Background

In recent years, advancements in data analysis have allowed for more thorough assessments of landslide and flood hazards. Given the importance of safeguarding the lives of residents and tourists, it has become increasingly vital to monitor hazard levels in locations hosting large events. Our project specifically targets cities hosting the XXV Winter Olympic Games, which are popular tourist destinations. These cities are often situated in mountainous regions, making them susceptible to landslides and flooding. Certain areas, such as Milan with its Seveso River overflows or Valtellina's Ruinon landslide, have experienced severe events that have had significant impacts on residents.

Purpose

Our project aims to address the safety concerns surrounding locations hosting events for the XXV Winter Olympic Games, which are prominent tourist destinations. Given the susceptibility of these cities to landslides and flooding, particularly during the winter months, it is crucial to provide authorities and tourists with accurate and timely hazard assessments. By leveraging advancements in data analysis and visualization techniques, our project seeks to empower stakeholders to make informed decisions regarding safety measures and risk mitigation strategies. Ultimately, the goal is to enhance the safety and well-being of residents and tourists during the Olympic Games and beyond.

OVERALL DESCRIPTION

Scope

Our project's scope encompasses the development of a user-friendly web application designed to assess the safety of locations hosting events for the Milan-Cortina 2026 Winter Olympics, particularly for tourists and community members. This application will enable users to access, process, and visualize data and maps related to hazard risks in these areas. By providing interactive maps, historical data analysis, and notification systems, the app aims to enhance user awareness of potential risks and assist in making informed decisions regarding safety measures. Initially, the project will utilize data from the IdroGeo API to analyze various hazard indicators and visualize them for the selected cities hosting Olympic events, including Milan (MI), Cortina (BL), Rho (MI), Assago (MI), Bormio (SO), Livigno (SO), Predazzo (TN), Rasun-Anterselva (BZ), Tesero (TN), and Verona (VR).

User Characteristics

Based on our predictions, users of the application can be categorized into two main groups: general users and experts.

General Users:

- General users, including tourists and event attendees, may use the application for trip planning and decision-making.

- They rely on environmental analysis and hazard predictions to ensure their safety during visits to areas prone to landslides and floods.

- General users seek information on potential hazards and vulnerabilities to make informed choices about their activities and routes.

Experts:

- Experts, such as emergency responders, researchers, and urban planners, utilize the application for in-depth analysis and risk assessment.

- They leverage advanced predictive capabilities and detailed hazard data to develop comprehensive emergency response plans.

- Experts identify and assess potential hazards and vulnerabilities at a granular level, contributing to the development of strategies to mitigate risks and enhance resilience to natural disasters.

By distinguishing between general users and experts, we highlight the different needs and objectives of these user groups when interacting with the application.

User Story

Story 1 — Query landslide/flood data to plan travel

As a traveller, I want to query landslide/flood information of my destination (location), so that I can adjust my plans accordingly and ensure a safe journey.

Story 2 — Develop emergency response plan

As an emergency response expert,I want to track detailed hazard data,so that I can develop emergency response plans effectively.

Story 3 — Utilize landslide/flood data for urban planning

As a city planner, I want to utilize historical flood and landslide data, so that I can incorporate risk mitigation measures into urban development plans.

Use Cases

Actors : Non Register User, Interactive web app, IdroGeo API

Entry condition:true(The application can always query the landslide data for a

city(location) in IdroGeo API)

Case 1 — Basic data visualisation

Flow of events:

- The non-registered user accesses the application.

- The application provides the user with a drop down bar to select the desired city(location).

- The non-registered user choose the city(location) for which they want to retrieve landslide data.

- The application sends a query to the IdroGeo API with the city(location)

- The IdroGeo API returns the landslide data for the city(location)

- The application displays the retrieved landslide data/ visualization to the non-registered user.

Exceptions: if the application fails to query the IdroGeo API for landslide data, it displays an error message to the non-registered user and prompts them to try again later.

Special Requirements: the application displays the geological data or visualizations returned from the IdroGeo API in an effective way, using formats such as tables, charts, or maps. The presentation should be easy to understand
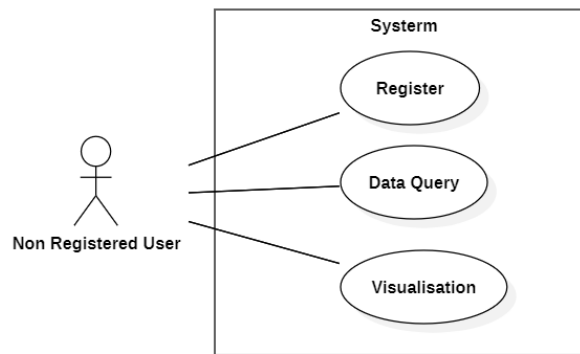
Case 2 —Register

Flow of events:

- The user clicks on the user profile icon to open the dropdown showing account actions

- The user clicks on the register icon

- The user navigates to the registration page

- The system presents the user with input fields for username and password

- The user enters their username and password into the respective fields

- The user submits the registration form

- The system validates the entered information, ensuring that the username are unique

- If the validation is successful, the system creates a new account for the user and stores their registration details

- The system notifies the user that their registration was successful

Exceptions: if the systerm fails to creat a account, it displays an error message to the non-registered user and prompts them to try again later.

Special Requirements:the username should be unique

Actors : Register User, Application, IdroGeo API

Entry condition:true(The application can always query the landslide data for a city(location) in IdroGeo API)

Case 3 — log in

Flow of events:

- The user clicks on the user profile icon to open the dropdown showing account actions

- The user clicks on the login icon

- The user navigates to the login page

- The system presents the user with input fields for username and password

- The user enters their username and password into the respective fields

- The user submits the login form

- The system verifies the entered username and password

- If the credentials are valid, the system logs the user into their account and redirects them to the home page.

Exceptions: if the credentials are invalid, the system displays an error message indicating that the login attempt failed

Special Requirements:the user must have an existing account under the same username

Case 4 — Hazard Report

Flow of events:

- The user clicks on the report icon

- The user navigates to the report page

- The system presents the user with input fields for username ,city name ,hazard type

- The user enters their username ,city name ,hazard type into the respective fields

- The user submits the form

- The system store the information

Exceptions: if the store is failled, the system displays an error message indicating that the store is failed

Special Requirements:the user must log in
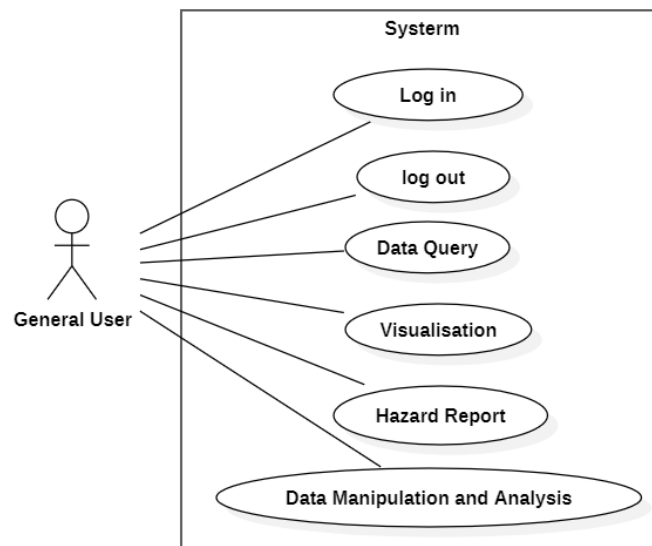
Actors : Expert User, Application, IdroGeo API

Entry condition:true(The application can always query the landslide data for a

city(location) in IdroGeo API)

Case 5 — Data Analysis

Flow of events:

- The expert user accesses the detailed hazard data feature within the application

- The application presents options for selecting the type of hazard data and the geographic area of interest

- The expert user selects the desired hazard dataand specifies the geographic area for analysis

- The application retrieves the detailed hazard data and area from the database or IdroGeo API

- The application presents the retrieved hazard data to the expert user

Exceptions: if the data is void, the system displays an error message indicating that the data is void

Special Requirements:the user must be expert user

Case 6 — log out

Flow of events:

- The user clicks on the user profile icon to open the dropdown showing account actions

- The user choos log out icon

- The system logs the user out of their current session

- The system displays a confirmation message indicating that the user has been successfully logged out

Exceptions: If log out failled , the system displays an error message indicating that the log out attempt failed

Special Requirements:the user must be log in
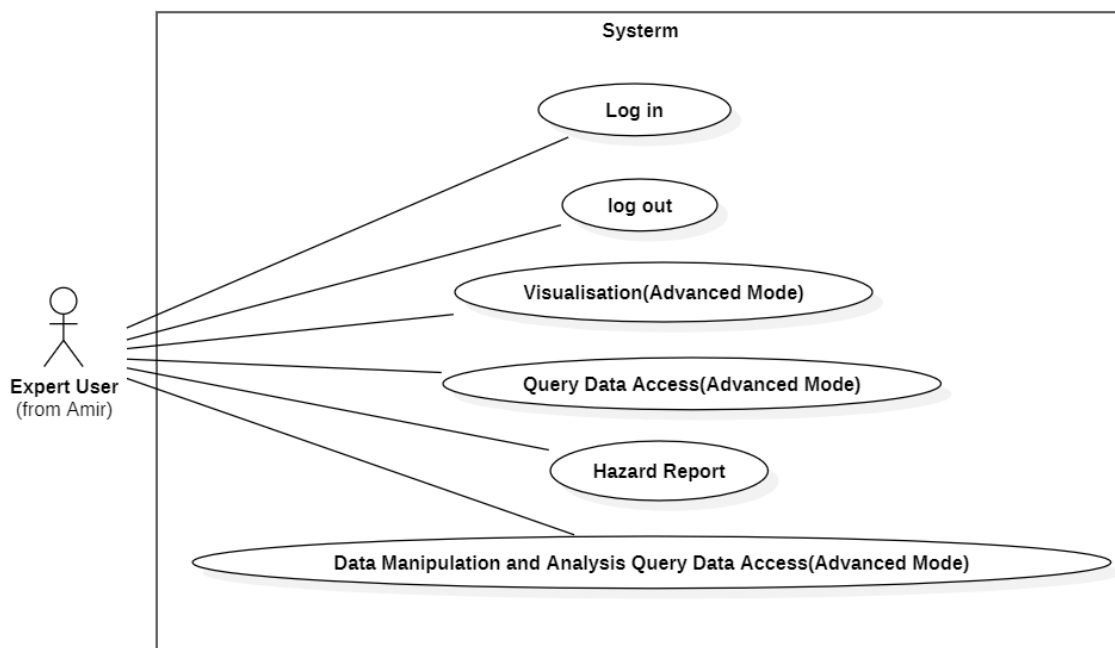
Functional Requirements

 The functional requirements of the system are categorized based on user roles, namely general users and experts, to cater to their specific needs and capabilities:

For General Users:

1. Visualization of Hazard Data:

   - Utilize an interactive map interface to display hazard data for requested cities.

   - Represent hazard levels using intuitive color-coded indicators on the map.

2. Spatial Measurements:

   - Allow users to take spatial measurements, including distances and areas, directly on the interactive map.

3. Simple Querying:

   - Provide a user-friendly interface for creating simple queries to analyze landslide and flood phenomena.

4. Basic Data Display:

   - Display hazard data through thematic maps or charts in a simplified format for easy comprehension.

5. Metadata Access:

   - Allow users to view basic metadata information of the hazard indicators used in the system.

6. Reporting Hazards:

   - Enable users to report hazardous situations encountered by providing a simple reporting interface.

   - Allow users to report the severity of hazards using a predefined scale (e.g., 5 levels).

For Experts:

1. Advanced Querying:

   - Provide advanced query functionalities for experts to conduct in-depth analyses of hazard data.

   - Enable experts to create specific queries by combining various types of hazard-related information from the database.

2. Detailed Data Display:

   - Present hazard data with detailed indicators and attributes for experts to perform comprehensive analyses.

3. Metadata Export:

- Allow experts to export metadata information of hazard indicators for further analysis or documentation purposes.

4. Hazard Reporting:

- Enable experts to report hazardous situations with detailed information on hazard indicators, severity levels, and location specifics.

- Provide an interface for experts to attach additional documentation or evidence related to reported hazards.

5. Administrative Actions:

- Allow system administrators to review and validate hazard reports submitted by experts.

- Provide functionality for administrators to approve or reject reported hazards based on validation criteria.

By incorporating these functional requirements, the system will effectively support both general users and experts in assessing and responding to landslide and flood hazards in areas hosting the Winter Olympic Games.

Non-functional Requirements

1. **Performance**:

- Response time for data queries and visualization tasks should be less than 5 seconds to enhance user experience.

- The system should be capable of handling concurrent user access and maintaining performance during peak usage periods.

2. **Security**:

- User authentication and authorization mechanisms should be enforced to control access to sensitive data and features within the application.

- Data encryption techniques should be employed to protect user privacy and ensure the confidentiality of information transmitted over the network.

3. **Reliability**:

- The system should be highly available, with minimal downtime for maintenance or updates, to ensure uninterrupted access for users.

- Fault tolerance mechanisms should be implemented to mitigate the impact of system failures and ensure data integrity and consistency.

4. **Scalability**:

- The system should be designed to accommodate potential growth in data volume and user traffic, ensuring scalability to meet future demands.

5. **Usability**:

- The user interface should be intuitive and user-friendly, with clear navigation and easily understandable visualizations to facilitate data exploration and analysis.

6. **Maintainability**:

- The codebase should be modular and well-structured to facilitate future maintenance, updates, and enhancements to the application.

- Comprehensive documentation, including system architecture and user guides, should be provided to support developers, administrators, and end-users in understanding and maintaining the software.

SYSTEM MODELS

Activity Diagram
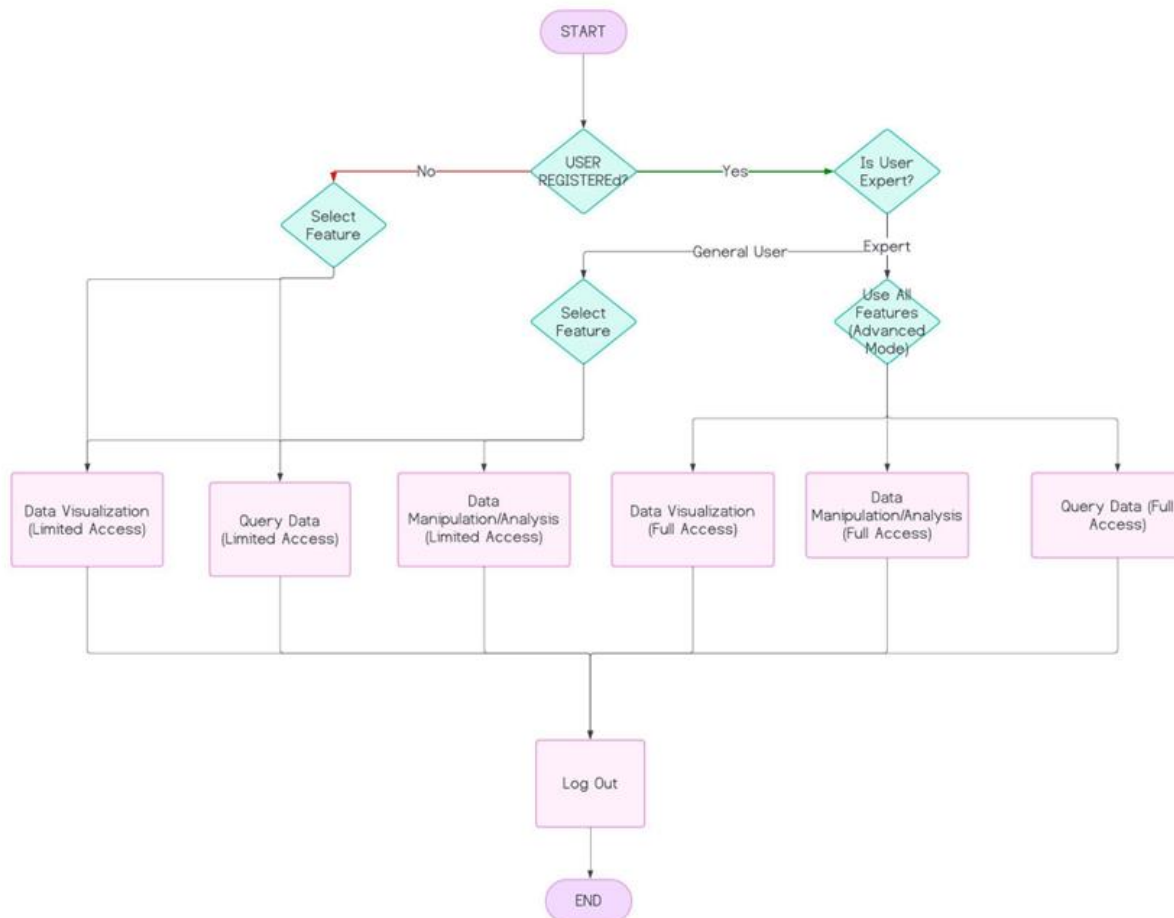
The process begins with users having the option to either register or proceed without registering. If already registered, users can log in; otherwise, they can continue with limited access.

Query Data

This functionality enables both visitors and experts to retrieve specific data:

- Surface areas prone to flood risk
- Buildings susceptible to flood damage
- Surface areas vulnerable to landslides
- Buildings at risk of landslides

Experts (e.g., civil protection, requiring login) can access additional data:

- Population residing in flood-prone areas
- Population at risk of landslides
- Local business units facing flood risks
- Local business units vulnerable to landslides
- Cultural heritage sites at risk of landslides
- Cultural heritage sites vulnerable to floods
- Families at risk of landslides
- Families at risk of floods

Users must provide the following information to retrieve desired data:

- Region name
- Province name
- Municipality name

Geographic Visualization

This functionality enables both visitors and experts to visualize data geographically and make spatial measurements directly on the interactive map. Users can select specific indicators, causing the map to change colors in each region using a bar legend (heatmaps).

If users are registered, they gain access to additional functionalities upon logging in:

Data Manipulation & Analysis:

This feature empowers users to manipulate data, conduct analyses, and report new accidents, including:

- Creating specific queries with the option of leveraging data present in the database by combining various types of information.

- Displaying data through thematic maps or charts.

- Viewing the metadata of the indicators used.

- Reporting new accidents or modifying existing ones as necessary.

After performing any operations, the user can choose to end the process.