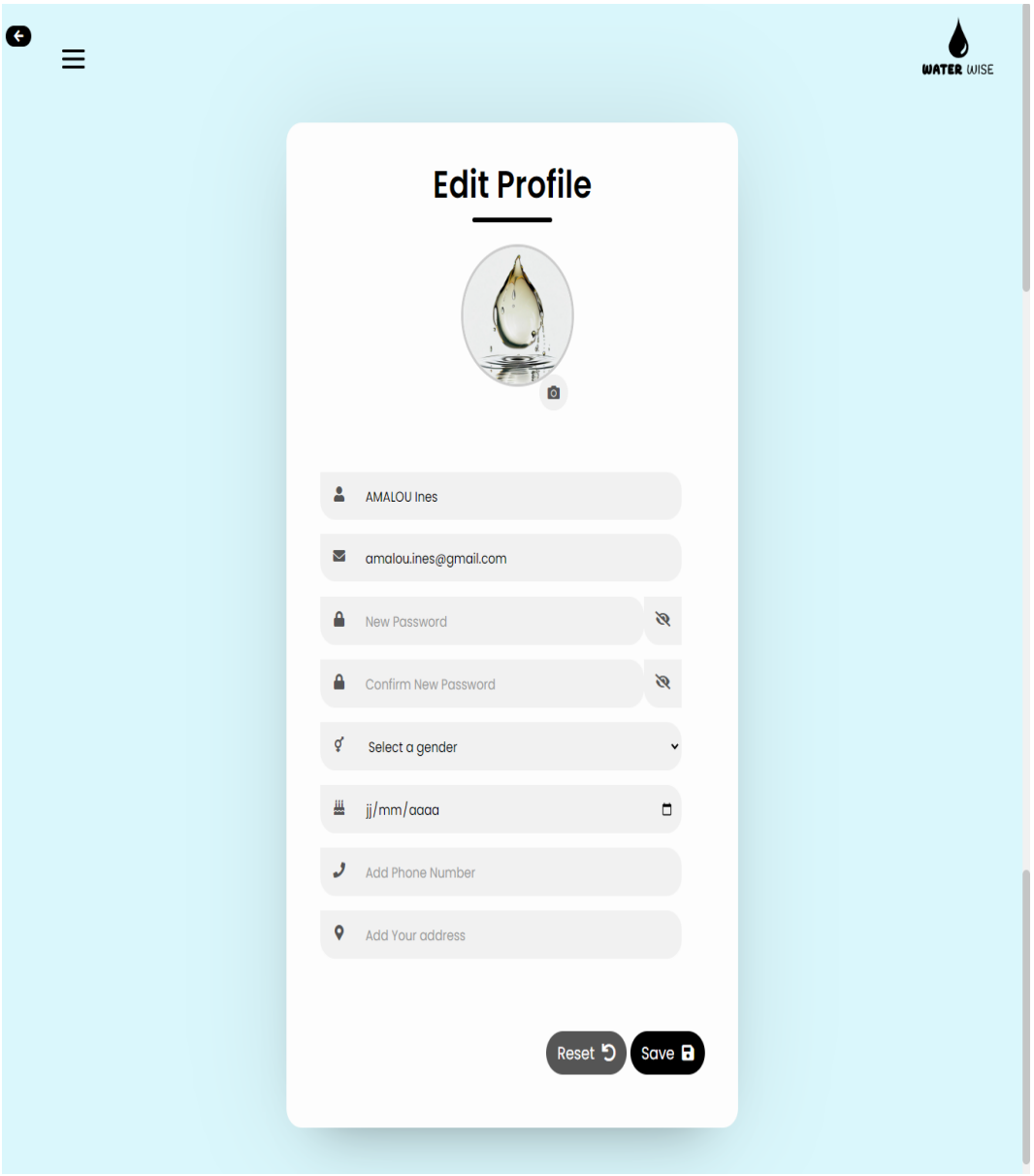


Figure III.67: Edit Profile page.

- **Change Password page:**

  The "Change Password" page is a form that allows administrators to change their password, which is recommended upon their first login.

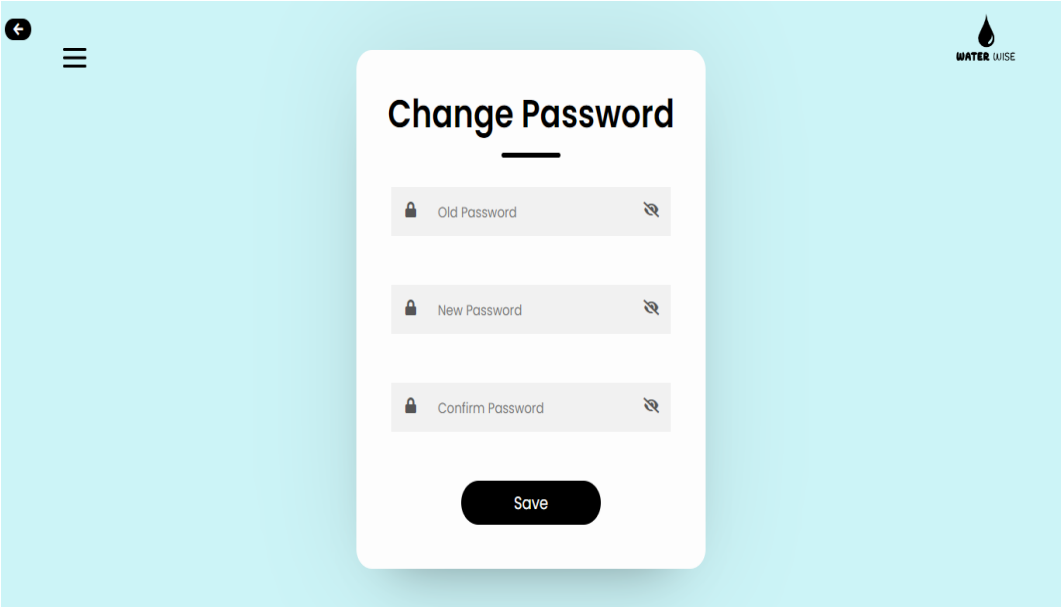


Figure III.68: Change Password page.

- **Messages page:**

  The "Messages" page displays all the messages sent by visitors, with an option to delete each message.

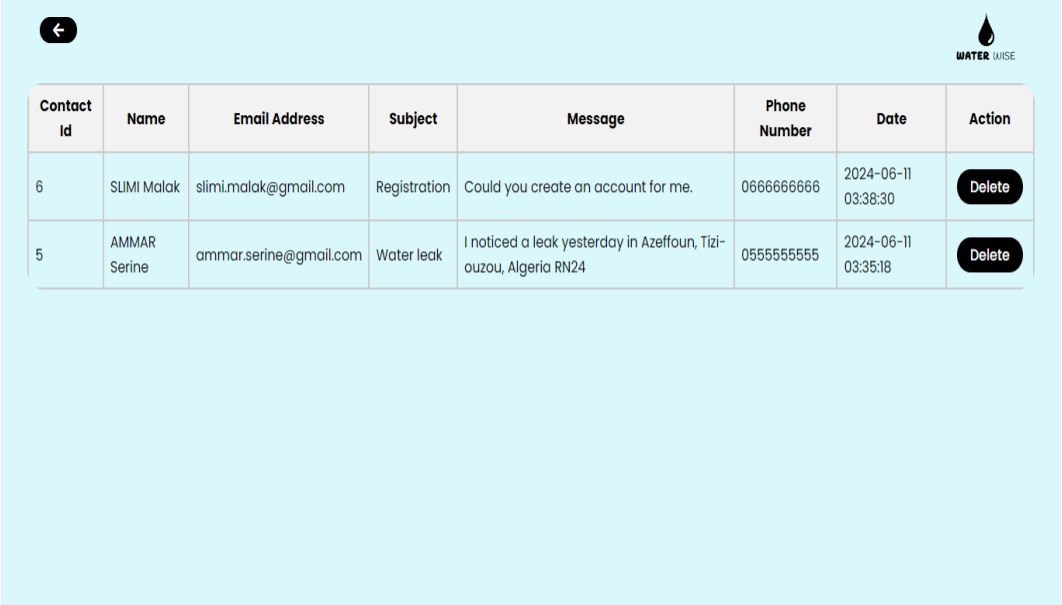


Figure III.69: Messages page.

- **Users List page:**

  The "Users" page allows administrators to list all the users and provides options to delete or modify their information.

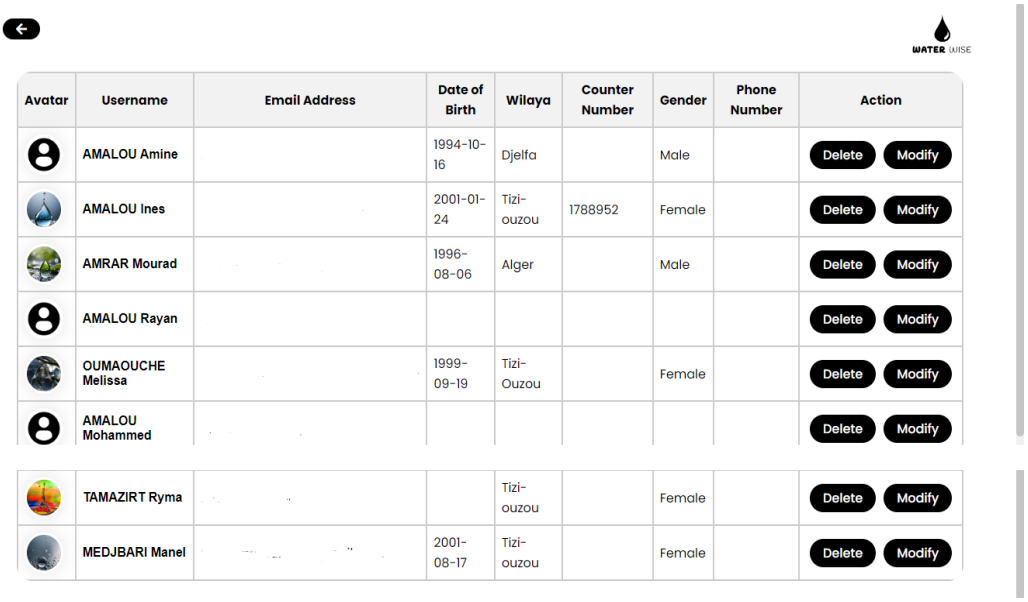


Figure III.70: Users List page.

- **Modify user page:**

  The "Users" page allows administrators to list all the users and provides options to delete or modify their information.

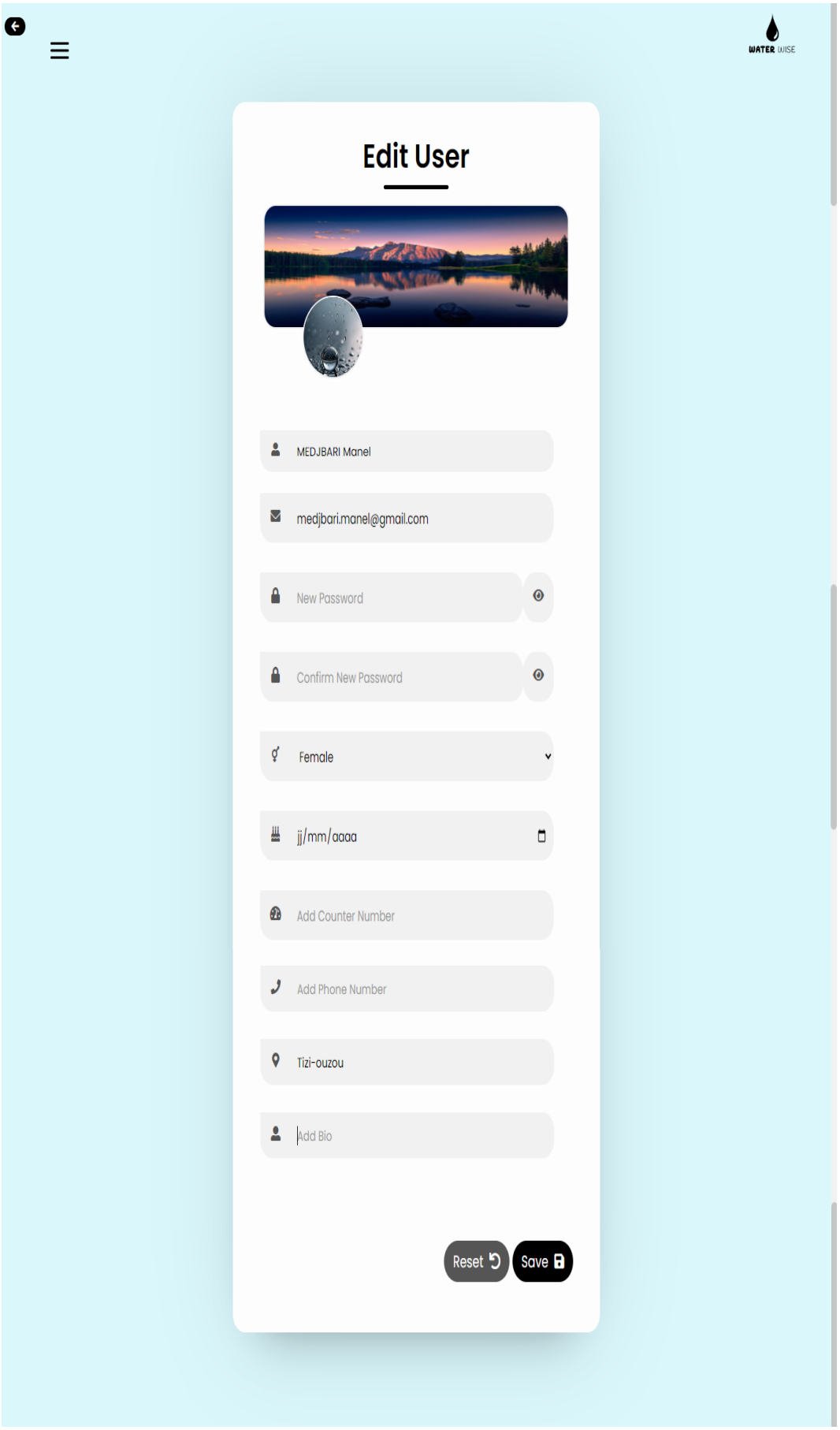


Figure III.71: Modify user page.

- **Administrators list page:**

  The "Administrators" page is a list displaying all the administrators and their details.

Figure III.72: Administrators list page.

- **Technicians list page:**

  The "Technicians" page displays all the technicians and their details, providing an option to delete them.

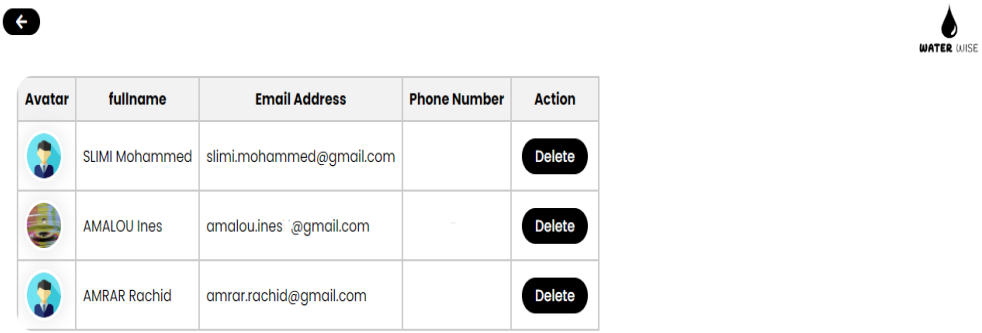


Figure III.73: Technicians list page.

- **Add User page:**

The "Add User" feature is a form that enables the creation of a new user account. Additionally, upon creation, the system sends a message to the user's email containing the registration coordinates.

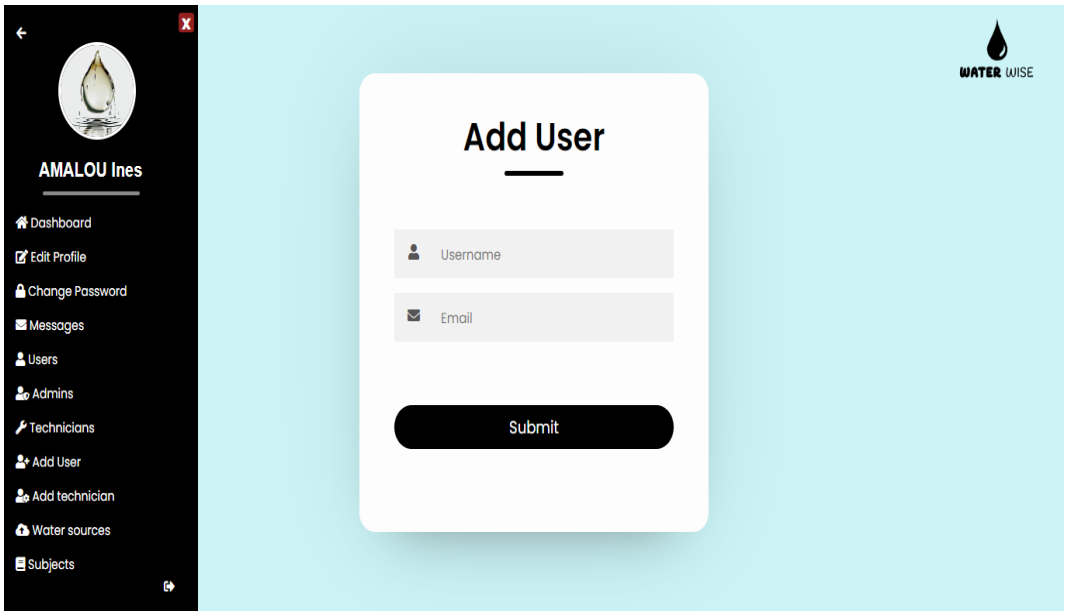


Figure III.74: Add User page.

- **Add Technician page:**

  Similar to adding a user, when adding a technician.

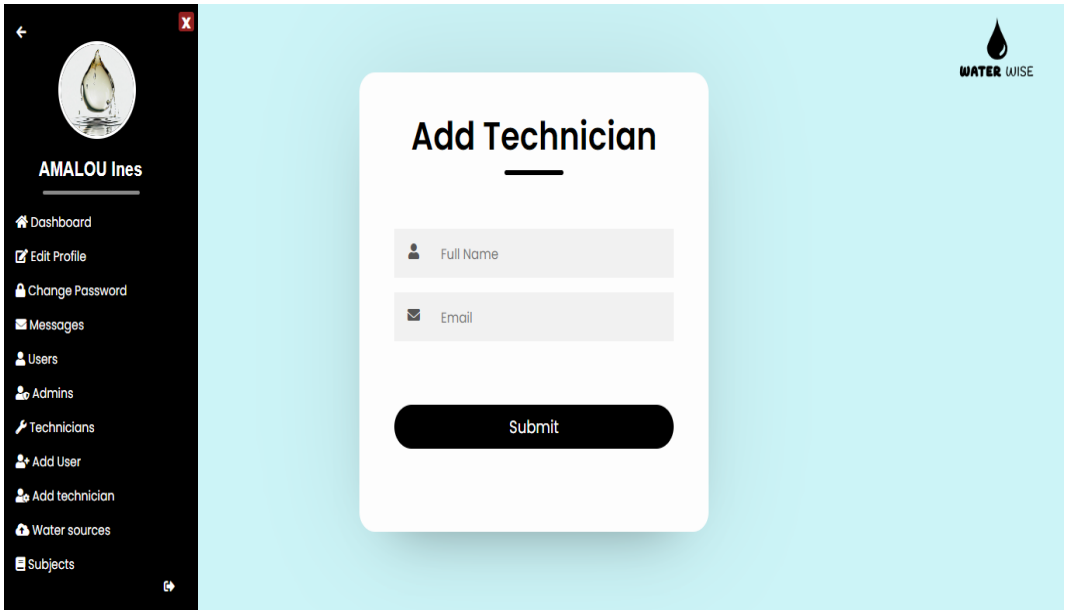


Figure III.75: Add Technician page.

- **Water Sources page:**

  "Water Sources" page contains all the added water sources with a deletion option.

Report ID	Latitude	Longitude	Place Name	Description	Date	Type	User ID	Photo	Delete
1	51.179342979289	19.0283203125	138, Biała, gmina Rząśnia, Pajęczno County, Łódź, 98-332, Pologne	natural flowing water source	2024-06-10 19:34:35	water_source	2

 | Delete |
| 2 | 36.615527631349 | 3.1228637695313 | Raïs, Sidi Moussa, Daïra Baraki, Alger, 16189, Algérie | naturel source of water | 2024-06-10 19:37:38 | water_source | 2

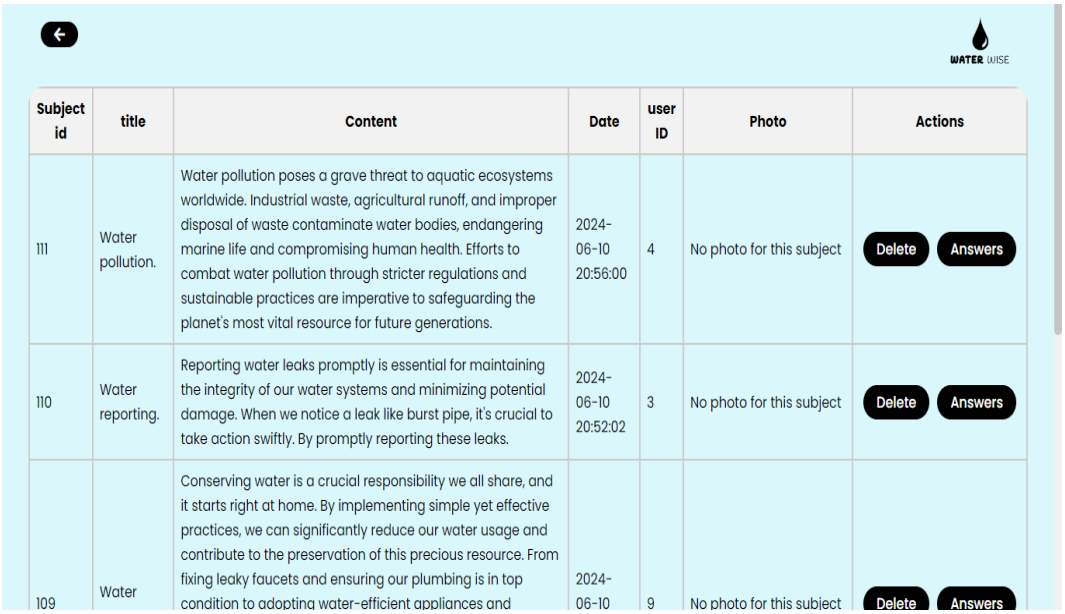
 | Delete |
| 3 | 26.273714024406 | 29.37744140625 | Nouvelle-Vallée, Égypte | drinkable water source | 2024-06-10 19:23:49 | water_source | 6

 | Delete |

Figure III.76: Water Sources page.

- **Subjects page:**

  "Subjects" page displays all the added subjects, offering two actions: delete or display answers. Answers are shown with an option to delete them as well.



Subject id	title	Content	Date	user ID	Photo	Actions
111	Water pollution.	Water pollution poses a grave threat to aquatic ecosystems worldwide. Industrial waste, agricultural runoff, and improper disposal of waste contaminate water bodies, endangering marine life and compromising human health. Efforts to combat water pollution through stricter regulations and sustainable practices are imperative to safeguarding the planet's most vital resource for future generations.	2024-06-10 20:56:00	4	No photo for this subject	Delete Answers
110	Water reporting.	Reporting water leaks promptly is essential for maintaining the integrity of our water systems and minimizing potential damage. When we notice a leak like burst pipe, it's crucial to take action swiftly. By promptly reporting these leaks.	2024-06-10 20:52:02	3	No photo for this subject	Delete Answers
109	Water	Conserving water is a crucial responsibility we all share, and it starts right at home. By implementing simple yet effective practices, we can significantly reduce our water usage and contribute to the preservation of this precious resource. From fixing leaky faucets and ensuring our plumbing is in top condition to adopting water-efficient appliances and	2024-06-	9	No photo for this subject	Delete Answers

Figure III.77: Water Sources page.

- **Display answers page:**

Figure III.78: Display answers page.

III.5.4 Technician space

- **Dashboard page:**

  Once a technician has logged in, they will see the dashboard page, which includes two cards and the navigation bar, as shown above:

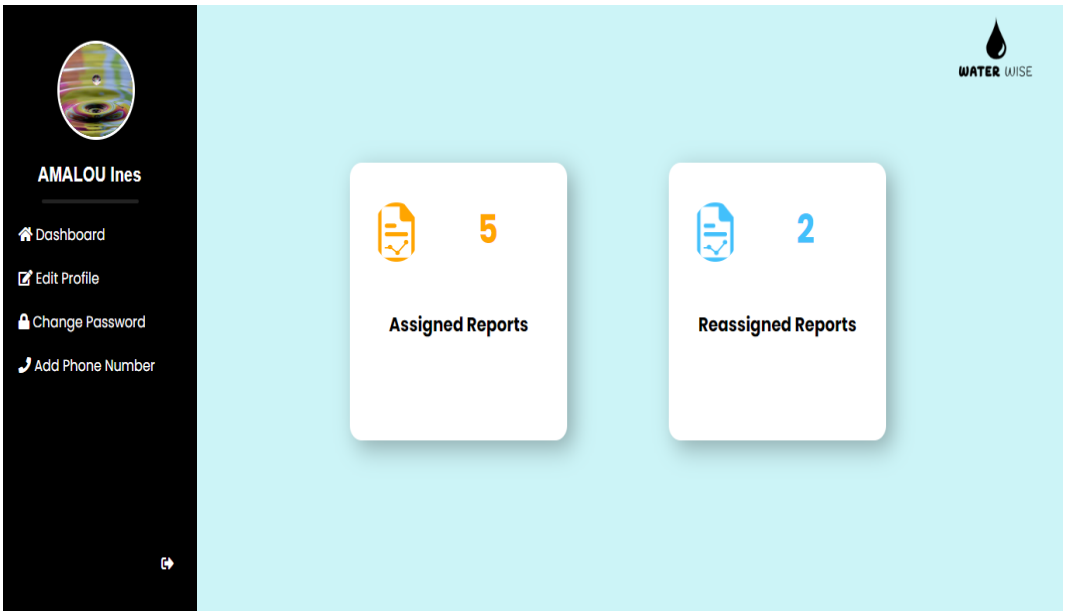
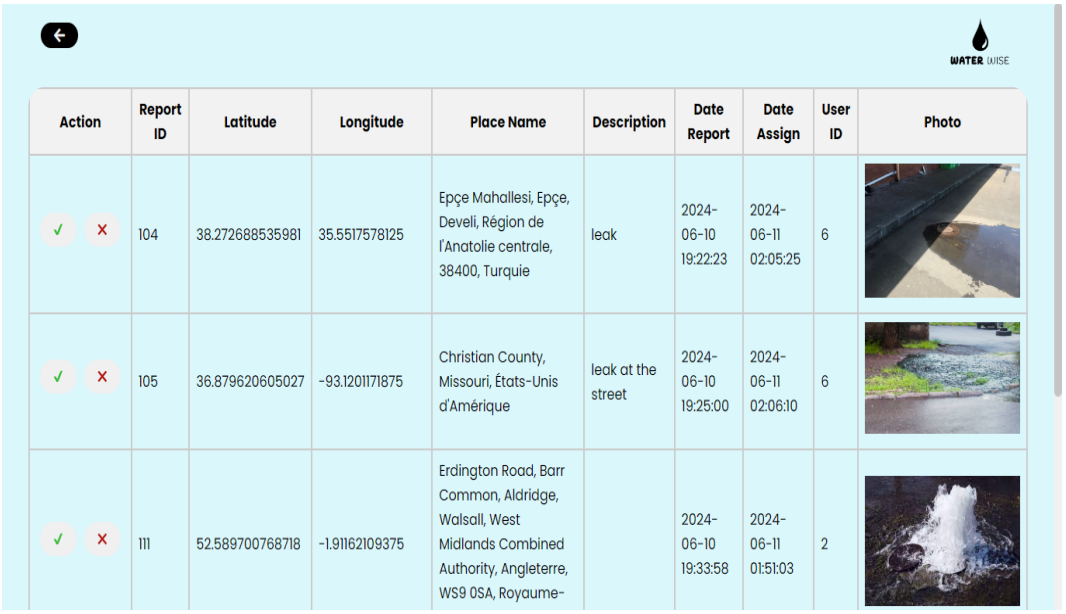


Figure III.79: Dashboard page.

- **Assigned Reports page:**

  The first card is "Assigned Reports," which contains all the reports assigned to the technician. Here, the technician has two options: reject the reports or validate

the work once finished.

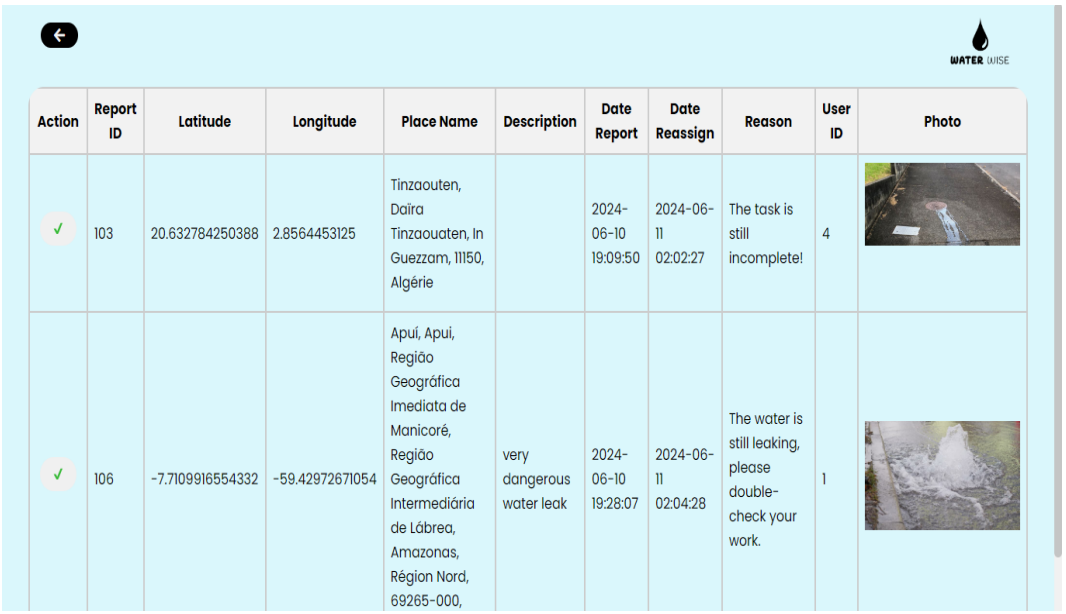


Action	Report ID	Latitude	Longitude	Place Name	Description	Date Report	Date Assign	User ID	Photo
✓ ✗	104	38.272688535981	35.5517578125	Epçe Mahallesi, Epçe, Develi, Région de l'Anatolie centrale, 38400, Turquie	leak	2024-06-10 19:22:23	2024-06-11 02:05:25	6	
✓ ✗	105	36.879620605027	-93.1201171875	Christian County, Missouri, États-Unis d'Amérique	leak at the street	2024-06-10 19:25:00	2024-06-11 02:06:10	6	
✓ ✗	111	52.589700768718	-1.91162109375	Erdington Road, Barr Common, Aldridge, Walsall, West Midlands Combined Authority, Angleterre, WS9 0SA, Royaume-		2024-06-10 19:33:58	2024-06-11 01:51:03	2	

Figure III.80: Assigned Reports page.

- **Reassigned Reports page:**

  The second card, "Reassigned Reports," represents the reports that a technician needs to redo. It includes an approval button for the completed work.



Action	Report ID	Latitude	Longitude	Place Name	Description	Date Report	Date Reassign	Reason	User ID	Photo
✓	103	20.632784250388	2.8564453125	Tinzaouten, Daïra Tinzaouaten, In Guezzam, 11150, Algérie		2024-06-10 19:09:50	2024-06-11 02:02:27	The task is still incomplete!	4	
✓	106	-7.7109916554332	-59.42972671054	Apuí, Apui, Região Geográfica Imediata de Manicoré, Região Geográfica Intermediária de Lábrea, Amazonas, Région Nord, 69265-000,	very dangerous water leak	2024-06-10 19:28:07	2024-06-11 02:04:28	The water is still leaking, please double-check your work.	1	

Figure III.81: Reassigned Reports page.

- **Edit Profile page:**

  The "Edit Profile" page enables technicians to edit their profiles.

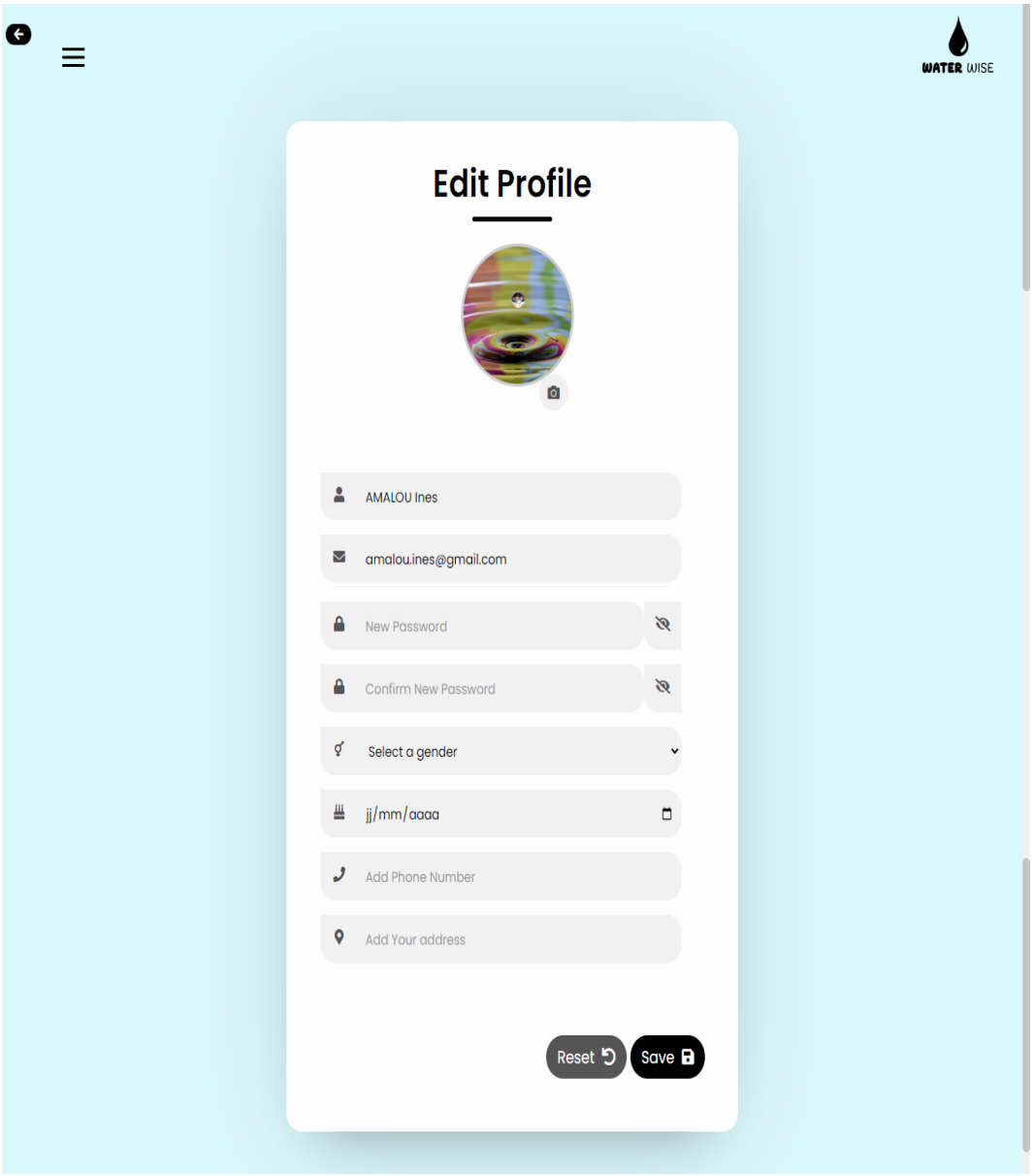


Figure III.82: Edit Profile page.

- **Change Password page:**

  "Change Password" page is a form for changing the password.

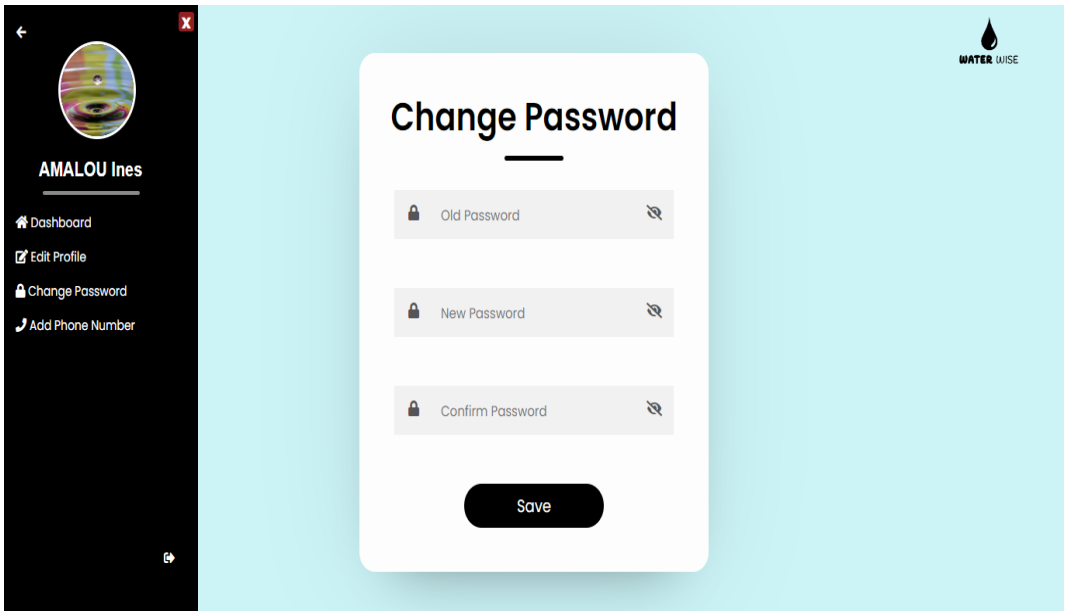


Figure III.83: Change Password page.

- **Add Phone Number page:**

  The "Add Phone Number" page allows users to input their phone number.

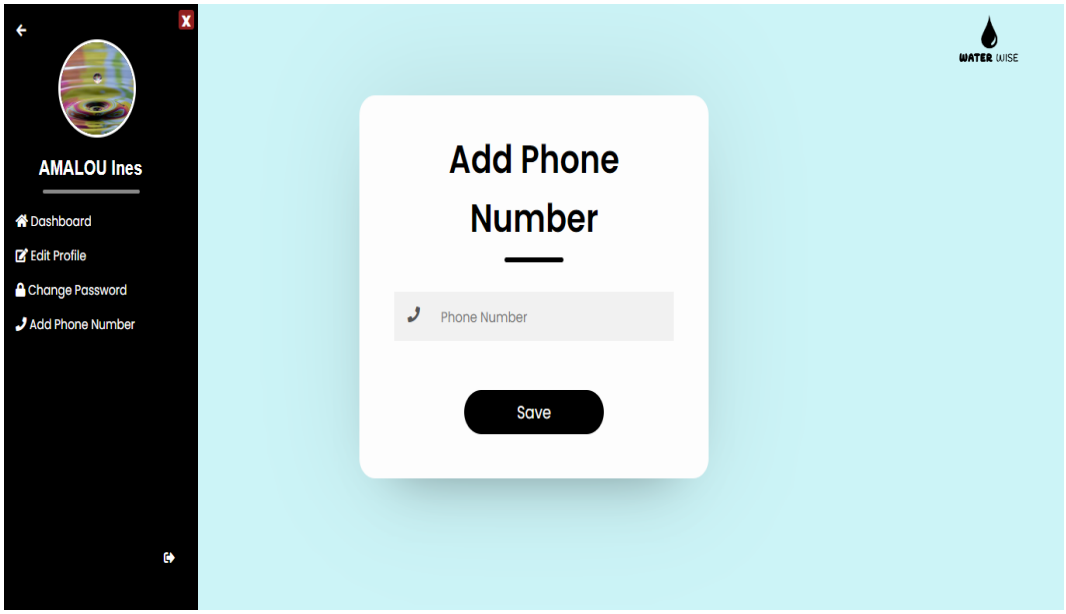


Figure III.84: Add Phone Number page.

III.6 Some examples of the source code

- **Footer section code:**

```
    <!-- footer section  -->
<footer>
    <div class="footer">
        <div class="footer-logo">
            <img src="../images/water-wise-logo.png" alt="logo" id="logo">
        </div>

        <div class="footer-list">
            <ul class="footer-elements">
                <li><a href="home.php">Home</a></li>
                <li><a href="services.php">services</a></li>
                <li><a href="help.php">Help</a></li>
            </ul>
        </div>

        <div class="footer-copyrights">
            <p>&copy;2024_WaterWise</p>
        </div>

        <!-- back to top -->
        <div class="back-to-top-button">
            <a href="#" class="back-to-top">
                <i class="bi bi-arrow-up-short"></i>
            </a>
        </div>

    </div>
</footer>
```

Figure III.85: Footer section code.

- **Dropdown menu code:**

```
<!--drop down menu-->
<div class="dropdown">
    <button onclick="myFunction()" class="dropdown-btn">
        <!--profile picture-->
        <div class="dropdown-profile-picture-container">
            <?php
                if (!empty($user['profile_picture'])) {
                        echo '<img src="../uploads/profile-pictures/' . $user['profile_picture'] . '" alt="Profile Picture"
                                class="dropdown-profile-picture">';
                } else {
                    $default_profile_picture = "../images/default-profile-picture.png";
                        echo '<img src="' . $default_profile_picture . '" alt="Default Profile Picture" class="dropdown-profile-picture">';
                }
            ?>
        </div>
    </button>

    <div id="dropdown-menu" class="dropdown-content">
            <div class="username">
                <?= $_SESSION['username']; ?>
                <hr class="dropdown-line">
            </div>

        <a href="favorite_posts.php"><i class="fas fa-heart icon"></i>Favorites</a>
        <a href="https://www.ade.dz/e-paiement/"><i class="fas fa-credit-card icon"></i>Pay Bill</a>
        <a href="delete_account.php"><i class="fas fa-trash-alt icon"></i>Delete Account</a>
        <a href="logout.php"><i class="fas fa-sign-out-alt icon"></i>Logout</a>
    </div>
</div>
```

Figure III.86: Dropdown menu code.

Chapter IV

Annex

The annex section, presents the sequence diagrams that illustrate the interactions within our application. These diagrams provide a detailed visualization of the processes and data flow, complementing the main text. Each diagram offers insights into the application's functionality, highlighting the communication between different components. This section is essential for understanding the intricate operations and ensuring accurate implementation.

IV.1 Sequence Diagram

Definition: A sequence diagram is a UML diagram that illustrates the sequence of messages between objects in an interaction. It consists of a group of objects that are represented by lifelines, and the messages that they exchange over time during the interaction.

Hereafter, we construct a sequence diagram for each use case:

- **Sequence diagram for the 'Registration' use case:**

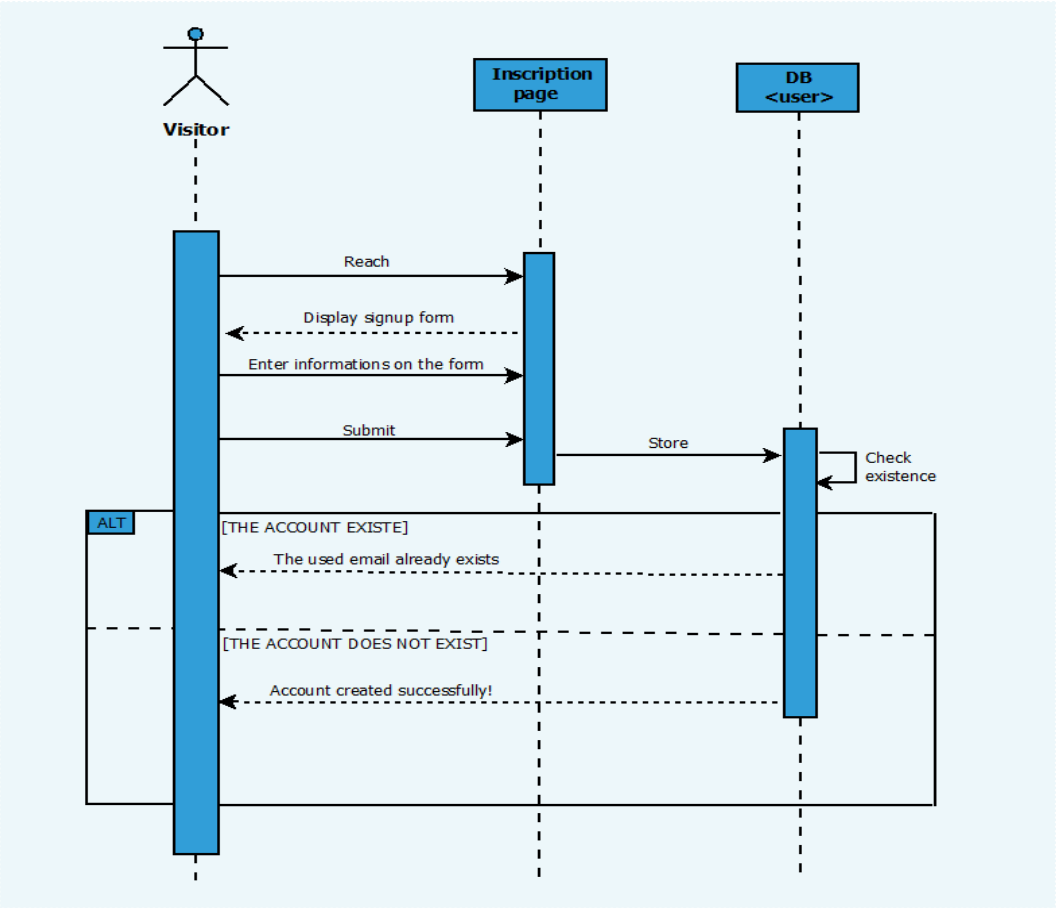


Figure IV.1: “Registration” sequence diagram

- **Sequence diagram for the ’Authentication’ use case:**

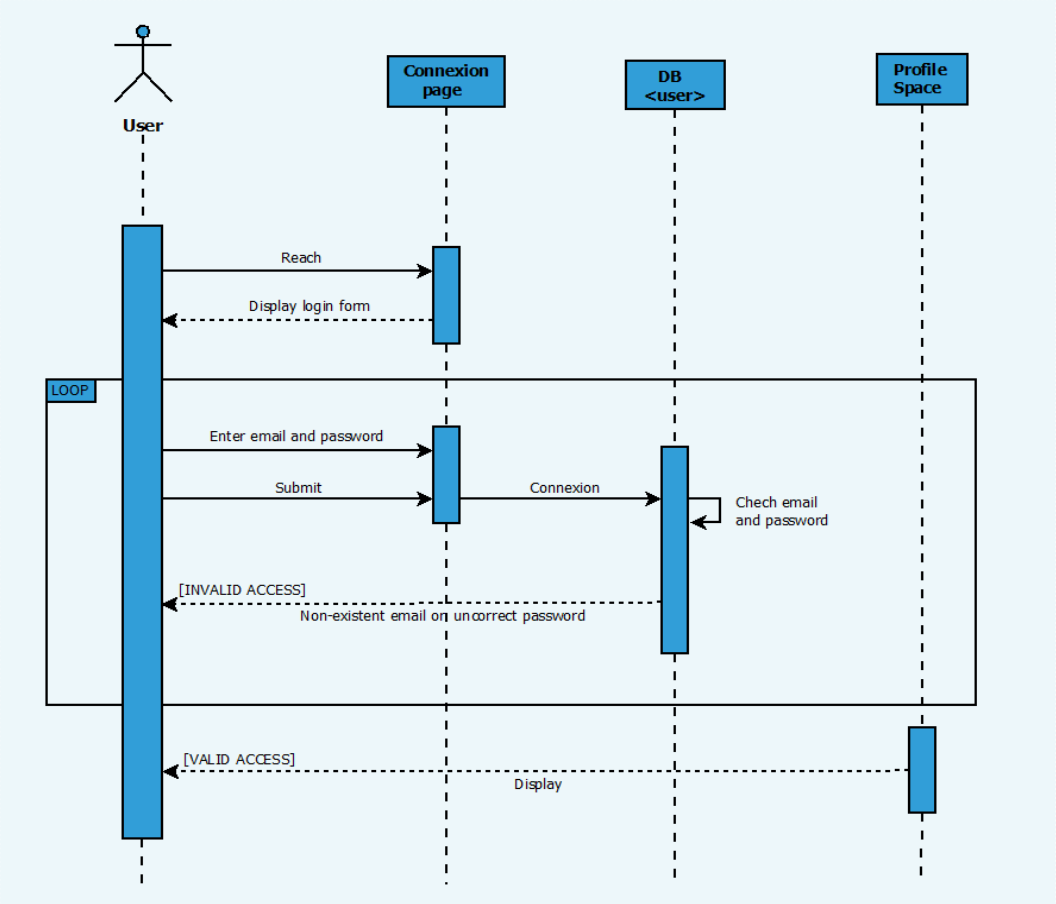


Figure IV.2: “Authentication” sequence diagram

- **Sequence diagram for the ’Contact Us’ use case:**

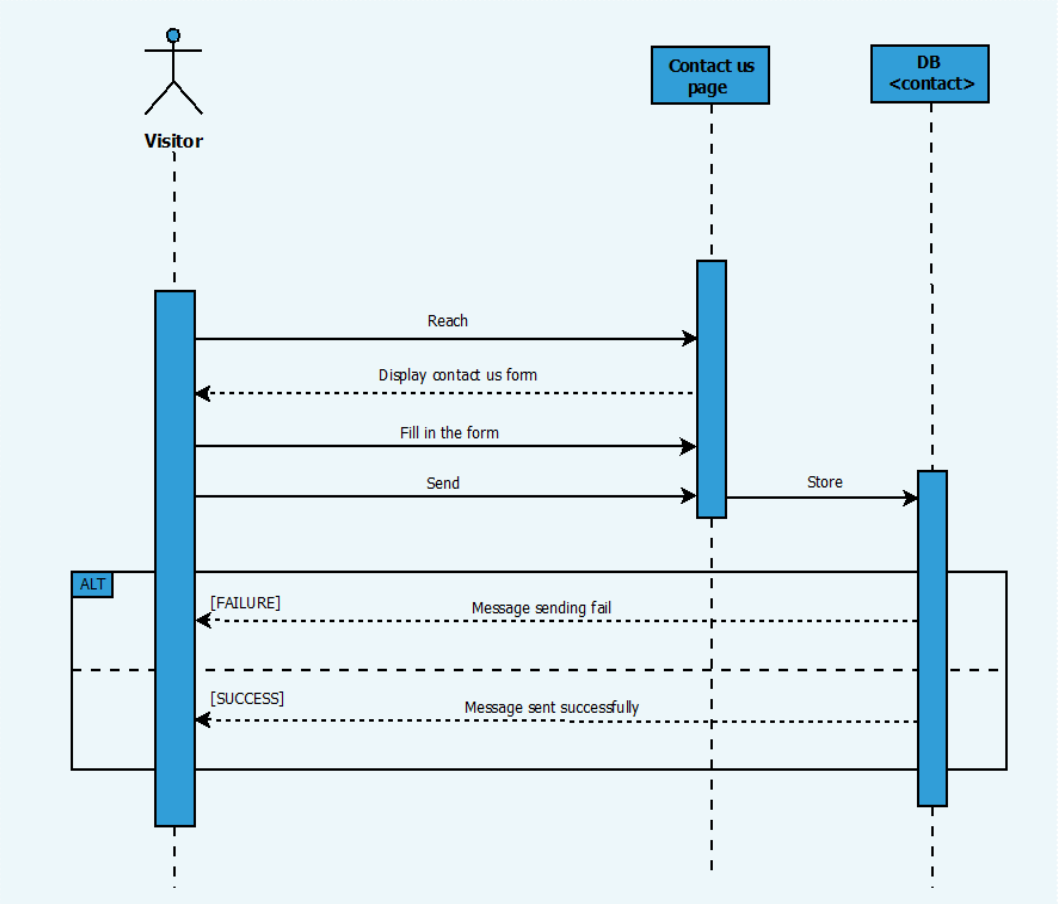


Figure IV.3: “Contact Us” sequence diagram

- **Sequence diagram for the ’Search’ use case:**

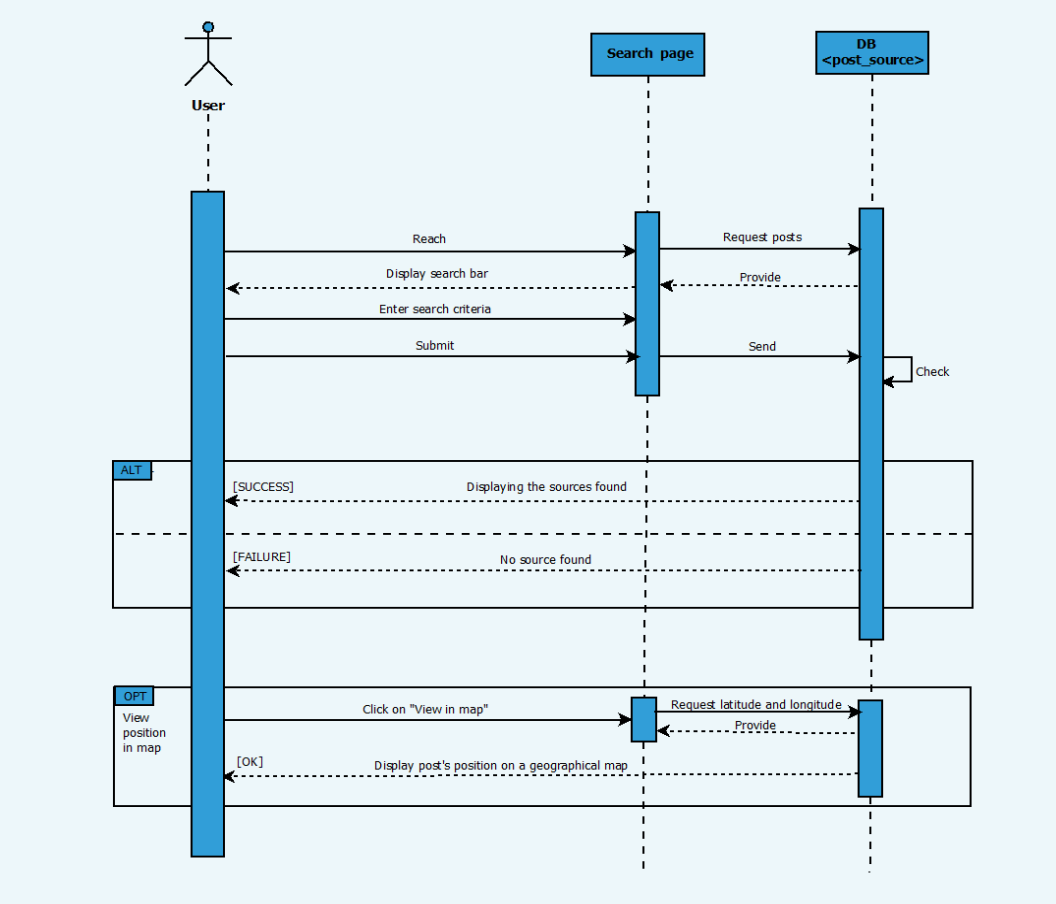


Figure IV.4: “Search” sequence diagram

- **Sequence diagram for the ’Add Post’ use case:**

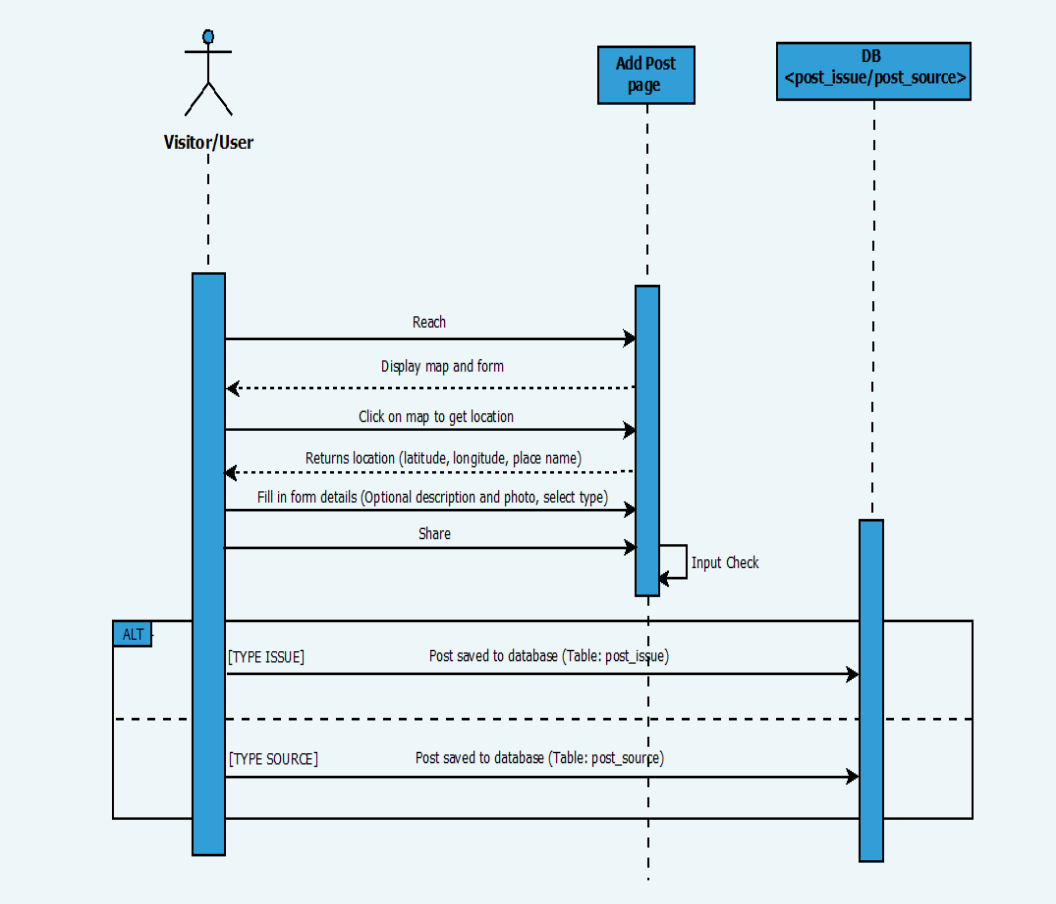


Figure IV.5: “Add Post” sequence diagram

- **Sequence diagram for the ’Manage Posts’ use case:**

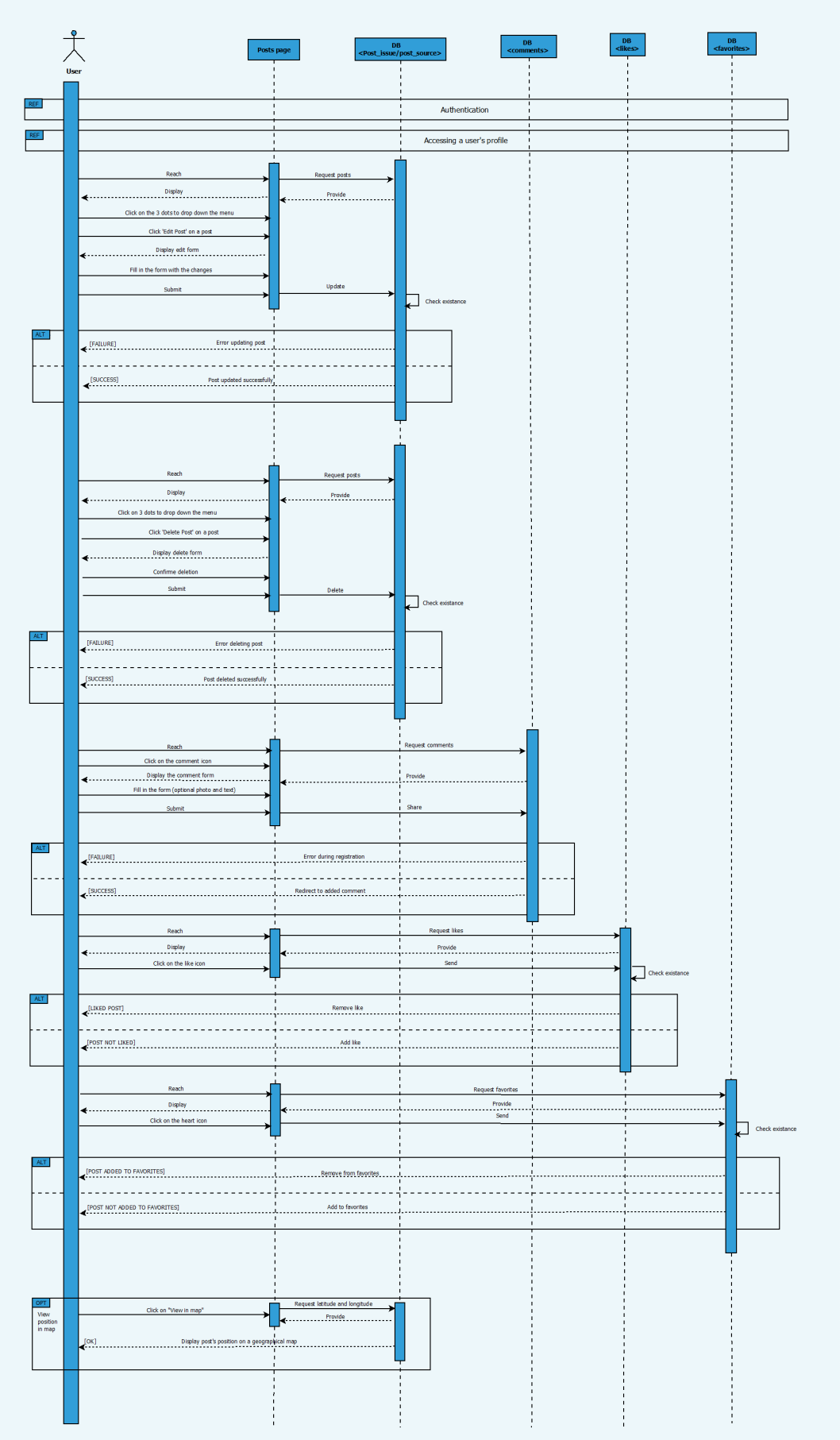


Figure IV.6: “Manage Posts” sequence diagram

- **Sequence diagram for the 'Manage Forum' use case:**

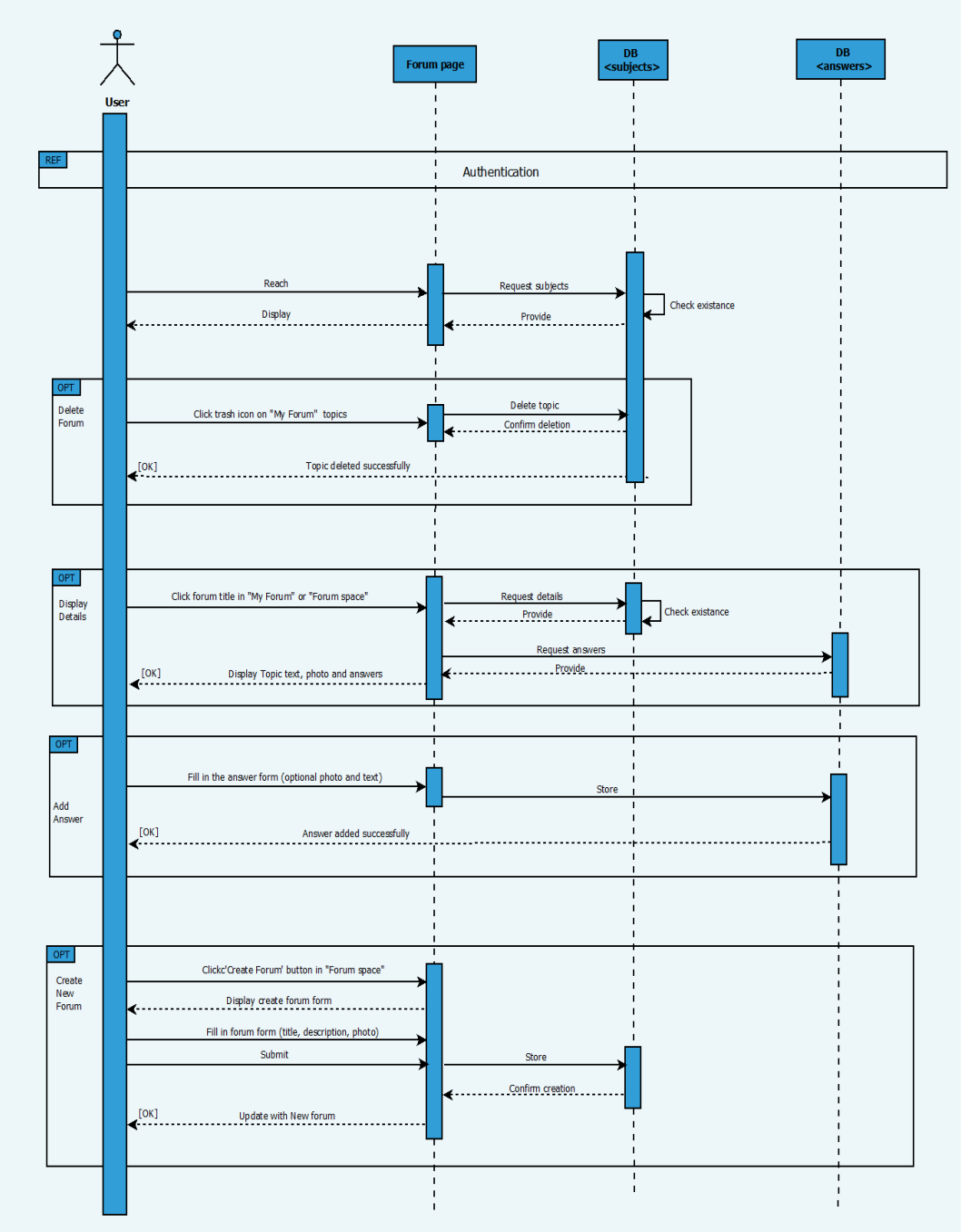


Figure IV.7: "Manage Forum" sequence diagram

- **Sequence diagram for the 'Assign Reports' use case:**

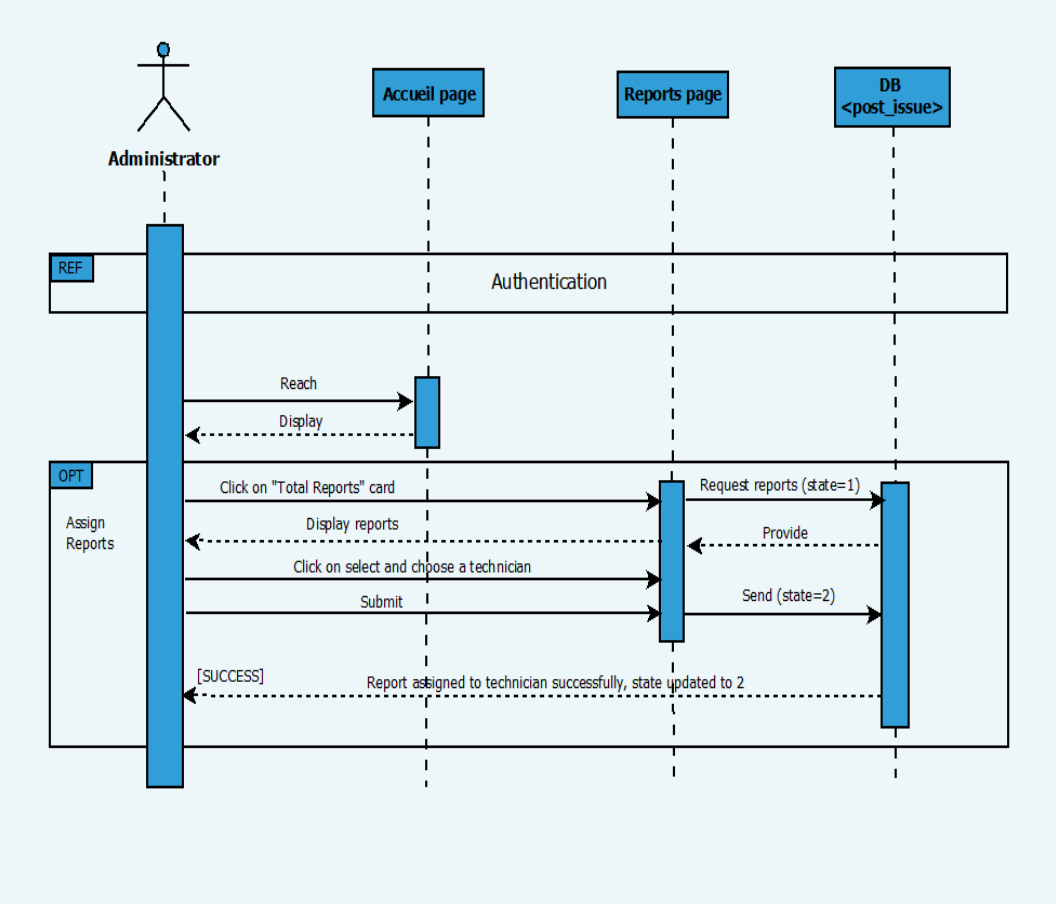


Figure IV.8: “Assign Reports” sequence diagram

- **Sequence diagram for the ’Manage users’ use case:**

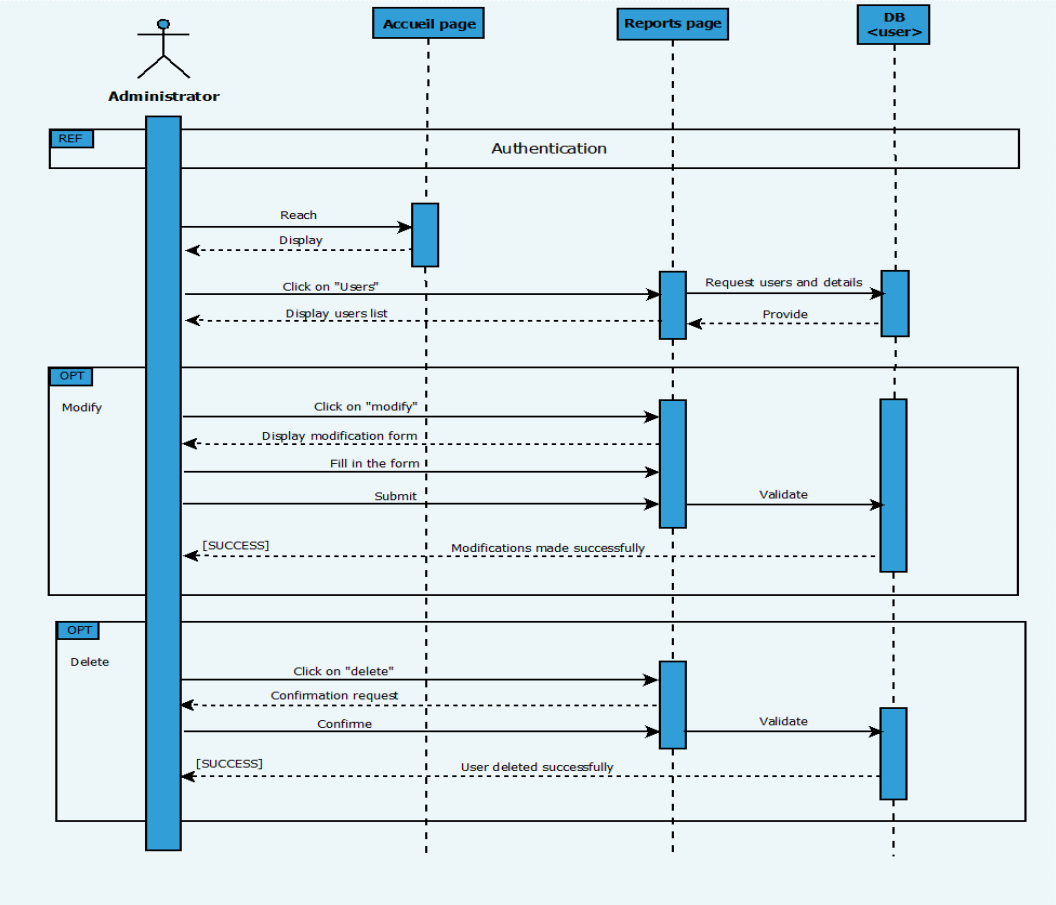


Figure IV.9: “Manage users” sequence diagram

- **Sequence diagram for the ’Manage messages’ use case:**

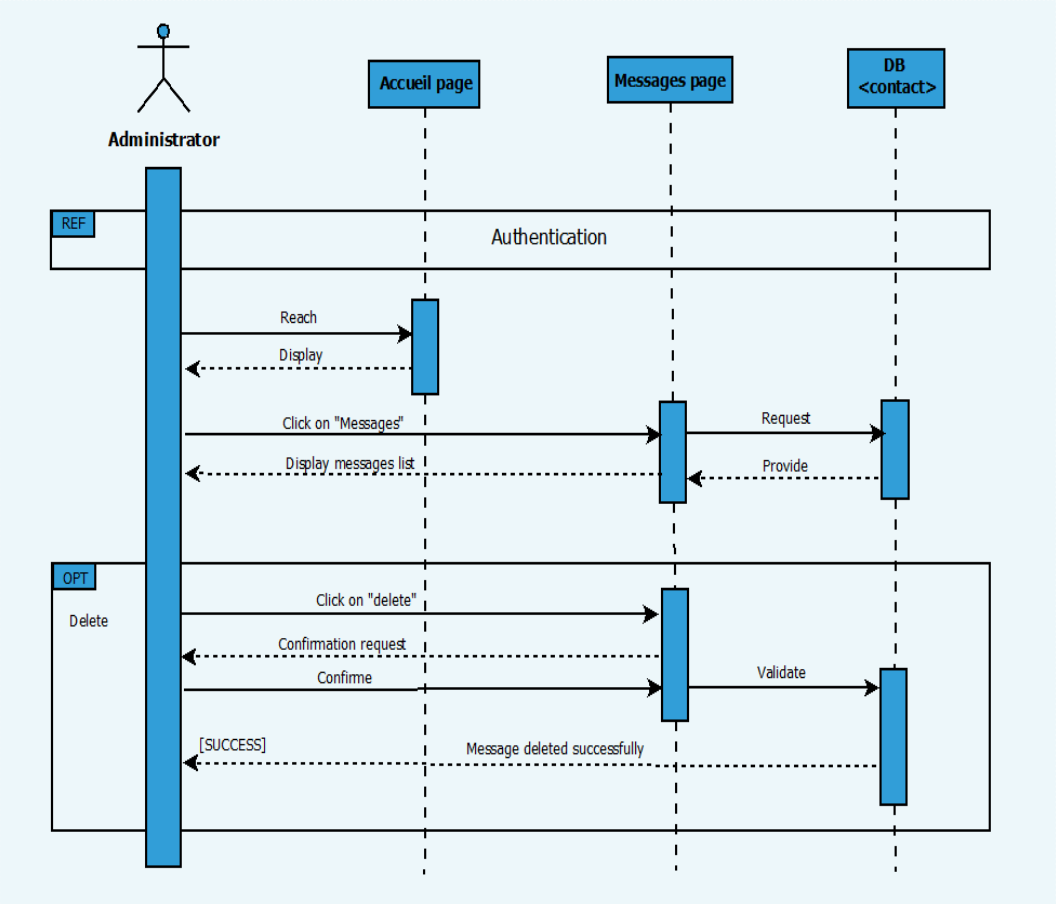


Figure IV.10: “Manage messages” sequence diagram

- **Sequence diagram for the ’Add technician’ use case:**

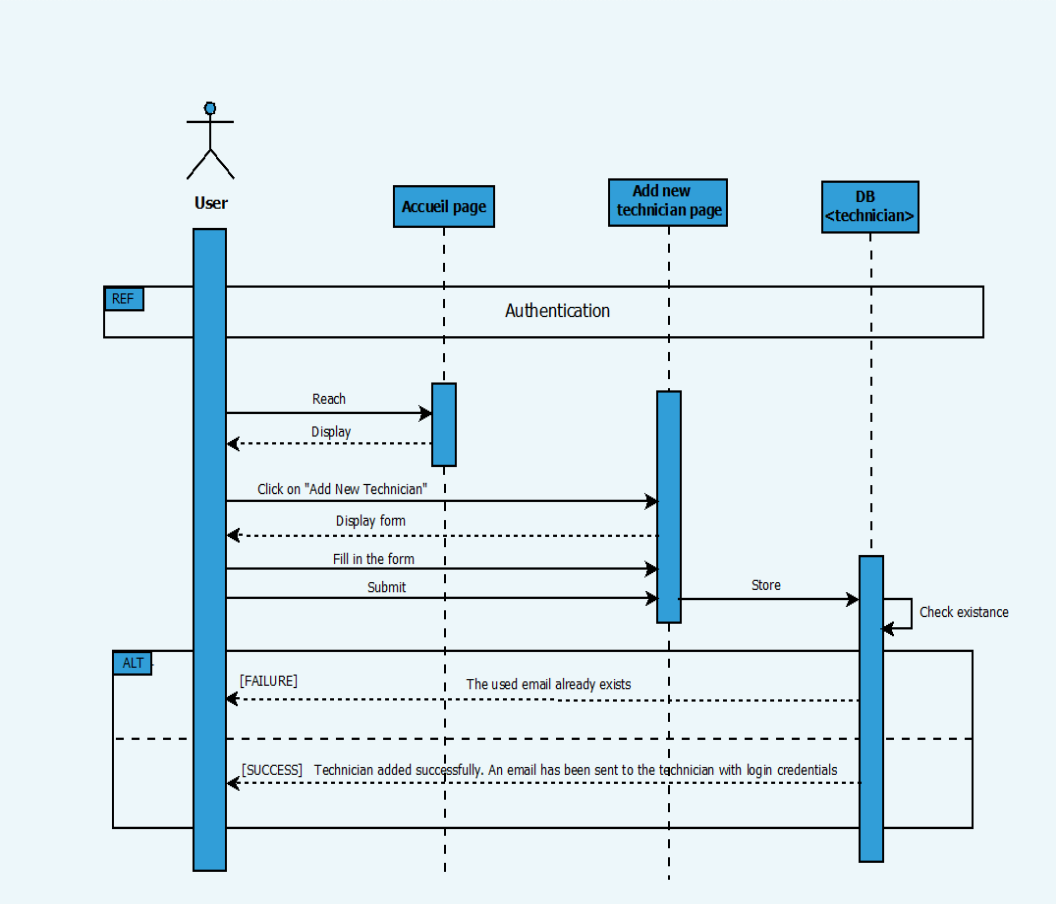


Figure IV.11: “Add technician” sequence diagram

- **Sequence diagram for the ’Assigned reports’ use case:**

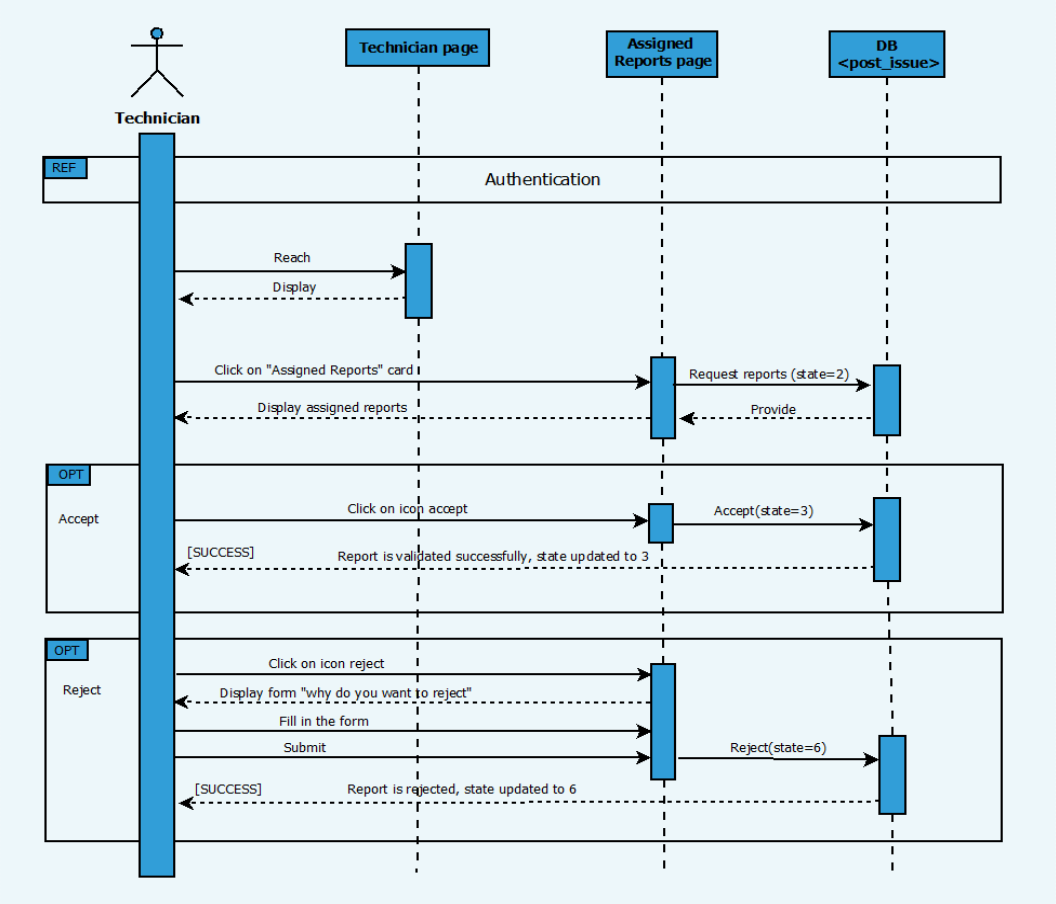


Figure IV.12: “Assigned reports” sequence diagram

General Conclusion and Perspectives

Conclusion

In these broader considerations, our project offers a specific implementation of the digital revolution as it continues to reorganize human-technology interactions, dilemmas and tensions in the form of contemporary water management challenges. From this understanding and utilizing concepts of collaboration and innovation, we launched WaterWise - a collaborative web application based on collective intelligence concept that helps to save water. WaterWise uses some of the latest technology to offer innovative new water management options to help secure supplies in an energy efficient way, while increasing public awareness of this precious resource. We have achieved all objectives stated above, and we have solutions to all challenges, which we have encountered. As such, our project demonstrates how web applications are tools for transformation that can encourage sustainability, collective responsibility and help build a future where technology and collaboration foster an environmentally sustainable society for generations to come.

Perspectives

Given the limited time, this work is only the beginning and remains open to significant expansion. Our goal is to refine and enhance our application, both in design and functionality, with the intent to develop these ideas further and broaden their scope as we progress. These enhancements include:

- Incorporate additional languages into the application.
- Add functionality that allows to display the quality of the water.
- Predict the user's consumption for the upcoming years.
- Ensure some of the application's functionalities work offline, such as searching for a water source or displaying favorite posts.
- Provide the option to download photos available in the application.

- Allow users to upload multiple photos simultaneously.
- Enable users to upload videos in the same way they upload photos.
- Track the movements of anonymous users while ensuring stringent security measures.
- Include comments management functionality in the administrator's dashboard.
- Add functionality for administrators to verify the counter numbers provided by users.
- Enable technicians to access the forum space, allowing them to assist users by addressing their questions and concerns.
- Add a news section to our application.
- Enable users to follow and message each other.
- Host our website.
- Adapt our website for multiple platforms, such as developing a mobile application that will be available on the Play Store.

Conclusion Générale

Dans ces considérations plus larges, notre projet offre une mise en œuvre spécifique de la révolution numérique alors qu'elle continue de réorganiser les interactions homme-technologie, les dilemmes et les tensions sous forme de défis contemporains de gestion de l'eau· À partir de cette compréhension et en utilisant des concepts de collaboration et d'innovation, nous avons lancé WaterWise - une application web collaborative basée sur le concept d'intelligence collective qui aide à économiser l'eau· WaterWise utilise certaines des dernières technologies pour offrir de nouvelles options innovantes de gestion de l'eau afin de sécuriser les approvisionnements de manière écoénergétique, tout en sensibilisant le public à cette précieuse ressource· Nous avons atteint tous les objectifs énoncés ci-dessus, et nous avons des solutions à tous les défis auxquels nous avons été confrontés· En tant que tel, notre projet démontre comment les applications web sont des outils de transformation qui peuvent encourager la durabilité, la responsabilité collective et contribuer à construire un avenir où la technologie et la collaboration favorisent une société écologiquement durable pour les générations à venir·

LIST OF ABBREVIATIONS

API	**A**pplication **P**rogramming **I**nterface
CDN	**C**ontent **D**elivery **N**etwork
CSS	**C**ascading **S**tyle **S**heets
DBMS	**D**ata **B**ase **M**anagement **S**ystem
DIA	**D**iagram **E**ditor
HTML	**H**yper **T**ext **M**arkup **L**anguage
IOT	**I**nternt **O**f **T**ings
JS	**J**ava **S**cript
OOP	**O**bject **O**riented **P**rogramming
OSM	**O**pen **S**treet **M**ap
PHP	**H**ypertext **P**reprocessor
RDBMS	**R**elational **D**ata **B**ase **M**anagement **S**ystem
SQL	**S**tructured **Q**uery **L**anguage
UML	**U**nified **M**odeling **L**anguage
VSC	**V**isual **S**tudio **C**ode