PROJECT REQUIREMENTS/SPECIFICATION DRAFT

Date: 19 September 2024

MONTCLAIR STATE UNIVERSITY

PHASE - 1

Climate Data Visualization

By: TEAM SPAM-HA! (SH)

Course: CSIT 515 Software Engineering & Reliability – Fall 2024

UNDER THE GUIDANCE OF

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BS, MS, EDM, EdD

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Meeting Times:

Day	Time	Type
Tuesday	8:30 PM - 9:30 PM	Virtual
Thursday	8:30 PM - 9:30 PM	In-Person
Ad-hoc Meetings	Scheduled as needed based on project milestones.	Depending on the project milestone.

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1. Project Overview

The **Climate Data Visualization** system will be designed to develop a comprehensive web application that will visualize real-time and historical climate data. This project will help users understand the impact of climate change by displaying global data on key climate indicators such as temperature changes, sea levels, and weather patterns through advanced visualizations. The system will also leverage AI-driven predictions to forecast future trends, further enhancing public awareness and understanding of climate change. The application aims to make climate data accessible to a broad audience through user-friendly interfaces, interactive features, and accurate data from trusted sources.

2. Functional Requirements

2.1. Real-Time Data Integration

- **Description:** The system will fetch real-time climate data from trusted sources like NASA, NOAA, and other reliable organizations, ensuring up-to-date and accurate data representation.
- **Data Sources:** The application will utilize APIs provided by organizations such as NASA and NOAA to integrate real-time data.
- **Expected Output:** The data fetched will be displayed in an easy-to-understand format, including charts, graphs, and maps. The system will automatically refresh the data periodically to keep the information current.

2.2. Visualization of Global Temperature, Sea Levels, and Weather Patterns

- **Description:** The application will visualize key aspects of climate change, such as global temperature variations, sea level rise, and shifting weather patterns.
- **Graphical Representations:** The system will employ clear and sophisticated visualizations, such as line graphs for temperature trends, bar charts for historical data, and interactive maps for global data.
- **Audience:** The visualization tools will be designed for a diverse user base, ensuring that both technical and non-technical users can understand and engage with the data.

2.3. Content Management System (CMS)

- **Description:** The platform will include a content management system that allows authorized users (e.g., developers, and administrators) to manage the content on the website, including posting new articles, editing existing content, and removing outdated information.
- **Functionality:** The CMS will feature user authentication and role-based access controls to ensure that only authorized personnel can modify the website content.

2.4. Data Storage

- **Description:** The system will allow users to store and retrieve climate data for specific regions. This will enable users to explore historical and projected climate impacts in various locations.
- **Functionality:** Users will be able to search and filter data by region, time, and climate metrics and access stored data as needed. Data will be stored locally using a lightweight database like SQLite and updated with real-time information from external sources.

2.5. Interactive Maps

- **Description**: The application will include an interactive map feature that allows users to explore climate data by geographic location.
- **Map Features**:
    - Users will be able to zoom in and out to view data at various levels of granularity, from global to local regions.
    - Users will click on specific regions to access detailed climate information such as temperature trends, sea-level projections, and weather patterns.
    - The map will be updated in real time and will provide a visually engaging and informative experience.

3. Non-Functional Requirements

3.1. Performance

- The system will efficiently handle real-time data processing, ensuring that users experience minimal delays when loading data visualizations.
- The AI-driven climate predictions will be generated within seconds, allowing users to explore future climate scenarios without noticeable lag.

3.2. Usability

- The platform will feature a clean, intuitive user interface designed to be accessible to both technical and non-technical users. Users will easily navigate the system and quickly access relevant data.
- All visualizations will be interactive and easy to understand, catering to users with varying expertise levels.

3.3. Scalability

- The system will be designed to scale, handling increased data volume and user traffic as necessary. The architecture will accommodate growth without significant performance degradation.

3.4. Reliability

- The system will maintain reliable operations, even if external data sources experience downtime. A caching mechanism will store the most recent data locally to display it to users when real-time data fetching fails.

4. Project Scope

4.1. In-Scope

- **Data Integration**: Real-time data from NASA and NOAA will be integrated into the system.
- **Data Visualization**: Interactive maps, charts, and graphs will display the climate data.
- **AI/ML Integration**: AI-driven models will predict future climate scenarios based on historical data.
- **CMS**: Authorized users will have access to a CMS for managing content.

4.2. Out-of-Scope

- **Advanced AI/ML Models**: Predictive analytics beyond climate data, such as economic models, will not be included.
- **Non-Authoritative Data Sources**: Data from unverified or non-authoritative sources will not be integrated.
- **Production-Scale Deployment**: The focus will be on local development or small-scale deployment, not large-scale production environments.

5. Constraints

5.1. Data Source Reliability

- **Description**: The system will rely on external APIs from NASA and NOAA for real-time climate data. If these services experience downtime, the system's ability to provide updated information will be affected.
- **Mitigation**: A data caching mechanism will store the most recent data locally, allowing the system to display relevant information during API outages.

5.2. Data Accuracy and Latency

- **Description**: Since the system will process real-time data from external sources, there may be delays in data updates or inaccuracies in raw data provided by third parties.
- **Mitigation**: Set appropriate update intervals and cross-validate data with multiple sources to minimize discrepancies and ensure data accuracy.

5.3. System Performance

- **Description**: Real-time data fetching and processing may lead to performance issues, especially when dealing with large data sets or high-traffic loads.
- **Mitigation**: Optimize backend APIs for faster data retrieval and implement pagination or lazy loading for large data sets to reduce the load on the system.

5.4. Scalability

- **Description**: The initial scope of the project is designed for moderate data volumes. As the system scales with more users and larger datasets, the platform may experience slowdowns or require significant infrastructure upgrades.
- **Mitigation**: Design the system architecture to be scalable, such as using modular services or cloud infrastructure, so that it can handle future expansion without significant rework.

5.5. Resource Limitations

- **Description**: Development resources such as time, computing power, and budget are limited, which could affect the complexity and features that can be implemented within the project timeline.
- **Mitigation**: Prioritize core features (real-time data, basic visualizations) and leave non-essential features (advanced AI/ML models, extensive geographic coverage) for future phases.

5.6. User Expertise

- **Description**: The platform will cater to a broad audience, including users with varying levels of technical expertise. Ensuring that all users can interact with complex data visualizations may be challenging.
- **Mitigation**: Provide multiple levels of user interaction, such as simplified views for general users and advanced features for more experienced users. Include tooltips and educational content to assist non-expert users.

5.7. Legal and Regulatory Constraints

- **Description**: The application may be subject to data usage restrictions, intellectual property rights for third-party data, or environmental policy regulations, depending on the region.
- **Mitigation**: Ensure all external data sources are used in compliance with relevant legal agreements and adhere to licensing agreements when visualizing or distributing third-party data.

6. Conclusion

The **Climate Data Visualization** system will create a valuable resource for visualizing the impacts of climate change. By providing both real-time and predictive insights through comprehensive visualizations and interactive maps, the platform will help raise awareness about the global climate crisis. Integrating data from authoritative sources, the project will ensure accuracy while making the information accessible to a broad audience.