**Requirement Analysis and Specification Document**

***Emilia-Romagna region*** *exposure to potential risk and hazard to* ***flooding*** *and its impact on* ***households***

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Requirement Analysis and Verification

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1. **Contextualization**

According to Steinhausen et al. (2022), Italy is the third country with the highest probability of suffering from flooding after Germany and France. Flooding has constantly proved to be a hazard for many Italian cities, impacting households and posing a severe risk to citizens' safety and health. Flooding is a significant and persistent problem in several Italian cities, particularly in the Emilia-Romagna region, where the region was last hit by a devastating flood in May 2023 which killed 17 people and caused over 7 billion euros in damage (Bertazzi, Marco) Therefore, it is crucial to assess the possible risks and dangers related to flooding in the area and devising effective solutions to lessen its impact.

1. **Objectives**

The RASD document provides a comprehensive and assertive analysis of this issue, focusing on critical aspects such as requirements, stakeholders, actors, and use cases; to facilitate better planning and flood-risk management to prevent or mitigate future flooding scenarios. This will be obtained by building a web application as an open-source, for any user to access and benefit from the information captured.

1. **Scope and Limitations**

The development of a web-based tool to query, visualize, and analyze data is proposed. Information about potential natural hazards such as flooding, only for the region of Emilia-Romagna will be furnished to any user who wants to save this data. Information data will be redeemed from the PIR (Hazards and Risk Indicators) of The Italian Institute for Environmental Protection and Research (ISPRA) IdroGEO API.

The web application proposed will allow the user to obtain simple statistical values such as probability rates, and correlating factors among risk and season incidence. The period that will be used to feed the software is from XXXX to XXXX, and will be delimited by the following factors: X, X, X.

1. **Solution Overview**

The software will provide the user with visual data analytics of Emilia-Romagna’s territory color classified by risk. Considering that risk will be a mathematical relation between severity and probability, a matrix chart will be provided for better understanding.

| **Severeness**  **Probability** | **Catastrophic: 4** | **Critical: 3** | **Moderate: 2** | **Marginal: 1** |
| --- | --- | --- | --- | --- |
| **Frequent: 5** | **High** | **High** | **High** | **Medium** |
| **Probable: 4** | **High** | **High** | **Serious** | **Medium** |
| **Occasional: 3** | **High** | **Serious** | **Medium** | **Low** |
| **Remote: 2** | **Serious** | **Medium** | **Low** | **Low** |
| **Improbable: 1** | **Medium** | **Low** | **Low** | **Low** |

***Table No. 1*** *- Risk (Probability vs Severeness) Matrix*

Data will be available and displayed to the user, in the following formats:

* Metadata text
* Attribute tables
* Regional map
* Risk matrix of place and season
* Charts

Likewise, the software will provide information based on statistical calculations and risk assessment. It will also provide the sum of millimeters of rain as context for the seasonal risk. Comparisons and correlation factors among data.

1. **Phenomena Description**

1.World Phenomena

The real world phenomena related to our study is the probability of flooding in a given area, and the potential  damage posed to the households in that area.

Flooding is mainly influenced by precipitation levels and rainfall intensity. The severity and probability of flooding vary depending on the local topography, terrain, and the degree of flood control infrastructure development.

The flood indicator can be calculated using various models. In this case, we adopt the flood indicator provided by IdroGEO.

Likewise, the severity of the impact on local households can also be calculated using multiple models . In this scenario, we will focus on the web app ,and provide users with the necessary data in the query results, such as the number of families, residences, buildings, etc., enabling users to obtain the data and conduct their analysis.

1. Machine Phenomena

**Data acquisition and update**:get relative data in time via API request.

**Data visualization**: to visualize the basemap,for users to have an intuitive  way to inveraction with map data, and display the results of spatial analysis.

**Geospatial data analysis**: Performing spatial analysis by using geopandas.

**Data storage**：storing the acquired data for user manipulation and geospatial analysis,

1. Shared Phenomena

Search: Allows both user and the machine to query for geospatial coordinates, to determine area of flood risk analysis

Retreive data: After inserting geospatial coordinates, the data is retrieved by the machine and user.

Visualization: The machine provides a visualized map of various colors, corresponding to the aforementioned risk matrix, for users to identify and evaluate.

Sort and Analyze: The user is able to specify certain points using the interface, which the machine can recall information related to Metadata text, Attribute tables, Regional map, Risk matrix of place and season, Charts

1. **Requirements**

The success of the software will be achieved by satisfying the user's needs

1. **Functional requirements**

* The system will allow users to query a specific comune or municipality’s (to be determined) flood risk and demographic data in Emilia-Romagna. The system is able to retrieve and plot the demographic indicators (population density, age group, family household, etc. tbd) and/or buildings alongside their corresponding flood risk.

A print out of the dashboard will be provided for download in PDF format.

1. **Non-Functional requirements**

* Data visibility will be clear and attractive, a color gradient will differentiate flood risk indicators (look for the ISO norm mentioned in GIS class lol).
* Color gradient will distinguish demographic data
* (if we have it) Building data will be represented by the geospatial footprint in contrasting color with the base map
* The program's interface will be informative, showing the geographic coordinates/projection and legend that delineates the indicators.
* The information concerning demographic data and flood risk indicators will be displayed in English for ease of use.

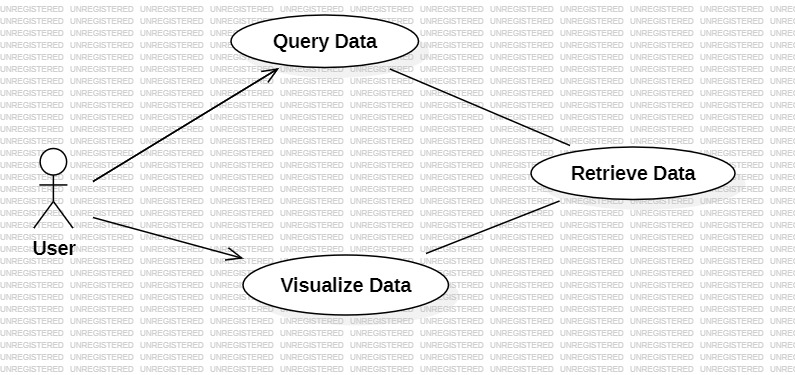
1. **Technical requirements**

* The language of implementation will be Python, using Anaconda and Jupyter Notebook as development tools
* Geopandas will be mainly be used to visualize and analyze data(Don’t forget to add the database and webservice).

1. **Domain Assumptions**

Users will have access to the project repository in GitHub. This platform will serve as a channel where users can provide feedback, resolve frequently asked questions, and give constructive criticism to improve the service. This will be achieved by providing a general e-mail for users to write the developers.

1. **Use Cases**
   1. ***Diagram***



* 1. ***Description***

|  |  |
| --- | --- |
| **Use Case No. 1** | |
| **Name** | Data Query |
| **Primary Actors** | User |
| **Entry** | Hazard Risk Identification |
| **Flow of Events** | **1.** User accesses the search field to start the query  **2.** User indicates the desire to search for a specific place and its flooding risk  **3.** User selects the scenario and season  **4.** System displays search results matching users' supplied criteria  **5.** User acknowledges |
| **Exit** | User acknowledges information retrieved |
| **Exceptional Cases** | **a.** User searches an area out of the study zone  **b.** User decides to change zone before querying information |
| **Special Requirements** | User only receives the information searched and not other |
| **User Story** | As a user, I want to query data so that I can identify possible hazard risks in a certain region inside Emilia-Romagna's zones |

***Table No. 2*** *- Use Case No. 1*

|  |  |
| --- | --- |
| **Use Case No. 2** | |
| **Name** | Data Analysis |
| **Primary Actors** | User |
| **Entry** | Analytical assessment with provided data |
| **Flow of Events** | **1.** User sorts the relevant information  **2.** User asks the system to display the metadata and attribute tables  **3.** System displays search results matching users' supplied criteria  **4.** User acknowledges |
| **Exit** | User acknowledges information retrieved |
| **Exceptional Cases** | **a.** User searches for additional information that is not provided by the software  **b.** User decides to change zone while querying information |
| **Special Requirements** | User only receives the information searched and not other |
| **User Story** | As a user, I want to analyze data in a particular area, so that I can identify possible hazard risks in Emilia-Romagna's zones |

***Table No. 3*** *- Use Case No. 2*

|  |  |
| --- | --- |
| **Use Case No. 3** | |
| **Name** | Statistical Analysis |
| **Primary Actors** | User |
| **Entry** | Statistical Computations |
| **Flow of Events** | **1.** User selects the basic statistical computations to be calculated  **2.** System displays data results matching users' supplied criteria  **3.** User acknowledges |
| **Exit** | User acknowledges information retrieved |
| **Exceptional Cases** | **a.** User desire more complex calculations  **b.** User decides to change statistical computation before previous calculations have been displayed |
| **Special Requirements** | User only receives the information searched and not other |
| **User Story** | As a user, I want to run statistical analyzes, so that I can comprehend the probability, correlations, and risk in Emilia-Romagna's zones |

***Table No. 4*** *- Use Case No. 3*

|  |  |
| --- | --- |
| **Use Case No. 4** | |
| **Name** | Data Visualization |
| **Primary Actors** | User |
| **Entry** | Data Visualization |
| **Flow of Events** | **1.** User specifies the data that wants to be visualized  **2.** User determines the way the data is represented (tables/graphs)  **3.** User acknowledges |
| **Exit** | User acknowledges information retrieved |
| **Exceptional Cases** | **a.** User does not specify the data to be displayed  **b.** User decides to change data while representing information |
| **Special Requirements** | User only receives the information searched and not other |
| **User Story** | As a user, I want to visualize data in different forms, so that I can study possible hazard risks in Emilia-Romagna's zones |

***Table No. 5*** *- Use Case No. 4*

|  |  |
| --- | --- |
| **Use Case No. 5** | |
| **Name** | Data Download |
| **Primary Actors** | User |
| **Entry** | Data Download |
| **Flow of Events** | **1.** User specifies the data that wants to be downloaded  **2.** User determines the format in which the data is downloaded (cvs, txt, xml)  **3.** User acknowledges |
| **Exit** | User acknowledges information retrieved |
| **Exceptional Cases** | **a.** User does not specify the format  **b.** User decides to change format while downloading information |
| **Special Requirements** | User only receives the information searched and not other |
| **User Story** | As a user, I want to download data in different formats, so that I can study possible hazard risks in Emilia-Romagna's zones |

***Table No. 6*** *- Use Case No. 5*

1. **Bibliography**

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