THE UNIVERSITY OF BUEA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER ENGINEERING

CEF 440: INTERNET PROGRAMMING AND MOBILE PROGRAMMING

Group 22

REQUIREMENTS GATHERING

Task 2

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1. <u>INTRODUCTION</u>

In the wake of the growing frequency and intensity of natural disasters around the world, effective disaster management has become a critical priority for governments, emergency services, and communities. To develop a comprehensive disaster management strategy, it is essential to thoroughly understand the requirements and needs of all stakeholders involved.

This report presents the findings from a requirements gathering exercise focused on improving disaster preparedness, response, and recovery capabilities. The goal was to identify the key needs, challenges, and opportunities across various aspects of disaster management, including early warning systems, evacuation planning, emergency supplies and logistics, search and rescue operations, sheltering and housing, and long-term recovery efforts.

Requirement gathering is the process of collecting information about what the stakeholders want to achieve. It is a vital step in the software development life cycle. This task ensures there is clarity in the project and ease in its development as all other processes such as the requirement analysis or system design is dependent on what requirements are gathered.

To carry out this comprehensive requirements gathering initiative, the project team followed a structured approach consisting of the following key steps:

2. <u>REQUIREMENTS GATHERING FROM EXISTING DOCUMENTATION</u>

A disaster management system is a comprehensive framework or set of processes, policies, and procedures that are designed to help organizations and communities prepare for, respond to, and recover from disasters. It provides a structured approach to managing all aspects of disaster management, from prevention and mitigation to response and recovery.

2.1 Literature Review:

Traditional methods of disaster management are based on indigenous knowledge and practices that have been passed down from generation to generation. Traditional disaster management primarily relies on manual processes and often involves the following steps:

2.1 Preparedness:
- Develop disaster plans and procedures
- Conduct training and drills
- Stockpile supplies and resources
- Identify vulnerable areas and populations

2.2 Response:
- Activate emergency response teams
- Assess the situation and needs
- Provide immediate assistance to affected communities
- Coordinate with relevant authorities and organizations

2.3 Recovery:
- Restore essential services and infrastructure
- Support affected individuals and communities
- Conduct damage assessments

- Develop long-term recovery plans

2.4 Mitigation:
- Identify and reduce risks before disasters occur
- Implement policies and measures to lessen the impact of disasters
- Raise awareness about disaster prevention
- Invest in infrastructure resilience

The traditional method of disaster management is however due to lack of real time data to create awareness of possible occurring event and as a result, early warning or alert systems are not being utilized which would have improve the disaster management process. Another key limitation to the traditional methods for disaster management is the drawback in communication and collaboration among stakeholders involved as well as the users.

A mobile based application for disaster management utilizes technology to enhance and streamline the traditional disaster management process. Key features of such an application may include:

1) **Real-time data collection and analysis:** Collects and analyzes data from various sources (e.g., sensors, social media, satellite imagery) to provide real-time situational awareness during disasters
2) **Early warning systems**: Monitors data to issue early warnings and alerts, enabling timely evacuation and response.
3) **Resource management**: Tracks and manages available resources (e.g., personnel, equipment, supplies) to optimize their allocation during response and recovery efforts.
4) **Communication and coordination**: Facilitates communication between emergency responders, government agencies, and affected communities, ensuring timely information sharing and coordination.
5) **Damage assessment**: Uses technology (e.g., drones, satellite imagery) to conduct rapid and accurate damage assessments, aiding in recovery planning and resource allocation.
6) **Public education and preparedness**: Provides educational resources and tools to raise awareness about disaster preparedness and risk reduction measures.

Therefore, with a mobile based application for disaster management, we can improve the disaster recovery management system through;

- Improved situational awareness through real-time data
- Faster and more accurate response due to early warning systems
- Optimized resource management and coordination
- Enhanced communication and collaboration
- More efficient damage assessment and recovery planning
- Increased public awareness and preparedness

While disaster management applications offer significant benefits, they are not intended to replace traditional disaster management methods but rather to complement and enhance them. By leveraging technology, these applications can improve the efficiency, effectiveness, and coordination of disaster management efforts.

Based on existing mobile applications for disaster recovery management, some loopholes have been identified as many of the applications focus on managing a single natural or manmade disaster such as fire, or earthquake or landslide. Some of these applications are meant only for sending out warning alerts and others do not have any communication channels for collaboration between stakeholders, users and emergency responders as well as volunteers. Also, none of the existing applications target all four phases in disaster management. Therefore, in this project, we aim to overcome these shortcomings by designing a system that will involve all four phases in the

disaster management life cycle, give out timely alerts and provide a communication channel for easy collaboration and so on.

3. <u>**STAKEHOLDER IDENTIFICATION**</u>

Stakeholders are individuals, groups, or organizations that have an interest, involvement, or concern in the project's success or failure. Stakeholders can have a direct or indirect influence on the project's objectives, outcomes, and deliverables. An effective disaster management system requires a collaborative effort from various stakeholders. Here's a breakdown of key stakeholder groups for our disaster management system, outlining their roles throughout the disaster management cycle:

3.1 Citizens:
   a. **Preparedness**:
      i. Stay informed about disaster risks (e.g., landslides, floods)
      ii. Participate in drills and preparedness training
      iii. Take mitigation measures around homes (e.g., clear drainage ditches, secure loose objects)
   b. **Mitigation**:
      i. Participate in community-based mitigation projects (e.g., planting trees to prevent erosion)
      ii. Advocate for stricter building codes in high-risk areas
   c. **Response**:
      i. Follow evacuation orders promptly
      ii. Seek shelter in designated locations
      iii. Report incidents to authorities.
   d. **Recovery**:
      i. Assist with cleanup efforts
      ii. Access recovery resources (shelters, food, water)

3.2 Emergency Responders (Firefighters, Police, Medical Personnel, Search and Rescue Teams):
   a. **Preparedness**:
      i. Train for various disaster scenarios
      ii. Maintain equipment and supplies
      iii. Participate in public education on hazard mitigation
   b. **Mitigation**:
      i. Conduct hazard assessments and identify high-risk areas
      ii. Participate in mock disaster drills
   c. **Response**:
      i. Conduct search and rescue operations
      ii. Provide medical aid to injured population
      iii. Assess damage to infrastructure and property
   d. **Recovery**:
      i. Support ongoing search and rescue efforts
      ii. Assist with infrastructure repair

3.3 Government Agencies (National Disaster Management Agency (NDMA), Ministry of Public Health, Local authorities):
   a. **Preparedness**:

      i. Develop comprehensive disaster management plans
      ii. Conduct risk assessments to identify vulnerable areas
      iii. Organize public education campaigns on preparedness measures
      iv. Implement mitigation projects (e.g., building seawalls, reinforcing infrastructure)

  b. **Mitigation**:
      i. Enforce building codes and land-use regulations in hazard-prone areas
      ii. Invest in early warning systems and public awareness campaigns
      iii. Develop evacuation plans for vulnerable communities

  c. **Response**:
      i. Coordinate response efforts among different stakeholders
      ii. Allocate resources (personnel, supplies) to affected areas
      iii. Manage shelters and evacuation centers

  d. **Recovery**:
      i. Lead recovery efforts and reconstruction projects
      ii. Provide financial assistance to individuals and businesses
      iii. Develop long-term plans for risk reduction

3.4 Non-Governmental Organizations (NGOs) (Red Cross/Crescent Society, International aid organizations):

  a. **Preparedness**:
      i. Partner with local communities for preparedness training
      ii. Stockpile relief supplies (food, water, medicine)
      iii. Support mitigation efforts (e.g., community tree planting)

  b. **Mitigation**:
      i. Advocate for community-based disaster risk reduction programs
      ii. Provide resources for mitigation measures in vulnerable communities

  c. **Response**:
      i. Provide humanitarian assistance (search and rescue, medical care)
      ii. Distribute relief supplies to affected population

  d. **Recovery**:
      i. Support long-term recovery efforts (housing reconstruction, livelihood support)
      ii. Provide social services (psychological support, childcare)

3.5 Media (News outlets, radio stations):

  a. **Preparedness**:
      i. Share public information about disaster risks and mitigation strategies
      ii. Disseminate preparedness tips and drills schedule

  b. **Mitigation**:
      i. Partner with government agencies to raise public awareness about mitigation measures
      ii. Promote a culture of preparedness through educational programs

  c. **Response**:
      i. Broadcast critical information (evacuation orders, shelter locations)
      ii. Provide real-time updates on the disaster situation

  d. **Recovery**:
      i. Report on recovery efforts and ongoing needs
      ii. Offer platforms for public communication and resource sharing

4. <u>DATA COLLECTION</u>

This section outlines the data collection methods and tools used to understand the community's level of preparedness for unexpected events. The goal was to gather information from a diverse range of residents to identify areas of strength and potential gaps in preparedness efforts.

4.1 Methods:

We employed a multi-pronged approach to data collection, utilizing three methods:

4.1.1 Web-Based Survey

The primary method of data collection was a web-based survey created using Google Forms. This platform offered several advantages:

- **Accessibility:** Google Forms is user-friendly and accessible on various devices with internet access, making it convenient for a wider audience to participate. (https://forms.gle/7ctGEsQNciEiSxNv8)
- **Data Security:** Google Forms offers built-in security features to protect respondent privacy and ensure the confidentiality of all collected data.
- **Data Analysis Capabilities:** Google Forms automatically compiles responses into spreadsheets facilitating efficient data analysis and reporting.

4.1.1.1 Survey Design:

The survey consisted of a mix of question types:

- **Multiple Choice:** Selecting from pre-defined options (e.g., disaster awareness, mitigation measures taken)
- **Likert Scale:** Gauging agreement levels on preparedness statements (e.g., importance of disaster preparedness)
- **Open Ended:** Allowing for detailed responses and capturing specific concerns or suggestions (e.g., preferred information sources, ideas for community preparedness efforts)

The survey was designed to be completed in approximately 10 minutes. A pre-testing phase was conducted with a small group of residents (approximately 20) to ensure clarity, flow, and appropriate question phrasing.

Here are the example survey questions in the online survey form:

DISASTER MANAGEMENT SYSTEM

We're conducting a brief survey to understand how prepared people in our community are for unexpected events. Your participation is completely voluntary and all your answers will be kept confidential. This information will be used to develop better resources and support to help our community stay safe.

takemjim43@gmail.com Switch accounts

Not shared

Resubmit to save

* Indicates required question

Age Range *

○ 18-24

○ 25-34

○ 35-44

○ 45-54

○ 55-64

○ 65+

○ Other: _____

Gender *

○ MALE

○ FEMALE

Neighborhood you live in

Your answer

In your opinion, what are the most likely natural disasters to affect your location? (Select all that apply)

☐ Floods

☐ Landslides

☐ Earthquakes

☐ Volcanic eruptions

☐ Other: _____

Have you ever experienced a natural disaster ?

○ YES

○ NO

Have you participated in any disaster preparedness training or drills in the past year?

○ Yes

○ No

○ Maybe

Does your household have a disaster preparedness plan

○ Yes

○ No

If you answered yes to having a plan, does your plan include the following? (Select all that apply)

☐ Designated evacuation route

☐ Emergency contact information

☐ Location of a safe shelter

☐ Stockpile of emergency supplies (food, water, first-aid kit)

☐ Other: _____

Have you taken any steps to mitigate potential disaster risks around your home? (Select all that apply)

☐ Cleared drainage ditches

☐ Secured loose objects outside your home

☐ Trimmed overhanging trees

☐ Reinforced windows and doors (if applicable)

☐ Other: _____

Where do you get information about disaster risks and preparedness? (Select all that apply)

- ☐ Local radio stations
- ☐ Community meetings
- ☐ Government websites
- ☐ Social media
- ☐ Family and friends
- ☐ Other: _____

Are you aware of the emergency response procedures in your neighborhood in the event of a disaster?

- ○ Yes
- ○ No

Do you know the location of the nearest emergency shelter in your neighborhood?

- ○ No
- ○ Yes
- ○ Maybe

Are you familiar with the warning signs or signals that indicate a potential disaster?

- ○ Yes
- ○ No

Do you have a plan in place for evacuating your home in the event of a disaster

- ○ Yes
- ○ No

Do you have a designated family communication plan in case of separation during a disaster?

- ○ Yes
- ○ No

Do you have alternative methods of communication in case regular communication channels are disrupted? (e.g., backup phone, radio)

- ○ Yes
- ○ No

Do you have an emergency supply kit prepared in your home?

- ○ Yes
- ○ No

If yes, please select the items you have in your emergency supply kit: (Select all that apply)

- ☐ Flashlights and batteries
- ☐ Non-perishable food items
- ☐ Bottled water
- ☐ First aid supplies
- ☐ Medications
- ☐ Personal hygiene items
- ☐ Blankets or sleeping bags
- ☐ Cash or important documents
- ☐ Other: _____

Imagine there was a mobile application designed to help residents prepare for and respond to disasters. Would you be interested in using such an application?

- ○ Yes
- ○ No

If yes, what features would you like this application to have? (Select all that apply) and if you choose other, add the functionalites you wish the app should possess

- ☐ Real-time emergency alerts and updates
- ☐ Information on disaster preparedness and mitigation strategies
- ☐ Evacuation route maps and shelter locations
- ☐ Family communication tools
- ☐ Resource directory for disaster relief services
- ☐ Offline functionality (access to information without internet)
- ☐ Other: _____

Are you involved in any community groups or organizations that focus on disaster preparedness?

- ○ Yes
- ○ No

Do you have any suggestions or feedback on how the local government can improve effective disaster management

Your answer

Submit

4.1.1.2 Data Collection Process:

The survey was disseminated through various online channels to reach a broad audience:

- Social media platforms (e.g., Facebook, Twitter, WhatsApp etc.) relevant to the community
- Community websites and online bulletin boards

4.1.1.3 Sample Size and Demographics:

The survey aimed for a diverse sample to represent the entire community. While we cannot pinpoint exact demographics until data analysis, the distribution methods were chosen to encourage participation from all age groups and backgrounds. (Raw data was collected for approximately 20 people through the pre-testing phase).

4.1.1.4 Data Security and Confidentiality:

The survey was designed anonymously, and no personal identifying information was collected. All responses will be kept confidential and used solely for the purpose of improving community disaster preparedness resources.

4.1.2 Citizen Interviews

Citizen interviews provided an opportunity to gain detailed insights and personal perspectives from residents.

- **Interview Format:** Semi-structured interviews allowed for flexibility to explore topics in more depth based on the resident's responses.
- **Sample Selection:** A purposive sampling approach was used to ensure a diverse group of participants representing different age groups, neighborhoods, and backgrounds potentially impacted by disasters (approximately 30 – 40 participants.
- **Interview Topics:** The interview guide covered topics such as:
  - o Disaster awareness and concerns
  - o Existing preparedness measures taken at home and within the community
  - o Information sources and preferred communication channels during disasters
  - o Perceptions of community preparedness efforts
  - o Suggestions for improvement

4.1.2.1 Data Collection Process:

Interviews were conducted in-person at a mutually convenient location or remotely via our popular social media platforms e.g. WhatsApp, Facebook etc. Informed consent was obtained from all participants before the interview began.

4.1.2.2 Data Security and Confidentiality:

All interviews were conducted confidentially. Participants were informed that their responses would be anonymized in the final report.

4.1.3 Document Review

We conducted a review of existing documents relevant to community preparedness to gather data and gain historical context and insights from past experiences. Here are some examples of documents reviewed, though the specific documents will vary depending on your community:

- **Local emergency response plans:**
  https://floodready.vermont.gov/update_plans/local_emergency_operations
  https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/local-government/em_planning_guide_for_la_fn.pdf
  https://www.alertmedia.com/blog/emergency-response-plan/

- **Incident reports from previous disasters:** https://ourworldindata.org/grapher/natural-disasters-by-type
- **Community risk assessments:**
  https://rb.gy/8gge9t
  https://riskassessment.strategicfire.org/wp-content/uploads/2016/03/Community-Risk-Assessment-Guide-v1.5.pdf
  https://dipecholac.net/docs/files/Community%20Risk%20Assessment%20Training%20Module%20Malawi.pdf
- **Public awareness campaigns on disaster preparedness:** https://rb.gy/r28tce, https://rb.gy/lt0s9y

Document review helped identify:

- Existing resources
- Potential vulnerabilities documented in past incidents
- Gaps in current preparedness initiatives

4.1.3.1 Data Collection Process:

Existing documents were collected from relevant local government agencies, emergency response organizations, and community archives.

4.1.3.2 Sample Size and Demographics:

This section is not applicable to document review, as the focus is on the content of the documents themselves.

4.1.3.3 Data Security and Confidentiality:

All documents were handled securely and in accordance with data privacy regulations.

5. BUSINESS REQUIREMENTS

The business requirements define the high-level goals, objectives, and needs that the system is intended to fulfill. Business requirements describe why a project is needed, whom it will benefit, when and where it will take place, and what standards will be used to evaluate it.

Business requirements typically focus on the "why" behind the software project, rather than the specific "what" or "how" of the system's functionality. They provide the overarching purpose and rationale for developing the software. The business requirements for this project include:

5.1 Comprehensive Disaster Management Lifecycle Support

- The system shall provide an integrated platform to support all stages of the disaster management lifecycle, including preparedness, response, recovery, and mitigation.

- The system shall offer a range of functionalities and features tailored to the needs of individual users, emergency responders, and other relevant stakeholders.

5.1 Real-Time Alerting and Notification

- The system shall incorporate a real-time alerting and notification system to disseminate critical information to users during emergencies.
- Alerts shall be customized based on users' geographic locations and preferences, providing timely warnings about impending disasters, evacuation orders, and other relevant information.

5.3 Incident Reporting and Coordinated Response

- The system shall allow users to report incidents and request assistance directly through the mobile application.
- The system shall facilitate coordination between emergency responders, volunteers, and affected communities, enabling efficient allocation of resources and timely response to emerging needs.

5.4 Geospatial Mapping and Situational Awareness

- The system shall 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.
- The system shall enhance situational awareness and support informed decision-making for emergency management personnel.

5.5 Community Engagement and Collaboration

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

5.6 Compliance and Security

- The system shall comply with all relevant industry standards, regulations, and best practices for emergency management systems.
- The system shall implement robust security measures to protect sensitive data and ensure the integrity of the system.
- The system shall adhere to data privacy guidelines and regulations to safeguard the personal information of affected individuals.

6 FUNCTIONAL REQUIREMENTS

Functional requirements of a system, in simple terms, are the specific tasks and features that the system needs to perform to meet the needs of its users. They define what the system is supposed to do and how it should behave under certain conditions.

The functional requirements of our disaster management system are listed below:

6.1 User Registration and Authentication: The application should allow users to register and create an account. It should support secure authentication mechanisms to protect user's personal data like email, password, name etc.

6.2 Real-Time Alerts and Notifications: The application should incorporate a system to send real-time alerts and notifications to users about impending disasters, evacuation orders, and other relevant information. These alerts should be customizable based on users' geographic locations and preferences.

6.3 Incident Reporting: Users should be able to report incidents and request assistance directly through the mobile application. The system should support different types of incident reports, including text, photos, and videos.

6.4 Emergency Resource Access: The application should provide access to emergency resources such as first aid guides, emergency contact numbers, and safety tips.

6.5 Communication with Authorities: The application should facilitate communication between users and authorities. This could include features like direct messaging, emergency calls, and request tracking.

6.6 Geospatial Data Integration: The application 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.

6.7 Community Engagement Features: The application 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. The application to should also permit users with resources to become emergency volunteers.

6.8 Data Privacy and Security: The application should ensure the privacy and security of user data. This includes complying with relevant data protection regulations and implementing appropriate security measures.

6.9 Offline Functionality: Considering that disasters can disrupt internet connectivity, the application should provide essential features in offline mode, such as viewing downloaded emergency guides or maps.

6.10 Multilingual Support: To ensure the application is usable by a diverse range of users, it should support multiple languages.

6.11 User Feedback and Support: The application should provide mechanisms for users to give feedback and get support. This could include a help center, FAQ section, and customer support contact.

7   NON-FUNCTIONAL REQUIREMENTS

To ensure the effectiveness of our disaster management system, several non-functional requirements are crucial. These non-functional requirements address how the system should perform or behave rather than what specific features it offers.

7.1 Usability: The system should be easy to use without prior experience or training, for people with varying technical skills and should support multiple languages.

7.2 Performance: The app should function with minimal delays, even in areas with low network connectivity.

7.3 Security: User data and system information must be protected against cyberattacks and unauthorized access.

7.4 Reliability: The system must consistently function during emergencies with minimal delays and downtime, providing accurate and up-to-date information.

    7.5 Scalability: The system should be able to handle a large influx of users concurrently during disasters.

    7.6 Maintainability: The system should be easy to update and maintain over time to adapt to changing technologies and disaster risks.

    7.7 Accessibility: The system should be accessible for people with disabilities, including features for visually impaired and hearing-impaired users.

8   REQUIREMENTS DOCUMENTATION

Requirements documentation refers to the written document that captures and defines the requirements for a software system or product. It serves as the foundation for the entire software development process and is a crucial artifact in any software project. Documenting the requirements in a clear and structured manner is essential for communication and traceability. The requirements documentation serves as a communication tool between the stakeholders (e.g., customers, users, product owners) and the development team. Not only will this documentation be helpful at the end of the project when you reflect back on goals achieved, updates accomplished, features added and bugs fixed, but it will also act to help manage stakeholder expectations, and keep team members focused and on track. The requirements documentation typically includes the following key elements:

- Review Existing Documentation
- Identify Stakeholders
- Business Requirements
- Gather Functional Requirements
- Non-Functional Requirements…

This report acts as our requirements document as it defines the essential business and functional requirements for the development of the Mobile-Based Disaster Management System. The requirements document ensures the final product meets the goals, addresses the stakeholders' needs, and provides a solid foundation for the design and development of the system. It will serve as the foundation for the development team, allowing them to build a system that meets the specified criteria and can be updated later if stakeholder needs are changed.

9   MANAGING REQUIREMENT CHANGES

Given the dynamic nature of disaster management requirements and the potential for evolving stakeholder needs, a process needs to be put in place to manage the changes to the documented requirements. This change management process will ensure the disaster management system remains aligned with evolving stakeholder needs and stay responsive, relevant, and effective over time.

9.1 Change Request Submission: Once a change request is approved, the project team will update the requirements documentation accordingly, including the requirement descriptions, user stories, traceability matrix, and any other relevant artifacts.

The versioning system will be used to track the changes and maintain a clear history of the requirement evolution.

9.2 Communication and Dissemination: The project team will communicate the approved changes to all relevant stakeholders, including development teams, users, and external partners.

This will ensure that everyone involved in the disaster management system is aware of the updates and can adjust their plans and processes accordingly.

9.3 Ongoing Monitoring and Evaluation: The project team will continuously monitor the implementation and effectiveness of the changed requirements, gathering feedback from users and stakeholders.

This feedback will be used to further refine the requirements and inform future change requests, ensuring the disaster management system remains optimized and responsive to evolving needs.

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