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UNIVERSITY OF INFORMATION TECHNOLOGY AND SCIENCES

Course title : Scientific Research and Methodology

Course Code :418

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Flood Monitoring System Using IoT ,GIS Technologies and and Cloud-Connected Drones

Introduction: Floods are a recurring natural disaster in Bangladesh, affecting millions of lives and causing severe economic losses. Climate change has further increased the frequency and intensity of these floods. Current flood monitoring systems often provide delayed or insufficiently localized information, leading to reduced effectiveness in early warning and disaster preparedness.

Problem Statement: Floods remain one of the most destructive natural hazards in Bangladesh, with current systems falling short in both real-time flood monitoring and emergency response. There is a significant gap in the ability to deliver timely assistance to flood-affected populations in remote and hard-to-reach areas. Integrating real-time flood monitoring with a drone-based emergency response system will allow for quicker and more effective disaster relief efforts.

Objective:

1. **Real-time Flood Detection and Monitoring**: Use IoT sensors and satellite data to provide real-time monitoring of water levels and rainfall.
2. **GIS-based Flood Mapping**: Create dynamic maps of flood-affected areas using GIS to visualize the extent and severity of floods.
3. **Cloud-Connected Drone Response**: Deploy **drones** to deliver **food**, **medicine**, and perform **rescue operations** in flood-affected areas.
4. **Data Analytics and Prediction**: Utilize machine learning for analyzing flood patterns and improving prediction models for better disaster preparedness.
5. **Enhanced Communication**: Provide real-time alerts to residents and authorities about flood conditions and drone rescue missions.

Methodology

1. **IoT Sensor Deployment**:
   - **Water level sensors** and **rain gauges** will be installed in flood-prone areas.
   - Sensor data will be transmitted to the cloud for real-time processing and flood level assessment.
2. **Data Integration with NASA GFMS**:
   - Satellite data from **NASA's Global Flood Monitoring System (GFMS)** will provide comprehensive information on larger flood events, complementing local sensor data.
3. **GIS Flood Mapping**:
   - Use **Leaflet** or **CARTO** to create interactive flood maps in real-time, displaying areas impacted by flooding.
   - Maps will integrate data from IoT sensors, satellites, and historical flood records to improve accuracy.
4. **Cloud-Connected Drones for Rescue and Delivery**:

- **Drones** will be equipped with **cloud connectivity** for receiving real-time instructions on **where to deliver supplies** or **conduct rescue missions**.
- **Drone capabilities**:
  - **Rescue operations**: Identifying and transporting stranded individuals in flooded areas.
  - **Supply delivery**: Transporting essential items such as **food, water, and medicine** to affected people.
- Drones will be **autonomously dispatched** based on sensor data and GIS flood maps.

5. **Real-time Alerts**:
   - The system will issue **real-time alerts** to residents and local authorities via **SMS**, **mobile apps**, and **emails**, providing updates on flood status, drone operations, and safety instructions.
6. **Machine Learning for Predictive Analysis**:
   - Machine learning models will be trained on **historical flood data** and real-time sensor inputs to predict **flood patterns** and optimize drone response strategies.

Project Deliverables

- **IoT Flood Monitoring Network**: A network of water level and rainfall sensors in flood-prone areas.
- **GIS-Based Flood Map**: Real-time maps showing flood-affected areas.
- **Cloud-Connected Drone Fleet**: Drones equipped for **rescue operations** and **food/medicine delivery**.
- **Real-time Alerts and Notifications**: An alerting system to inform the public and authorities of flood risks and drone operations.
- **Machine Learning Flood Prediction Model**: A predictive model to forecast future floods and optimize emergency response.

Stakeholders

- **Local Authorities**: Will monitor floods and coordinate rescue operations using real-time data and drone responses.
- **NGOs and Relief Organizations**: Will use the drone system to **deliver supplies** and assist in evacuations.
- **Residents in Flood-Prone Areas**: Will receive **real-time alerts** and benefit from drone-delivered supplies during floods.
- **Meteorological and Hydrological Agencies**: Can integrate the system into broader flood monitoring and disaster management frameworks.

Timeline

Task	Duration
Phase 1: Research and Planning	1 month
Phase 2: IoT Sensor and Drone Procurement	2 months
Phase 3: System Development (IoT, GIS, Cloud, Drones)	3 months
Phase 4: GIS Mapping and Data Integration	2 months
Phase 5: Drone Testing and Calibration	1 month
Phase 6: Launch and Public Awareness	1 month
Phase 7: Ongoing Monitoring and Maintenance	Ongoing

Budget Estimate

Category	Estimated Cost (USD)
IoT Sensors (Water Level, Rain Gauges)	12 lakh tk
Cloud Infrastructure	3 lakh tk
GIS Mapping Software	1 lakh tk
Drone Fleet (Rescue and Supply Delivery)	15 lakh tk
Mobile and Web Development	3 lakh tk
Maintenance and Calibration	2 lakh tk/year
Miscellaneous (Travel, Installation)	2 lakh tk
Total Estimated Budget	**: 38 lakh tk**

Challenges and Risk Management

- **Drone Battery Life and Range**: Drones may have limited flight range and battery life, impacting their ability to operate in large flood zones. **Solution**: Use long-range drones with solar charging capability.
- **Weather Conditions**: Adverse weather conditions may affect drone performance during floods. **Solution**: Drones will be equipped with **water-resistant designs** and **adaptive flight paths**.

- **Data Connectivity in Remote Areas**: Poor connectivity can hinder real-time monitoring and drone dispatch. **Solution**: Implement **offline modes** for data storage and **pre-programmed drone missions** for disconnected areas.
- **Drone Regulations**: Legal issues surrounding drone usage in public spaces may arise. **Solution**: Collaborate with local government to ensure drone operations are compliant with regulations.

Sustainability

The **Flood Monitoring and Emergency Response System** is designed to be sustainable in the long term:

- **Solar-Powered Sensors and Drones**: Reducing the system's energy dependency by using solar power for IoT sensors and drones.
- **Community Engagement**: Train local communities in basic drone operation and maintenance, ensuring smooth operation during emergencies.
- **Cloud-Based Scalability**: The cloud-based system allows for easy scalability as more drones and sensors are deployed in the future.

Conclusion

This project combines advanced **IoT, GIS, and drone technology** to revolutionize flood monitoring and disaster response in Bangladesh. By integrating **cloud-connected drones** capable of performing **rescue operations** and **delivering essential supplies**, the system addresses a critical gap in emergency preparedness. The **real-time alerts** and **predictive models** will ensure timely and effective responses to flooding events, significantly reducing the damage and loss of life.