**Capstone Project Concept Note and Implementation Plan**

**Project Title:** ResQNet+ – AI Emergency Response & Satellite-Based Disaster Monitoring

**Team Members**

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**Concept Note**

1. **Project Overview**

ResQNet+ is a Liberia-focused emergency management platform that combines rapid citizen and first responder communication with real-time disaster monitoring. The platform addresses

SDG 3 (Good Health & Well-being),

SDG 9 (Industry, Innovation & Infrastructure),

SDG 11 (Sustainable Cities & Communities),

SDG 13 (Climate Action).

It aims to mitigate the impact of disasters such as floods and bushfires by integrating citizen reports with AI-based satellite monitoring, ensuring faster alerts and better resource allocation.

1. **Objectives**

The objectives of ResQNet+ are:

* To provide real-time disaster monitoring and early warnings for at-risk communities.
* To integrate citizen reports with satellite data for comprehensive hazard analysis.
* To enhance emergency response coordination through AI-driven insights.

1. **Background**

Disaster response in Liberia faces challenges such as delayed alerts and limited monitoring capabilities. Existing solutions like Copernicus EMS and Ushahidi demonstrate the feasibility of satellite-based hazard mapping and citizen-driven data collection. However, these solutions lack real-time, localized monitoring for resource-limited settings. ResQNet+ bridges this gap by combining mobile alerts with AI-based satellite analysis.

1. **Methodology**

The project will use a hybrid approach:

* Deep Learning (e.g., U-Net, DeepLab) for pixel-wise segmentation of satellite imagery.
* Machine Learning (e.g., Gradient Boosting, Isolation Forest) for anomaly detection in environmental time-series data.
* Google Earth Engine for large-scale satellite data processing.

1. **Architecture Design Diagram**

The architecture includes:

* Data Sources: Sentinel-1, Sentinel-2, MODIS, VIIRS, and crowd-sourced reports.
* Preprocessing: Radiometric calibration, cloud masking, and index calculations.
* AI Models: U-Net for image segmentation and Gradient Boosting for anomaly detection.
* Mobile App: For citizen alerts and first-aid training.
* Backend: Google Earth Engine for data processing and analysis.

1. **Data Sources**

The data sources include:

* Satellite Data: Sentinel-1 (flood mapping), Sentinel-2 (NDWI/NDVI), MODIS/VIIRS (fire detection).
* Ancillary Data: WorldPop, LISGIS, OSM, CHIRPS.
* Crowd-sourced Data: In-app reports and SMS/USSD submissions.

Preprocessing steps involve calibration, filtering, and alignment to ensure data quality.

1. **Literature Review**

Existing studies validate the use of satellite data and citizen-driven reporting for disaster management. Copernicus EMS and Ushahidi demonstrate the feasibility of rapid hazard mapping and community input, respectively. ResQNet+ builds on these approaches by integrating them into a unified system tailored for Liberia.

**Implementation Plan**

1. **Technology Stack**

Technologies include:

* Programming Languages: Python, JavaScript.
* Libraries: TensorFlow, PyTorch, Scikit-learn.
* Frameworks: Google Earth Engine, Flask.
* Tools: Android Studio, QGIS.

1. **Timeline**

The timeline includes:

* Week 1: Data collection and preprocessing.
* Week 2: Model development and training.
* Week 3: Model evaluation and integration.
* Week 4: Deployment and field validation.

1. **Milestones**

* Completion of data preprocessing pipeline.
* Successful training of AI models.
* Integration of hazard alerts into the mobile app.
* Deployment in pilot regions.

1. **Challenges and Mitigations**

Challenges include:

* Data quality: Addressed through partnerships with NDMA and LISGIS for ground truth data.
* Model performance: Improved through iterative training and validation.
* Technical constraints: Mitigated by using lightweight models for mobile deployment.

1. **Ethical Considerations**

Ethical considerations include:

* Data privacy: Ensuring secure storage and processing of user data.
* Bias: Addressing potential biases in training data through diverse data sources.
* Community impact: Engaging local stakeholders to ensure the solution meets their needs.

1. **References**

* Copernicus Emergency Management Service (EMS): Demonstrates the feasibility of fast satellite-based hazard mapping for floods and fires.
* Ushahidi Crisis Mapping (Kenya): Combines citizen reports and geospatial data for effective emergency coordination.
* Sentinel-1 SAR and Sentinel-2 optical data for flood and vegetation mapping.
* MODIS/VIIRS for fire detection.
* Ancillary data like WorldPop, LISGIS, and CHIRPS for population and rainfall data.
* Google Earth Engine for satellite data processing.
* AI models like U-Net and Gradient Boosting for disaster detection.