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**FACULTY OF ENGINEERING AND TECHNOLOGY**

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**CEF440: Internet and Mobile Programming**



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# **Identify Stakeholders**

A critical first step is identifying the individuals and groups who will be involved with the system. These stakeholders can be broadly categorised as follows:

* **Emergency Responders**: These are the first responders who are directly involved in the rescue and relief operations during a disaster. examples include Firefighters, paramedics, police, etc.
* **Government Agencies**: These agencies play a crucial role in disaster management, from planning and coordination to implementation and monitoring of disaster response. examples include Local, regional, and national disaster management authorities.
* **Community Members**: The local community members are the primary users of the system. Their feedback and participation are essential for the system’s effectiveness. examples include Residents, volunteers, neighbourhood watch groups.
* **Non-Governmental Organisations (NGOs)**: often play a significant role in disaster management, especially in providing humanitarian aid and support.
* **Educational Institutions:** Schools, colleges, and universities may be involved in disaster preparedness training, hosting evacuation shelters, or providing resources for community resilience programs.
* **Healthcare Providers:** Hospitals, clinics, and healthcare professionals play a crucial role in disaster response, providing medical assistance, triage, and emergency care to affected individuals.
* **Media Organizations:** News outlets, radio stations, and social media platforms can help disseminate important information and warnings to the public during emergencies.

# **Define Objectives**

The objectives of the Mobile-Based Disaster Management System include:

* **Improving Response Time**: Minimise the time between the occurrence of a disaster and the arrival of appropriate assistance.
* **Ensure inclusivity and accessibility:** by incorporating features such as voice commands, text-to-speech, and easy-to-navigate interfaces for users with disabilities.
* **Provide tailored resources:** to help individuals with disabilities prepare for and respond to disasters effectively.
* **Data** **Privacy** **and** **Security**: Implement robust data security measures to protect sensitive user information collected during emergencies.
* **Offline** **Functionality**: Develop functionalities that can operate even with limited or no internet connectivity, allowing critical operations to continue in disrupted situations
* **Public** **Education** **and** **Awareness**: Incorporate educational resources within the app to prepare communities for different types of disasters and promote preventative measures.
* **Long-Term Recovery Support**: Integrate features that connect users with long-term recovery resources like housing assistance, financial aid programs, and rebuilding initiatives.
* **Accessibility**: Ensure the system is accessible to individuals with disabilities by incorporating features like text-to-speech, screen readers, and support for multiple languages.
* **Enhancing Communication**: Facilitate effective communication among all stakeholders involved in disaster response and management.
* **Increasing Community Resilience**: Equip communities with tools and resources to better prepare for, respond to, and recover from disasters.
* **Optimising Resource Allocation**: Efficiently allocate resources such as personnel, equipment, and supplies based on real-time information and needs assessment.
* **Providing Real-Time Updates**: Disseminate accurate and timely information regarding disaster situations, including alerts, warnings, and evacuation notices.

# **User Requirements**

A mobile-based Disaster Management System should offer a range of functionalities to help users effectively prepare for, respond to, and recover from disasters. From our research, below are some functionalities which are essential for the effectiveness and helpfulness of such an app.

1. **Emergency Alerts and Notifications:** The system should send push notifications to users for real-time alerts about disasters, including severe weather, natural disasters and other emergencies, ensuring they stay informed promptly.
2. **Disaster Preparedness Information:** Provide users with guides and checklists to prepare for disasters, including evacuation plans and emergency kit lists. Enhancing their readiness.
3. **Location-Based Services:** Utilise GPS to offer location-specific information such as evacuation routes and nearby shelters, enabling users to make informed decisions based on their current location.
4. **Communication Tools:** Offer various communication channels like text messaging and social media integration to keep users connected with emergency services and loved ones during disasters.
5. **Crowdsourced Reporting:** Allow users to report incidents and damage, aiding authorities in assessing the situation and prioritising response efforts effectively.
6. **Resource Coordination:** Connect those in need with available resources, volunteers, and support services to streamline assistance and aid distribution during emergencies.
7. **Emergency Contacts:** Provide easy access to essential contact information for emergency services and local authorities, ensuring users can quickly reach out for help when needed.
8. **Offline Functionality:** Ensure critical features of the app remain accessible even without internet connectivity, ensuring users can access vital information during disasters, even in remote areas.
9. **Multi**-**Language Support:** Offer support for multiple languages to ensure the app is accessible to diverse populations, facilitating effective communication and understanding in multicultural communities.
10. **Educational Resources**: Provide educational materials and training modules to help users learn about disaster preparedness and response procedures, empowering them to take appropriate action during emergencies.
11. **Post-Disaster Recovery Assistance**: Offer guidance and support for the recovery phase including information on accessing assistance programs and rebuilding efforts, aiding users in the aftermath of disasters.
12. **Privacy and Security**: Implement robust security measures to protect user data and ensure privacy, fostering trust and confidence in the system’s reliability and integrity.

# **Technical Requirements**

The technical requirements of our Disaster Management System include specific features, functionalities, and technical specifications necessary for the development and operation of the app. These requirements ensure that the app meets user needs, performs reliably, and complies with technical standards.

1. **Cross-Platform Compatibility:** The app should be compatible with major mobile platformssuch as iOS and Android to reach a broad user base.
2. **Responsive Design**: The app should have a responsive design that adapts to various screen sizes and resolutions, ensuring optimal user experience across different devices, including smartphones and tablets.
3. **Offline Functionality**: Incorporate offline functionality to ensure that critical features of the app remain accessible even without an internet connection, enabling users to access essential information during emergencies.
4. **Secure Data Storage**: Ensure secure storage and transmission of user data, including personal information and location data, to protect user privacy and comply with data protection regulations.
5. **Data Visualization**: Implement data visualisation techniques such as maps, charts, and graphs to present information in a clear and comprehensible manner, enhancing user understanding of the situation.
6. **Accessibility Features**: Incorporate accessibility features such as screen readers, voice commands, and adjustable font sizes to accommodate users with disabilities and ensure equitable access to information and functionality.
7. **Robust Backend Infrastructure**: Develop a scalable and resilient backend infrastructure to support the app's functionality, including servers for data storage, processing, and communication.
8. **Crowdsourcing Capabilities**: Enable users to report incidents, hazards, and damage through the app, facilitating crowdsourced data collection to aid emergency response and assessment efforts.
9. **Communication Tools**: Integrate communication tools such as text messaging, voice calls, and social media sharing to enable users to stay connected with emergency services and their social networks during disasters.
10. **Multi-Language Support.**
11. **Push Notifications.**
12. **Location-Based Services.**

# **Functional Requirements**

5.1. Real-time Alerting System

* The system should be able to deliver real-time alerts to users based on their geographic locations and preferences.
* Alerts should cover various types of emergencies such as natural disasters, public safety threats, and health emergencies.
* Users should have the option to customize their alert preferences, including the types of alerts they receive and the communication channels (e.g., push notifications, SMS, email).

5.2 Incident Reporting and Assistance

* Users should be able to report incidents directly through the mobile application, including providing details such as the type and location of the incident.
* The system should facilitate coordination between emergency responders, volunteers, and affected communities to allocate resources and provide assistance promptly.
* Users should have access to a directory of emergency contacts and resources for requesting assistance during emergencies.

5.3. Geospatial Data Integration

* The system should integrate with geospatial data and mapping services to provide users with interactive maps displaying real-time information about disaster-affected areas, evacuation routes, shelter locations, and other relevant spatial data.
* Users should be able to view overlays of various data layers (e.g., flood zones, fire risk areas) on the map to enhance situational awareness and decision-making during emergencies.

5.4. Community Engagement Features

* The system should include features to promote community engagement and collaboration, such as forums, chat rooms, and social media integration.
* These tools should facilitate information sharing, peer support, and collective action among users and stakeholders involved in disaster response and recovery efforts.

# **Non-Functional Requirements**

6.1. Performance

* The system should be capable of handling peak loads during emergencies without significant degradation in performance.
* Response times for critical functionalities such as alert delivery and incident reporting should meet predefined service level agreements (SLAs).

6.2. Reliability

* The system should be highly reliable, ensuring continuous operation without disruptions even under high usage or adverse conditions.
* Redundancy measures should be in place to mitigate the impact of potential hardware or software failures.

6.3. Usability

* The system should provide an intuitive user interface that is easy to navigate and understand, catering to users of varying technical proficiency.
* User interactions should be streamlined, minimising the number of steps required to perform common tasks such as reporting incidents or accessing resources.

6.4 Security

* Robust security measures should be implemented to protect user data and ensure the integrity of the system.
* This includes encryption of sensitive information, secure authentication mechanisms, and regular security audits to identify and address potential vulnerabilities.

6.5. Scalability

* The system should be designed to accommodate increasing user demand during emergencies, scaling resources dynamically to ensure uninterrupted service.
* This includes provisions for scaling infrastructure such as servers, databases, and network bandwidth to handle sudden spikes in traffic.

6.6. Regulatory Compliance

* The system should comply with relevant data protection laws and industry standards, ensuring the privacy and security of user data.
* This includes adherence to regulations such as GDPR, HIPAA, or local data protection laws governing the collection, storage, and processing of personal information.

# **Data Requirements**

Effective disaster management relies on robust data collection and processing mechanisms. The Disaster Management System will gather various types of data to support preparedness, response, and recovery efforts. This includes;

* **User Information:** Personal details of users registering with the application, including name, contact information, and location.
* **Incident Reports:** Information reported by users about disasters, emergencies, or incidents, including location, type, severity, and timestamp.
* **Geospatial Data:** Spatial data related to disaster-affected areas, evacuation routes, shelter locations, and other relevant geographic information.
* **Real-Time Alerts:** Data for generating and sending real-time alerts and notifications to users based on their geographic locations and preferences.
* **Communication Logs:** Records of communication between users, emergency responders, and other stakeholders through the application's messaging and reporting features.
* **Resource Allocation:** Data on available resources, such as emergency supplies, medical facilities, and personnel, to facilitate efficient allocation and coordination during response efforts.
* **Community Engagement:** Information generated through community engagement features like forums, chat rooms, and social media integration, including user-generated content, discussions, and collaborations.

# **Constraints and Assumptions**

Several factors may influence the design and implementation of the Disaster Management System. Budget limitations will necessitate cost-effective solutions, while time constraints will drive adherence to project deadlines. Technological limitations, such as device compatibility and network connectivity, may pose challenges. Here we outline the constraints and also assumptions made;

* **Budget Limitations:** The project must operate within a predefined budget, which may constrain the selection of technologies, features, and development timelines.
* **Time Constraints:** There may be deadlines or time-sensitive milestones that need to be met, influencing the development and deployment schedule of the system.
* **Technological Limitations:** The system's functionality and performance may be constrained by the capabilities of mobile devices, network infrastructure, and third-party services.

## Assumptions:

* **Assumption 1:** Users will have access to smartphones with internet connectivity to use the mobile application.
* **Assumption 2:** The system will rely on reliable sources of geospatial data and mapping services for accurate representation of disaster-affected areas and related information.
* **Assumption 3:** Emergency responders and stakeholders will actively engage with the system and utilize its features for effective disaster management.
* **Assumption 4:** The mobile application will adhere to relevant privacy and data protection regulations to ensure the confidentiality and security of user information.

# **Risk Management**

Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses.

## Preparedness

Preparedness in disaster management refers to the actions taken before a disaster occurs to ensure effective response and reduce the impact of the disaster on individuals, communities, and infrastructure. Key components of preparedness include:

* **Risk Assessment:** Identifying potential hazards, vulnerabilities, and risks that could affect the community and infrastructure. This involves analysing historical data, conducting vulnerability assessments, and understanding the likelihood and potential impact of various hazards.
* **Planning and Training:** Developing emergency response plans, protocols, and procedures tailored to different types of disasters. This includes establishing communication channels, evacuation routes, and coordination mechanisms among emergency responders and stakeholders. Training programs and drills are conducted to ensure that individuals and organisations are prepared to respond effectively during emergencies.

## Response

Response in disaster management refers to the immediate actions taken during and immediately after a disaster to save lives, protect property, and meet the basic needs of affected individuals and communities. Key components of response include:

* **Emergency Warning and Communication:** Issuing timely and accurate warnings and alerts to inform the public about impending disasters and provide instructions for evacuation, sheltering, or other protective actions. Communication channels, such as emergency broadcast systems, sirens, and mobile alerts, are utilized to reach affected populations.
* **Search and Rescue Operations:** Mobilizing emergency response teams, including firefighters, paramedics, and search and rescue personnel, to locate and rescue individuals trapped or injured by the disaster. Specialized equipment, such as search dogs, drones, and heavy machinery, may be deployed to assist in rescue efforts.
* **Medical Care and First Aid:** Providing emergency medical care, triage, and first aid to individuals injured during the disaster. Establishing medical facilities, field hospitals, and triage centers to treat casualties and stabilize patients before transport to hospitals or medical facilities.

## Recovery

Recovery in disaster management refers to the process of rebuilding and restoring communities, infrastructure, and services in the aftermath of a disaster. It involves long-term efforts to address the physical, economic, social, and psychological impacts of the disaster. Some key components of recovery include:

* Damage Assessment and Rehabilitation: Conducting damage assessments to evaluate the extent of damage to infrastructure, buildings, and public facilities. Prioritizing repairs, reconstruction, and rehabilitation efforts based on the severity of damage and the needs of affected communities.
* Economic and Financial Recovery: Supporting businesses, industries, and livelihoods affected by the disaster to recover and rebuild. Providing financial assistance, loans, grants, and tax incentives to stimulate economic recovery, create jobs, and revitalize local economies.

## Mitigation

Mitigation in disaster management refers to actions taken to prevent or reduce the severity and impact of disasters on individuals, communities, and infrastructure. It involves identifying and implementing measures to minimize risk and enhance resilience to future disasters. Key components of mitigation include:

* **Risk Reduction Measures:** Implementing structural and non-structural measures to reduce the likelihood and impact of disasters. This includes building codes, land-use planning, zoning regulations, and structural reinforcements to mitigate the effects of hazards such as earthquakes, floods, and hurricanes.
* **Ecosystem Restoration and Conservation:** Protecting and restoring natural ecosystems, such as wetlands, forests, and coastal habitats, to provide natural buffers against disasters and enhance resilience. Ecosystem-based approaches, such as mangrove restoration and floodplain management, can reduce the risk of floods, landslides, and storm surges.
* **Infrastructure Resilience:** Strengthening critical infrastructure and lifeline systems, such as transportation networks, water supply systems, and power grids, to withstand disasters. Retrofitting existing infrastructure and incorporating resilient design features to improve resistance to hazards and minimize disruption during disasters.
* **Community Engagement and Education:** Engaging with communities to raise awareness about disaster risks, mitigation measures, and preparedness actions. Empowering communities to take proactive steps to reduce their vulnerability and enhance resilience through education, training, and community-based initiatives.