POLITECNICO DI MILANO

Requirement Analysis and Specification Document V2.0

WEB-BASED APPLICATION FOR Water quality monitoring of the Pomperaug river

Authors

Ahmed Omer Ahmed Mukhtar - 10833977
Forough Rajabi - 10807901
Huzaifa Mohammed Khair Khider Abdulaziz – 10782594
Madeleine Abbes - 10859693

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SECTION 1

General Overview:

Summer months bring outdoor recreation including water-based activities like fishing, boating, and swimming to the Pompraug River in state of Connecticut, United States.
High bacteria levels in water can make it unsafe for such recreation, we are focusing here on Escherichia coli (E. coli), it is the type of bacteria under study, it is found abundantly in the gut of mammals including humans, is used as the primary sanitary indicator for fresh water.
High bacteria levels can indicate water quality degradation from pollutant sources such as agricultural runoff, septic contamination, and pet waste. E. coli usually poses little concern to humans with the exception of one strain that is capable of causing illness. Prolonged exposure to or swallowing water containing high levels of E. coli can cause mild to severe symptoms that may present in a way similar to a stomach virus, an ear infection or a rash. Typical recovery is expected within a few days to over a week.
Bacteria ranges represent risk thresholds, which are based on the statistical chances of getting sick if individuals come in contact with the water in these bacteria ranges. Tests are for E. coli, a bacterium that is found in the guts of all warm-blooded animals, including humans. Most E. coli will not cause illness. E. coli is tested because it is often an indicator for the presence of other, more difficult to test for pathogens that may cause waterborne illnesses to those swimming, wading, or boating.
What mentioned above encouraged us to intend a system to to represent water quality by using citizen science data collection to provide a web-based platform that visualizes and monitors bacteria in the watershed.

Purpose of the system:

The aim of the project is to indicate the water quality and its validity for the several uses or activities such as swimming, fishing, and wading…etc. by providing a useful visualization and analysis tools in a desktop web-based application interface, which is a result of the classification of the water of the river in monitoring sites.
the system divided water of the river into several classes, these classes are determining the safety of the water in the watershed area to the different activities and uses.

Scope of the Project:

This project is concerning about providing information to users (Specialist, researchers or local citizens) about water quality of the Pomperaug watershed, by displaying the data collected by The Pomperaug River Watershed Coalition (PRWC) on a user-friendly and accessible web application .

The web-application will offer a map of the dataset, together with some useful information about the water quality impact can have on environment and human health. allowing the user to visualize data collected by the PRWC. Data classification visible from the web application will allow user to understand the situation in the Pomperaug watershed. It will also provide a good example to illustrate evolution of the water quality in an area strongly impacted by human activity.

SECTION 2

Domain analysis:

Software

By software, we mean our application. In the following, we will not discuss the singularities of the hardware nor of the system hosting our software. The term software will only be used as a synonym of our application to be designed.

Epicollect5

Epicollect5 is a mobile and web application for free and easy data collection. It provides both web and mobile applications for the generation of forms and freely hosted project websites for data collection. © 2021 Centre for Genomic Pathogen Surveillance, more info available on Epicollect5.

WSGI

Web Server Gateway Interface. A calling convention for web servers to forward requests to web applications or frameworks written in the Python programming language.

DBMS

Database Management Service. Software that interacts with end-users, applications, and the database itself to capture, create, maintain, and control access to the database and analyses stored data. MySQL, PostgreSQL, Microsoft SQL Server, Oracle Database, and Microsoft Access are examples of widely available DBMSs. For the development of this project, PostgreSQL has been chosen.

HTTP

Hyper Text Transfer Protocol. A protocol for distributed, collaborative, hypermedia information systems as the foundation of data communication for the World Wide Web, where hypertext documents include hyperlinks to other resources that the user can easily access.

API

Application Programming Interface. A computing interface to a software component or a system, that defines how other components or other systems can use it or interact with each other, regardless of the programming language implemented, allowing for interoperability. An API defines the kind of requests that can be made to the software and how to make them to obtain a certain response.

REST API

REST: Representational State Transfer. A software architectural style that defines the set of constraints to be used for creating Web Services, to provide interoperability between computer systems on the Internet. A REST API is a web service API that uses URIs, HTTP protocol, and JSON for data format.

SQL

Structured Query Language. A domain-specific language used in programming and designed for managing data held in a relational database management system (RDBMS), or for stream processing in a relational data stream management system (RDSMS).

CRUD operations
Operations to be performed in an SQL database. These transactions describe the overall interaction with the database and contain: Create, Read, Update and Delete.

Users/Guests

This term should define the person using the application. Someone is a user at the moment they start using the software. Before and after, they are not user anymore.
The user is a visitor who uses the web-application without specific experience on analyzing geographical aspects. The system allows users to visualize data in map and tables form.

Registered members

Members are registered users. A user becomes a member of the application when they register their credentials and the software keep them in memory. The member can be an expert or local civilian user who uses the web-application to visualize data, concerning analyzing the geographical aspects and add comment if it is needed.

Actor

Actors are both users and members.

DATASET:

The web application could make use of the following dataset gathered and stored on Epicollect5:

- Epicollect5 - PRWC Bacteria Sampling 2020

This dataset contains a total of 179 entries (last visited 30-oct-2020). All are collected via the same questionnaire, resulting in data entries containing 24 attributes each. Some of these attributes requests to upload photos or to mention the used method of sampling, etc., and can thus be overlooked. A clean up of the data before storing it on the local server database will be implemented to keep only the relevant attributes.

SECTION 3

Relevant Phenomena:

In this section we discuss

"**The World Phenomena**" phenomena's that the machine cannot observe,

"**The Machine Phenomena**" phenomena located entirely in the machine

and phenomena's that are shared among the two.

world phenomena:

1. Observing color, smell, and the level of the water.
2. Taking water samples
3. Data acquisition (Collecting data that users can add to database.)

machine phenomena:

1. The software stores the registration information in server database.
2. The user's password is encrypted before being stored in the software's database.

shared phenomena:

1. The user selects "*Enter as Guest!*" option to continue as a guest not a member.
2. User Registration:

    - The user selects the sign-up button.
    - The software asks the user to fill the registration form.
    - The software returns with "Username already exists" if a username exists.
    - The user makes a request to confirm the registration.
    - The user is redirected to the log in page

3. Member Login:

    - The member selects the log in button
    - The software asks member to enter his username and password.
    - The member enters his log in information in the right fields.
    - The software check If the username or the password are not within the database, the software returns with an error message "Incorrect Username, Password".
    - If the login informations are correct the software return the member the home page

4. The software offers to the User/Member information about points on map for which we have data.
5. Member Logout
    - The member chose to end his season and logout by clicking the logout button.
    - The member is redirected again to the start page

6. Closing the software.

Phenomena	Controlled by
Opening the software	World
Enter as a Guest	World
User Registration	World
Member login	World
User session	Machine
Data are displayed in a map and shown to both users and members.	World
Member logout	World
Closing the software.	World

SECTION 4

USE CASE MODELS

Use cases describe the functional requirements of a system from the end user's perspective, creating a goal-focused sequence of events that is easy for users and developers to follow.

UC1: Enter as a Guest

Actors: Users, Members

1. Entry Condition: The User opens the website.
2. The user chooses to enter as a guest option from the start page.
3. The software renders the home page

UC2: Registration

Actors: Users.

1. Entry Condition: The User opens the website.
2. The user chooses to register as a member and selects the “sign up ” option from the start page.
3. The website opens the registration window.
4. The user is asked to fill in the registration form, including a username, email address, and a password.
5. The user fills the form and confirms the process.
6. The user’s email and username are stored in the software’s database.
7. The user’s password is encrypted before being stored in the software’s database.
8. Exit condition: the software stores the registration information in the database.
9. Exception: the software returns with “Username/e-mail already exists” if a username exists.

UC3: Login

Actors: Users, Registered members.

1. Entry Condition: The User/Member opens the web-application.
2. The software offers to the user to log in as a member or continue as a user.
3. The member enters a username and password.
4. The software check if the username and password are within the database.
5. The software responds by verifying the member and either granting or denying access to the system.
6. Exit Condition: the software retrieves the home page.
7. Exception: If the username or the password are not within the database, the software shows an error message to the member.
8. Upon entry, the software creates a new user session, including cookies e.g., the user’s geolocation and username

UC 4: Data Visualization

Actors: Users, Registered members.

1. Entry Conditions: The User/Member opens the web application:
   - The user enters the home page directly.
   - The member enters his username and password.
2. The web application displays a base map for both members and the users.
3. the software offers to the User/Member information about points on map that contain (coordinates, water levels, bacteria results etc).
4. Exit Condition: members logout and users close the website.

UC4: Commenting

The member can add comments to validate the data being visualized by the website.
Actors: Registered members.

Flow:

1. The member must be already logged in.
2. The software provides a field for member's input.
3. Users are asked to register first.
4. The member types in a comment.
5. The member selects the "comment" option.
6. The software stores the comment in the database.
7. The software displays the post on the message board.
8. Exit condition: the user's comment is successfully stored and displayed.
9. Constrains: the person who can add comment must be a member of the website.

UC6: Logout

Actor: Member
Flow:

1. The member must be already logged in.
2. Users does not have this functionality displayed in their interface.
3. Members selects the "logout" button on the home page.
4. The software requires the member to confirm the logout operation.
5. The member confirms the operation.
6. The software closes the user session, causing the session cookies to expire
7. The software returns the member to the starting page

SECTION 5

REQUIREMENTS

Requirements should precise all the feature that will contain our software. They are divided in different subsections.

TECHNICAL REQUIREMENTS

The web application should meet the following technical requirements:

1. The software should be coded in python language.
2. The software should collect the data from Epicollect5 dataset ,process, filter, and then store the data in the database.
3. The system shall display web pages by the means of HTML code and CSS.
4. The system should be available as web application that can be used throughout the web browser.

FUNCTIONAL REQUIREMENTS

The web application should meet the following functional requirements:

1. The system shall access data from the Epicollect5 database and present it to the user in a map.
2. The system should allow users to register as members with a username, email, and a password.
3. The system should allow members to login and log out using their (username and password).
4. The system should allow users to query and visualize data according to their needs (location, bacteria levels, etc.) i.e., provide data analysis by the means of filters.
5. The system should display multiple base maps.
6. Information about points can be retrieved by the user/member by clicking on a point.
7. The system will offer entering a comment to the data base for members.
8. The system will offer data addition for members.

NON-FUNCTIONAL REQUIREMENTS

The web application should meet the following non-functional requirements:

1. The system should be available for 24/7.
2. The system should return feedback within a 5 second window.

SECTION 6

EFFORT SPENT

Ahmed Omer Ahmed Mukhtar: 25%
Forough Rajabi: 25%
Huzaifa Mohammad Khair Khider Abdulaziz: 25%
Madeleine Abbes: 25%

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