وكالة الإمارات للفضاء
UAE SPACE AGENCY

United Arab Emirates

Selected Theme & Project Title

Theme: Flood Disaster Management
Project Title: Flood Risk Mapping System for the UAE

Executive Summary

The United Arab Emirates occasionally experiences flooding due to intense rainfall events. Currently, the absence of accurate, real-time flood risk data hampers effective planning, risk assessment, and emergency response. Our project aims to develop a flood risk map using remote sensing technology. This map will provide stakeholders with timely and precise flood risk information, enhancing their ability to anticipate flood events, improve infrastructure and logistic planning, execute prompt disaster response actions, and provide route assessments to ensure safety and efficiency during flood events.

Identify the problem that your developed application Is going to solve

The UAE occasionally experiences flooding due to heavy rainfall. The absence of accurate, real-time flood risk data hampers effective planning, risk assessment, and emergency response. Our application aims to resolve these challenges by providing a detailed flood risk map. This tool will empower stakeholders to anticipate flood events, enhance infrastructure planning, execute prompt disaster response actions, and provide route assessments to ensure safety and efficiency during flood events.

Specify the targeted end-users/Added Values:

Key Stakeholders:

- **Government Agencies**: Enhance urban planning, infrastructure development, and emergency response strategies.
- **Emergency Services**: Optimize routes and resource allocation during flood events.
- **Farming & Agriculture**: Inform farmers about potential floods and their intensity to mitigate damage to crops.
- **Delivery Companies**: Provide route assessments to ensure safe deliveries during flood events.

Our initial focus will be on delivery companies like Talabat and Amazon. The rationale behind this choice is twofold:

- **Commercial Viability**: Delivery companies represent a profitable stream of income as they depend heavily on reliable and efficient logistics. During flood events, ensuring safe and timely deliveries is crucial to maintain customer satisfaction. By providing a real-time flood risk route checker, we can offer significant value to these companies by optimizing their operations during extreme weather conditions.

- **Lower Accuracy Requirement**: Compared to emergency response teams, delivery companies have a relatively lower accuracy requirement. This makes them an ideal starting point for deploying our real-time flood risk checker. As the system evolves, we can refine it for more critical applications such as emergency services, which demand higher precision.

By addressing the logistical challenges faced by delivery companies during flood events, we can generate early revenue and validate the functionality of our system before expanding to other stakeholders.

Types of data that will be used and tools:

Data Types:

- Satellite imagery
- Historical flood records
- Meteorological data (e.g., rainfall, weather patterns)

Tools:

- Remote sensing software (e.g., GIQ, Google Earth Engine, Sentinel Hub)
- Programming language: Python
- Python packages for data handling (e.g., pandas, numpy, seaborn, …)
- Image processing and model training (e.g., PyTorch, scikit-learn, OpenCV)

Development approach:

Our Flood Risk Mapping System uses various types of data like satellite images and weather data to create a real-time map that shows which areas are likely to flood. This map can help delivery companies and other users to plan safe routes and avoid flood-affected areas. Here is a high level of our approach:

1. Data Collection:

-We collect satellite images, weather data, and historical flood records.

- These data are gathered from sources like Google Earth Engine and other remote sensing tools.

2. Data Processing:

- The collected data is processed using computer vision and machine learning techniques.

- The system uses Python and several machine learning libraries (like PyTorch, OpenCV) to handle this data.

3. Route Checker API:

- The system will check whether any part of the route is affected by flooding and return a status: "affected" or "unaffected"

4. Municipal Data Integration:

- Real-time updates from local authorities about road conditions (like road clearance after floods) are also considered to give the most up-to-date route information.

5. Flood Risk Prediction:

- As the system grows, we will also create a Flood Risk Map. This map will predict flood-prone areas based on past flood data and weather forecasts.
- It will help in future planning by identifying which areas are more likely to flood, even if there is no current live data.

Any additional information that you would like to add

Product Roadmap:

Phase 1: Real-Time Route Checker API

Objective: Enable delivery companies to check flood-affected routes in real-time for efficient delivery during and after flood events. Since satellite imagery is updated weekly, the API will provide the latest available flood status based on the most recent imagery.

- **Feature 1.1: Route Flood Detection API**
    - **Description**: Given a route, detect if any part is affected by flooding using satellite imagery and change detection algorithm.
    - **Key Technologies**: SAR images (pre- and post-event), change detection algorithm.
    - **Outcome**: API returns route status—affected or unaffected—based on the latest satellite data. Users are informed of the timestamp of the most recent imagery to help gauge the accuracy of the flood status.
- **Feature 1.2: Municipal Clearance Data Integration [optional]**
    - **Description**: Incorporate real-time municipal data on road clearance after water removal.
    - **Outcome**: Updated route status based on municipal reports, improving route status accuracy.

Phase 2: Flood Assessment & Classification

Objective: Expand to detect, classify, and quantify flood extents

- **Feature 2.1: Change Detection and Classification**

- **Description**: Detect changes between pre- and post-event images, classify them as flood-related or non-flood.
- **Key Technologies**: Machine learning, clustering, image processing.

- **Feature 2.2: Flood Severity Mapping**

  - **Description**: Quantify and classify flood severity (light, heavy, unaffected areas).
  - **Outcome**: API returns route status—lightly flooded, heavily flooded, unaffected.

Phase 3: Historical Data & Risk Map Generation

Objective: Create a predictive flood risk map based on historical data, satellite imagery, and weather forecasts.

- **Feature 3.1: Historical Flood Data Collection**

  - **Description**: Build a database of past flood events using SAR, Sentinel-2, and meteorological data.
  - **Outcome**: A dataset for flood trend analysis.

- **Feature 3.2: Flood Risk Prediction Model**

  - **Description**: Develop a model to predict flood-prone areas based on historical flood patterns and weather forecasts.
  - **Outcome**:
    - A risk map predicting potential future floods, helping in preemptive planning and logistics.
    - API returns route status based on the risk map even in the absence of live data categorizing routes as lightly flooded, heavily flooded, or unaffected.

Project team Member Names, Academic Qualifications, Email ID and Mobile Numbers

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